

# The `xint` source code

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This is 1.2 of 2015/10/10.

- Release 1.2 of 2015/10/10 has entirely rewritten the core arithmetic routines in `xintcore`. Many macros benefit indirectly from the faster core routines. The new model is yet to be extended to other portions of the code: for example the routines of `xintbinhex` could be made faster for very big inputs if they adopted some of the style used now for the basic arithmetic routines.

The parser of `xintexpr` is also faster at gathering digits and does not have a limit at 5000 digits per number anymore.

- Extensive changes in release 1.1 of 2014/10/28 were located in `xintexpr`. Also with that release, packages `xintkernel` and `xintcore` were extracted from `xinttools` and `xint`, and `\xintAdd` was modified to not multiply denominators blindly.

`xinttools` is not loaded anymore by `xint`, nor by `xintfrac`. It is loaded by `xintexpr`.

Large portions of the code date back to the initial release, and at that time I was learning my trade in expandable TeX macro programming. At some point in the future, I will have to re-examine the older parts of the code.

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This package provides the common minimal code base for loading management and catcode control and also a few programming utilities. With 1.2 a few more helper macros and all `\chardef`'s have been moved here. The package is loaded by both `xintcore.sty` and `xinttools.sty` hence by all other packages.

First appeared as a separate package with release 1.1.

## 1.1 Catcodes, $\varepsilon$ -TeX and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified.

The method for catcodes was also initially directly inspired by these packages.

Starting with version 1.06 of the package, also ``` must be catcode-protected, because we replace everywhere in the code the twice-expansion done with `\expandafter` by the systematic use of `\roman\numeral-`0`.

Starting with version 1.06b I decide that I suffer from an indigestion of @ signs, so I replace them all with underscores `_`, à la  $\TeX$ 3.

Release 1.09b is more economical: some macros are defined already in `xint.sty` (now in `xintkernel.sty`) and re-used in other modules. All catcode changes have been unified and `\XINT_storecatcodes` will be used by each module to redefine `\XINT_restorecatcodes_endinput` in case catcodes have changed in-between the loading of `xint.sty` (now `xintkernel.sty`) and the module (not very probable but...).

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2   \catcode13=5      % ^^M
3   \endlinechar=13 %
4   \catcode123=1     % {
5   \catcode125=2     % }
6   \catcode35=6      % #
7   \catcode44=12     % ,
8   \catcode45=12     % -
9   \catcode46=12     % .
10  \catcode58=12     % :
11  \catcode95=11     % _
12  \expandafter
13    \ifx\csname PackageInfo\endcsname\relax
14      \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
15    \else
16      \def\y#1#2{\PackageInfo{#1}{#2}}%
17    \fi
18  \let\z\relax
19  \expandafter
20    \ifx\csname numexpr\endcsname\relax
21      \y{xintkernel}{\numexpr not available, aborting input}%
22      \def\z{\endgroup\endinput}%
23    \else
24      \expandafter
25        \ifx\csname XINTsetupcatcodes\endcsname\relax
26        \else
27          \y{xintkernel}{I was already loaded, aborting input}%

```

```

28     \def\z{\endgroup\endinput}%
29     \fi
30     \fi
31     \ifx\z\relax\else\expandafter\z\fi%

```

1.2 corrects a long-standing somewhat subtle bug, of which the author became aware only on 15/09/2013: earlier releases had `\aftergroup\endinput` above, rather than `\def\z{\endgroup\endinput}` and the `\ifx` test. The `\endinput` token was indeed inserted after the `\endgroup` from `\PrepareCatcodes`, but all material and in particular `\XINT_setupcatcodes` from the macro now called `\PrepareCatcodes` was expanded before the `\endinput` had come into effect ! as a result the catcodes would be modified in unwanted ways, in Plain  $\TeX$ , if the source had for example `\input xint.sty` followed by `\input xintkernel.sty`: the catcode changes would be done before the second input of `xintkernel.sty` had been aborted. One didn't see the situation under  $\LaTeX$  (in normal circumstances), because a second `\usepackage{xintkernel}` would not do any input of `xintkernel.sty` to start with.

```

32 \def\PrepareCatcodes
33 {%
34     \endgroup
35     \def\XINT_restorecatcodes
36     {% takes care of all, to allow more economical code in modules
37         \catcode59=\the\catcode59 % ; xintexpr
38         \catcode126=\the\catcode126 % ~ xintexpr
39         \catcode39=\the\catcode39 % ' xintexpr
40         \catcode34=\the\catcode34 % " xintbinhex, and xintexpr
41         \catcode63=\the\catcode63 % ? xintexpr
42         \catcode124=\the\catcode124 % | xintexpr
43         \catcode38=\the\catcode38 % & xintexpr
44         \catcode64=\the\catcode64 % @ xintexpr
45         \catcode33=\the\catcode33 % ! xintexpr
46         \catcode93=\the\catcode93 % ] -, xintfrac, xintseries, xintcfrac
47         \catcode91=\the\catcode91 % [ -, xintfrac, xintseries, xintcfrac
48         \catcode36=\the\catcode36 % $ xintgcd only
49         \catcode94=\the\catcode94 % ^
50         \catcode96=\the\catcode96 % `
51         \catcode47=\the\catcode47 % /
52         \catcode41=\the\catcode41 % )
53         \catcode40=\the\catcode40 % (
54         \catcode42=\the\catcode42 % *
55         \catcode43=\the\catcode43 % +
56         \catcode62=\the\catcode62 % >
57         \catcode60=\the\catcode60 % <
58         \catcode58=\the\catcode58 % :
59         \catcode46=\the\catcode46 % .
60         \catcode45=\the\catcode45 % -
61         \catcode44=\the\catcode44 % ,
62         \catcode35=\the\catcode35 % #
63         \catcode95=\the\catcode95 % _
64         \catcode125=\the\catcode125 % }
65         \catcode123=\the\catcode123 % {
66         \endlinechar=\the\endlinechar
67         \catcode13=\the\catcode13 % ^^M
68         \catcode32=\the\catcode32 %
69         \catcode61=\the\catcode61\relax % =
70     }%

```

# 1 Package *xintkernel* implementation

```

71 \edef\XINT_restorecatcodes_endinput
72 {%
73     \XINT_restorecatcodes\noexpand\endinput %
74 }%
75 \def\XINT_setcatcodes
76 {%
77     \catcode61=12 % =
78     \catcode32=10 % space
79     \catcode13=5 % ^^M
80     \endlinechar=13 %
81     \catcode123=1 % {
82     \catcode125=2 % }
83     \catcode95=11 % _ LETTER
84     \catcode35=6 % #
85     \catcode44=12 % ,
86     \catcode45=12 % -
87     \catcode46=12 % .
88     \catcode58=11 % : LETTER
89     \catcode60=12 % <
90     \catcode62=12 % >
91     \catcode43=12 % +
92     \catcode42=12 % *
93     \catcode40=12 % (
94     \catcode41=12 % )
95     \catcode47=12 % /
96     \catcode96=12 % `
97     \catcode94=11 % ^ LETTER
98     \catcode36=3 % $
99     \catcode91=12 % [
100    \catcode93=12 % ]
101    \catcode33=12 % !
102    \catcode64=11 % @ LETTER
103    \catcode38=12 % &
104    \catcode124=12 % |
105    \catcode63=11 % ? LETTER
106    \catcode34=12 % "
107    \catcode39=12 % '
108    \catcode126=3 % ~ MATH
109    \catcode59=12 % ;
110 }%
111 \XINT_setcatcodes
112 }%
113 \PrepareCatcodes
    Other modules could possibly be loaded under a different catcode regime.
114 \def\XINTsetupcatcodes {% for use by other modules
115     \edef\XINT_restorecatcodes_endinput
116     {%
117         \XINT_restorecatcodes\noexpand\endinput %
118     }%
119     \XINT_setcatcodes
120 }%
```

## 1.2 Package identification

Inspired from HEIKO OBERDIEK's packages. Modified in 1.09b to allow re-use in the other modules. Also I assume now that if `\ProvidesPackage` exists it then does define `\ver@<pkgname>.sty`, code of HO for some reason escaping me (compatibility with LaTeX 2.09 or other things ??) seems to set extra precautions.

1.09c uses e-TeX `\ifdefined`.

```

121 \ifdefined\ProvidesPackage
122   \let\XINT_providespackage\relax
123 \else
124   \def\XINT_providespackage #1#2[#3]%
125       {\immediate\write-1{Package: #2 #3}%
126        \expandafter\xdef\csname ver@#2.sty\endcsname{#3}}%
127 \fi
128 \XINT_providespackage
129 \ProvidesPackage {xintkernel}%
130 [2015/10/10 v1.2 Paraphernalia for the xint packages (jfb)]%
```

## 1.3 Constants

v1.2 decides to move them to *xintkernel* from *xintcore* and *xint*. The `\count`'s are left in their respective packages.

```

131 \chardef\xint_c_      0
132 \chardef\xint_c_i     1
133 \chardef\xint_c_ii    2
134 \chardef\xint_c_iii   3
135 \chardef\xint_c_iv    4
136 \chardef\xint_c_v     5
137 \chardef\xint_c_vi    6
138 \chardef\xint_c_vii   7
139 \chardef\xint_c_viii  8
140 \chardef\xint_c_ix    9
141 \chardef\xint_c_x     10
142 \chardef\xint_c_xiv   14
143 \chardef\xint_c_xvi   16
144 \chardef\xint_c_xviii 18
145 \chardef\xint_c_xxii  22
146 \chardef\xint_c_ii^v  32
147 \chardef\xint_c_ii^vi 64
148 \chardef\xint_c_ii^vii 128
149 \mathchardef\xint_c_ii^viii 256
150 \mathchardef\xint_c_ii^xii 4096
151 \mathchardef\xint_c_x^iv 10000
```

## 1.4 Token management utilities

```

152 \def\XINT_tmpa { }%
153 \ifx\XINT_tmpa\space\else
154   \immediate\write-1{Package xintkernel Warning: ATTENTION!}%
155   \immediate\write-1{\string\space\XINT_tmpa macro does not have its normal
156    meaning.}%
157   \immediate\write-1{\XINT_tmpa\XINT_tmpa\XINT_tmpa\XINT_tmpa
158    All kinds of catastrophes will ensue!!!!}%
```

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```
159 \fi
160 \def\XINT_tmpb {}%
161 \ifx\XINT_tmpb\empty\else
162   \immediate\write-1{Package xintkernel Warning: ATTENTION!}%
163   \immediate\write-1{\string\empty\XINT_tmpa macro does not have its normal
164     meaning.}%
165   \immediate\write-1{\XINT_tmpa\XINT_tmpa\XINT_tmpa\XINT_tmpa
166     All kinds of catastrophes will ensue!!!!}%
167 \fi
168 \let\XINT_tmpa\relax \let\XINT_tmpb\relax
169 \ifdefined\space\else\def\space { }\fi
170 \ifdefined\empty\else\def\empty {} \fi
171 \long\def\xint_gobble_ {}%
172 \long\def\xint_gobble_i #1{}%
173 \long\def\xint_gobble_ii #1#2{}%
174 \long\def\xint_gobble_iii #1#2#3{}%
175 \long\def\xint_gobble_iv #1#2#3#4{}%
176 \long\def\xint_gobble_v #1#2#3#4#5{}%
177 \long\def\xint_gobble_vi #1#2#3#4#5#6{}%
178 \long\def\xint_gobble_vii #1#2#3#4#5#6#7{}%
179 \long\def\xint_gobble_viii #1#2#3#4#5#6#7#8{}%
180 \long\def\xint_firstofone #1{#1}%
181 \long\def\xint_firstoftwo #1#2{#1}%
182 \long\def\xint_secondoftwo #1#2{#2}%
183 \long\def\xint_firstofone_thenstop #1{ #1}%
184 \long\def\xint_firstoftwo_thenstop #1#2{ #1}%
185 \long\def\xint_secondoftwo_thenstop #1#2{ #2}%
186 \def\xint_minus_thenstop { -}%
187 \def\xint_exchangetwo_keepbraces #1#2{{#2}{#1}}%
```

### 1.5 “gob til” macros and UD style fork

Some moved here from *xintcore* by release 1.2.

```
188 \long\def\xint_gob_til_R #1\R {}%
189 \long\def\xint_gob_til_W #1\W {}%
190 \long\def\xint_gob_til_Z #1\Z {}%
191 \def\xint_gob_til_zero #10{}%
192 \def\xint_gob_til_one #11{}%
193 \def\xint_gob_til_zeros_iii #1000{}%
194 \def\xint_gob_til_zeros_iv #10000{}%
195 \def\xint_gob_til_eightzeroes #100000000{}%
196 \def\xint_gob_til_exclam #1!{}% catcode 12 exclam
197 \def\xint_gob_til_dot #1.{}%
198 \def\xint_gob_til_G #1G{}%
199 \def\xint_gob_til_minus #1-{}%
200 \def\xint_gob_til_relax #1\relax {}%
201 \def\xint_UDzerominusfork #10-#2#3\krof {#2}%
202 \def\xint_UDzerofork #10#2#3\krof {#2}%
203 \def\xint_UDsignfork #1-#2#3\krof {#2}%
204 \def\xint_UDwfork #1\W#2#3\krof {#2}%
205 \def\xint_UDXINTWfork #1\XINT_W#2#3\krof {#2}%
206 \def\xint_UDzerosfork #100#2#3\krof {#2}%
207 \def\xint_UDonezerofork #110#2#3\krof {#2}%

```

```

208 \def\xint_UDsignsfork      #1--#2#3\krof {#2}%
209 \let\xint_relax\relax
210 \def\xint_brelax {\xint_relax }%
211 \long\def\xint_gob_til_xint_relax #1\xint_relax {}%

```

## 1.6 `\xint_afterfi`

```

212 \long\def\xint_afterfi #1#2\fi {\fi #1}%

```

## 1.7 `\xint_bye`

```

213 \long\def\xint_bye #1\xint_bye {}%

```

## 1.8 `\xintdothis`, `\xintorthat`

New with 1.1. Public names without underscores with 1.2. Used as `\if..\xint_dothis{..}\fi` <multiple times> followed by `\xint_orthat{...}`. To be used with less probable things first.

```

214 \long\def\xint_dothis #1#2\xint_orthat #3{\fi #1}% v1.1
215 \let\xint_orthat \xint_firstofone
216 \long\def\xintdothis #1#2\xintorthat #3{\fi #1}%
217 \let\xintorthat \xint_firstofone

```

## 1.9 `\xint_zapspaces`

1.1. This little utility zaps leading, intermediate, trailing, spaces in completely expanding context (`\edef`, `\csname . . . \endcsname`).

```
\xint_zapspaces foo<space>\xint_gobble_i
```

Will remove some brace pairs (but not spaces inside them). By the way the `\zap@spaces` of LaTeX2e handles unexpectedly things such as `\zap@spaces 1 {22} 3 4 \@empty` (spaces are not all removed). This does not happen with `\xint_zapspaces`.

Explanation: if there are leading spaces, then the first #1 will be empty, and the first #2 being undelimited will be stripped from all the remaining leading spaces, if there was more than one to start with. Of course brace-stripping may occur. And this iterates: each time a #2 is removed, either we then have spaces and next #1 will be empty, or we have no spaces and #1 will end at the first space. Ultimately #2 will be `\xint_gobble_i`.

This is not really robust as it may switch the expansion order of macros, and the `\xint_zapspaces` token might end up being fetched up by a macro. But it is enough for our purposes, for example:

```
\the\numexpr \xint_zapspaces 1 2 \xint_gobble_i\relax
```

expands to 12, and not 12\relax. Imagine also:

```
\the\numexpr 1 2\expandafter.\the\numexpr ...
```

The space will delay the `\expandafter`. Thus we have to get rid of spaces in contexts where arguments are fetched by delimited macros and fed to `\numexpr` (or for any reason can contain spaces). I apply this corrective treatment so far only in `xintexpr` but perhaps I should in `xintfrac` too. As said above, perhaps the `zapspaces` should force expansion too, but I leave it standing.

```

218 \def\xint_zapspaces #1 #2{#1#2\xint_zapspaces }% v1.1

```

## 1.10 `\odef`, `\oodef`, `\fdef`

May be prefixed with `\global`. No parameter text.

```

219 \def\xintodef #1{\expandafter\def\expandafter#1\expandafter }%
220 \def\xintoodef #1{\expandafter\expandafter\expandafter\def

```

## 1 Package *xintkernel* implementation

```
221 \expandafter\expandafter\expandafter#1%
222 \expandafter\expandafter\expandafter}%
223 \def\xintfdef #1#2{\expandafter\def\expandafter#1\expandafter
224 {\romannumeral-`0#2}}%
225 \ifdefined\odef\else\let\odef\xintodef\fi
226 \ifdefined\oodef\else\let\oodef\xintoodef\fi
227 \ifdefined\fdef\else\let\fdef\xintfdef\fi
```

### 1.11 *\xintReverseOrder*

*\xintReverseOrder*: does NOT expand its argument. Thus one must use some *\expandafter* if argument is a macro. A faster reverse, but only applicable to (many) digit tokens has been provided with *\csh{xintReverseDigits}* from 1.2 *xintcore*.

```
228 \def\xintReverseOrder {\romannumeral0\xintreverseorder}%
229 \long\def\xintreverseorder #1%
230 {%
231   \XINT_rord_main {}#1%
232   \xint_relax
233   \xint_bye\xint_bye\xint_bye\xint_bye
234   \xint_bye\xint_bye\xint_bye\xint_bye
235   \xint_relax
236 }%
237 \long\def\XINT_rord_main #1#2#3#4#5#6#7#8#9%
238 {%
239   \xint_bye #9\XINT_rord_cleanup\xint_bye
240   \XINT_rord_main {#9#8#7#6#5#4#3#2#1}%
241 }%
242 \long\edef\XINT_rord_cleanup\xint_bye\XINT_rord_main #1#2\xint_relax
243 {%
244   \noexpand\expandafter\space\noexpand\xint_gob_til_xint_relax #1%
245 }%
```

### 1.12 *\xintLength*

*\xintLength* does NOT expand its argument.

```
246 \def\xintLength {\romannumeral0\xintlenth}%
247 \long\def\xintlenth #1%
248 {%
249   \XINT_length_loop
250   0.#1\xint_relax\xint_relax\xint_relax\xint_relax
251   \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
252 }%
253 \long\def\XINT_length_loop #1.#2#3#4#5#6#7#8#9%
254 {%
255   \xint_gob_til_xint_relax #9\XINT_length_finish_a\xint_relax
256   \expandafter\XINT_length_loop\the\numexpr #1+\xint_c_viii.%
257 }%
258 \def\XINT_length_finish_a\xint_relax\expandafter\XINT_length_loop
259 \the\numexpr #1+\xint_c_viii.#2\xint_bye
260 {%
261   \XINT_length_finish_b #2\W\W\W\W\W\W\W\W\Z {#1}%
```



```

262 }%
263 \def\XINT_length_finish_b #1#2#3#4#5#6#7#8\Z
264 {%
265     \xint_gob_til_W
266     #1\XINT_length_finish_c \xint_c_
267     #2\XINT_length_finish_c \xint_c_i
268     #3\XINT_length_finish_c \xint_c_ii
269     #4\XINT_length_finish_c \xint_c_iii
270     #5\XINT_length_finish_c \xint_c_iv
271     #6\XINT_length_finish_c \xint_c_v
272     #7\XINT_length_finish_c \xint_c_vi
273     \W\XINT_length_finish_c \xint_c_vii\Z
274 }%
275 \edef\XINT_length_finish_c #1#2\Z #3%
276     {\noexpand\expandafter\space\noexpand\the\numexpr #3+#1\relax}%
277 \XINT_restorecatcodes_endinput%

```

## 2 Package `xinttools` implementation

.1	Catcodes, $\varepsilon$ -T <sub>E</sub> X and reload detection . . .	9	.17	<code>\xintloop</code> , <code>\xintbreakloop</code> , <code>\xintbreak-</code>	
.2	Package identification . . . . .	10		<code>loopanddo</code> , <code>\xintloopskiptonext</code> . . . .	23
.3	<code>\xintgodef</code> , <code>\xintgoodef</code> , <code>\xintgfdef</code> . . .	10	.18	<code>\xintiloop</code> , <code>\xintiloopindex</code> , <code>\xintouter-</code>	
.4	<code>\xintRevWithBraces</code> . . . . .	11		<code>ilopindex</code> , <code>\xintbreakloop</code> , <code>\xintbreak-</code>	
.5	<code>\xintZapFirstSpaces</code> . . . . .	11		<code>ilopanddo</code> , <code>\xintilopskiptonext</code> , <code>\xin-</code>	
.6	<code>\xintZapLastSpaces</code> . . . . .	12		<code>tilopskipandredo</code> . . . . .	23
.7	<code>\xintZapSpaces</code> . . . . .	13	.19	<code>\XINT_xflet</code> . . . . .	24
.8	<code>\xintZapSpacesB</code> . . . . .	13	.20	<code>\xintApplyInline</code> . . . . .	25
.9	<code>\xintCSVtoList</code> , <code>\xintCSVtoListNonStripped</code> 13		.21	<code>\xintFor</code> , <code>\xintFor*</code> , <code>\xintBreakFor</code> , <code>\xint-</code>	
.10	<code>\xintListWithSep</code> . . . . .	15		<code>BreakForAndDo</code> . . . . .	26
.11	<code>\xintNthElt</code> . . . . .	15	.22	<code>\XINT_forever</code> , <code>\xintintegers</code> , <code>\xintdimen-</code>	
.12	<code>\xintKeep</code> . . . . .	17		<code>sions</code> , <code>\xinrationals</code> . . . . .	28
.13	<code>\xintTrim</code> . . . . .	19	.23	<code>\xintForpair</code> , <code>\xintForthree</code> , <code>\xintForfour</code> 30	
.14	<code>\xintApply</code> . . . . .	20	.24	<code>\xintAssign</code> , <code>\xintAssignArray</code> , <code>\xintDig-</code>	
.15	<code>\xintApplyUnbraced</code> . . . . .	20		<code>itsOf</code> . . . . .	31
.16	<code>\xintSeq</code> . . . . .	21			

Release 1.09g of 2013/11/22 splits off `xinttools.sty` from `xint.sty`. Starting with 1.1, `xinttools` ceases being loaded automatically by `xint`.

### 2.1 Catcodes, $\varepsilon$ -T<sub>E</sub>X and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified. The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2 \catcode13=5 % ^^M
3 \endlinechar=13 %
4 \catcode123=1 % {
5 \catcode125=2 % }
6 \catcode64=11 % @
7 \catcode35=6 % #
8 \catcode44=12 % ,
9 \catcode45=12 % -

```

## 2 Package *xinttools* implementation

```
10 \catcode46=12 % .
11 \catcode58=12 % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xinttools.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintkernel.sty\endcsname
15 \expandafter
16   \ifx\csname PackageInfo\endcsname\relax
17     \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18   \else
19     \def\y#1#2{\PackageInfo{#1}{#2}}%
20   \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23   \y{xinttools}{\numexpr not available, aborting input}%
24   \aftergroup\endinput
25 \else
26   \ifx\x\relax % plain-TeX, first loading of xinttools.sty
27     \ifx\w\relax % but xintkernel.sty not yet loaded.
28       \def\z{\endgroup\input xintkernel.sty\relax}%
29     \fi
30   \else
31     \def\empty {}%
32     \ifx\x\empty % LaTeX, first loading,
33     % variable is initialized, but \ProvidesPackage not yet seen
34       \ifx\w\relax % xintkernel.sty not yet loaded.
35         \def\z{\endgroup\RequirePackage{xintkernel}}%
36       \fi
37     \else
38       \aftergroup\endinput % xinttools already loaded.
39     \fi
40   \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty
```

### 2.2 Package identification

```
44 \XINT_providespackage
45 \ProvidesPackage{xinttools}%
46 [2015/10/10 v1.2 Expandable and non-expandable utilities (jfb)]%
```

*\XINT\_toks* is used in macros such as *\xintFor*. It is not used elsewhere in the xint bundle.

```
47 \newtoks\XINT_toks
48 \xint_firstofone{\let\XINT_sptoken= } %<- space here!
```

### 2.3 *\xintgodef*, *\xintgoodef*, *\xintgfdef*

1.09i. For use in *\xintAssign*.

```
49 \def\xintgodef {\global\xintodef }%
50 \def\xintgoodef {\global\xintoodef }%
51 \def\xintgfdef {\global\xintfdef }%
```

## 2.4 \xintRevWithBraces

New with 1.06. Makes the expansion of its argument and then reverses the resulting tokens or braced tokens, adding a pair of braces to each (thus, maintaining it when it was already there.) The reason for `\xint_relax`, here and in other locations, is in case #1 expands to nothing, the `\romannumeral-0` must be stopped

```

52 \def\xintRevWithBraces {\romannumeral0\xintrevwithbraces }%
53 \def\xintRevWithBracesNoExpand {\romannumeral0\xintrevwithbracesnoexpand }%
54 \long\def\xintrevwithbraces #1%
55 {%
56     \expandafter\XINT_revwbr_loop\expandafter{\expandafter}%
57     \romannumeral-`0#1\xint_relax\xint_relax\xint_relax\xint_relax
58         \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
59 }%
60 \long\def\xintrevwithbracesnoexpand #1%
61 {%
62     \XINT_revwbr_loop {}%
63     #1\xint_relax\xint_relax\xint_relax\xint_relax
64     \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
65 }%
66 \long\def\XINT_revwbr_loop #1#2#3#4#5#6#7#8#9%
67 {%
68     \xint_gob_til_xint_relax #9\XINT_revwbr_finish_a\xint_relax
69     \XINT_revwbr_loop {{#9}{#8}{#7}{#6}{#5}{#4}{#3}{#2}#1}%
70 }%
71 \long\def\XINT_revwbr_finish_a\xint_relax\XINT_revwbr_loop #1#2\xint_bye
72 {%
73     \XINT_revwbr_finish_b #2\R\R\R\R\R\R\R\Z #1%
74 }%
75 \def\XINT_revwbr_finish_b #1#2#3#4#5#6#7#8\Z
76 {%
77     \xint_gob_til_R
78     #1\XINT_revwbr_finish_c \xint_gobble_viii
79     #2\XINT_revwbr_finish_c \xint_gobble_vii
80     #3\XINT_revwbr_finish_c \xint_gobble_vi
81     #4\XINT_revwbr_finish_c \xint_gobble_v
82     #5\XINT_revwbr_finish_c \xint_gobble_iv
83     #6\XINT_revwbr_finish_c \xint_gobble_iii
84     #7\XINT_revwbr_finish_c \xint_gobble_ii
85     \R\XINT_revwbr_finish_c \xint_gobble_i\Z
86 }%

```

1.1c revisited this old code and improved upon the earlier endings.

```
87 \edef\XINT_revwbr_finish_c #1#2\Z {\noexpand\expandafter\space #1}%
```

## 2.5 \xintZapFirstSpaces

1.09f, written [2013/11/01]. Modified (2014/10/21) for release 1.1 to correct the bug in case of an empty argument, or argument containing only spaces, which had been forgotten in first version. New version is simpler than the initial one. This macro does NOT expand its argument.

```
88 \def\xintZapFirstSpaces {\romannumeral0\xintzapfirstspaces }%
```

defined via an `\edef` in order to inject space tokens inside.

```
89 \long\edef\xintzapfirstspaces #1%
90   {\noexpand\XINT_zapbsp_a \space #1\xint_relax \space\space\xint_relax }%
91 \xint_firstofone {\long\edef\XINT_zapbsp_a #1 } %<- space token here
92 {%
```

If the original #1 started with a space, the grabbed #1 is empty. Thus `_again?` will see `#1=\xint_bye`, and hand over control to `_again` which will loop back into `\XINT_zapbsp_a`, with one initial space less. If the original #1 did not start with a space, or was empty, then the #1 below will be a `<sptoken>`, then an extract of the original #1, not empty and not starting with a space, which contains what was up to the first `<sp><sp>` present in original #1, or, if none preexisted, `<sptoken>` and all of #1 (possibly empty) plus an ending `\xint_relax`. The added initial space will stop later the `\romannumeral0`. No brace stripping is possible. Control is handed over to `\XINT_zapbsp_b` which strips out the ending `\xint_relax<sp><sp>\xint_relax`

```
93 \noexpand\XINT_zapbsp_again? #1\noexpand\xint_bye\noexpand\XINT_zapbsp_b #1\space\space
94 }%
95 \long\def\XINT_zapbsp_again? #1{\xint_bye #1\XINT_zapbsp_again }%
96 \xint_firstofone{\def\XINT_zapbsp_again\XINT_zapbsp_b} {\XINT_zapbsp_a }%
97 \long\def\XINT_zapbsp_b #1\xint_relax #2\xint_relax {#1}%
```

## 2.6 `\xintZapLastSpaces`

1.09f, written [2013/11/01].

```
98 \def\xintZapLastSpaces {\romannumeral0\xintzaplastspaces }%
```

Next macro is defined via an `\edef` for the space tokens.

```
99 \long\edef\xintzaplastspaces #1{\noexpand\XINT_zapesp_a {} \noexpand\empty#1%
100                                     \space\space\noexpand\xint_bye\xint_relax}%
```

The `\empty` from `\xintzaplastspaces` is to prevent brace removal in the #2 below. The `\expandafter` chain removes it.

```
101 \xint_firstofone {\long\def\XINT_zapesp_a #1#2 } %<- second space here
102   {\expandafter\XINT_zapesp_b\expandafter{#2}{#1}}%
```

Notice again an `\empty` added here. This is in preparation for possibly looping back to `\XINT_zapesp_a`. If the initial #1 had no `<sp><sp>`, the stuff however will not loop, because #3 will already be `<some spaces>\xint_bye`. Notice that this macro fetches all way to the ending `\xint_relax`. This looks not very efficient, but how often do we have to strip ending spaces from something which also has inner stretches of `_multiple_` space tokens ?;-).

```
103 \long\def\XINT_zapesp_b #1#2#3\xint_relax
104   {\XINT_zapesp_end? #3\XINT_zapesp_e {#2#1}\empty #3\xint_relax }%
```

When we have been over all possible `<sp><sp>` things, we reach the ending space tokens, and #3 will be a bunch of spaces (possibly none) followed by `\xint_bye`. So the #1 in `_end?` will be `\xint_bye`. In all other cases #1 can not be `\xint_bye` (assuming naturally this token does not arise in original input), hence control falls back to `\XINT_zapesp_e` which will loop back to `\XINT_zapesp_a`.

```
105 \long\def\XINT_zapesp_end? #1{\xint_bye #1\XINT_zapesp_end }%
```

We are done. The #1 here has accumulated all the previous material, and is stripped of its ending spaces, if any.

```
106 \long\def\XINT_zapesp_end\XINT_zapesp_e #1#2\xint_relax { #1}%
```

We haven't yet reached the end, so we need to re-inject two space tokens after what we have gotten so far. Then we loop.

```
107 \long\edef\XINT_zapesp_e #1{\noexpand \XINT_zapesp_a {#1\space\space}}%
```

## 2.7 \xintZapSpaces

1.09f, written [2013/11/01]. Modified for 1.1, 2014/10/21 as it has the same bug as \xintZapFirstSpaces. We in effect do first \xintZapFirstSpaces, then \xintZapLastSpaces.

```
108 \def\xintZapSpaces {\romannumeral0\xintzapspaces }%
109 \long\edef\xintzapspaces #1% like \xintZapFirstSpaces.
110     {\noexpand\XINT_zapsp_a \space #1\xint_relax \space\space\xint_relax }%
111 \xint_firstofone {\long\edef\XINT_zapsp_a #1 } %
112     {\noexpand\XINT_zapsp_again? #1\noexpand\xint_bye\noexpand\XINT_zapsp_b #1\space\space}%
113 \long\def\XINT_zapsp_again? #1{\xint_bye #1\XINT_zapsp_again }%
114 \xint_firstofone{\def\XINT_zapsp_again\XINT_zapsp_b} {\XINT_zapsp_a }%
115 \xint_firstofone{\def\XINT_zapsp_b} {\XINT_zapsp_c }%
116 \long\edef\XINT_zapsp_c #1\xint_relax #2\xint_relax {\noexpand\XINT_zapesp_a
117     {} \noexpand \empty #1\space\space\noexpand\xint_bye\xint_relax }%
```

## 2.8 \xintZapSpacesB

1.09f, written [2013/11/01]. Strips up to one pair of braces (but then does not strip spaces inside).

```
118 \def\xintZapSpacesB {\romannumeral0\xintzapspacesb }%
119 \long\def\xintzapspacesb #1{\XINT_zapspb_one? #1\xint_relax\xint_relax
120     \xint_bye\xintzapspaces {#1}}%
121 \long\def\XINT_zapspb_one? #1#2%
122     {\xint_gob_til_xint_relax #1\XINT_zapspb_onlyspaces\xint_relax
123     \xint_gob_til_xint_relax #2\XINT_zapspb_bracedorone\xint_relax
124     \xint_bye {#1}}%
125 \def\XINT_zapspb_onlyspaces\xint_relax
126     \xint_gob_til_xint_relax\xint_relax\XINT_zapspb_bracedorone\xint_relax
127     \xint_bye #1\xint_bye\xintzapspaces #2{ }%
128 \long\def\XINT_zapspb_bracedorone\xint_relax
129     \xint_bye #1\xint_relax\xint_bye\xintzapspaces #2{ #1}%
```

## 2.9 \xintCSVtoList, \xintCSVtoListNonStripped

\xintCSVtoList transforms a,b,...,z into {a}{b}...{z}. The comma separated list may be a macro which is first f-expanded. First included in release 1.06. Here, use of \Z (and \R) perfectly safe.

[2013/11/02]: Starting with 1.09f, automatically filters items with \xintZapSpacesB to strip away all spaces around commas, and spaces at the start and end of the list. The original is kept as \xintCSVtoListNonStripped, and is faster. But ... it doesn't strip spaces.

## 2 Package *xinttools* implementation

```

130 \def\xintCSVtoList {\romannumeral0\xintcsvtolist }%
131 \long\def\xintcsvtolist #1{\expandafter\xintApply
132     \expandafter\xintzapspacesb
133     \expandafter{\romannumeral0\xintcsvtolistnonstripped{#1}}}%
134 \def\xintCSVtoListNoExpand {\romannumeral0\xintcsvtolistnoexpand }%
135 \long\def\xintcsvtolistnoexpand #1{\expandafter\xintApply
136     \expandafter\xintzapspacesb
137     \expandafter{\romannumeral0\xintcsvtolistnonstrippednoexpand{#1}}}%
138 \def\xintCSVtoListNonStripped {\romannumeral0\xintcsvtolistnonstripped }%
139 \def\xintCSVtoListNonStrippedNoExpand
140     {\romannumeral0\xintcsvtolistnonstrippednoexpand }%
141 \long\def\xintcsvtolistnonstripped #1%
142 {%
143     \expandafter\XINT_csvtol_loop_a\expandafter
144     {\expandafter}\romannumeral-`0#1%
145     ,\xint_bye,\xint_bye,\xint_bye,\xint_bye
146     ,\xint_bye,\xint_bye,\xint_bye,\xint_bye,\Z
147 }%
148 \long\def\xintcsvtolistnonstrippednoexpand #1%
149 {%
150     \XINT_csvtol_loop_a
151     {#1,\xint_bye,\xint_bye,\xint_bye,\xint_bye
152     ,\xint_bye,\xint_bye,\xint_bye,\xint_bye,\Z
153 }%
154 \long\def\XINT_csvtol_loop_a #1#2,#3,#4,#5,#6,#7,#8,#9,%
155 {%
156     \xint_bye #9\XINT_csvtol_finish_a\xint_bye
157     \XINT_csvtol_loop_b {#1}{#2}{#3}{#4}{#5}{#6}{#7}{#8}{#9}}%
158 }%
159 \long\def\XINT_csvtol_loop_b #1#2{\XINT_csvtol_loop_a {#1#2}}%
160 \long\def\XINT_csvtol_finish_a\xint_bye\XINT_csvtol_loop_b #1#2#3\Z
161 {%
162     \XINT_csvtol_finish_b #3\R,\R,\R,\R,\R,\R,\R,\Z #2{#1}%
163 }%

```

1.1c revisits this old code and improves upon the earlier endings. But as the `_d..` macros have already nine parameters, I needed the `\expandafter` and `\xint_gob_til_Z` in `finish_b` (compare `\XINT_keep_endb`, or also `\XINT_RQ_end_b`).

```

164 \def\XINT_csvtol_finish_b #1,#2,#3,#4,#5,#6,#7,#8\Z
165 {%
166     \xint_gob_til_R
167     #1\expandafter\XINT_csvtol_finish_dviii\xint_gob_til_Z
168     #2\expandafter\XINT_csvtol_finish_dvii \xint_gob_til_Z
169     #3\expandafter\XINT_csvtol_finish_dvi  \xint_gob_til_Z
170     #4\expandafter\XINT_csvtol_finish_dv   \xint_gob_til_Z
171     #5\expandafter\XINT_csvtol_finish_div  \xint_gob_til_Z
172     #6\expandafter\XINT_csvtol_finish_diii \xint_gob_til_Z
173     #7\expandafter\XINT_csvtol_finish_dii  \xint_gob_til_Z
174     \R\XINT_csvtol_finish_di \Z
175 }%
176 \long\def\XINT_csvtol_finish_dviii #1#2#3#4#5#6#7#8#9{ #9}%
177 \long\def\XINT_csvtol_finish_dvii  #1#2#3#4#5#6#7#8#9{ #9{#1}}%

```

```

178 \long\def\XINT_csvtol_finish_dvi #1#2#3#4#5#6#7#8#9{ #9{#1}{#2}}%
179 \long\def\XINT_csvtol_finish_dv #1#2#3#4#5#6#7#8#9{ #9{#1}{#2}{#3}}%
180 \long\def\XINT_csvtol_finish_div #1#2#3#4#5#6#7#8#9{ #9{#1}{#2}{#3}{#4}}%
181 \long\def\XINT_csvtol_finish_diii #1#2#3#4#5#6#7#8#9{ #9{#1}{#2}{#3}{#4}{#5}}%
182 \long\def\XINT_csvtol_finish_dii #1#2#3#4#5#6#7#8#9{
183 { #9{#1}{#2}{#3}{#4}{#5}{#6}}%
184 \long\def\XINT_csvtol_finish_di\Z #1#2#3#4#5#6#7#8#9{
185 { #9{#1}{#2}{#3}{#4}{#5}{#6}{#7}}%

```

## 2.10 `\xintListWithSep`

1.04. `\xintListWithSep {sep}{a}{b}...{z}` returns a `\sep b \sep ... \sep z`. It f-expands its second argument. The 'sep' may be `\par`'s: the macro `\xintlistwithsep` etc... are all declared long. 'sep' does not have to be a single token. It is not expanded.

```

186 \def\xintListWithSep {\romannumeral0\xintlistwithsep}%
187 \def\xintListWithSepNoExpand {\romannumeral0\xintlistwithsepnoexpand}%
188 \long\def\xintlistwithsep #1#2%
189 { \expandafter\XINT_lws\expandafter {\romannumeral-`0#2}{#1}}%
190 \long\def\XINT_lws #1#2{\XINT_lws_start {#2}#1\xint_bye}%
191 \long\def\xintlistwithsepnoexpand #1#2{\XINT_lws_start {#1}#2\xint_bye}%
192 \long\def\XINT_lws_start #1#2%
193 {%
194 \xint_bye #2\XINT_lws_dont\xint_bye
195 \XINT_lws_loop_a {#2}{#1}%
196}%
197 \long\def\XINT_lws_dont\xint_bye\XINT_lws_loop_a #1#2{}%
198 \long\def\XINT_lws_loop_a #1#2#3%
199 {%
200 \xint_bye #3\XINT_lws_end\xint_bye
201 \XINT_lws_loop_b {#1}{#2#3}{#2}%
202}%
203 \long\def\XINT_lws_loop_b #1#2{\XINT_lws_loop_a {#1#2}}%
204 \long\def\XINT_lws_end\xint_bye\XINT_lws_loop_b #1#2#3{ #1}%

```

## 2.11 `\xintNthElt`

First included in release 1.06.

`\xintNthElt {i}{stuff f-expanding to {a}{b}...{z}}` (or 'tokens' `abcd...z`) returns the *i*th element (one pair of braces removed). The list is first f-expanded. The `\xintNthEltNoExpand` does no expansion of its second argument. Both variants expand the first argument inside `\numexpr`.

With *i* = 0, the number of items is returned. This is different from `\xintLen` which is only for numbers (particularly, it checks the sign) and different from `\xintLength` which does not f-expand its argument.

Negative values return the *|i|*th element from the end. Release 1.09m rewrote the initial bits of the code (which checked the sign of #1 and expanded or not #2), some 'improvements' made earlier in 1.09c were quite sub-efficient. Now uses `\xint_UDzerominusfork`, moved from `xint.sty`.

```

205 \def\xintNthElt {\romannumeral0\xintnthelt}%
206 \def\xintNthEltNoExpand {\romannumeral0\xintntheltnoexpand}%
207 \def\xintnthelt #1#2%
208 {%
209 \expandafter\XINT_nthelt_a\the\numexpr #1\expandafter.%

```

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```

210 \expandafter{\romannumeral-`0#2}%
211 }%
212 \def\xintntheltnoexpand #1%
213 {%
214 \expandafter\XINT_nthelt_a\the\numexpr #1.%
215 }%
216 \def\XINT_nthelt_a #1#2.%
217 {%
218 \xint_UDzerominusfork
219 #1-{\XINT_nthelt_bzero}%
220 0#1{\XINT_nthelt_bneg {#2}}%
221 0-{\XINT_nthelt_bpos {#1#2}}%
222 \krof
223 }%
224 \long\def\XINT_nthelt_bzero #1%
225 {%
226 \XINT_length_loop 0.#1\xint_relax\xint_relax\xint_relax\xint_relax
227 \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
228 }%
229 \long\def\XINT_nthelt_bneg #1#2%
230 {%
231 \expandafter\XINT_nthelt_loop_a\expandafter {\the\numexpr #1\expandafter}%
232 \romannumeral0\xintrevwithbracesnoexpand {#2}%
233 \xint_relax\xint_relax\xint_relax\xint_relax
234 \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
235 }%
236 \long\def\XINT_nthelt_bpos #1#2%
237 {%
238 \XINT_nthelt_loop_a {#1}#2\xint_relax\xint_relax\xint_relax\xint_relax
239 \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
240 }%
241 \def\XINT_nthelt_loop_a #1%
242 {%
243 \ifnum #1>\xint_c_viii
244 \expandafter\XINT_nthelt_loop_b
245 \else
246 \XINT_nthelt_getit
247 \fi
248 {#1}%
249 }%
250 \long\def\XINT_nthelt_loop_b #1#2#3#4#5#6#7#8#9%
251 {%
252 \xint_gob_til_xint_relax #9\XINT_nthelt_silentend\xint_relax
253 \expandafter\XINT_nthelt_loop_a\expandafter{\the\numexpr #1-\xint_c_viii}%
254 }%
255 \def\XINT_nthelt_silentend #1\xint_bye { }%
256 \def\XINT_nthelt_getit\fi #1%
257 {%
258 \fi\expandafter\expandafter\expandafter\XINT_nthelt_finish
259 \csname xint_gobble_\romannumeral\numexpr#1-\xint_c_i\endcsname
260 }%
261 \long\edef\XINT_nthelt_finish #1#2\xint_bye

```



```

262   {\noexpand\xint_gob_til_xint_relax #1\noexpand\expandafter\space
263                                     \noexpand\xint_gobble_ii\xint_relax\space #1}%

```

## 2.12 \xintKeep

First included in release 1.09m.

\xintKeep {i}{stuff f-expanding to {a}{b}...{z}} (or 'tokens' abcd...z, but each naked token ends up braced in the output) returns (in two expansion steps) the first i elements from the list, which is first f-expanded. The i is expanded inside \numexpr. The variant \xintKeepNoExpand does not expand the list argument.

With i = 0, the empty sequence is returned.

With i < 0, the last |i| elements are returned (in the same order as in the original list).

With |i| equal to or bigger than the length of the (f-expanded) list, the full list is returned.

```

264 \def\xintKeep          {\romannumeral0\xintkeep }%
265 \def\xintKeepNoExpand {\romannumeral0\xintkeepnoexpand }%
266 \def\xintkeep #1#2%
267 {%
268   \expandafter\XINT_keep_a\the\numexpr #1\expandafter.%
269   \expandafter{\romannumeral-`0#2}%
270 }%
271 \def\xintkeepnoexpand #1%
272 {%
273   \expandafter\XINT_keep_a\the\numexpr #1.%
274 }%
275 \def\XINT_keep_a #1#2.%
276 {%
277   \xint_UDzerominusfork
278     #1-{\expandafter\space\xint_gobble_i }%
279     0#1{\XINT_keep_bneg_a {#2}}%
280     0-{\XINT_keep_bpos {#1#2}}%
281   \krof
282 }%
283 \long\def\XINT_keep_bneg_a #1#2%
284 {%
285   \expandafter\XINT_keep_bneg_b \the\numexpr \xintLength{#2}-#1.{#2}%
286 }%
287 \def\XINT_keep_bneg_b #1#2.%
288 {%
289   \xint_UDzerominusfork
290     #1-{\xint_firstofone_thenstop }%
291     0#1{\xint_firstofone_thenstop }%
292     0-{\XINT_trim_bpos {#1#2}}%
293   \krof
294 }%
295 \long\def\XINT_keep_bpos #1#2%
296 {%
297   \XINT_keep_loop_a {#1}{#2\xint_relax\xint_relax\xint_relax\xint_relax
298     \xint_relax\xint_relax\xint_relax\xint_bye
299 }%
300 \def\XINT_keep_loop_a #1%
301 {%
302   \ifnum #1>\xint_c_vi

```

## 2 Package *xinttools* implementation

```
303     \expandafter\XINT_keep_loop_b
304   \else
305     \XINT_keep_finish
306   \fi
307   {#1}%
308 }%
309 \long\def\XINT_keep_loop_b #1#2#3#4#5#6#7#8#9%
310 {%
311   \xint_gob_til_xint_relax #9\XINT_keep_enda\xint_relax
312   \expandafter\XINT_keep_loop_c\expandafter{\the\numexpr #1-\xint_c_vii}%
313   {{#3}{#4}{#5}{#6}{#7}{#8}{#9}}{#2}%
314 }%
315 \long\def\XINT_keep_loop_c #1#2#3{\XINT_keep_loop_a {#1}{#3#2}}%
316 \long\def\XINT_keep_enda\xint_relax
317   \expandafter\XINT_keep_loop_c\expandafter #1#2#3#4\xint_bye
318 {%
319   \XINT_keep_endb #4\W\W\W\W\W\W\Z #2{#3}%
320 }%
321 \def\XINT_keep_endb #1#2#3#4#5#6#7\Z
322 {%
323   \xint_gob_til_W
324   #1\XINT_keep_endc_
325   #2\XINT_keep_endc_i
326   #3\XINT_keep_endc_ii
327   #4\XINT_keep_endc_iii
328   #5\XINT_keep_endc_iv
329   #6\XINT_keep_endc_v
330   \W\XINT_keep_endc_vi\Z
331 }%
332 \long\def\XINT_keep_endc_ #1\Z #2#3#4#5#6#7#8#9{ #9}%
333 \long\def\XINT_keep_endc_i #1\Z #2#3#4#5#6#7#8#9{ #9{#2}}%
334 \long\def\XINT_keep_endc_ii #1\Z #2#3#4#5#6#7#8#9{ #9{#2}{#3}}%
335 \long\def\XINT_keep_endc_iii #1\Z #2#3#4#5#6#7#8#9{ #9{#2}{#3}{#4}}%
336 \long\def\XINT_keep_endc_iv #1\Z #2#3#4#5#6#7#8#9{ #9{#2}{#3}{#4}{#5}}%
337 \long\def\XINT_keep_endc_v #1\Z #2#3#4#5#6#7#8#9{ #9{#2}{#3}{#4}{#5}{#6}}%
338 \long\def\XINT_keep_endc_vi\Z #1#2#3#4#5#6#7#8{ #8{#1}{#2}{#3}{#4}{#5}{#6}}%
339 \long\def\XINT_keep_finish\fi #1#2#3#4#5#6#7#8#9\xint_bye
340 {%
341   \fi\XINT_keep_finish_loop_a {#1}{{#3}{#4}{#5}{#6}{#7}{#8}}\Z {#2}%
342 }%
343 \def\XINT_keep_finish_loop_a #1%
344 {%
345   \xint_gob_til_zero #1\XINT_keep_finish_z0%
346   \expandafter\XINT_keep_finish_loop_b\expandafter
347     {\the\numexpr #1-\xint_c_i}%
348 }%
349 \long\def\XINT_keep_finish_z0%
350   \expandafter\XINT_keep_finish_loop_b\expandafter #1#2#3\Z #4{ #4#2}%
351 \long\def\XINT_keep_finish_loop_b #1#2#3%
352 {%
353   \xint_gob_til_xint_relax #3\XINT_keep_finish_exit\xint_relax
354   \XINT_keep_finish_loop_c {#1}{#2}{#3}%

```

```

355 }%
356 \long\def\XINT_keep_finish_exit\xint_relax
357     \XINT_keep_finish_loop_c #1#2#3\Z #4{ #4#2}%
358 \long\def\XINT_keep_finish_loop_c #1#2#3%
359     {\XINT_keep_finish_loop_a {#1}{#2{#3}}}%

```

## 2.13 `\xintTrim`

First included in release 1.09m.

`\xintTrim {i}{stuff f-expanding to {a}{b}...{z}}` (or ``tokens' abcd...z`, but each naked token ends up braced in the output) returns (in two expansion steps) the sequence with the first  $i$  elements omitted. The list is first f-expanded. The  $i$  is expanded inside `\numexpr`. Variant `\xintTrimNoExpand` does not expand the list argument.

With  $i = 0$ , the original (expanded) list is returned.

With  $i < 0$ , the last  $|i|$  elements from the tail are suppressed.

With  $|i|$  equal to or bigger than the length of the (f-expanded) list, the empty list is returned.

```

360 \def\xintTrim          {\romannumeral0\xinttrim }%
361 \def\xintTrimNoExpand {\romannumeral0\xinttrimnoexpand }%
362 \def\xinttrim #1#2%
363 {%
364     \expandafter\XINT_trim_a\the\numexpr #1\expandafter.%
365     \expandafter{\romannumeral-`0#2}%
366 }%
367 \def\xinttrimnoexpand #1%
368 {%
369     \expandafter\XINT_trim_a\the\numexpr #1.%
370 }%
371 \def\XINT_trim_a #1#2.%
372 {%
373     \xint_UDzerominusfork
374     #1-{\xint_firstofone_thenstop }%
375     0#1{\XINT_trim_bneg_a {#2}}%
376     0-{\XINT_trim_bpos {#1#2}}%
377     \krof
378 }%
379 \long\def\XINT_trim_bneg_a #1#2%
380 {%
381     \expandafter\XINT_trim_bneg_b \the\numexpr \xintLength{#2}-#1.{#2}%
382 }%
383 \def\XINT_trim_bneg_b #1#2.%
384 {%
385     \xint_UDzerominusfork
386     #1-{\expandafter\space\xint_gobble_i }%
387     0#1{\expandafter\space\xint_gobble_i }%
388     0-{\XINT_keep_bpos {#1#2}}%
389     \krof
390 }%
391 \long\def\XINT_trim_bpos #1#2%
392 {%
393     \XINT_trim_loop_a {#1}#2\xint_relax\xint_relax\xint_relax\xint_relax
394     \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
395 }%

```

```

396 \def\XINT_trim_loop_a #1%
397 {%
398   \ifnum #1>\xint_c_vii
399     \expandafter\XINT_trim_loop_b
400   \else
401     \XINT_trim_finish
402   \fi
403   {#1}%
404 }%
405 \long\def\XINT_trim_loop_b #1#2#3#4#5#6#7#8#9%
406 {%
407   \xint_gob_til_xint_relax #9\XINT_trim_silentend\xint_relax
408   \expandafter\XINT_trim_loop_a\expandafter{\the\numexpr #1-\xint_c_viii}%
409 }%
410 \def\XINT_trim_silentend #1\xint_bye { }%
411 \def\XINT_trim_finish\fi #1%
412 {%
413   \fi\expandafter\expandafter\expandafter\XINT_trim_finish_a
414   \expandafter\expandafter\expandafter\space % avoids brace removal
415   \csname xint_gobble_\romannumeral\numexpr#1\endcsname
416 }%
417 \long\def\XINT_trim_finish_a #1\xint_relax #2\xint_bye {#1}%

```

## 2.14 \xintApply

`\xintApply {\macro}{a}{b}...{z}` returns `{\macro{a}}...{\macro{b}}` where each instance of `\macro` is *f-expanded*. The list itself is first *f-expanded* and may thus be a macro. Introduced with release 1.04.

```

418 \def\xintApply          {\romannumeral0\xintapply }%
419 \def\xintApplyNoExpand {\romannumeral0\xintapplynoexpand }%
420 \long\def\xintapply #1#2%
421 {%
422   \expandafter\XINT_apply\expandafter {\romannumeral-`0#2}%
423   {#1}%
424 }%
425 \long\def\XINT_apply #1#2{\XINT_apply_loop_a {#2}#1\xint_bye }%
426 \long\def\xintapplynoexpand #1#2{\XINT_apply_loop_a {#1}#2\xint_bye }%
427 \long\def\XINT_apply_loop_a #1#2#3%
428 {%
429   \xint_bye #3\XINT_apply_end\xint_bye
430   \expandafter
431   \XINT_apply_loop_b
432   \expandafter {\romannumeral-`0#2{#3}}{#1}{#2}%
433 }%
434 \long\def\XINT_apply_loop_b #1#2{\XINT_apply_loop_a {#2{#1}}}%
435 \long\def\XINT_apply_end\xint_bye\expandafter\XINT_apply_loop_b
436   \expandafter #1#2#3{ #2}%

```

## 2.15 \xintApplyUnbraced

`\xintApplyUnbraced {\macro}{a}{b}...{z}` returns `\macro{a}...\macro{z}` where each instance of `\macro` is *f-expanded* using `\romannumeral-`0`. The second argument may be a macro as it is itself

also f-expanded. No braces are added: this allows for example a non-expandable `\def` in `\macro`, without having to do `\gdef`. Introduced with release 1.06b.

```

437 \def\xintApplyUnbraced {\romannumeral0\xintapplyunbraced }%
438 \def\xintApplyUnbracedNoExpand {\romannumeral0\xintapplyunbracednoexpand }%
439 \long\def\xintapplyunbraced #1#2%
440 {%
441   \expandafter\XINT_applyunbr\expandafter {\romannumeral-`0#2}%
442   {#1}%
443 }%
444 \long\def\XINT_applyunbr #1#2{\XINT_applyunbr_loop_a {}{#2}#1\xint_bye }%
445 \long\def\xintapplyunbracednoexpand #1#2%
446   {\XINT_applyunbr_loop_a {}{#1}#2\xint_bye }%
447 \long\def\XINT_applyunbr_loop_a #1#2#3%
448 {%
449   \xint_bye #3\XINT_applyunbr_end\xint_bye
450   \expandafter\XINT_applyunbr_loop_b
451   \expandafter {\romannumeral-`0#2{#3}}{#1}{#2}%
452 }%
453 \long\def\XINT_applyunbr_loop_b #1#2{\XINT_applyunbr_loop_a {#2}#1}%
454 \long\def\XINT_applyunbr_end\xint_bye\expandafter\XINT_applyunbr_loop_b
455   \expandafter #1#2#3{ #2}%

```

## 2.16 `\xintSeq`

1.09c. Without the optional argument puts stress on the input stack, should not be used to generate thousands of terms then.

```

456 \def\xintSeq {\romannumeral0\xintseq }%
457 \def\xintseq #1{\XINT_seq_chkopt #1\xint_bye }%
458 \def\XINT_seq_chkopt #1%
459 {%
460   \ifx [#1\expandafter\XINT_seq_opt
461     \else\expandafter\XINT_seq_noopt
462   \fi #1%
463 }%
464 \def\XINT_seq_noopt #1\xint_bye #2%
465 {%
466   \expandafter\XINT_seq\expandafter
467   {\the\numexpr#1\expandafter}\expandafter{\the\numexpr #2}%
468 }%
469 \def\XINT_seq #1#2%
470 {%
471   \ifcase\ifnum #1=#2 0\else\ifnum #2>#1 1\else -1\fi\fi\space
472   \expandafter\xint_firstoftwo_thenstop
473   \or
474   \expandafter\XINT_seq_p
475   \else
476   \expandafter\XINT_seq_n
477   \fi
478   {#2}{#1}%
479 }%
480 \def\XINT_seq_p #1#2%

```

```

481 {%
482   \ifnum #1>#2
483     \expandafter\expandafter\expandafter\XINT_seq_p
484   \else
485     \expandafter\XINT_seq_e
486   \fi
487   \expandafter{\the\numexpr #1-\xint_c_i}{#2}{#1}%
488 }%
489 \def\XINT_seq_n #1#2%
490 {%
491   \ifnum #1<#2
492     \expandafter\expandafter\expandafter\XINT_seq_n
493   \else
494     \expandafter\XINT_seq_e
495   \fi
496   \expandafter{\the\numexpr #1+\xint_c_i}{#2}{#1}%
497 }%
498 \def\XINT_seq_e #1#2#3{ }%
499 \def\XINT_seq_opt [\xint_bye #1]#2#3%
500 {%
501   \expandafter\XINT_seqo\expandafter
502   {\the\numexpr #2\expandafter}\expandafter
503   {\the\numexpr #3\expandafter}\expandafter
504   {\the\numexpr #1}%
505 }%
506 \def\XINT_seqo #1#2%
507 {%
508   \ifcase\ifnum #1=#2 0\else\ifnum #2>#1 1\else -1\fi\fi\space
509     \expandafter\XINT_seqo_a
510   \or
511     \expandafter\XINT_seqo_pa
512   \else
513     \expandafter\XINT_seqo_na
514   \fi
515   {#1}{#2}%
516 }%
517 \def\XINT_seqo_a #1#2#3{ {#1}}%
518 \def\XINT_seqo_o #1#2#3#4{ #4}%
519 \def\XINT_seqo_pa #1#2#3%
520 {%
521   \ifcase\ifnum #3=\xint_c_ 0\else\ifnum #3>\xint_c_ 1\else -1\fi\fi\space
522     \expandafter\XINT_seqo_o
523   \or
524     \expandafter\XINT_seqo_pb
525   \else
526     \xint_afterfi{\expandafter\space\xint_gobble_iv}%
527   \fi
528   {#1}{#2}{#3}{#1}%
529 }%
530 \def\XINT_seqo_pb #1#2#3%
531 {%
532   \expandafter\XINT_seqo_pc\expandafter{\the\numexpr #1+#3}{#2}{#3}%

```

```

533 }%
534 \def\XINT_seqo_pc #1#2%
535 {%
536   \ifnum #1>#2
537     \expandafter\XINT_seqo_o
538   \else
539     \expandafter\XINT_seqo_pd
540   \fi
541   {#1}{#2}%
542 }%
543 \def\XINT_seqo_pd #1#2#3#4{\XINT_seqo_pb {#1}{#2}{#3}{#4{#1}}}%
544 \def\XINT_seqo_na #1#2#3%
545 {%
546   \ifcase\ifnum #3=\xint_c_ 0\else\ifnum #3>\xint_c_ 1\else -1\fi\fi\space
547   \expandafter\XINT_seqo_o
548   \or
549   \xint_afterfi{\expandafter\space\xint_gobble_iv}%
550   \else
551   \expandafter\XINT_seqo_nb
552   \fi
553   {#1}{#2}{#3}{#1}%
554 }%
555 \def\XINT_seqo_nb #1#2#3%
556 {%
557   \expandafter\XINT_seqo_nc\expandafter{\the\numexpr #1+#3}{#2}{#3}%
558 }%
559 \def\XINT_seqo_nc #1#2%
560 {%
561   \ifnum #1<#2
562     \expandafter\XINT_seqo_o
563   \else
564     \expandafter\XINT_seqo_nd
565   \fi
566   {#1}{#2}%
567 }%
568 \def\XINT_seqo_nd #1#2#3#4{\XINT_seqo_nb {#1}{#2}{#3}{#4{#1}}}%

```

## 2.17 `\xintloop`, `\xintbreakloop`, `\xintbreakloopaddo`, `\xintloopskiptonext`

1.09g [2013/11/22]. Made long with 1.09h.

```

569 \long\def\xintloop #1#2\repeat {#1#2\xintloop_again\fi\xint_gobble_i {#1#2}}%
570 \long\def\xintloop_again\fi\xint_gobble_i #1{\fi
571   #1\xintloop_again\fi\xint_gobble_i {#1}}%
572 \long\def\xintbreakloop #1\xintloop_again\fi\xint_gobble_i #2{%
573 \long\def\xintbreakloopaddo #1#2\xintloop_again\fi\xint_gobble_i #3{#1}%
574 \long\def\xintloopskiptonext #1\xintloop_again\fi\xint_gobble_i #2{%
575   #2\xintloop_again\fi\xint_gobble_i {#2}}%

```

## 2.18 `\xintiloop`, `\xintiloopindex`, `\xintouteriloopindex`, `\xintbreakiloop`, `\xintbreakiloopaddo`, `\xintiloopskiptonext`, `\xintiloopskipandredo`

1.09g [2013/11/22]. Made long with 1.09h.

```

576 \def\xintilooop [#1+#2]{%
577   \expandafter\xintilooop_a\the\numexpr #1\expandafter.\the\numexpr #2.}%
578 \long\def\xintilooop_a #1.#2.#3#4\repeat{%
579   #3#4\xintilooop_again\fi\xint_gobble_iii {#1}{#2}{#3#4}}%
580 \def\xintilooop_again\fi\xint_gobble_iii #1#2{%
581   \fi\expandafter\xintilooop_again_b\the\numexpr#1+#2.#2.}%
582 \long\def\xintilooop_again_b #1.#2.#3{%
583   #3\xintilooop_again\fi\xint_gobble_iii {#1}{#2}{#3}}%
584 \long\def\xintbreakilooop #1\xintilooop_again\fi\xint_gobble_iii #2#3#4{%}
585 \long\def\xintbreakilooopanddo
586   #1.#2\xintilooop_again\fi\xint_gobble_iii #3#4#5{#1}%
587 \long\def\xintilooopindex #1\xintilooop_again\fi\xint_gobble_iii #2%
588   {#2#1\xintilooop_again\fi\xint_gobble_iii {#2}}%
589 \long\def\xintouterilooopindex #1\xintilooop_again
590   #2\xintilooop_again\fi\xint_gobble_iii #3%
591   {#3#1\xintilooop_again #2\xintilooop_again\fi\xint_gobble_iii {#3}}%
592 \long\def\xintilooopskiptonext #1\xintilooop_again\fi\xint_gobble_iii #2#3{%
593   \expandafter\xintilooop_again_b \the\numexpr#2+#3.#3.}%
594 \long\def\xintilooopskipandredo #1\xintilooop_again\fi\xint_gobble_iii #2#3#4{%
595   #4\xintilooop_again\fi\xint_gobble_iii {#2}{#3}{#4}}%

```

## 2.19 \XINT\_xflet

1.09e [2013/10/29]: we f-expand unbraced tokens and swallow arising space tokens until the dust settles.

```

596 \def\XINT_xflet #1%
597 {%
598   \def\XINT_xflet_macro {#1}\XINT_xflet_zapsp
599 }%
600 \def\XINT_xflet_zapsp
601 {%
602   \expandafter\futurelet\expandafter\XINT_token
603   \expandafter\XINT_xflet_sp?\romannumeral-`0%
604 }%
605 \def\XINT_xflet_sp?
606 {%
607   \ifx\XINT_token\XINT_sptoken
608     \expandafter\XINT_xflet_zapsp
609   \else\expandafter\XINT_xflet_zapspB
610   \fi
611 }%
612 \def\XINT_xflet_zapspB
613 {%
614   \expandafter\futurelet\expandafter\XINT_tokenB
615   \expandafter\XINT_xflet_spB?\romannumeral-`0%
616 }%
617 \def\XINT_xflet_spB?
618 {%
619   \ifx\XINT_tokenB\XINT_sptoken
620     \expandafter\XINT_xflet_zapspB
621   \else\expandafter\XINT_xflet_eq?
622   \fi

```



```

623 }%
624 \def\XINT_xflet_eq?
625 {%
626   \ifx\XINT_token\XINT_tokenB
627     \expandafter\XINT_xflet_macro
628   \else\expandafter\XINT_xflet_zapsp
629   \fi
630 }%

```

## 2.20 \xintApplyInline

1.09a: `\xintApplyInline\macro{a}{b}...{z}` has the same effect as executing `\macro{a}` and then applying again `\xintApplyInline` to the shortened list `{b}...{z}` until nothing is left. This is a non-expandable command which will result in quicker code than using `\xintApplyUnbraced`. It f-expands its second (list) argument first, which may thus be encapsulated in a macro.

Rewritten in 1.09c. Nota bene: uses catcode 3 Z as privated list terminator.

```

631 \catcode`Z 3
632 \long\def\xintApplyInline #1#2%
633 {%
634   \long\expandafter\def\expandafter\XINT_inline_macro
635   \expandafter ##\expandafter 1\expandafter {#1{##1}}%
636   \XINT_xflet\XINT_inline_b #2Z% this Z has catcode 3
637 }%
638 \def\XINT_inline_b
639 {%
640   \ifx\XINT_token Z\expandafter\xint_gobble_i
641   \else\expandafter\XINT_inline_d\fi
642 }%
643 \long\def\XINT_inline_d #1%
644 {%
645   \long\def\XINT_item{#1}\XINT_xflet\XINT_inline_e
646 }%
647 \def\XINT_inline_e
648 {%
649   \ifx\XINT_token Z\expandafter\XINT_inline_w
650   \else\expandafter\XINT_inline_f\fi
651 }%
652 \def\XINT_inline_f
653 {%
654   \expandafter\XINT_inline_g\expandafter{\XINT_inline_macro {##1}}%
655 }%
656 \long\def\XINT_inline_g #1%
657 {%
658   \expandafter\XINT_inline_macro\XINT_item
659   \long\def\XINT_inline_macro ##1{#1}\XINT_inline_d
660 }%
661 \def\XINT_inline_w #1%
662 {%
663   \expandafter\XINT_inline_macro\XINT_item
664 }%

```

## 2.21 `\xintFor`, `\xintFor*`, `\xintBreakFor`, `\xintBreakForAndDo`

1.09c [2013/10/09]: a new kind of loop which uses macro parameters #1, #2, #3, #4 rather than macros; while not expandable it survives executing code closing groups, like what happens in an alignment with the & character. When inserted in a macro for later use, the # character must be doubled.

The non-star variant works on a csv list, which it expands once, the star variant works on a token list, which it (repeatedly) f-expands.

1.09e adds `\XINT_forever` with `\xintintegers`, `\xintdimensions`, `\xintrationals` and `\xintBreakFor`, `\xintBreakForAndDo`, `\xintifForFirst`, `\xintifForLast`. On this occasion `\xint_firstoftwo` and `\xint_secondoftwo` are made long.

1.09f: rewrites large parts of `\xintFor` code in order to filter the comma separated list via `\xintCSVtoList` which gets rid of spaces. The #1 in `\XINT_for_forever?` has an initial space token which serves two purposes: preventing brace stripping, and stopping the expansion made by `\xintcsvtolist`. If the `\XINT_forever` branch is taken, the added space will not be a problem there.

1.09f rewrites (2013/11/03) the code which now allows all macro parameters from #1 to #9 in `\xintFor`, `\xintFor*`, and `\XINT_forever`.

```

665 \def\xINT_tmpa #1#2{\ifnum #2<#1 \xint_afterfi {{#####2}}\fi}%
666 \def\xINT_tmpb #1#2{\ifnum #1<#2 \xint_afterfi {{#####2}}\fi}%
667 \def\xINT_tmpc #1%
668 {%
669   \expandafter\edef \csname XINT_for_left#1\endcsname
670     {\xintApplyUnbraced {\XINT_tmpa #1}{123456789}}%
671   \expandafter\edef \csname XINT_for_right#1\endcsname
672     {\xintApplyUnbraced {\XINT_tmpb #1}{123456789}}%
673 }%
674 \xintApplyInline \XINT_tmpc {123456789}%
675 \long\def\xintBreakFor      #1Z{%}%
676 \long\def\xintBreakForAndDo #1#2Z{#1}%
677 \def\xintFor {\let\xintifForFirst\xint_firstoftwo
678   \futurelet\xINT_token\xINT_for_ifstar }%
679 \def\xINT_for_ifstar {\ifx\xINT_token*\expandafter\xINT_forx
680   \else\expandafter\xINT_for \fi }%
681 \catcode`U 3 % with numexpr
682 \catcode`V 3 % with xintfrac.sty (xint.sty not enough)
683 \catcode`D 3 % with dimexpr
684 \def\xINT_flet_zapsp
685 {%
686   \futurelet\xINT_token\xINT_flet_sp?
687 }%
688 \def\xINT_flet_sp?
689 {%
690   \ifx\xINT_token\xINT_sptoken
691     \xint_afterfi{\expandafter\xINT_flet_zapsp\romannumeral0}%
692   \else\expandafter\xINT_flet_macro
693   \fi
694 }%
695 \long\def\xINT_for #1#2in#3#4#5%
696 {%
697   \expandafter\xINT_toks\expandafter
698     {\expandafter\xINT_for_d\the\numexpr #2\relax {#5}}%
699   \def\xINT_flet_macro {\expandafter\xINT_for_forever?\space}%

```

## 2 Package *xinttools* implementation

```

700 \expandafter\XINT_flet_zapsp #3Z%
701 }%
702 \def\XINT_for_forever? #1Z%
703 {%
704 \ifx\XINT_token U\XINT_to_forever\fi
705 \ifx\XINT_token V\XINT_to_forever\fi
706 \ifx\XINT_token D\XINT_to_forever\fi
707 \expandafter\the\expandafter\XINT_toks\romannumeral0\xintcsvtolist {#1}Z%
708 }%
709 \def\XINT_to_forever\fi #1\xintcsvtolist #2{\fi \XINT_forever #2}%
710 \long\def\XINT_forx *#1#2in#3#4#5%
711 {%
712 \expandafter\XINT_toks\expandafter
713 {\expandafter\XINT_forx_d\the\numexpr #2\relax {#5}}%
714 \XINT_xflet\XINT_forx_forever? #3Z%
715 }%
716 \def\XINT_forx_forever?
717 {%
718 \ifx\XINT_token U\XINT_to_forxever\fi
719 \ifx\XINT_token V\XINT_to_forxever\fi
720 \ifx\XINT_token D\XINT_to_forxever\fi
721 \XINT_forx_empty?
722 }%
723 \def\XINT_to_forxever\fi #1\XINT_forx_empty? {\fi \XINT_forever }%
724 \catcode`U 11
725 \catcode`D 11
726 \catcode`V 11
727 \def\XINT_forx_empty?
728 {%
729 \ifx\XINT_token Z\expandafter\xintBreakFor\fi
730 \the\XINT_toks
731 }%
732 \long\def\XINT_for_d #1#2#3%
733 {%
734 \long\def\XINT_y ##1##2##3##4##5##6##7##8##9{#2}%
735 \XINT_toks {{#3}}%
736 \long\edef\XINT_x {\noexpand\XINT_y \csname XINT_for_left#1\endcsname
737 \the\XINT_toks \csname XINT_for_right#1\endcsname }%
738 \XINT_toks {\XINT_x\let\xintifForFirst\xint_secondoftwo\XINT_for_d #1{#2}}%
739 \futurelet\XINT_token\XINT_for_last?
740 }%
741 \long\def\XINT_forx_d #1#2#3%
742 {%
743 \long\def\XINT_y ##1##2##3##4##5##6##7##8##9{#2}%
744 \XINT_toks {{#3}}%
745 \long\edef\XINT_x {\noexpand\XINT_y \csname XINT_for_left#1\endcsname
746 \the\XINT_toks \csname XINT_for_right#1\endcsname }%
747 \XINT_toks {\XINT_x\let\xintifForFirst\xint_secondoftwo\XINT_forx_d #1{#2}}%
748 \XINT_xflet\XINT_for_last?
749 }%
750 \def\XINT_for_last?
751 {%

```

```

752 \let\xintifForLast\xint_secondoftwo
753 \ifx\XINT_token Z\let\xintifForLast\xint_firstoftwo
754 \xint_afterfi{\xintBreakForAndDo{\XINT_x\xint_gobble_i Z}}\fi
755 \the\XINT_toks
756 }%

```

## 2.22 `\XINT_forever`, `\xintintegers`, `\xintdimensions`, `\xintrationals`

New with 1.09e. But this used inadvertently `\xintiadd`/`\xintimul` which have the unnecessary `\xintnum` overhead. Changed in 1.09f to use `\xintiiadd`/`\xintiimul` which do not have this overhead. Also 1.09f uses `\xintZapSpacesB` for the `\xintrationals` case to get rid of leading and ending spaces in the #4 and #5 delimited parameters of `\XINT_forever_opt_a` (for `\xintintegers` and `\xintdimensions` this is not necessary, due to the use of `\numexpr` resp. `\dimexpr` in `\XINT_?expr_Ua`, resp. `\XINT_?expr_Da`).

```

757 \catcode`U 3
758 \catcode`D 3
759 \catcode`V 3
760 \let\xintegers      U%
761 \let\xintintegers   U%
762 \let\xintdimensions D%
763 \let\xintrationals  V%
764 \def\XINT_forever #1%
765 {%
766   \expandafter\XINT_forever_a
767   \csname XINT_?expr_\ifx#1UU\else\ifx#1DD\else V\fi\fi a\expandafter\endcsname
768   \csname XINT_?expr_\ifx#1UU\else\ifx#1DD\else V\fi\fi i\expandafter\endcsname
769   \csname XINT_?expr_\ifx#1UU\else\ifx#1DD\else V\fi\fi \endcsname
770 }%
771 \catcode`U 11
772 \catcode`D 11
773 \catcode`V 11
774 \def\XINT_?expr_Ua #1#2%
775   {\expandafter{\expandafter\numexpr\the\numexpr #1\expandafter\relax
776     \expandafter\relax\expandafter}%
777   \expandafter{\the\numexpr #2}}%
778 \def\XINT_?expr_Da #1#2%
779   {\expandafter{\expandafter\dimexpr\number\dimexpr #1\expandafter\relax
780     \expandafter s\expandafter p\expandafter\relax\expandafter}%
781   \expandafter{\number\dimexpr #2}}%
782 \catcode`Z 11
783 \def\XINT_?expr_Va #1#2%
784 {%
785   \expandafter\XINT_?expr_Vb\expandafter
786   {\romannumeral-`0\xintraawithzeros{\xintZapSpacesB{#2}}}%
787   {\romannumeral-`0\xintraawithzeros{\xintZapSpacesB{#1}}}%
788 }%
789 \catcode`Z 3
790 \def\XINT_?expr_Vb #1#2{\expandafter\XINT_?expr_Vc #2.#1}%
791 \def\XINT_?expr_Vc #1/#2.#3/#4.%
792 {%
793   \xintifEq {#2}{#4}%
794   {\XINT_?expr_Vf {#3}{#1}{#2}}%

```

## 2 Package *xinttools* implementation

```

795     {\expandafter\XINT_?expr_Vd\expandafter
796     {\romannumeral0\xintiimul {#2}{#4}}%
797     {\romannumeral0\xintiimul {#1}{#4}}%
798     {\romannumeral0\xintiimul {#2}{#3}}%
799     }%
800 }%
801 \def\XINT_?expr_Vd #1#2#3{\expandafter\XINT_?expr_Ve\expandafter {#2}{#3}{#1}}%
802 \def\XINT_?expr_Ve #1#2{\expandafter\XINT_?expr_Vf\expandafter {#2}{#1}}%
803 \def\XINT_?expr_Vf #1#2#3{{#2/#3}{0}{#1}{#2}{#3}}%
804 \def\XINT_?expr_Ui {\numexpr 1\relax}{1}}%
805 \def\XINT_?expr_Di {\dimexpr 0pt\relax}{65536}}%
806 \def\XINT_?expr_Vi {{1/1}{0111}}%
807 \def\XINT_?expr_U #1#2%
808     {\expandafter{\expandafter\numexpr\the\numexpr #1+#2\relax\relax}{#2}}%
809 \def\XINT_?expr_D #1#2%
810     {\expandafter{\expandafter\dimexpr\the\numexpr #1+#2\relax sp\relax}{#2}}%
811 \def\XINT_?expr_V #1#2{\XINT_?expr_Vx #2}%
812 \def\XINT_?expr_Vx #1#2%
813 {%
814     \expandafter\XINT_?expr_Vy\expandafter
815     {\romannumeral0\xinttiadd {#1}{#2}}{#2}%
816 }%
817 \def\XINT_?expr_Vy #1#2#3#4%
818 {%
819     \expandafter{\romannumeral0\xinttiadd {#3}{#1}/#4}{#1}{#2}{#3}{#4}}%
820 }%
821 \def\XINT_forever_a #1#2#3#4%
822 {%
823     \ifx #4[\expandafter\XINT_forever_opt_a
824     \else\expandafter\XINT_forever_b
825     \fi #1#2#3#4%
826 }%
827 \def\XINT_forever_b #1#2#3Z{\expandafter\XINT_forever_c\the\XINT_toks #2#3}%
828 \long\def\XINT_forever_c #1#2#3#4#5%
829     {\expandafter\XINT_forever_d\expandafter #2#4#5{#3}Z}%
830 \def\XINT_forever_opt_a #1#2#3[#4+#5]#6Z%
831 {%
832     \expandafter\expandafter\expandafter
833     \XINT_forever_opt_c\expandafter\the\expandafter\XINT_toks
834     \romannumeral-`0#1{#4}{#5}#3%
835 }%
836 \long\def\XINT_forever_opt_c #1#2#3#4#5#6{\XINT_forever_d #2{#4}{#5}#6{#3}Z}%
837 \long\def\XINT_forever_d #1#2#3#4#5%
838 {%
839     \long\def\XINT_y ##1##2##3##4##5##6##7##8##9{#5}%
840     \XINT_toks {{#2}}%
841     \long\edef\XINT_x {\noexpand\XINT_y \csname XINT_for_left#1\endcsname
842         \the\XINT_toks \csname XINT_for_right#1\endcsname }%
843     \XINT_x
844     \let\xintifForFirst\xint_secondoftwo
845     \expandafter\XINT_forever_d\expandafter #1\romannumeral-`0#4{#2}{#3}#4{#5}%
846 }%

```

2.23 `\xintForpair`, `\xintForthree`, `\xintForfour`

1.09c.

[2013/11/02] 1.09f `\xintForpair` delegate to `\xintCSVtoList` and its `\xintZapSpacesB` the handling of spaces. Does not share code with `\xintFor` anymore.

[2013/11/03] 1.09f: `\xintForpair` extended to accept #1#2, #2#3 etc... up to #8#9, `\xintForthree`, #1#2#3 up to #7#8#9, `\xintForfour` id.

```

847 \catcode`j 3
848 \long\def\xintForpair #1#2#3in#4#5#6%
849 {%
850   \let\xintifForFirst\xint_firstoftwo
851   \XINT_toks {\XINT_forpair_d #2{#6}}%
852   \expandafter\the\expandafter\XINT_toks #4jZ%
853 }%
854 \long\def\XINT_forpair_d #1#2#3(#4)#5%
855 {%
856   \long\def\XINT_y ##1##2##3##4##5##6##7##8##9{#2}%
857   \XINT_toks \expandafter{\romannumeral0\xintcsvtolist{ #4}}%
858   \long\edef\XINT_x {\noexpand\XINT_y \csname XINT_for_left#1\endcsname
859     \the\XINT_toks \csname XINT_for_right\the\numexpr#1+\xint_c_i\endcsname}%
860   \let\xintifForLast\xint_secondoftwo
861   \ifx #5j\expandafter\xint_firstoftwo
862     \else\expandafter\xint_secondoftwo
863   \fi
864   {\let\xintifForLast\xint_firstoftwo
865     \xintBreakForAndDo {\XINT_x \xint_gobble_i Z}}%
866   \XINT_x
867   \let\xintifForFirst\xint_secondoftwo\XINT_forpair_d #1{#2}%
868 }%
869 \long\def\xintForthree #1#2#3in#4#5#6%
870 {%
871   \let\xintifForFirst\xint_firstoftwo
872   \XINT_toks {\XINT_forthree_d #2{#6}}%
873   \expandafter\the\expandafter\XINT_toks #4jZ%
874 }%
875 \long\def\XINT_forthree_d #1#2#3(#4)#5%
876 {%
877   \long\def\XINT_y ##1##2##3##4##5##6##7##8##9{#2}%
878   \XINT_toks \expandafter{\romannumeral0\xintcsvtolist{ #4}}%
879   \long\edef\XINT_x {\noexpand\XINT_y \csname XINT_for_left#1\endcsname
880     \the\XINT_toks \csname XINT_for_right\the\numexpr#1+\xint_c_ii\endcsname}%
881   \let\xintifForLast\xint_secondoftwo
882   \ifx #5j\expandafter\xint_firstoftwo
883     \else\expandafter\xint_secondoftwo
884   \fi
885   {\let\xintifForLast\xint_firstoftwo
886     \xintBreakForAndDo {\XINT_x \xint_gobble_i Z}}%
887   \XINT_x
888   \let\xintifForFirst\xint_secondoftwo\XINT_forthree_d #1{#2}%
889 }%
890 \long\def\xintForfour #1#2#3in#4#5#6%
891 {%

```

```

892 \let\xintifForFirst\xint_firstoftwo
893 \XINT_toks {\XINT_forfour_d #2{#6}}%
894 \expandafter\the\expandafter\XINT_toks #4jZ%
895 }%
896 \long\def\XINT_forfour_d #1#2#3(#4)#5%
897 {%
898 \long\def\XINT_y ##1##2##3##4##5##6##7##8##9{#2}%
899 \XINT_toks \expandafter{\romannumeral0\xintcsvtolist{ #4}}%
900 \long\edef\XINT_x {\noexpand\XINT_y \csname XINT_for_left#1\endcsname
901 \the\XINT_toks \csname XINT_for_right\the\numexpr#1+\xint_c_iii\endcsname}%
902 \let\xintifForLast\xint_secondoftwo
903 \ifx #5j\expandafter\xint_firstoftwo
904 \else\expandafter\xint_secondoftwo
905 \fi
906 {\let\xintifForLast\xint_firstoftwo
907 \xintBreakForAndDo {\XINT_x \xint_gobble_i Z}%
908 \XINT_x
909 \let\xintifForFirst\xint_secondoftwo\XINT_forfour_d #1{#2}%
910 }%
911 \catcode`Z 11
912 \catcode`j 11

```

## 2.24 \xintAssign, \xintAssignArray, \xintDigitsOf

\xintAssign {a}{b}..{z}\to A\B...Z resp. \xintAssignArray {a}{b}..{z}\to\U.  
\xintDigitsOf=\xintAssignArray.

1.1c 2015/09/12 has (belatedly) corrected some "features" of \xintAssign which didn't like the case of a space right before the "\to", or the case with the first token not an opening brace and the subsequent material containing brace groups. The new code handles gracefully these situations.

```

913 \def\xintAssign{\def\XINT_flet_macro {\XINT_assign_fork}\XINT_flet_zapsp }%
914 \def\XINT_assign_fork
915 {%
916 \let\XINT_assign_def\def
917 \ifx\XINT_token[\expandafter\XINT_assign_opt
918 \else\expandafter\XINT_assign_a
919 \fi
920 }%
921 \def\XINT_assign_opt [#1]%
922 {%
923 \ifcsname #1def\endcsname
924 \expandafter\let\expandafter\XINT_assign_def \csname #1def\endcsname
925 \else
926 \expandafter\let\expandafter\XINT_assign_def \csname xint#1def\endcsname
927 \fi
928 \XINT_assign_a
929 }%
930 \long\def\XINT_assign_a #1\to
931 {%
932 \def\XINT_flet_macro{\XINT_assign_b}%
933 \expandafter\XINT_flet_zapsp\romannumeral-`0#1\xint_relax\to
934 }%
935 \long\def\XINT_assign_b

```

```

936 {%
937   \ifx\XINT_token\bgroup
938     \expandafter\XINT_assign_c
939   \else\expandafter\XINT_assign_f
940   \fi
941 }%
942 \long\def\XINT_assign_f #1\xint_relax\to #2%
943 {%
944   \XINT_assign_def #2{#1}%
945 }%
946 \long\def\XINT_assign_c #1%
947 {%
948   \def\xint_temp {#1}%
949   \ifx\xint_temp\xint_brelax
950     \expandafter\XINT_assign_e
951   \else
952     \expandafter\XINT_assign_d
953   \fi
954 }%
955 \long\def\XINT_assign_d #1\to #2%
956 {%
957   \expandafter\XINT_assign_def\expandafter #2\expandafter{\xint_temp}%
958   \XINT_assign_c #1\to
959 }%
960 \def\XINT_assign_e #1\to {}%
961 \def\xintRelaxArray #1%
962 {%
963   \edef\XINT_restoreescapechar {\escapechar\the\escapechar\relax}%
964   \escapechar -1
965   \expandafter\def\expandafter\xint_arrayname\expandafter {\string #1}%
966   \XINT_restoreescapechar
967   \xintilop [\csname\xint_arrayname 0\endcsname+-1]
968   \global
969   \expandafter\let\csname\xint_arrayname\xintilopindex\endcsname\relax
970   \ifnum \xintilopindex > \xint_c_
971   \repeat
972   \global\expandafter\let\csname\xint_arrayname 00\endcsname\relax
973   \global\let #1\relax
974 }%
975 \def\xintAssignArray{\def\XINT_flet_macro {\XINT_assignarray_fork}%
976   \XINT_flet_zapsp }%
977 \def\XINT_assignarray_fork
978 {%
979   \let\XINT_assignarray_def\def
980   \ifx\XINT_token[\expandafter\XINT_assignarray_opt
981     \else\expandafter\XINT_assignarray
982   \fi
983 }%
984 \def\XINT_assignarray_opt [#1]%
985 {%
986   \ifcsname #1def\endcsname
987     \expandafter\let\expandafter\XINT_assignarray_def \csname #1def\endcsname

```



## 2 Package *xinttools* implementation

```

988 \else
989 \expandafter\let\expandafter\XINT_assignarray_def
990 \csname xint#1def\endcsname
991 \fi
992 \XINT_assignarray
993 }%
994 \long\def\XINT_assignarray #1\to #2%
995 {%
996 \edef\XINT_restoreescapechar {\escapechar\the\escapechar\relax }%
997 \escapechar -1
998 \expandafter\def\expandafter\xint_arrayname\expandafter {\string #2}%
999 \XINT_restoreescapechar
1000 \def\xint_itemcount {0}%
1001 \expandafter\XINT_assignarray_loop \romannumeral-`0#1\xint_relax
1002 \csname\xint_arrayname 00\expandafter\endcsname
1003 \csname\xint_arrayname 0\expandafter\endcsname
1004 \expandafter {\xint_arrayname}#2%
1005 }%
1006 \long\def\XINT_assignarray_loop #1%
1007 {%
1008 \def\xint_temp {#1}%
1009 \ifx\xint_brelax\xint_temp
1010 \expandafter\def\csname\xint_arrayname 0\expandafter\endcsname
1011 \expandafter{\the\numexpr\xint_itemcount}%
1012 \expandafter\expandafter\expandafter\XINT_assignarray_end
1013 \else
1014 \expandafter\def\expandafter\xint_itemcount\expandafter
1015 {\the\numexpr\xint_itemcount+\xint_c_i}%
1016 \expandafter\XINT_assignarray_def
1017 \csname\xint_arrayname\xint_itemcount\expandafter\endcsname
1018 \expandafter{\xint_temp }%
1019 \expandafter\XINT_assignarray_loop
1020 \fi
1021 }%
1022 \def\XINT_assignarray_end #1#2#3#4%
1023 {%
1024 \def #4##1%
1025 {%
1026 \romannumeral0\expandafter #1\expandafter{\the\numexpr ##1}%
1027 }%
1028 \def #1##1%
1029 {%
1030 \ifnum ##1<\xint_c_
1031 \xint_afterfi {\xintError:ArrayIndexIsNegative\space }%
1032 \else
1033 \xint_afterfi {%
1034 \ifnum ##1>#2
1035 \xint_afterfi {\xintError:ArrayIndexBeyondLimit\space }%
1036 \else\xint_afterfi
1037 {\expandafter\expandafter\expandafter\space\csname #3##1\endcsname}%
1038 \fi}%
1039 \fi

```

```

1040 }%
1041 }%
1042 \let\xintDigitsOf\xintAssignArray
1043 \let\XINT_tmpa\relax \let\XINT_tmpb\relax \let\XINT_tmpc\relax
1044 \XINT_restorecatcodes_endinput%

```

### 3 Package *xintcore* implementation

.1	Catcodes, $\varepsilon$ -T <sub>E</sub> X and reload detection	34	.15	<code>\xintHalf</code>	44
.2	Package identification	35	.16	<code>\xintDec</code>	44
.3	Counts for holding needed constants	35	.17	<code>\xintInc</code>	45
.4	<code>\xintNum</code>	35	.18	Core arithmetic	46
.5	Zeroes	36	.19	<code>\xintiAdd</code> , <code>\xintiiAdd</code>	46
.6	Blocks of eight digits	37	.20	<code>\xintiSub</code> , <code>\xintiiSub</code>	49
.7	Blocks of eight, for needs of v1.2 <code>\xintiiDivision</code>	38	.21	<code>\xintiMul</code> , <code>\xintiiMul</code>	53
.8	<code>\xintReverseDigits</code>	40	.22	<code>\xintiSqr</code> , <code>\xintiiSqr</code>	57
.9	<code>\xintSgn</code> , <code>\xintiiSgn</code> , <code>\XINT_Sgn</code> , <code>\XINT_cntSgn</code>	40	.23	<code>\xintiPow</code> , <code>\xintiiPow</code>	58
.10	<code>\xintiOpp</code> , <code>\xintiiOpp</code>	41	.24	<code>\xintiFac</code> , <code>\xintiiFac</code>	61
.11	<code>\xintiAbs</code> , <code>\xintiiAbs</code>	42	.25	<code>\xintiDivision</code> , <code>\xintiQuo</code> , <code>\xintiRem</code> , <code>\xintiiDivision</code> , <code>\xintiiQuo</code> , <code>\xintiiRem</code>	64
.12	<code>\xintFDg</code> , <code>\xintiiFDg</code>	42	.26	<code>\xintiDivRound</code> , <code>\xintiiDivRound</code>	77
.13	<code>\xintLDg</code> , <code>\xintiiLDg</code>	43	.27	<code>\xintiDivTrunc</code> , <code>\xintiiDivTrunc</code>	79
.14	<code>\xintDouble</code>	43	.28	<code>\xintiMod</code> , <code>\xintiiMod</code>	79
			.29	"Load <code>xintfrac</code> " macros	80

Got split off from *xint* with release 1.1. Release 1.1 also added the new macro `\xintiiDivRound`. The package does not load *xinttools*.

The core arithmetic routines have been entirely rewritten for release 1.2.

The commenting continues (2015/10/10) to be very sparse: actually it got worse than ever with release 1.2. I will possibly add comments at a later date, but for the time being the new routines are not commented at all.

Also, with 1.2, `\xintAdd` etc... have been left undefined control sequences: only `\xintiAdd` and `\xintiiAdd` (etc...) are provided via *xintcore*. It was announced a long time ago that `\xintAdd` etc... were to be removed from *xint* and only defined by *xintfrac*.

#### 3.1 Catcodes, $\varepsilon$ -T<sub>E</sub>X and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified. The method for catcodes was also initially directly inspired by these packages.

```

1 \beginingroup\catcode61\catcode48\catcode32=10\relax%
2 \catcode13=5 % ^^M
3 \endlinechar=13 %
4 \catcode123=1 % {
5 \catcode125=2 % }
6 \catcode64=11 % @
7 \catcode35=6 % #
8 \catcode44=12 % ,
9 \catcode45=12 % -
10 \catcode46=12 % .

```

### 3 Package *xintcore* implementation

```

11 \catcode58=12 % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xintcore.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintkernel.sty\endcsname
15 \expandafter
16 \ifx\csname PackageInfo\endcsname\relax
17 \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18 \else
19 \def\y#1#2{\PackageInfo{#1}{#2}}%
20 \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23 \y{xintcore}{numexpr not available, aborting input}%
24 \aftergroup\endinput
25 \else
26 \ifx\x\relax % plain-TeX, first loading of xintcore.sty
27 \ifx\w\relax % but xintkernel.sty not yet loaded.
28 \def\z{\endgroup\input xintkernel.sty\relax}%
29 \fi
30 \else
31 \def\empty {}%
32 \ifx\x\empty % LaTeX, first loading,
33 % variable is initialized, but \ProvidesPackage not yet seen
34 \ifx\w\relax % xintkernel.sty not yet loaded.
35 \def\z{\endgroup\RequirePackage{xintkernel}}%
36 \fi
37 \else
38 \aftergroup\endinput % xintkernel already loaded.
39 \fi
40 \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty

```

### 3.2 Package identification

```

44 \XINT_providespackage
45 \ProvidesPackage{xintcore}%
46 [2015/10/10 v1.2 Expandable arithmetic on big integers (jfb)]%

```

### 3.3 Counts for holding needed constants

```

47 \ifdefined\m@ne\let\xint_c_mone\m@ne
48 \else\csname newcount\endcsname\xint_c_mone \xint_c_mone -1 \fi
49 \newcount\xint_c_x^viii \xint_c_x^viii 1000000000
50 \newcount\xint_c_x^ix \xint_c_x^ix 1000000000
51 \newcount\xint_c_x^viii_mone \xint_c_x^viii_mone 99999999
52 \newcount\xint_c_xii_e_viii \xint_c_xii_e_viii 12000000000
53 \newcount\xint_c_xi_e_viii_mone \xint_c_xi_e_viii_mone 1099999999
54 \newcount\xint_c_xii_e_viii_mone\xint_c_xii_e_viii_mone 1199999999

```

### 3.4 *\xintNum*

For example *\xintNum* {-----+-----000000000000003}  
1.05 defines *\xintiNum*, which allows redefinition of *\xintNum* by *xintfrac.sty* Slightly modified

### 3 Package *xintcore* implementation

in 1.06b ( $\backslash R \rightarrow \backslash xint\_relax$ ) to avoid initial re-scan of input stack (while still allowing empty #1). In versions earlier than 1.09a it was entirely up to the user to apply  $\backslash xintnum$ ; starting with 1.09a arithmetic macros of *xint.sty* (like earlier already *xintfrac.sty* with its own  $\backslash xintnum$ ) make use of  $\backslash xintnum$ . This allows arguments to be count registers, or even  $\backslash numexpr$  arbitrary long expressions (with the trick of braces, see the user documentation).

Note (10/2015): I should take time to revisit this.

```
55 \def\xintiNum {\romannumeral0\xintinum}%
56 \def\xintinum #1%
57 {%
58   \expandafter\XINT_num_loop
59   \romannumeral-`0#1\xint_relax\xint_relax\xint_relax\xint_relax
60   \xint_relax\xint_relax\xint_relax\xint_relax\Z
61}%
62 \let\xintNum\xintiNum \let\xintnum\xintinum
63 \def\XINT_num #1%
64 {%
65   \XINT_num_loop #1\xint_relax\xint_relax\xint_relax\xint_relax
66   \xint_relax\xint_relax\xint_relax\xint_relax\Z
67}%
68 \def\XINT_num_loop #1#2#3#4#5#6#7#8%
69 {%
70   \xint_gob_til_xint_relax #8\XINT_num_end\xint_relax
71   \XINT_num_NumEight #1#2#3#4#5#6#7#8%
72}%
73 \edef\XINT_num_end\xint_relax\XINT_num_NumEight #1\xint_relax #2\Z
74 {%
75   \noexpand\expandafter\space\noexpand\the\numexpr #1+\xint_c_\relax
76}%
77 \def\XINT_num_NumEight #1#2#3#4#5#6#7#8%
78 {%
79   \ifnum \numexpr #1#2#3#4#5#6#7#8+\xint_c_= \xint_c_
80   \xint_afterfi {\expandafter\XINT_num_keepsign_a
81   \the\numexpr #1#2#3#4#5#6#7#81\relax}%
82   \else
83   \xint_afterfi {\expandafter\XINT_num_finish
84   \the\numexpr #1#2#3#4#5#6#7#8\relax}%
85   \fi
86}%
87 \def\XINT_num_keepsign_a #1%
88 {%
89   \xint_gob_til_one#1\XINT_num_gobackto loop 1\XINT_num_keepsign_b
90}%
91 \def\XINT_num_gobackto loop 1\XINT_num_keepsign_b {\XINT_num_loop}%
92 \def\XINT_num_keepsign_b #1{\XINT_num_loop -}%
93 \def\XINT_num_finish #1\xint_relax #2\Z { #1}%

```

### 3.5 Zeroes

Changed for 1.2 which has a base model of eight digits rather than four for the basic operations.

```
94 \edef\XINT_cuz_small #1#2#3#4#5#6#7#8%
95 {%

```

### 3 Package *xintcore* implementation

```
96 \noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5#6#7#8\relax
97 }%
98 %%%%%%%%%%
99 \def\XINT_cuz #1#2#3#4#5#6#7#8#9%
100 {%
101 \xint_gob_til_R #9\XINT_cuz_e \R
102 \xint_gob_til_eightzeroes #1#2#3#4#5#6#7#8\XINT_cuz_z 00000000%
103 \XINT_cuz_clean #1#2#3#4#5#6#7#8#9%
104 }%
105 \edef\XINT_cuz_clean #1#2#3#4#5#6#7#8#9\R
106 {\noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5#6#7#8\relax #9}%
107 \edef\XINT_cuz_e\R #1\XINT_cuz_clean #2\R
108 {\noexpand\expandafter\space\noexpand\the\numexpr #2\relax }%
109 \def\XINT_cuz_z 00000000\XINT_cuz_clean 00000000{\XINT_cuz }%
110 %%%%%%%%%%
111 \def\XINT_cuz_byviii #1#2#3#4#5#6#7#8#9%
112 {%
113 \xint_gob_til_R #9\XINT_cuz_byviii_e \R
114 \xint_gob_til_eightzeroes #1#2#3#4#5#6#7#8\XINT_cuz_byviii_z 00000000%
115 \XINT_cuz_byviii_clean #1#2#3#4#5#6#7#8#9%
116 }%
117 \def\XINT_cuz_byviii_clean #1\R { #1}%
118 \def\XINT_cuz_byviii_e\R #1\XINT_cuz_byviii_clean #2\R{ #2}%
119 \def\XINT_cuz_byviii_z 00000000\XINT_cuz_byviii_clean 00000000{\XINT_cuz_byviii}%

```

### 3.6 Blocks of eight digits

*Lingua of release 1.2.*

```
120 \def\XINT_zeroes_forviii #1#2#3#4#5#6#7#8%
121 {%
122 \xint_gob_til_R #8\XINT_zeroes_forviii_end\R\XINT_zeroes_forviii
123 }%
124 \edef\XINT_zeroes_forviii_end\R\XINT_zeroes_forviii #1#2#3#4#5#6#7#8#9\W
125 {%
126 \noexpand\expandafter\space\noexpand\xint_gob_til_one #2#3#4#5#6#7#8%
127 }%
128 %%%%%%%%%%
129 \def\XINT_rsepbyviii #1#2#3#4#5#6#7#8%
130 {%
131 \XINT_rsepbyviii_b {#1#2#3#4#5#6#7#8}%
132 }%
133 \def\XINT_rsepbyviii_b #1#2#3#4#5#6#7#8#9%
134 {%
135 #2#3#4#5#6#7#8#9\expandafter!\the\numexpr
136 1#1\expandafter.\the\numexpr 1\XINT_rsepbyviii
137 }%
138 \def\XINT_rsepbyviii_end_B #1\relax #2#3{#2.}%
139 \def\XINT_rsepbyviii_end_A #1#2\expandafter #3\relax #4#5{#2.1#5.}%
140 %%%%%%%%%%
141 \def\XINT_sepandrev
142 {%
143 \expandafter\XINT_sepandrev_a\the\numexpr 1\XINT_rsepbyviii

```

### 3 Package *xintcore* implementation

```
144 }%
145 \def\XINT_sepandrev_a {\XINT_sepandrev_b {}}%
146 \def\XINT_sepandrev_b #1#2.#3.#4.#5.#6.#7.#8.#9.%
147 {%
148   \xint_gob_til_R #9\XINT_sepandrev_end\R
149   \XINT_sepandrev_b {#9!#8!#7!#6!#5!#4!#3!#2!#1}%
150 }%
151 \def\XINT_sepandrev_end\R\XINT_sepandrev_b #1#2\W {\XINT_sepandrev_done #1}%
152 \def\XINT_sepandrev_done #11#2!{ }%
153 %%%%%%%%%%
154 \def\XINT_sepandrev_andcount
155 {%
156   \expandafter\XINT_sepandrev_andcount_a\the\numexpr 1\XINT_rsepbyviii
157 }%
158 \def\XINT_sepandrev_andcount_a {\XINT_sepandrev_andcount_b 0.{}%
159 \def\XINT_sepandrev_andcount_b #1.#2#3.#4.#5.#6.#7.#8.#9.%
160 {%
161   \xint_gob_til_R #9\XINT_sepandrev_andcount_end\R
162   \expandafter\XINT_sepandrev_andcount_b \the\numexpr #1+\xint_c_xiv.%
163   {#9!#8!#7!#6!#5!#4!#3!#2}%
164 }%
165 \def\XINT_sepandrev_andcount_end\R
166   \expandafter\XINT_sepandrev_andcount_b\the\numexpr #1+\xint_c_xiv.#2#3#4\W
167 {\expandafter\XINT_sepandrev_andcount_done\the\numexpr \xint_c_ii*#3+#1.#2}%
168 \edef\XINT_sepandrev_andcount_done #1.#21#3!%
169   {\noexpand\expandafter\space\noexpand\the\numexpr #1-#3.}%
```

### 3.7 Blocks of eight, for needs of v1.2 *\xintiiDivision*.

```
170 \def\XINT_sepbyviii_andcount
171 {%
172   \expandafter\XINT_sepbyviii_andcount_a\the\numexpr\XINT_sepbyviii
173 }%
174 \def\XINT_sepbyviii #1#2#3#4#5#6#7#8%
175 {%
176   1#1#2#3#4#5#6#7#8\expandafter!\the\numexpr\XINT_sepbyviii
177 }%
178 \def\XINT_sepbyviii_end #1\relax {\relax\XINT_sepbyviii_andcount_end!}%
179 \def\XINT_sepbyviii_andcount_a {\XINT_sepbyviii_andcount_b \xint_c_.}%
180 \def\XINT_sepbyviii_andcount_b #1.#2!#3!#4!#5!#6!#7!#8!#9!%
181 {%
182   #2\expandafter!\the\numexpr#3\expandafter!\the\numexpr#4\expandafter
183   !\the\numexpr#5\expandafter!\the\numexpr#6\expandafter!\the\numexpr
184   #7\expandafter
185   !\the\numexpr#8\expandafter!\the\numexpr#9\expandafter!\the\numexpr
186   \expandafter\XINT_sepbyviii_andcount_b\the\numexpr #1+\xint_c_viii.%
187 }%
188 \def\XINT_sepbyviii_andcount_end #1\XINT_sepbyviii_andcount_b\the\numexpr
189   #2+\xint_c_viii.#3#4\W {\expandafter.\the\numexpr #2+#3.}%
190 %%%%%%%%%%
191 \def\XINT_rev_nounsep #1#2!#3!#4!#5!#6!#7!#8!#9!%
192 {%
193   \xint_gob_til_R #9\XINT_rev_nounsep_end\R
```

### 3 Package *xintcore* implementation

```

194 \XINT_rev_nounsep {#9!#8!#7!#6!#5!#4!#3!#2!#1}%
195 }%
196 \def\XINT_rev_nounsep_end\R\XINT_rev_nounsep #1#2\W {\XINT_rev_nounsep_done #1}%
197 \def\XINT_rev_nounsep_done #11{ 1}%
198 %%%%%%%%%%
199 \def\XINT_sepbyviii_Z #1#2#3#4#5#6#7#8%
200 {%
201 1#1#2#3#4#5#6#7#8\expandafter!\the\numexpr\XINT_sepbyviii_Z
202 }%
203 \def\XINT_sepbyviii_Z_end #1\relax {\relax\Z!}%
204 %%%%%%%%%%
205 \def\XINT_unsep_cuzsmall #11#2!1#3!1#4!1#5!1#6!1#7!1#8!1#9!%
206 {%
207 \xint_gob_til_R #9\XINT_unsep_cuzsmall_end\R
208 \XINT_unsep_cuzsmall {#1#2#3#4#5#6#7#8#9}%
209 }%
210 \def\XINT_unsep_cuzsmall_end\R
211 \XINT_unsep_cuzsmall #1{\XINT_unsep_cuzsmall_done #1}%
212 \def\XINT_unsep_cuzsmall_done #1\R #2\W{\XINT_cuz_small #1}%
213 \def\XINT_unsep_delim {1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W}%
214 %%%%%%%%%%
215 \def\XINT_div_unsepQ #11#2!1#3!1#4!1#5!1#6!1#7!1#8!1#9!%
216 {%
217 \xint_gob_til_R #9\XINT_div_unsepQ_end\R
218 \XINT_div_unsepQ {#1#2#3#4#5#6#7#8#9}%
219 }%
220 \def\XINT_div_unsepQ_end\R\XINT_div_unsepQ #1{\XINT_div_unsepQ_x #1}%
221 \def\XINT_div_unsepQ_x #1#2#3#4#5#6#7#8#9%
222 {%
223 \xint_gob_til_R #9\XINT_div_unsepQ_e \R
224 \xint_gob_til_eightzeroes #1#2#3#4#5#6#7#8\XINT_div_unsepQ_y 00000000%
225 \expandafter\XINT_div_unsepQ_done \the\numexpr #1#2#3#4#5#6#7#8.#9%
226 }%
227 \def\XINT_div_unsepQ_e\R\xint_gob_til_eightzeroes #1\XINT_div_unsepQ_y #2\W
228 {\the\numexpr #1\relax \Z}%
229 \def\XINT_div_unsepQ_y #1.#2\R #3\W{\XINT_cuz_small #2\Z}%
230 \def\XINT_div_unsepQ_done #1.#2\R #3\W { #1#2\Z}%
231 %%%%%%%%%%
232 \def\XINT_div_unsepR #11#2!1#3!1#4!1#5!1#6!1#7!1#8!1#9!%
233 {%
234 \xint_gob_til_R #9\XINT_div_unsepR_end\R
235 \XINT_div_unsepR {#1#2#3#4#5#6#7#8#9}%
236 }%
237 \def\XINT_div_unsepR_end\R\XINT_div_unsepR #1{\XINT_div_unsepR_done #1}%
238 \def\XINT_div_unsepR_done #1\R #2\W {\XINT_cuz #1\R}%
239 %%%%%%%%%%
240 \def\XINT_unrevbyviii #11#2!1#3!1#4!1#5!1#6!1#7!1#8!1#9!%
241 {%
242 \xint_gob_til_R #9\XINT_unrevbyviii_a\R
243 \XINT_unrevbyviii {#9#8#7#6#5#4#3#2#1}%
244 }%
245 \edef\XINT_unrevbyviii_a\R\XINT_unrevbyviii #1#2\W

```

```

246      {\noexpand\expandafter\space
247       \noexpand\romannumeral-\`0\noexpand\xint_gob_til_Z #1}%
248 \def\xINT_smallunrevbyviii 1#1!1#2!1#3!1#4!1#5!1#6!1#7!1#8!#9\W%
249 {%
250     \expandafter\xINT_cuz_small\xint_gob_til_Z #8#7#6#5#4#3#2#1%
251 }%

```

### 3.8 \xintReverseDigits

v1.2. Needed now by \xintLDg.

```

252 \def\XINT_microrevsep #1#2#3#4#5#6#7#8%
253 {%
254     1#8#7#6#5#4#3#2#1\expandafter!\the\numexpr\XINT_microrevsep
255 }%
256 \def\XINT_microrevsep_end #1\W #2\expandafter #3\Z{#2!}%
257 \def\xintReverseDigits {\romannumeral0\xintreversedigits }%
258 \def\xintreversedigits #1{\expandafter\XINT_reversedigits\romannumeral-`0#1\Z}%
259 \def\XINT_reversedigits #1%
260 {%
261     \xint_UDsignfork
262     #1{\expandafter\xint_minus_thenstop\romannumeral0\XINT_reversedigits_a}%
263     -{\XINT_reversedigits_a #1}%
264     \krof
265 }%
266 \def\XINT_reversedigits_a #1\Z
267 {%
268     \expandafter\XINT_revdigits_a\the\numexpr\expandafter\XINT_microrevsep
269     \romannumeral-`0#1{\XINT_microrevsep_end\W}\XINT_microrevsep_end
270     \XINT_microrevsep_end\XINT_microrevsep_end
271     \XINT_microrevsep_end\XINT_microrevsep_end
272     \XINT_microrevsep_end\XINT_microrevsep_end\Z
273     1\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\W
274 }%
275 \def\XINT_revdigits_a {\XINT_revdigits_b {}}%
276 \def\XINT_revdigits_b #1#2!1#3!1#4!1#5!1#6!1#7!1#8!1#9!%
277 {%
278     \xint_gob_til_R #9\XINT_revdigits_end\R
279     \XINT_revdigits_b {#9#8#7#6#5#4#3#2#1}%
280 }%
281 \edef\XINT_revdigits_end\R\XINT_revdigits_b #1#2\W
282 {\noexpand\expandafter\space\noexpand\xint_gob_til_Z #1}%

```

### 3.9 \xintSgn, \xintiiSgn, \XINT\_Sgn, \XINT\_cntSgn

Changed in 1.05. Earlier code was unnecessarily strange. 1.09a with `\xintnum` 1.09i defines `\XINT_Sgn` and `\XINT_cntSgn` (was `\XINT__Sgn` in 1.09i) for reasons of internal optimizations.

xintfrac.sty will overwrite \xintsgn with use of \xintraw rather than \xintnum, naturally.

```

283 \def\xintiisgn {\romannumeral0\xintiisgn }%
284 \def\xintiisgn #1%
285 {%

```



```

286 \expandafter\XINT_sgn \romannumeral-\`0#1\Z%
287 }%
288 \def\xintSgn {\romannumeral0\xintsgn }%
289 \def\xintsgn #1%
290 {%
291 \expandafter\XINT_sgn \romannumeral0\xintnum{#1}\Z%
292 }%
293 \def\XINT_sgn #1#2\Z
294 {%
295 \xint_UDzerominusfork
296 #1-{ 0}%
297 0#1{ -1}%
298 0-{ 1}%
299 \krof
300 }%
301 \def\XINT_Sgn #1#2\Z
302 {%
303 \xint_UDzerominusfork
304 #1-{0}%
305 0#1{-1}%
306 0-{1}%
307 \krof
308 }%
309 \def\XINT_cntSgn #1#2\Z
310 {%
311 \xint_UDzerominusfork
312 #1-\xint_c_
313 0#1\xint_c_mone
314 0-\xint_c_i
315 \krof
316 }%

```

### 3.10 \xintiOpp, \xintiiOpp

```

317 \def\xintiiOpp {\romannumeral0\xintiiopp }%
318 \def\xintiiopp #1%
319 {%
320 \expandafter\XINT_opp \romannumeral-\`0#1%
321 }%
322 \def\xintiOpp {\romannumeral0\xintiopp }%
323 \def\xintiopp #1%
324 {%
325 \expandafter\XINT_opp \romannumeral0\xintnum{#1}%
326 }%
327 \def\XINT_Opp #1{\romannumeral0\XINT_opp #1}%
328 \def\XINT_opp #1%
329 {%
330 \xint_UDzerominusfork
331 #1-{ 0}% zero
332 0#1{ }% negative
333 0-{ -#1}% positive
334 \krof
335 }%

```

### 3.11 `\xintiAbs`, `\xintiiAbs`

Release 1.09a has now `\xintiabs` which does `\xintnum` and this is inherited by `DecSplit`, by `Sqr`, and macros of `xintgcd.sty`. Attention, car ces macros de toute façon doivent passer à la valeur absolue et donc en profite pour faire le `\xintnum`, mais pour optimisation sans overhead il vaut mieux utiliser `\xintiiAbs` ou autre point d'accès.

```

336 \def\xintiiAbs {\romannumeral0\xintiiabs }%
337 \def\xintiiabs #1%
338 {%
339   \expandafter\XINT_abs \romannumeral-`0#1%
340 }%
341 \def\xintiAbs {\romannumeral0\xintiabs }%
342 \def\xintiabs #1%
343 {%
344   \expandafter\XINT_abs \romannumeral0\xintnum{#1}%
345 }%
346 \def\XINT_Abs #1{\romannumeral0\XINT_abs #1}%
347 \def\XINT_abs #1%
348 {%
349   \xint_UDsignfork
350   #1{ }%
351   -{ #1}%
352   \krof
353 }%

```

### 3.12 `\xintFDg`, `\xintiiFDg`

FIRST DIGIT. Code simplified in 1.05. And prepared for redefinition by `xintfrac` to parse through `\xintNum`. Version 1.09a inserts the `\xintnum` already here.

```

354 \def\xintiiFDg {\romannumeral0\xintiifdg }%
355 \def\xintiifdg #1%
356 {%
357   \expandafter\XINT_fdg \romannumeral-`0#1\W\Z
358 }%
359 \def\xintFDg {\romannumeral0\xintfdg }%
360 \def\xintfdg #1%
361 {%
362   \expandafter\XINT_fdg \romannumeral0\xintnum{#1}\W\Z
363 }%
364 \def\XINT_FDg #1{\romannumeral0\XINT_fdg #1\W\Z }%
365 \def\XINT_fdg #1#2#3\Z
366 {%
367   \xint_UDzerominusfork
368   #1-{ 0}% zero
369   0#1{ #2}% negative
370   0-{ #1}% positive
371   \krof
372 }%

```

### 3.13 `\xintLDg`, `\xintiLDg`

LAST DIGIT. Simplified in 1.05. And prepared for extension by `xintfrac` to parse through `\xintNum`. Release 1.09a adds the `\xintnum` already here, and this propagates to `\xintOdd`, etc... 1.09e The `\xintiLDg` is for defining `\xintiiOdd` which is used once (currently) elsewhere .

bug fix (1.1b): `\xintiLDg` is needed by the division macros next, thus it needs to be in the `xintcore.sty`.

Rewritten for 1.2.

```

373 \def\xintLDg {\romannumeral0\xintldg }%
374 \def\xintldg #1{\xintiildg {\xintNum{#1}}}%
375 \def\xintiilDg {\romannumeral0\xintiildg }%
376 \def\xintiildg #1%
377 {%
378   \expandafter\XINT_ldg_done\romannumeral0%
379   \expandafter\XINT_revdigits_a\the\numexpr\expandafter\XINT_microrevsep
380   \romannumeral0\expandafter\XINT_abs
381   \romannumeral-`0#1{\XINT_microrevsep_end\W}\XINT_microrevsep_end
382   \XINT_microrevsep_end\XINT_microrevsep_end
383   \XINT_microrevsep_end\XINT_microrevsep_end
384   \XINT_microrevsep_end\XINT_microrevsep_end\Z
385   1\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
386   \Z
387 }%
388 \def\XINT_ldg_done #1#2\Z { #1}%

```

### 3.14 `\xintDouble`

v1.08. Rewritten for v1.2.

```

389 \def\xintDouble {\romannumeral0\xintdouble }%
390 \def\xintdouble #1%
391 {%
392   \expandafter\XINT_dbl\romannumeral-`0#1\Z
393 }%
394 \def\XINT_dbl #1%
395 {%
396   \xint_UDzerominusfork
397   #1-\XINT_dbl_zero
398   0#1\XINT_dbl_neg
399   0-{\XINT_dbl_pos #1}%
400   \krof
401 }%
402 \def\XINT_dbl_zero #1\Z { 0}%
403 \def\XINT_dbl_neg
404   {\expandafter\xint_minus_thenstop\romannumeral0\XINT_dbl_pos }%
405 \def\XINT_dbl_pos #1\Z
406 {%
407   \expandafter\XINT_dbl_pos_aa
408   \romannumeral0\expandafter\XINT_sepandrev
409   \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\{10}0000001\W
410   #1\XINT_rsepbyviii_end_A 2345678%
411   \XINT_rsepbyviii_end_B 2345678\relax XX%

```

```

412 \R.\R.\R.\R.\R.\R.\R.\R.\W 1\Z!%
413 1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
414 }%
415 \def\XINT_dbl_pos_aa
416 {%
417 \expandafter\XINT_mul_out\the\numexpr\XINT_verysmallmul 0.2!%
418 }%

```

### 3.15 \xintHalf

v1.08. Rewritten for v1.2.

```

419 \def\xintHalf {\romannumeral0\xinthalf }%
420 \def\xinthalf #1%
421 {%
422 \expandafter\XINT_half\romannumeral-`0#1\Z
423 }%
424 \def\XINT_half #1%
425 {%
426 \xint_UDzerominusfork
427 #1-\XINT_half_zero
428 0#1\XINT_half_neg
429 0-{XINT_half_pos #1}%
430 \krof
431 }%
432 \def\XINT_half_zero #1\Z { 0}%
433 \def\XINT_half_neg {\expandafter\XINT_opp\romannumeral0\XINT_half_pos }%
434 \def\XINT_half_pos #1\Z
435 {%
436 \expandafter\XINT_half_pos_a
437 \romannumeral0\expandafter\XINT_sepandrev
438 \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\{10}0000001\W
439 #1\XINT_rsepbyviii_end_A 2345678%
440 \XINT_rsepbyviii_end_B 2345678\relax XX%
441 \R.\R.\R.\R.\R.\R.\R.\R.\W
442 1\Z!%
443 1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
444 }%
445 \def\XINT_half_pos_a
446 {\expandafter\XINT_half_pos_b\the\numexpr\XINT_verysmallmul 0.5!}%
447 \def\XINT_half_pos_b 1#1#2#3#4#5#6#7#8!1#9%
448 {%
449 \xint_gob_til_Z #9\XINT_half_small \Z
450 \XINT_mul_out 1#1#2#3#4#5#6#7!1#9%
451 }%
452 \edef\XINT_half_small \Z\XINT_mul_out 1#1!#2\W
453 {%
454 \noexpand\expandafter\space\noexpand\the\numexpr #1\relax
455 }%

```

### 3.16 \xintDec

v1.08. Rewritten for v1.2.

```

456 \def\xintDec {\romannumeral0\xintdec }%
457 \def\xintdec #1%
458 {%
459     \expandafter\XINT_dec\romannumeral-`0#1\Z
460 }%
461 \def\XINT_dec #1%
462 {%
463     \xint_UDzerominusfork
464     #1-\XINT_dec_zero
465     0#1\XINT_dec_neg
466     0-{\XINT_dec_pos #1}%
467     \krof
468 }%
469 \def\XINT_dec_zero #1\Z { -1}%
470 \def\XINT_dec_neg
471     {\expandafter\xint_minus_thenstop\romannumeral0\XINT_inc_pos }%
472 \def\XINT_dec_pos #1\Z
473 {%
474     \expandafter\XINT_dec_pos_aa
475     \romannumeral0\expandafter\XINT_sepandrev
476     \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\{10}0000001\W
477     #1\XINT_rsepbyviii_end_A 2345678%
478     \XINT_rsepbyviii_end_B 2345678\relax XX%
479     \R.\R.\R.\R.\R.\R.\R.\R.\W
480     \Z!\Z!\Z!\Z!\Z!\Z!\W
481 }%
482 \def\XINT_dec_pos_aa {\XINT_sub_aa 100000001!\Z!\Z!\Z!\Z!\Z!\Z!\W }%

```

### 3.17 \xintInc

v1.08. Rewritten for v1.2.

```

483 \def\xintInc {\romannumeral0\xintinc }%
484 \def\xintinc #1%
485 {%
486     \expandafter\XINT_inc\romannumeral-`0#1\Z
487 }%
488 \def\XINT_inc #1%
489 {%
490     \xint_UDzerominusfork
491     #1-\XINT_inc_zero
492     0#1\XINT_inc_neg
493     0-{\XINT_inc_pos #1}%
494     \krof
495 }%
496 \def\XINT_inc_zero #1\Z { 1}%
497 \def\XINT_inc_neg {\expandafter\XINT_opp\romannumeral0\XINT_dec_pos }%
498 \def\XINT_inc_pos #1\Z
499 {%
500     \expandafter\XINT_inc_pos_aa
501     \romannumeral0\expandafter\XINT_sepandrev
502     \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\{10}0000001\W
503     #1\XINT_rsepbyviii_end_A 2345678%

```

```

504 \XINT_rsepbyviii_end_B 2345678\relax XX%
505 \R.\R.\R.\R.\R.\R.\R.\R.\W
506 \Z!\Z!\Z!\Z!\Z!\Z!\W
507 }%
508 \def\XINT_inc_pos_aa {\XINT_add_aa 1000000001!\Z!\Z!\Z!\Z!\Z!\Z!\W }%

```

### 3.18 Core arithmetic

The four operations have been rewritten entirely for release v1.2. The new routines works with separated blocks of eight digits. They all measure first the lengths of the arguments, even addition and subtraction (this was not the case with *xintcore.sty* 1.1 or earlier.)

The technique of chaining `\the\numexpr` induces a limitation on the maximal size depending on the size of the input save stack and the maximum expansion depth. For the current (TL2015) settings (5000, resp. 10000), the induced limit for addition of numbers is at 19968 and for multiplication it is observed to be 19959 (valid as of 2015/10/07).

Side remark: I tested that `\the\numexpr` was more efficient than `\number`. But it reduced the allowable numbers for addition from 19976 digits to 19968 digits.

### 3.19 `\xintiAdd`, `\xintiiAdd`

```

509 \def\xintiAdd {\romannumeral0\xintiadd }%
510 \def\xintiadd #1{\expandafter\XINT_iadd\romannumeral0\xintnum{#1}\Z }%
511 \def\xintiiAdd {\romannumeral0\xintiiadd }%
512 \def\xintiiadd #1{\expandafter\XINT_iiadd\romannumeral-`0#1\Z }%
513 \def\XINT_iiadd #1#2\Z #3%
514 {%
515 \expandafter\XINT_add_nfork\expandafter #1\romannumeral-`0#3\Z #2\Z
516 }%
517 \def\XINT_iadd #1#2\Z #3%
518 {%
519 \expandafter\XINT_add_nfork\expandafter #1\romannumeral0\xintnum{#3}\Z #2\Z
520 }%
521 \def\XINT_add_fork #1#2\Z #3\Z {\XINT_add_nfork #1#3\Z #2\Z}%
522 \def\XINT_add_nfork #1#2%
523 {%
524 \xint_UDzerofork
525 #1\XINT_add_firstiszero
526 #2\XINT_add_secondiszero
527 0{}}%
528 \krof
529 \xint_UDsignsfork
530 #1#2\XINT_add_minusminus
531 #1-\XINT_add_minusplus
532 #2-\XINT_add_plusminus
533 --\XINT_add_plusplus
534 \krof #1#2%
535 }%
536 \def\XINT_add_firstiszero #1\krof 0#2#3\Z #4\Z { #2#3}%
537 \def\XINT_add_secondiszero #1\krof #20#3\Z #4\Z { #2#4}%
538 \def\XINT_add_minusminus #1#2%
539 {\expandafter\xint_minus_thenstop\romannumeral0\XINT_add_pp_a {}{}}%
540 \def\XINT_add_minusplus #1#2{\XINT_sub_mm_a {}#2}%

```

### 3 Package *xintcore* implementation

```

541 \def\XINT_add_plusminus #1#2%
542 {\expandafter\XINT_opp\romannumeral0\XINT_sub_mm_a #1{}}%
543 \def\XINT_add_pp_a #1#2#3\Z
544 {%
545 \expandafter\XINT_add_pp_b
546 \romannumeral0\expandafter\XINT_sepandrev_andcount
547 \romannumeral0\XINT_zeroes_forviii #2#3\R\R\R\R\R\R\R\R{10}0000001\W
548 #2#3\XINT_rsepbyviii_end_A 2345678%
549 \XINT_rsepbyviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
550 \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
551 \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
552 \X #1%
553 }%
554 \let\XINT_add_plusplus \XINT_add_pp_a
555 \def\XINT_add_pp_b #1.#2\X #3\Z
556 {%
557 \expandafter\XINT_add_checklengths
558 \the\numexpr #1\expandafter.%
559 \romannumeral0\expandafter\XINT_sepandrev_andcount
560 \romannumeral0\XINT_zeroes_forviii #3\R\R\R\R\R\R\R\R{10}0000001\W
561 #3\XINT_rsepbyviii_end_A 2345678%
562 \XINT_rsepbyviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
563 \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
564 \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
565 \Z!\Z!\Z!\Z!\Z!\W #2\Z!\Z!\Z!\Z!\Z!\W
566 }%
567 \def\XINT_add_checklengths #1.#2.%
568 {%
569 \ifnum #2>#1
570 \expandafter\XINT_add_exchange
571 \else
572 \expandafter\XINT_add_A
573 \fi
574 #1.#2.%
575 }%
576 \def\XINT_add_exchange #1.#2.#3\Z!\Z!\Z!\Z!\Z!\W #4\Z
577 {%
578 \XINT_add_A #2.#1.#4\Z!\Z!\Z!\Z!\Z!\W #3\Z
579 }%
580 \def\XINT_add_A #1.#2.%
581 {%
582 \ifnum #1>\xint_c_vi %
583 \expandafter\XINT_add_aa
584 \else \expandafter\XINT_add_aa_small
585 \fi
586 }%
587 %%%%%%%%%%%
588 \def\XINT_add_out #1\Z #2\W%
589 {%
590 \expandafter\XINT_cuz_small\romannumeral0\XINT_unrevbyviii {}%
591 #11\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\W
592 }%

```

### 3 Package *xintcore* implementation

```
593 \def\XINT_add_out_small #1\Z #2\W%
594 {%
595     \XINT_smallunrevbyviii #11\Z!1\R!1\R!1\R!1\R!1\R!1\R!\W
596 }%
597 %%%%%%%%%%
598 \def\XINT_add_aa {\expandafter\XINT_add_out\the\numexpr\XINT_add_a \xint_c_ii}%
599 \def\XINT_add_aa_small
600     {\expandafter\XINT_add_out_small\the\numexpr\XINT_add_a \xint_c_ii}%
601 \def\XINT_add_a #1!#2!#3!#4!#5\W #6!#7!#8!#9!%
602 {%
603     \XINT_add_b #1!#6!#2!#7!#3!#8!#4!#9!#5\W
604 }%
605 \def\XINT_add_b #1#2!#3!%
606 {%
607     \xint_gob_til_Z #2\XINT_add_bi \Z
608     \expandafter\XINT_add_c\the\numexpr#1+#2+#3-\xint_c_ii.%
609 }%
610 \def\XINT_add_bi\Z
611     \expandafter\XINT_add_c
612     \the\numexpr#1+#2+#3-\xint_c_ii.#4!#5!#6!#7!#8!#9!\Z !\W
613 {%
614     \XINT_add_k #1#3!#5!#7!#9!%
615 }%
616 \def\XINT_add_c #1#2.%
617 {%
618     1#2\expandafter!\the\numexpr\XINT_add_d #1%
619 }%
620 \def\XINT_add_d #1#2!#3!%
621 {%
622     \xint_gob_til_Z #2\XINT_add_di \Z
623     \expandafter\XINT_add_e\the\numexpr#1+#2+#3-\xint_c_ii.%
624 }%
625 \def\XINT_add_di\Z\expandafter\XINT_add_e
626     \the\numexpr#1+#2+#3-\xint_c_ii.#4!#5!#6!#7!#8\W
627 {%
628     \XINT_add_k #1#3!#5!#7!%
629 }%
630 \def\XINT_add_e #1#2.%
631 {%
632     1#2\expandafter!\the\numexpr\XINT_add_f #1%
633 }%
634 \def\XINT_add_f #1#2!#3!%
635 {%
636     \xint_gob_til_Z #2\XINT_add_fi \Z
637     \expandafter\XINT_add_g\the\numexpr#1+#2+#3-\xint_c_ii.%
638 }%
639 \def\XINT_add_fi\Z\expandafter\XINT_add_g
640     \the\numexpr#1+#2+#3-\xint_c_ii.#4!#5!#6\W
641 {%
642     \XINT_add_k #1#3!#5!%
643 }%
644 \def\XINT_add_g #1#2.%
```



```

645 {%
646     1#2\expandafter!\the\numexpr\XINT_add_h #1%
647 }%
648 \def\XINT_add_h #1#2!#3!%
649 {%
650     \xint_gob_til_Z #2\XINT_add_hi \Z
651     \expandafter\XINT_add_i\the\numexpr#1+#2+#3-\xint_c_ii.%
652 }%
653 \def\XINT_add_hi\Z
654     \expandafter\XINT_add_i\the\numexpr#1+#2+#3-\xint_c_ii.#4\W
655 {%
656     \XINT_add_k #1#3!%
657 }%
658 \def\XINT_add_i #1#2.%
659 {%
660     1#2\expandafter!\the\numexpr\XINT_add_a #1%
661 }%
662 %%%%%%%%%%%
663 \def\XINT_add_k #1%
664     {\if #12\expandafter\XINT_add_ke\else\expandafter\XINT_add_l \fi}%
665 \def\XINT_add_ke #1%
666 {%
667     \xint_gob_til_Z #1\XINT_add_kf\Z 1%
668 }%
669 \def\XINT_add_kf\Z 1{1}%
670 \def\XINT_add_l #1%
671 {%
672     \xint_gob_til_Z #1\XINT_add_lf\Z \XINT_add_m 1%
673 }%
674 \def\XINT_add_lf\Z\XINT_add_m 1{100000001}%
675 \def\XINT_add_m #1!%
676 {%
677     \expandafter\XINT_add_n\the\numexpr\xint_c_i+#1.%
678 }%
679 \def\XINT_add_n #1#2.%
680 {%
681     1#2\expandafter!\the\numexpr\XINT_add_o #1%
682 }%
683 \def\XINT_add_o #1%
684     {\if #12\expandafter\XINT_add_l\else\expandafter\XINT_add_ke \fi}%

```

### 3.20 \xintiSub, \xintiiSub

Entirely rewritten for v1.2.

```

685 \def\xintiiSub {\romannumeral0\xintiisub }%
686 \def\xintiisub #1{\expandafter\XINT_iisub\romannumeral-`0#1\Z }%
687 \def\XINT_iisub #1#2\Z #3%
688 {%
689     \expandafter\XINT_sub_nfork\expandafter #1\romannumeral-`0#3\Z #2\Z
690 }%
691 \def\xintiSub {\romannumeral0\xintisub }%
692 \def\xintisub #1{\expandafter\XINT_isub\romannumeral0\xintnum{#1}\Z }%
693 \def\XINT_isub #1#2\Z #3%

```

### 3 Package *xintcore* implementation

```

694 {%
695   \expandafter\XINT_sub_nfork\expandafter #1\romannumeral0\xintnum{#3}\Z #2\Z
696 }%
697 \def\XINT_sub_nfork #1#2%
698 {%
699   \xint_UDzerofork
700     #1\XINT_sub_firstiszero
701     #2\XINT_sub_secondiszero
702     0{}}%
703   \krof
704   \xint_UDsignsfork
705     #1#2\XINT_sub_minusminus
706     #1-\XINT_sub_minusplus
707     #2-\XINT_sub_plusminus
708     --\XINT_sub_plusplus
709   \krof #1#2%
710 }%
711 \def\XINT_sub_firstiszero #1\krof 0#2#3\Z #4\Z {\XINT_opp #2#3}%
712 \def\XINT_sub_secondiszero #1\krof #20#3\Z #4\Z { #2#4}%
713 \def\XINT_sub_plusminus #1#2{\XINT_add_pp_a #1{}}%
714 \def\XINT_sub_plusplus #1#2%
715   {\expandafter\XINT_opp\romannumeral0\XINT_sub_mm_a #1#2}%
716 \def\XINT_sub_minusplus #1#2%
717   {\expandafter\xint_minus_thenstop\romannumeral0\XINT_add_pp_a {}}#2}%
718 \def\XINT_sub_minusminus #1#2{\XINT_sub_mm_a {}}}%
719 \def\XINT_sub_mm_a #1#2#3\Z
720 {%
721   \expandafter\XINT_sub_mm_b
722     \romannumeral0\expandafter\XINT_sepandrev_andcount
723     \romannumeral0\XINT_zeroes_forviii #2#3\R\R\R\R\R\R\R\R{10}0000001\W
724     #2#3\XINT_rsepbyviii_end_A 2345678%
725     \XINT_rsepbyviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
726     \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
727     \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
728   \X #1%
729 }%
730 \def\XINT_sub_mm_b #1.#2\X #3\Z
731 {%
732   \expandafter\XINT_sub_checklengths
733   \the\numexpr #1\expandafter.%
734   \romannumeral0\expandafter\XINT_sepandrev_andcount
735   \romannumeral0\XINT_zeroes_forviii #3\R\R\R\R\R\R\R\R{10}0000001\W
736   #3\XINT_rsepbyviii_end_A 2345678%
737   \XINT_rsepbyviii_end_B 2345678\relax \xint_c_ii\xint_c_iii
738   \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
739   \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
740   \Z!\Z!\Z!\Z!\Z!\W #2\Z!\Z!\Z!\Z!\Z!\W
741 }%
742 \def\XINT_sub_checklengths #1.#2.%
743 {%
744   \ifnum #2>#1
745     \expandafter\XINT_sub_exchange

```

### 3 Package *xintcore* implementation

```

746 \else
747 \expandafter\XINT_sub_aa
748 \fi
749 }%
750 \def\XINT_sub_exchange #1\Z!\Z!\Z!\Z!\Z!\W #2\Z
751 {%
752 \expandafter\XINT_opp\romannumeral0\XINT_sub_aa
753 #2\Z!\Z!\Z!\Z!\Z!\W #1\Z
754 }%
755 %%%%%%%%%%%
756 \def\XINT_sub_prepare_rescue #1\W {\relax\Z-\W}%
757 \def\XINT_sub_prepare_cuz #1\W {\relax\XINT_cuz_byviii!\Z 0\W\R}%
758 %%%%%%%%%%%
759 \def\XINT_sub_aa {\expandafter\XINT_sub_out\the\numexpr\XINT_sub_a \xint_c_i }%
760 \def\XINT_sub_out #1\Z #2#3\W
761 {%
762 \if-#2\expandafter\XINT_sub_startrescue\fi
763 \expandafter\XINT_cuz_small
764 \romannumeral0\XINT_unrevbyviii {}#11\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
765 }%
766 \def\XINT_sub_startrescue\expandafter\XINT_cuz_small
767 \romannumeral0\XINT_unrevbyviii #1#2\Z!#3\W
768 {%
769 \expandafter\XINT_sub_rescue_finish
770 \the\numexpr\XINT_sub_rescue_a #2!%
771 1\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W \R
772 }%
773 \def\XINT_sub_rescue_finish
774 {\expandafter-\romannumeral0\expandafter\XINT_cuz
775 \romannumeral0\XINT_unrevbyviii {}}%
776 \def\XINT_sub_rescue_a #1!%
777 {%
778 \expandafter\XINT_sub_rescue_c\the\numexpr \xint_c_xii_e_viii-#1.%
779 }%
780 \def\XINT_sub_rescue_c 1#1#2.%
781 {%
782 1#2\expandafter!\the\numexpr\XINT_sub_rescue_d #1%
783 }%
784 \def\XINT_sub_rescue_d #1#2#3!%
785 {%
786 \xint_gob_til_minus #2\XINT_sub_rescue_z -%
787 \expandafter\XINT_sub_rescue_c\the\numexpr \xint_c_xii_e_viii_mone-#2#3+#1.%
788 }%
789 \def\XINT_sub_rescue_z #1.{1!}%
790 %%%%%%%%%%%
791 \def\XINT_sub_a #1!#2!#3!#4!#5\W #6!#7!#8!#9!%
792 {%
793 \XINT_sub_b #1!#6!#2!#7!#3!#8!#4!#9!#5\W
794 }%
795 \def\XINT_sub_b #1#2#3!#4!%
796 {%
797 \xint_gob_til_Z #2\XINT_sub_bi \Z

```

### 3 Package *xintcore* implementation

```
798 \expandafter\XINT_sub_c\the\numexpr#1+1#4-#3-\xint_c.i.%
799 }%
800 \def\XINT_sub_c #1#2.%
801 {%
802   1#2\expandafter!\the\numexpr\XINT_sub_d #1%
803 }%
804 \def\XINT_sub_d #1#2#3!#4!%
805 {%
806   \xint_gob_til_Z #2\XINT_sub_di \Z
807   \expandafter\XINT_sub_e\the\numexpr#1+1#4-#3-\xint_c.i.%
808 }%
809 \def\XINT_sub_e #1#2.%
810 {%
811   1#2\expandafter!\the\numexpr\XINT_sub_f #1%
812 }%
813 \def\XINT_sub_f #1#2#3!#4!%
814 {%
815   \xint_gob_til_Z #2\XINT_sub_fi \Z
816   \expandafter\XINT_sub_g\the\numexpr#1+1#4-#3-\xint_c.i.%
817 }%
818 \def\XINT_sub_g #1#2.%
819 {%
820   1#2\expandafter!\the\numexpr\XINT_sub_h #1%
821 }%
822 \def\XINT_sub_h #1#2#3!#4!%
823 {%
824   \xint_gob_til_Z #2\XINT_sub_hi \Z
825   \expandafter\XINT_sub_i\the\numexpr#1+1#4-#3-\xint_c.i.%
826 }%
827 \def\XINT_sub_i #1#2.%
828 {%
829   1#2\expandafter!\the\numexpr\XINT_sub_a #1%
830 }%
831 \def\XINT_sub_bi\Z
832 \expandafter\XINT_sub_c\the\numexpr#1+1#2-#3.#4!#5!#6!#7!#8!#9!\Z !\W
833 {%
834   \XINT_sub_k #1#2!#5!#7!#9!%
835 }%
836 \def\XINT_sub_di\Z
837 \expandafter\XINT_sub_e\the\numexpr#1+1#2-#3.#4!#5!#6!#7!#8\W
838 {%
839   \XINT_sub_k #1#2!#5!#7!%
840 }%
841 \def\XINT_sub_fi\Z
842 \expandafter\XINT_sub_g\the\numexpr#1+1#2-#3.#4!#5!#6\W
843 {%
844   \XINT_sub_k #1#2!#5!%
845 }%
846 \def\XINT_sub_hi\Z
847 \expandafter\XINT_sub_i\the\numexpr#1+1#2-#3.#4\W
848 {%
849   \XINT_sub_k #1#2!%
```

```

850 }%
851 %%%%%%%%%%%
852 \def\XINT_sub_k #1#2%
853 {%
854   \xint_gob_til_Z #2\XINT_sub_p\Z \XINT_sub_l #1#2%
855 }%
856 \def\XINT_sub_l #1%
857 {%
858   \xint_UDzerofork
859     #1\XINT_sub_m
860     0{}%
861   \krof
862 }%
863 \def\XINT_sub_m #1!%
864 {%
865   \expandafter\XINT_sub_n\the\numexpr 1#1-\xint_c_i!%
866 }%
867 \def\XINT_sub_n 1#1%
868 {%
869   \xint_UDzerofork
870     #1{\XINT_sub_o}%
871     0{\XINT_sub_n_checkzero}%
872   \krof
873 }%
874 \def\XINT_sub_o #1!{1#1\expandafter!\the\numexpr\XINT_sub_m }%
875 \def\XINT_sub_n_checkzero #1!%
876 {%
877   \xint_gob_til_eightzeroes #1\XINT_sub_n_prepare_cuz 00000000%
878   1#1!%
879 }%
880 \def\XINT_sub_n_prepare_cuz 00000000100000000{1\XINT_sub_prepare_cuz}%
881 \def\XINT_sub_p\Z\XINT_sub_l #1\Z!%
882 {%
883   \xint_UDzerofork
884     #1{-1\XINT_sub_prepare_rescue}%
885     0{1\XINT_sub_prepare_cuz }%
886   \krof
887 }%

```

### 3.21 \xintiMul, \xintiiMul

Completely rewritten for v1.2.

```

888 \def\xintiMul {\romannumeral0\xintimul }%
889 \def\xintimul #1%
890 {%
891   \expandafter\XINT_imul\romannumeral0\xintnum{#1}\Z
892 }%
893 \def\XINT_imul #1#2\Z #3%
894 {%
895   \expandafter\XINT_mul_nfork\expandafter #1\romannumeral0\xintnum{#3}\Z #2\Z
896 }%
897 \def\xintiiMul {\romannumeral0\xintiimul }%

```

### 3 Package *xintcore* implementation

```

898 \def\xintiimul #1%
899 {%
900   \expandafter\XINT_iimul\romannumeral-`0#1\Z
901 }%
902 \def\XINT_iimul #1#2\Z #3%
903 {%
904   \expandafter\XINT_mul_nfork\expandafter #1\romannumeral-`0#3\Z #2\Z
905 }%

```

I have changed the fork, and it complicates matters elsewhere.

```

906 \def\XINT_mul_fork #1#2\Z #3\Z{\XINT_mul_nfork #1#3\Z #2\Z}%
907 \def\XINT_mul_nfork #1#2%
908 {%
909   \xint_UDzerofork
910   #1\XINT_mul_zero
911   #2\XINT_mul_zero
912   0{}%
913   \krof
914   \xint_UDsignsfork
915   #1#2\XINT_mul_minusminus
916   #1-\XINT_mul_minusplus
917   #2-\XINT_mul_plusminus
918   --\XINT_mul_plusplus
919   \krof #1#2%
920 }%
921 \def\XINT_mul_zero #1\krof #2#3\Z #4\Z { 0}%
922 \def\XINT_mul_minusminus #1#2{\XINT_mul_plusplus {}{}}%
923 \def\XINT_mul_minusplus #1#2%
924   {\expandafter\xint_minus_thenstop\romannumeral0\XINT_mul_plusplus {}#2}%
925 \def\XINT_mul_plusminus #1#2%
926   {\expandafter\xint_minus_thenstop\romannumeral0\XINT_mul_plusplus #1{}}%
927 \def\XINT_mul_plusplus #1#2#3\Z
928 {%
929   \expandafter\XINT_mul_pre_b
930   \romannumeral0\expandafter\XINT_sepandrev_andcount
931   \romannumeral0\XINT_zeroes_forviii #2#3\R\R\R\R\R\R\R\{10}0000001\W
932   #2#3\XINT_rsepybviii_end_A 2345678%
933   \XINT_rsepybviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
934   \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
935   \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
936   \W #1%
937 }%
938 \def\XINT_mul_pre_b #1.#2\W #3\Z
939 {%
940   \expandafter\XINT_mul_checklengths
941   \the\numexpr #1\expandafter.%
942   \romannumeral0\expandafter\XINT_sepandrev_andcount
943   \romannumeral0\XINT_zeroes_forviii #3\R\R\R\R\R\R\R\{10}0000001\W
944   #3\XINT_rsepybviii_end_A 2345678%
945   \XINT_rsepybviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
946   \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
947   \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W

```

### 3 Package *xintcore* implementation

```

948      1\Z!\W #21\Z!%
949      1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
950 }%

```

Cooking recipee, 2015/10/05.

```

951 \def\XINT_mul_checklengths #1.#2.%
952 {%
953   \ifnum #2=\xint_c_i\expandafter\XINT_mul_smallbyfirst\fi
954   \ifnum #1=\xint_c_i\expandafter\XINT_mul_smallbysecond\fi
955   \ifnum #2<#1
956     \ifnum \numexpr (#2-\xint_c_i)*(#1-#2)<383
957       \XINT_mul_exchange
958     \fi
959   \else
960     \ifnum \numexpr (#1-\xint_c_i)*(#2-#1)>383
961       \XINT_mul_exchange
962     \fi
963   \fi
964   \XINT_mul_start
965 }%
966 \def\XINT_mul_smallbyfirst #1\XINT_mul_start 1#2!1\Z!\W
967 {%
968   \ifnum#2=\xint_c_i\expandafter\XINT_mul_oneisone\fi
969   \ifnum#2<\xint_c_xxii\expandafter\XINT_mul_verysmall\fi
970   \expandafter\XINT_mul_out\the\numexpr\XINT_smallmul 1#2!%
971 }%
972 \def\XINT_mul_smallbysecond #1\XINT_mul_start #2\W 1#3!1\Z!%
973 {%
974   \ifnum#3=\xint_c_i\expandafter\XINT_mul_oneisone\fi
975   \ifnum#3<\xint_c_xxii\expandafter\XINT_mul_verysmall\fi
976   \expandafter\XINT_mul_out\the\numexpr\XINT_smallmul 1#3!#2%
977 }%
978 \def\XINT_mul_oneisone #1!\XINT_mul_out }%
979 \def\XINT_mul_verysmall\expandafter\XINT_mul_out
980       \the\numexpr\XINT_smallmul 1#1!%
981   {\expandafter\XINT_mul_out\the\numexpr\XINT_verysmallmul 0.#1!}%
982 \def\XINT_mul_exchange #1\XINT_mul_start #2\W #31\Z!%
983   {\fi\fi\XINT_mul_start #31\Z!\W #2}%
984 \def\XINT_mul_start
985   {\expandafter\XINT_mul_out\the\numexpr\XINT_mul_loop 100000000!\Z\W}%
986 \def\XINT_mul_out
987   {\expandafter\XINT_cuz_small\romannumeral0\XINT_unrevbyviii {}}%
988 \def\XINT_mul_loop #1\Z #2\W #3\W 1#4!%
989 {%
990   \xint_gob_til_Z #4\XINT_mul_e \Z
991   \expandafter\XINT_mul_a\the\numexpr \XINT_smallmul 1#4!#3\W
992   #11!\W #3\W
993 }%
994 \def\XINT_mul_a #11\Z!\W #2!1!#3\W
995 {%
996   \expandafter\XINT_mul_b\the\numexpr
997   \XINT_add_a \xint_c_ii #2!\Z!\Z!\Z!\Z!\Z!\W #1\Z!\Z!\Z!\Z!\Z!\W

```

### 3 Package *xintcore* implementation

```

998 }%
999 \def\XINT_mul_b 1#1!\{1#1\expandafter!\the\numexpr\XINT_mul_loop }%
1000 \def\XINT_mul_e\Z #1\W #2!1!#3\W #4\W {#2!1\Z!}%

```

1.2 small and mini multiplication in base  $10^8$  with carry. On output the small multiplication suppresses ending zeroes. The situation is different with addition which may end up inserting a final 1!, thus multiplication is « cleaner » in that aspect. Used by the main multiplication routines. But division, float factorial, etc.. have their own variants as they need output with specific constraints.

```

1001 \def\XINT_minimulwc_a 1#1.#2.#3!#4#5#6#7#8.%
1002 {%
1003   \expandafter\XINT_minimulwc_b
1004   \the\numexpr \xint_c_x^ix+#1+#3*#8.#3*#4#5#6#7+#2*#8.#2*#4#5#6#7.%
1005 }%
1006 \def\XINT_minimulwc_b 1#1#2#3#4#5#6.#7.%
1007 {%
1008   \expandafter\XINT_minimulwc_c
1009   \the\numexpr \xint_c_x^ix+#1#2#3#4#5+#7.#6.%
1010 }%
1011 \def\XINT_minimulwc_c 1#1#2#3#4#5#6.#7.#8.%
1012 {%
1013   1#6#7\expandafter!%
1014   \the\numexpr\expandafter\XINT_smallmul_a
1015   \the\numexpr \xint_c_x^viii+#1#2#3#4#5+#8.%
1016 }%
1017 \def\XINT_smallmul 1#1#2#3#4#5!\{ \XINT_smallmul_a 100000000.#1#2#3#4.#5!}%
1018 \def\XINT_smallmul_a #1.#2.#3!1#4!%
1019 {%
1020   \xint_gob_til_Z #4\XINT_smallmul_e\Z
1021   \XINT_minimulwc_a #1.#2.#3!#4.#2.#3!%
1022 }%
1023 \def\XINT_smallmul_e\Z\XINT_minimulwc_a 1#1.#2\Z #3!%
1024   {\xint_gob_til_eightzeroes #1\XINT_smallmul_f 000000001\relax #1!1\Z!}%
1025 \def\XINT_smallmul_f 000000001\relax 00000000!1{1\relax}%

```

This is multiplication by 1 up to 21. Last time I checked it is never called with a wasteful multiplicand of 1.

```

1026 \def\XINT_verysmallmul #1.#2!1#3!%
1027 {%
1028   \xint_gob_til_Z #3\XINT_verysmallmul_e\Z
1029   \expandafter\XINT_verysmallmul_a
1030   \the\numexpr #2*#3+#1.#2!%
1031 }%
1032 \def\XINT_verysmallmul_e\Z\expandafter\XINT_verysmallmul_a\the\numexpr
1033   #1+#2#3.#4!%
1034 {\xint_gob_til_zero #2\XINT_verysmallmul_f 0\xint_c_x^viii+#2#3!1\Z!}%
1035 \def\XINT_verysmallmul_f #1!1{1\relax}%
1036 \def\XINT_verysmallmul_a #1#2.%
1037 {%
1038   \unless\ifnum #1#2<\xint_c_x^ix
1039   \expandafter\XINT_verysmallmul_bi\else
1040   \expandafter\XINT_verysmallmul_bj\fi

```



```

1041 \the\numexpr \xint_c_x^ix+#1#2.%
1042 }%
1043 \def\XINT_verysmallmul_bj{\expandafter\XINT_verysmallmul_cj }%
1044 \def\XINT_verysmallmul_cj 1#1#2.%
1045 {1#2\expandafter!\the\numexpr\XINT_verysmallmul #1.}%
1046 \def\XINT_verysmallmul_bi\the\numexpr\xint_c_x^ix+#1#2#3.%
1047 {1#3\expandafter!\the\numexpr\XINT_verysmallmul #1#2.}%

```

Used by division and by squaring, not by multiplication itself.

```

1048 \def\XINT_minimul_a #1.#2!#3#4#5#6#7!%
1049 {%
1050 \expandafter\XINT_minimul_b
1051 \the\numexpr \xint_c_x^viii+#2*#7.#2*#3#4#5#6+#1*#7.#1*#3#4#5#6.%
1052 }%
1053 \def\XINT_minimul_b 1#1#2#3#4#5.#6.%
1054 {%
1055 \expandafter\XINT_minimul_c
1056 \the\numexpr \xint_c_x^ix+#1#2#3#4+#6.#5.%
1057 }%
1058 \def\XINT_minimul_c 1#1#2#3#4#5#6.#7.#8.%
1059 {%
1060 1#6#7\expandafter!\the\numexpr \xint_c_x^viii+#1#2#3#4#5+#8!%
1061 }%

```

### 3.22 \xintiSqr, \xintiiSqr

Rewritten for v1.2.

```

1062 \def\xintiiSqr {\romannumeral0\xintiisqr }%
1063 \def\xintiisqr #1%
1064 {%
1065 \expandafter\XINT_sqr\romannumeral0\xintiiabs{#1}\Z
1066 }%
1067 \def\xintiSqr {\romannumeral0\xintisqr }%
1068 \def\xintisqr #1%
1069 {%
1070 \expandafter\XINT_sqr\romannumeral0\xintiabs{#1}\Z
1071 }%
1072 \def\XINT_sqr #1\Z
1073 {%
1074 \expandafter\XINT_sqr_a
1075 \romannumeral0\expandafter\XINT_sepandrev_andcount
1076 \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\{10}0000001\W
1077 #1\XINT_rsepbyviii_end_A 2345678%
1078 \XINT_rsepbyviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
1079 \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
1080 \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
1081 \Z
1082 }%
1083 \def\XINT_sqr_a #1.%
1084 {%
1085 \ifnum #1=\xint_c_i \expandafter\XINT_sqr_small

```

```

1086             \else\expandafter\XINT_sqr_start\fi
1087 }%
1088 \def\XINT_sqr_small #1#2#3#4#5!\Z
1089 {%
1090     \ifnum #1#2#3#4#5<46341 \expandafter\XINT_sqr_verysmall\fi
1091     \expandafter\XINT_sqr_small_out
1092     \the\numexpr\XINT_minimul_a #1#2#3#4.#5!#1#2#3#4#5!%
1093 }%
1094 \edef\XINT_sqr_verysmall
1095     \expandafter\XINT_sqr_small_out\the\numexpr\XINT_minimul_a #1!#2!%
1096     {\noexpand\expandafter\space\noexpand\the\numexpr #2*#2\relax}%
1097 \def\XINT_sqr_small_out #1!#2!%
1098 {%
1099     \XINT_cuz #2#1\R
1100 }%
1101 \def\XINT_sqr_start #1\Z
1102 {%
1103     \expandafter\XINT_mul_out
1104     \the\numexpr\XINT_mul_loop 100000000!\Z\W #11\Z!\W #11\Z!%
1105     1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
1106 }%

```

### 3.23 \xintiPow, \xintiiPow

The exponent is not limited but with current default settings of tex memory, with xint 1.2, the maximal exponent for  $2^N$  is  $N = 2^{17} = 131072$ .

```

1107 \def\xintiiPow {\romannumeral0\xintiipow }%
1108 \def\xintiipow #1%
1109 {%
1110     \expandafter\xint_pow\romannumeral-`0#1\Z%
1111 }%
1112 \def\xintiPow {\romannumeral0\xintipow }%
1113 \def\xintipow #1%
1114 {%
1115     \expandafter\xint_pow\romannumeral0\xintnum{#1}\Z%
1116 }%
1117 \def\xint_pow #1#2\Z
1118 {%
1119     \xint_UDsignfork
1120     #1\XINT_pow_Aneg
1121     -\XINT_pow_Anonneg
1122     \krof
1123     #1{#2}%
1124 }%
1125 \def\XINT_pow_Aneg #1#2#3%
1126 {%
1127     \expandafter\XINT_pow_Aneg_\expandafter{\the\numexpr #3}\Z
1128 }%
1129 \def\XINT_pow_Aneg_ #1%
1130 {%
1131     \ifodd #1
1132         \expandafter\XINT_pow_Aneg_Bodd

```

### 3 Package *xintcore* implementation

```
1133 \fi
1134 \XINT_pow_Anonneg_ {#1}%
1135 }%
1136 \def\XINT_pow_Aneg_Bodd #1%
1137 {%
1138   \expandafter\XINT_opp\romannumeral0\XINT_pow_Anonneg_
1139 }%

B = #3, faire le xpxp. Modified with 1.06: use of \numexpr.

1140 \def\XINT_pow_Anonneg_ #1#2#3%
1141 {%
1142   \expandafter\XINT_pow_Anonneg_\expandafter {\the\numexpr #3}#1#2\Z
1143 }%
```

#1 = B, #2 = |A|. Modifié pour v1.1, car utilisait \XINT\_Cmp, ce qui d'ailleurs n'était sans doute pas super efficace, et m'obligeait à mettre \xintCmp dans xintcore. Donc ici A est déjà #2#3 et il y a un \Z après.

```
1144 \def\XINT_pow_Anonneg_ #1#2#3\Z
1145 {%
1146   \if\relax #3\relax\xint_dothis
1147     {\ifcase #2 \expandafter\XINT_pow_AisZero
1148       \or\expandafter\XINT_pow_AisOne
1149       \else\expandafter\XINT_pow_AatleastTwo
1150       \fi }\fi
1151   \xint_orthat \XINT_pow_AatleastTwo {#1}{#2#3}%
1152 }%
1153 \def\XINT_pow_AisOne #1#2{ 1}%

#1 = B
```

```
1154 \def\XINT_pow_AisZero #1#2%
1155 {%
1156   \ifcase\XINT_cntSgn #1\Z
1157     \xint_afterfi { 1}%
1158   \or
1159     \xint_afterfi { 0}%
1160   \else
1161     \xint_afterfi {\xintError:DivisionByZero\space 0}%
1162   \fi
1163 }%
1164 \def\XINT_pow_AatleastTwo #1%
1165 {%
1166   \ifcase\XINT_cntSgn #1\Z
1167     \expandafter\XINT_pow_BisZero
1168   \or
1169     \expandafter\XINT_pow_I_in
1170   \else
1171     \expandafter\XINT_pow_BisNegative
1172   \fi
1173   {#1}%
1174 }%
1175 \edef\XINT_pow_BisNegative #1#2%
```

### 3 Package *xintcore* implementation

```

1176     {\noexpand\xintError:FractionRoundedToZero\space 0}%
1177 \def\xINT_pow_BisZero #1#2{ 1}%

    B = #1 > 0, A = #2 > 1.

1178 % \def\xINT_pow_checkBsize #1%
1179 % {%
1180 %     \ifnum #1>131000
1181 %         \expandafter\xINT_pow_BtooBig
1182 %     \else
1183 %         \expandafter\xINT_pow_I_in
1184 %     \fi
1185 %     {#1}%
1186 %}%
1187 \edef\xINT_pow_BtooBig #1#2{\noexpand\xintError:ExponentTooBig\space 0}%
1188 %%%%%%%%%%%
1189 \def\xINT_pow_I_in #1#2%
1190 {%
1191     \expandafter\xINT_pow_I_loop
1192     \the\numexpr #1\expandafter.%
1193     \romannumeral0\expandafter\xINT_sepandrev
1194     \romannumeral0\xINT_zeroes_forviii #2\R\R\R\R\R\R\R\{10}0000001\W
1195     #2\xINT_rsepbyviii_end_A 2345678%
1196     \xINT_rsepbyviii_end_B 2345678\relax XX%
1197     \R.\R.\R.\R.\R.\R.\R.\R.W 1\Z!\W
1198     1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
1199}%
1200 \def\xINT_pow_I_loop #1.%
1201 {%
1202     \ifnum #1 = \xint_c_i\expandafter\xINT_pow_I_exit\fi
1203     \ifodd #1
1204         \expandafter\xINT_pow_II_in
1205     \else
1206         \expandafter\xINT_pow_I_squareit
1207     \fi #1.%
1208}%
1209 \def\xINT_pow_I_exit \ifodd #1\fi #2.#3\W {\xINT_mul_out #3}%
1210 \def\xINT_pow_I_squareit #1.#2\W%
1211 {%
1212     \expandafter\xINT_pow_I_loop
1213     \the\numexpr #1/\xint_c_ii\expandafter.%
1214     \the\numexpr\xINT_pow_mulbutcheckifsmall #2\W #2\W
1215}%
1216 %%%%%%%%%%%
1217 \def\xINT_pow_mulbutcheckifsmall #1!1#2%
1218 {%
1219     \xint_gob_til_Z #2\xINT_pow_mul_small\Z
1220     \xINT_mul_loop 100000000!\Z\W #1!1#2%
1221}%
1222 \def\xINT_pow_mul_small\Z\xINT_mul_loop 100000000!\Z\W 1#1!1\Z!\W
1223 {%
1224     \xINT_smallmul 1#1!%
1225}%

```

### 3 Package *xintcore* implementation

```

1226 %%%%%%%%%%
1227 \def\XINT_pow_II_in #1.#2\W
1228 {%
1229   \expandafter\XINT_pow_II_loop
1230   \the\numexpr #1/\xint_c_ii-\xint_c_i\expandafter.%
1231   \the\numexpr\XINT_pow_mulbutcheckifsmall #2\W #2\W #2\W
1232 }%
1233 \def\XINT_pow_II_loop #1.%
1234 {%
1235   \ifnum #1 = \xint_c_i\expandafter\XINT_pow_II_exit\fi
1236   \ifodd #1
1237     \expandafter\XINT_pow_II_odda
1238   \else
1239     \expandafter\XINT_pow_II_even
1240   \fi #1.%
1241 }%
1242 \def\XINT_pow_II_exit\ifodd #1\fi #2.#3\W #4\W
1243 {%
1244   \expandafter\XINT_mul_out
1245   \the\numexpr\XINT_pow_mulbutcheckifsmall #4\W #3%
1246 }%
1247 \def\XINT_pow_II_even #1.#2\W
1248 {%
1249   \expandafter\XINT_pow_II_loop
1250   \the\numexpr #1/\xint_c_ii\expandafter.%
1251   \the\numexpr\XINT_pow_mulbutcheckifsmall #2\W #2\W
1252 }%
1253 \def\XINT_pow_II_odda #1.#2\W #3\W
1254 {%
1255   \expandafter\XINT_pow_II_oddb
1256   \the\numexpr #1/\xint_c_ii-\xint_c_i\expandafter.%
1257   \the\numexpr\XINT_pow_mulbutcheckifsmall #3\W #2\W #2\W
1258 }%
1259 \def\XINT_pow_II_oddb #1.#2\W #3\W
1260 {%
1261   \expandafter\XINT_pow_II_loop
1262   \the\numexpr #1\expandafter.%
1263   \the\numexpr\XINT_pow_mulbutcheckifsmall #3\W #3\W #2\W
1264 }%

```

#### 3.24 *\xintiFac*, *\xintiiFac*

Moved to *xintcore.sty* with release 1.2 (to be usable by *\bnumexpr*). The routine has been partially rewritten and there is an intrinsic limit at 9999. Anyhow with current default settings of the *etex* memory and the current 1.2 routine (last commit: *eadalb1*), the maximal possible computation is 5971! (which has 19956 digits). Also, I add *\xintiiFac* which does only *\romannumeral-`0* and not *\numexpr* on its argument. This is for a silly slight optimization of the *\xintiexpr* (and *\bnumexpr*) parsers. If the argument is  $\geq 2^{31}$  an arithmetic overflow will occur in the *\ifnum*. This is not as good as in the *\numexpr*, but well.

```

1265 \def\xintiFac {\romannumeral0\xintifac }%
1266 \def\xintifac #1%
1267 {%

```

### 3 Package *xintcore* implementation

```

1268 \expandafter\XINT_fac_fork\expandafter {\the\numexpr#1}%
1269 }%
1270 \def\xintiiFac {\romannumeral0\xintiifac }%
1271 \def\xintiifac #1%
1272 {%
1273 \expandafter\XINT_fac_fork\expandafter {\romannumeral-`0#1}%
1274 }%
1275 \let\xintFac\xintiFac \let\xintfac\xintifac
1276 \def\XINT_fac_fork #1%
1277 {%
1278 \ifcase\XINT_cntSgn #1\Z
1279 \xint_afterfi{\expandafter\space\expandafter 1\xint_gobble_i }%
1280 \or
1281 \expandafter\XINT_fac_checksize
1282 \else
1283 \xint_afterfi{\expandafter\xintError:FactorialOfNegativeNumber
1284 \expandafter\space\expandafter 1\xint_gobble_i }%
1285 \fi
1286 {#1}%
1287 }%
1288 \def\XINT_fac_checksize #1%
1289 {%
1290 \ifnum #1>9999
1291 \xint_dothis{\expandafter\xintError:FactorialOfTooBigNumber
1292 \expandafter\space\expandafter 1\xint_gob_til_W }\fi
1293 \ifnum #1>465 \xint_dothis{\XINT_fac_bigloop_a #1.}\fi
1294 \ifnum #1>101 \xint_dothis{\XINT_fac_medloop_a #1.\XINT_mul_out}\fi
1295 \xint_orthat{\XINT_fac_smallloop_a #1.\XINT_mul_out}%
1296 1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
1297 }%
1298 \def\XINT_fac_bigloop_a #1.%
1299 {%
1300 \expandafter\XINT_fac_bigloop_b \the\numexpr
1301 #1+\xint_c_i-\xint_c_ii*((#1-464)/\xint_c_ii).#1.%
1302 }%
1303 \def\XINT_fac_bigloop_b #1.#2.%
1304 {%
1305 \expandafter\XINT_fac_medloop_a
1306 \the\numexpr #1-\xint_c_i.{\XINT_fac_bigloop_loop #1.#2.}%
1307 }%
1308 \def\XINT_fac_bigloop_loop #1.#2.%
1309 {%
1310 \ifnum #1>#2 \expandafter\XINT_fac_bigloop_exit\fi
1311 \expandafter\XINT_fac_bigloop_loop
1312 \the\numexpr #1+\xint_c_ii\expandafter.%
1313 \the\numexpr #2\expandafter.\the\numexpr\XINT_fac_bigloop_mul #1!%
1314 }%
1315 \def\XINT_fac_bigloop_exit #1!{\XINT_mul_out}%
1316 \def\XINT_fac_bigloop_mul #1!%
1317 {%
1318 \expandafter\XINT_smallmul
1319 \the\numexpr \xint_c_x^viii+#1*(#1+\xint_c_i)!%

```

### 3 Package *xintcore* implementation

```

1320 }%
1321 \def\XINT_fac_medloop_a #1.%
1322 {%
1323   \expandafter\XINT_fac_medloop_b
1324     \the\numexpr #1+\xint_c_i-\xint_c_iii*((#1-100)/\xint_c_iii).#1.%
1325 }%
1326 \def\XINT_fac_medloop_b #1.#2.%
1327 {%
1328   \expandafter\XINT_fac_smallloop_a
1329     \the\numexpr #1-\xint_c_i.{\XINT_fac_medloop_loop #1.#2.}%
1330 }%
1331 \def\XINT_fac_medloop_loop #1.#2.%
1332 {%
1333   \ifnum #1>#2 \expandafter\XINT_fac_loop_exit\fi
1334   \expandafter\XINT_fac_medloop_loop
1335     \the\numexpr #1+\xint_c_iii\expandafter.%
1336     \the\numexpr #2\expandafter.\the\numexpr\XINT_fac_medloop_mul #1!%
1337 }%
1338 \def\XINT_fac_medloop_mul #1!%
1339 {%
1340   \expandafter\XINT_smallmul
1341     \the\numexpr
1342       \xint_c_x^viii+#1*(#1+\xint_c_i)*(#1+\xint_c_ii)!%
1343 }%
1344 \def\XINT_fac_smallloop_a #1.%
1345 {%
1346   \csname
1347     XINT_fac_smallloop_\the\numexpr #1-\xint_c_iv*(#1/\xint_c_iv)\relax
1348   \endcsname #1.%
1349 }%
1350 \expandafter\def\csname XINT_fac_smallloop_1\endcsname #1.%
1351 {%
1352   \XINT_fac_smallloop_loop 2.#1.100000001!1\Z!%
1353 }%
1354 \expandafter\def\csname XINT_fac_smallloop_-2\endcsname #1.%
1355 {%
1356   \XINT_fac_smallloop_loop 3.#1.100000002!1\Z!%
1357 }%
1358 \expandafter\def\csname XINT_fac_smallloop_-1\endcsname #1.%
1359 {%
1360   \XINT_fac_smallloop_loop 4.#1.100000006!1\Z!%
1361 }%
1362 \expandafter\def\csname XINT_fac_smallloop_0\endcsname #1.%
1363 {%
1364   \XINT_fac_smallloop_loop 5.#1.1000000024!1\Z!%
1365 }%
1366 \def\XINT_fac_smallloop_loop #1.#2.%
1367 {%
1368   \ifnum #1>#2 \expandafter\XINT_fac_loop_exit\fi
1369   \expandafter\XINT_fac_smallloop_loop
1370     \the\numexpr #1+\xint_c_iv\expandafter.%
1371     \the\numexpr #2\expandafter.\the\numexpr\XINT_fac_smallloop_mul #1!%

```

```

1372 }%
1373 \def\XINT_fac_smallloop_mul #1!%
1374 {%
1375     \expandafter\XINT_smallmul
1376     \the\numexpr
1377         \xint_c_x^viii+#1*(#1+\xint_c_i)*(#1+\xint_c_ii)*(#1+\xint_c_iii)!%
1378 }%
1379 \def\XINT_fac_loop_exit #1!#2\Z!#3{#3#2\Z!}%

```

### 3.25 \xintiDivision, \xintiQuo, \xintiRem, \xintiiDivision, \xintiiQuo, \xintiiRem

Completely rewritten for v1.2. WARNING: some comments below try to describe the flow of tokens but they date back from xint 1.09j and I updated them on the fly while doing the 1.2 version. As the new works in base  $10^8$ , not  $10^4$  and "drops" the quotient digits, rather than store them upfront as the earlier code, I may well have not correctly converted all such comments. At the last minute some previously #1 became stuff like #1#2#3#4, then of course the old comments describing what the macro parameters stand for are necessarily wrong.

```

1380 \def\xintiiQuo {\romannumeral0\xintiiquo }%
1381 \def\xintiiRem {\romannumeral0\xintiiirem }%
1382 \def\xintiiquo {\expandafter\xint_firstoftwo_thenstop\romannumeral0\xintiidivision }%
1383 \def\xintiiirem {\expandafter\xint_secondoftwo_thenstop\romannumeral0\xintiidivision }%
1384 \def\xintiQuo {\romannumeral0\xintiquo }%
1385 \def\xintiRem {\romannumeral0\xintirem }%
1386 \def\xintiquo {\expandafter\xint_firstoftwo_thenstop\romannumeral0\xintidivision }%
1387 \def\xintirem {\expandafter\xint_secondoftwo_thenstop\romannumeral0\xintidivision }%
1388 \let\xintQuo\xintiQuo\let\xintquo\xintiquo % deprecated
1389 \let\xintRem\xintiRem\let\xintrem\xintirem % deprecated

```

#1 = A, #2 = B. On calcule le quotient et le reste dans la division euclidienne de A par B:  $A=BQ+R$ ,  $0 \leq R < |B|$ .

```

1390 \def\xintiDivision {\romannumeral0\xintidivision }%
1391 \def\xintidivision #1{\expandafter\XINT_idivision\romannumeral0\xintnum{#1}\Z }%
1392 \def\XINT_idivision #1#2\Z #3{\expandafter\XINT_iidivision_a\expandafter #1%
1393     \romannumeral0\xintnum{#3}\Z #2\Z }%
1394 \def\xintiiDivision {\romannumeral0\xintiidivision }%
1395 \def\xintiidivision #1{\expandafter\XINT_iidivision \romannumeral-`0#1\Z }%
1396 \def\XINT_iidivision #1#2\Z #3{\expandafter\XINT_iidivision_a\expandafter #1%
1397     \romannumeral-`0#3\Z #2\Z }%
1398 \def\XINT_iidivision_a #1#2% #1 de A, #2 de B.
1399 {%
1400     \if0#2\xint_dothis\XINT_iidivision_divbyzero\fi
1401     \if0#1\xint_dothis\XINT_iidivision_aiszero\fi
1402     \if-#2\xint_dothis{\expandafter\XINT_iidivision_bneg
1403         \romannumeral0\XINT_iidivision_bpos #1}\fi
1404     \xint_orthat{\XINT_iidivision_bpos #1#2}%
1405 }%
1406 \def\XINT_iidivision_divbyzero #1\Z #2\Z {\xintError:DivisionByZero{0}{0}}%
1407 \def\XINT_iidivision_aiszero #1\Z #2\Z {{0}{0}}%
1408 \def\XINT_iidivision_bneg #1% q->-q, r unchanged
1409     {\expandafter{\romannumeral0\XINT_opp #1}}%

```



### 3 Package *xintcore* implementation

```

1410 \def\XINT_iidivision_bpos #1%
1411 {%
1412     \xint_UDsignfork
1413         #1\XINT_iidivision_aneg
1414         -{\XINT_iidivision_apos #1}%
1415     \krof
1416 }%
1417 \def\XINT_iidivision_apos #1#2\Z #3\Z{\XINT_div_prepare {#2}{#1#3}}%
1418 \def\XINT_iidivision_aneg #1\Z #2\Z
1419     {\expandafter
1420         \XINT_iidivision_aneg_b\romannumeral0\XINT_div_prepare {#1}{#2}{#1}}%
1421 \def\XINT_iidivision_aneg_b #1#2{\if0\XINT_Sgn #2\Z
1422     \expandafter\XINT_iidivision_aneg_rzero
1423     \else
1424     \expandafter\XINT_iidivision_aneg_rpos
1425     \fi {#1}{#2}}%
1426 \def\XINT_iidivision_aneg_rzero #1#2#3{{-#1}{0}}% necessarily q was >0
1427 \def\XINT_iidivision_aneg_rpos #1%
1428 {%
1429     \expandafter\XINT_iidivision_aneg_end\expandafter
1430     {\expandafter-\romannumeral0\xintinc {#1}}% q-> -(1+q)
1431 }%
1432 \def\XINT_iidivision_aneg_end #1#2#3%
1433 {%
1434     \expandafter\xint_exchangetwo_keepbraces
1435     \expandafter{\romannumeral0\XINT_sub_mm_a {}{}#3\Z #2\Z}{#1}% r-> b-r
1436 }%
1437 %%%%%%%%%%%
1438 \def\XINT_div_prepare #1%
1439 {%
1440     \XINT_div_prepare_a #1\R\R\R\R\R\R\R {10}0000001\W !{#1}%
1441 }%
1442 \def\XINT_div_prepare_a #1#2#3#4#5#6#7#8#9%
1443 {%
1444     \xint_gob_til_R #9\XINT_div_prepare_small\R
1445     \XINT_div_prepare_b #9%
1446 }%
1447 %%%%%%%%%%%
1448 \def\XINT_div_prepare_small\R #1!#2%
1449 {%
1450     \ifcase #2
1451     \or\expandafter\XINT_div_BisOne
1452     \or\expandafter\XINT_div_BisTwo
1453     \else\expandafter\XINT_div_small_a
1454     \fi {#2}%
1455 }%
1456 \def\XINT_div_BisOne #1#2{{#2}{0}}%
1457 \def\XINT_div_BisTwo #1#2%
1458 {%
1459     \expandafter\expandafter\expandafter\XINT_div_BisTwo_a
1460     \ifodd\xintLDg{#2} \expandafter1\else \expandafter0\fi {#2}%
1461 }%

```

### 3 Package *xintcore* implementation

```

1462 \def\XINT_div_BisTwo_a #1#2%
1463 {%
1464     \expandafter{\romannumeral0\xinthalft {#2}}{#1}%
1465 }%
1466 \def\XINT_div_small_a #1#2%
1467 {%
1468     \expandafter\XINT_div_small_b
1469     \the\numexpr #1/\xint_c_ii\expandafter
1470     .\the\numexpr \xint_c_x^viii+#1\expandafter!%
1471     \romannumeral0%
1472     \XINT_div_small_ba #2\R\R\R\R\R\R\R\R{10}0000001\W
1473     #2\XINT_sepbyviii_Z_end 2345678\relax
1474 }%
1475 \def\XINT_div_small_b #1!#2{#2#1!}%
1476 \def\XINT_div_small_ba #1#2#3#4#5#6#7#8#9%
1477 {%
1478     \xint_gob_til_R #9\XINT_div_smallsmall\R
1479     \expandafter\XINT_div_dosmallldiv
1480     \the\numexpr\expandafter\XINT_sepbyviii_Z
1481         \romannumeral0\XINT_zeroes_forviii
1482     #1#2#3#4#5#6#7#8#9%
1483 }%
1484 \def\XINT_div_smallsmall\R
1485     \expandafter\XINT_div_dosmallldiv
1486     \the\numexpr\expandafter\XINT_sepbyviii_Z
1487     \romannumeral0\XINT_zeroes_forviii #1\R #2\relax
1488     {{\XINT_div_dosmallsmall}{#1}}%
1489 \def\XINT_div_dosmallsmall #1.1#2!#3%
1490 {%
1491     \expandafter\XINT_div_smallsmallend
1492     \the\numexpr (#3+#1)/#2-\xint_c_i.#2.#3.%
1493 }%
1494 \def\XINT_div_smallsmallend #1.#2.#3.{\expandafter
1495     {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #3-#1*#2}}%
1496 \def\XINT_div_dosmallldiv
1497     {{\expandafter\XINT_sdiv_out\the\numexpr\XINT_smallldivx_a}}%
1498 %%%%%%%%%%
1499 \def\XINT_div_prepare_b
1500     {\expandafter\XINT_div_prepare_c\romannumeral0\XINT_zeroes_forviii }%
1501 \def\XINT_div_prepare_c #1!%
1502 {%
1503     \XINT_div_prepare_d #1.00000000!{#1}%
1504 }%
1505 \def\XINT_div_prepare_d #1#2#3#4#5#6#7#8#9%
1506 {%
1507     \expandafter\XINT_div_prepare_e\xint_gob_til_dot #1#2#3#4#5#6#7#8#9!%
1508 }%
1509 \def\XINT_div_prepare_e #1!#2!#3#4%
1510 {%
1511     \XINT_div_prepare_f #4#3\X {#1}{#3}%
1512 }%
1513 \def\XINT_div_prepare_f #1#2#3#4#5#6#7#8#9\X

```

### 3 Package *xintcore* implementation

```

1514 {%
1515   \expandafter\XINT_div_prepare_g
1516   \the\numexpr #1#2#3#4#5#6#7#8+\xint_c_i\expandafter
1517   .\the\numexpr (#1#2#3#4#5#6#7#8+\xint_c_i)/\xint_c_ii\expandafter
1518   .\the\numexpr #1#2#3#4#5#6#7#8\expandafter
1519   .\romannumeral0\XINT_sepandrev_andcount
1520   #1#2#3#4#5#6#7#8#9\XINT_rsepbyviii_end_A 2345678%
1521   \XINT_rsepbyviii_end_B 2345678%
1522   \relax\xint_c_ii\xint_c_iii
1523   \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
1524   \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
1525   \X
1526 }%
1527 \def\XINT_div_prepare_g #1.#2.#3.#4.#5\X #6#7#8%
1528 {%
1529   \expandafter\XINT_div_prepare_h
1530   \the\numexpr\expandafter\XINT_sepbyviii_andcount
1531   \romannumeral0\XINT_zeroes_forviii #8#7\R\R\R\R\R\R\R\R{10}0000001\W
1532   #8#7\XINT_sepbyviii_end 2345678\relax
1533   \xint_c_vii!\xint_c_vi!\xint_c_v!\xint_c_iv!%
1534   \xint_c_iii!\xint_c_ii!\xint_c_i!\xint_c_\W
1535   {#1}{#2}{#3}{#4}{#5}{#6}%
1536 }%
1537 \def\XINT_div_prepare_h #11.#2.#3#4#5#6#7#8%
1538 {%
1539   \XINT_div_start_a {#2}{#6}{#1}{#3}{#4}{#5}{#7}{#8}%
1540 }%

```

L, K, A, x', y, x, B, «c». Attention que K est diminué de 1 plus loin. Comme xint 1.2 a déjà repéré K=1, on a ici au minimum K=2. Attention B est à l'envers, A est à l'endroit et les deux avec séparateurs. Attention que ce n'est pas ici qu'on boucle mais en \XINT\_div\_I\_a.

```

1541 \def\XINT_div_start_a #1#2%
1542 {%
1543   \ifnum #1 < #2
1544     \expandafter\XINT_div_zeroQ
1545   \else
1546     \expandafter\XINT_div_start_b
1547   \fi
1548   {#1}{#2}%
1549 }%
1550 \def\XINT_div_zeroQ #1#2#3#4#5#6#7%
1551 {%
1552   \expandafter\XINT_div_zeroQ_end
1553   \romannumeral0\XINT_unsep_cuzsmall
1554   #31\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W .%
1555 }%
1556 \def\XINT_div_zeroQ_end #1.#2%
1557   {\expandafter{\expandafter0\expandafter}\XINT_div_cleanR #1#2.}%

L, K, A, x', y, x, B, «c»->K.A.x{LK{x'y}x}B«c»

1558 \def\XINT_div_start_b #1#2#3#4#5#6%
1559 {%

```

### 3 Package *xintcore* implementation

```

1560 \expandafter\XINT_div_finish\the\numexpr
1561 \XINT_div_start_c {#2}.#3.{#6}{\#1}{#2}{\#4}{#5}{#6}}%
1562 }%
1563 \def\XINT_div_finish
1564 {%
1565 \expandafter\XINT_div_finish_a \romannumeral-`0\XINT_div_unsepQ
1566 }%
1567 \def\XINT_div_finish_a #1\Z #2.{\XINT_div_finish_b #2.{#1}}%

```

Ici ce sont routines de fin. Le reste déjà nettoyé. R.Q«c».

```

1568 \def\XINT_div_finish_b #1%
1569 {%
1570 \if0#1%
1571 \expandafter\XINT_div_finish_bRzero
1572 \else
1573 \expandafter\XINT_div_finish_bRpos
1574 \fi
1575 #1%
1576 }%
1577 \def\XINT_div_finish_bRzero 0.#1#2{\#1}{0}}%
1578 \def\XINT_div_finish_bRpos #1.#2#3%
1579 {%
1580 \expandafter\xint_exchangetwo_keepbraces\XINT_div_cleanR #1#3.{#2}%
1581 }%
1582 \def\XINT_div_cleanR #1000000000.{\#1}}%

```

Kalpha.A.x{LK{x'y}x}, B, «c», au début #2=alpha est vide. On fait une boucle pour prendre K unités de A (on a au moins L égal à K) et les mettre dans alpha.

```

1583 \def\XINT_div_start_c #1%
1584 {%
1585 \ifnum #1>\xint_c_vi
1586 \expandafter\XINT_div_start_ca
1587 \else
1588 \expandafter\XINT_div_start_cb
1589 \fi {\#1}%
1590 }%
1591 \def\XINT_div_start_ca #1#2.#3!#4!#5!#6!#7!#8!#9!%
1592 {%
1593 \expandafter\XINT_div_start_c\expandafter
1594 {\the\numexpr #1-\xint_c_vii}{#2#3!#4!#5!#6!#7!#8!#9!}%
1595 }%
1596 \def\XINT_div_start_cb #1%
1597 {\csname XINT_div_start_c\romannumeral\numexpr#1\endcsname}%
1598 \def\XINT_div_start_c_i #1.#2!%
1599 {\XINT_div_start_c_ #1#2!.}%
1600 \def\XINT_div_start_c_ii #1.#2!#3!%
1601 {\XINT_div_start_c_ #1#2!#3!.}%
1602 \def\XINT_div_start_c_iii #1.#2!#3!#4!%
1603 {\XINT_div_start_c_ #1#2!#3!#4!.}%
1604 \def\XINT_div_start_c_iv #1.#2!#3!#4!#5!%
1605 {\XINT_div_start_c_ #1#2!#3!#4!#5!.}%
1606 \def\XINT_div_start_c_v #1.#2!#3!#4!#5!#6!%

```

### 3 Package *xintcore* implementation

```

1607     {\XINT_div_start_c_ #1#2!#3!#4!#5!#6!.}%
1608 \def\XINT_div_start_c_vi #1.#2!#3!#4!#5!#6!#7!%
1609     {\XINT_div_start_c_ #1#2!#3!#4!#5!#6!#7!.}%

#1=a, #2=alpha (de longueur K, à l'endroit).#3=reste de A.#4=x, #5={LK{x'y}x},#6=B,«c» -> a, x,
alpha, B, {00000000}, L, K, {x'y},x, alpha'=reste de A, B«c».

1610 \def\XINT_div_start_c_ 1#1!#2.#3.#4#5#6%
1611 {%
1612     \XINT_div_I_a {#1}{#4}{1#1!#2}{#6}{00000000}#5{#3}{#6}%
1613 }%

Ceci est le point de retour de la boucle principale. a, x, alpha, B, q0, L, K, {x'y}, x, alpha',
B«c»

1614 \def\XINT_div_I_a #1#2%
1615 {%
1616     \expandafter\XINT_div_I_b\the\numexpr #1/#2.{#1}{#2}%
1617 }%
1618 \def\XINT_div_I_b #1%
1619 {%
1620     \xint_gob_til_zero #1\XINT_div_I_czero 0\XINT_div_I_c #1%
1621 }%

On intercepte petit quotient nul: #1=a, x, alpha, B, #5=q0, L, K, {x'y}, x, alpha', B«c» -> on lâche
un q puis {alpha} L, K, {x'y}, x, alpha', B«c».

1622 \def\XINT_div_I_czero 0\XINT_div_I_c 0.#1#2#3#4#5{1#5\XINT_div_I_g {#3}}%
1623 \def\XINT_div_I_c #1.#2#3%
1624 {%
1625     \expandafter\XINT_div_I_da\the\numexpr #2-#1*#3.#1.{#2}{#3}%
1626 }%

r.q.alpha, B, q0, L, K, {x'y}, x, alpha', B«c»

1627 \def\XINT_div_I_da #1.%
1628 {%
1629     \ifnum #1>\xint_c_ix
1630         \expandafter\XINT_div_I_dP
1631     \else
1632         \ifnum #1<\xint_c_
1633             \expandafter\expandafter\expandafter\XINT_div_I_dN
1634         \else
1635             \expandafter\expandafter\expandafter\XINT_div_I_db
1636         \fi
1637     \fi
1638 }%

attention très mauvaises notations avec _b et _db.

1639 \def\XINT_div_I_dN #1.%
1640 {%
1641     \expandafter\XINT_div_I_b\the\numexpr #1-\xint_c_i.%
1642 }%
1643 \def\XINT_div_I_db #1.#2#3#4#5%

```

### 3 Package *xintcore* implementation

```

1644 {%
1645   \expandafter\XINT_div_I_dc\expandafter #1%
1646   \romannumeral0\expandafter\XINT_div_sub\expandafter
1647     {\romannumeral0\XINT_rev_nounsep {}#4\R!\R!\R!\R!\R!\R!\R!\R!\W}%
1648     {\the\numexpr\XINT_div_verysmallmul #1!#51\Z!}%
1649   \Z {#4}{#5}%
1650 }%

```

La soustraction spéciale renvoie simplement - si le chiffre q est trop grand. On invoque dans ce cas I\_dP.

```

1651 \def\XINT_div_I_dc #1#2%
1652 {%
1653   \if-#2\expandafter\XINT_div_I_dd\else\expandafter\XINT_div_I_de\fi
1654   #1#2%
1655 }%
1656 \def\XINT_div_I_dd #1-\Z
1657 {%
1658   \if #11\expandafter\XINT_div_I_dz\fi
1659   \expandafter\XINT_div_I_dP\the\numexpr #1-\xint_c_i.XX%
1660 }%
1661 \def\XINT_div_I_dz #1XX#2#3#4%
1662 {%
1663   1#4\XINT_div_I_g {#2}%
1664 }%
1665 \def\XINT_div_I_de #1#2\Z #3#4#5{1#5+#1\XINT_div_I_g {#2}}%

```

q.alpha, B, q0, L, K, {x'y},x, alpha'B«c» (q=0 has been intercepted) -> 1nouveauq.nouvel alpha, L, K, {x'y}, x, alpha',B«c»

```

1666 \def\XINT_div_I_dP #1.#2#3#4#5#6%
1667 {%
1668   1#6+#1\expandafter\XINT_div_I_g\expandafter
1669   {\romannumeral0\expandafter\XINT_div_sub\expandafter
1670     {\romannumeral0\XINT_rev_nounsep {}#4\R!\R!\R!\R!\R!\R!\R!\R!\W}%
1671     {\the\numexpr\XINT_div_verysmallmul #1!#51\Z!}%
1672   }%
1673 }%

```

1#1=nouveau q. nouvel alpha, L, K, {x'y},x,alpha', BQ«c»

#1=q,#2=nouvel alpha,#3=L, #4=K, #5={x'y}, #6=x, #7= alpha',#8=B, «c» -> on laisse q puis {x'y}alpha.alpha'.{{x'y}xKL}B«c»

```

1674 \def\XINT_div_I_g #1#2#3#4#5#6#7%
1675 {%
1676   \expandafter !\the\numexpr
1677   \ifnum#2=#3
1678     \expandafter\XINT_div_exittofinish
1679   \else
1680     \expandafter\XINT_div_I_h
1681   \fi
1682   {#4}#1.#6.{#4}{#5}{#3}{#2}}{#7}%
1683 }%

```

### 3 Package *xintcore* implementation

```

{x'y}alpha.alpha'.{{x'y}xKL}B«c» -> Attention retour à l'envoyeur ici par terminaison des \the\numexpr.
On doit reprendre le Q déjà sorti, qui n'a plus de séparateurs, ni de leading 1. Ensuite R sans
leading zeros.«c»

1684 \def\XINT_div_exittofinish #1#2.#3.#4#5%
1685 {%
1686     1\expandafter\expandafter\expandafter!\expandafter\XINT_unsep_delim
1687     \romannumeral0\XINT_div_unsepR #2#31\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W.%
1688 }%

#1={x'y}alpha.#2!#3=reste de A. #4={{x'y},x,K,L},#5=B,«c» devient {x'y},alpha sur K+4 chiffres.B,
{{x'y},x,K,L}, #6= nouvel alpha',B,«c»

1689 \def\XINT_div_I_h #1.#2!#3.#4#5%
1690 {%
1691     \XINT_div_II_b #1#2!.{#5}{#4}{#3}{#5}%
1692 }%

{x'y}alpha.B, {{x'y},x,K,L}, nouveau alpha',B,«c»

1693 \def\XINT_div_II_b #1#2!#3!%
1694 {%
1695     \xint_gob_til_eightzeroes #2\XINT_div_II_skipc 00000000%
1696     \XINT_div_II_c #1{1#2}{#3}%
1697 }%

x'y{100000000}{1<8>}reste de alpha.#6=B,#7={{x'y},x,K,L}, alpha',B, «c» -> {x'y}x,K,L (à dimin-
uer de 4), {alpha sur K}B{q1=00000000}{alpha'}B,«c»

1698 \def\XINT_div_II_skipc 00000000\XINT_div_II_c #1#2#3#4#5.#6#7%
1699 {%
1700     \XINT_div_II_k #7{#4!#5}{#6}{00000000}%
1701 }%

x'ya->1qx'yalpha.B, {{x'y},x,K,L}, nouveau alpha',B, «c».

1702 \def\XINT_div_II_c #1#2#3#4%
1703 {%
1704     \expandafter\XINT_div_II_d\the\numexpr\XINT_div_mini
1705     #1.#2!#3!#4!{#1}{#2}{#3!#4!}%
1706 }%

1 suivi de q1 sur huit chiffres! #2=x', #3=y, #4=alpha.#5=B, {{x'y},x,K,L}, alpha', B, «c» -->
nouvel alpha.x',y,B,q1,{{x'y},x,K,L}, alpha', B, «c»

1707 \def\XINT_div_II_d 1#1#2#3#4#5!#6#7#8.#9%
1708 {%
1709     \expandafter\XINT_div_II_e
1710     \romannumeral0\expandafter\XINT_div_sub\expandafter
1711     {\romannumeral0\XINT_rev_nounsep {#8\R!\R!\R!\R!\R!\R!\R!\R!\W}%
1712     {\the\numexpr\XINT_div_smallmul_a 100000000.#1#2#3#4.#5!#91\Z!}%
1713     .{#6}{#7}{#9}{#1#2#3#4#5}%
1714 }%

```

### 3 Package *xintcore* implementation

$\alpha.x', y, B, q_1, \{\{x'y\}, x, K, L\}, \alpha', B, \llcorner c \rangle$ . Attention la soustraction spéciale doit maintenir les blocs  $1 < 8$ !

```

1715 \def\XINT_div_II_e 1#1!%
1716 {%
1717   \xint_gob_til_eightzeroes #1\XINT_div_II_skipf 00000000%
1718   \XINT_div_II_f 1#1!%
1719 }%

100000000!alpha sur K chiffres.#2=x', #3=y, #4=B, #5=q1, #6={\{x'y\}, x, K, L}, #7=alpha', B\llcorner c \rangle -> {\{x'y\}x, K, L
(à diminuer de 1), {\alpha sur K}B{q1}{\alpha'}B\llcorner c \rangle

1720 \def\XINT_div_II_skipf 00000000\XINT_div_II_f 100000000!#1.#2#3#4#5#6%
1721 {%
1722   \XINT_div_II_k #6{#1}{#4}{#5}%
1723 }%

1<a1>!1<a2>!, alpha (sur K+1 blocs de 8). x', y, B, q1, {\{x'y\}, x, K, L}, alpha', B, \llcorner c \rangle.

1724 \def\XINT_div_II_f #1!#2!#3.%
1725 {%
1726   \XINT_div_II_fa {#1!#2!}{#1!#2!#3}%
1727 }%
1728 \def\XINT_div_II_fa #1#2#3#4%
1729 {%
1730   \expandafter\XINT_div_II_g \the\numexpr\XINT_div_mini #3.#4!#1{#2}%
1731 }%

#1=q, #2=alpha (K+4), #3=B, #4=q1, {\{x'y\}, x, K, L}, alpha', BQ\llcorner c \rangle -> 1 puis nouveau q sur 8 chiffres.
nouvel alpha sur K blocs, B, {\{x'y\}, x, K, L}, alpha', B\llcorner c \rangle

1732 \def\XINT_div_II_g 1#1#2#3#4#5!#6#7#8%
1733 {%
1734   \expandafter \XINT_div_II_h
1735   \the\numexpr 1#1#2#3#4#5+#8\expandafter\expandafter\expandafter
1736   .\expandafter\expandafter\expandafter
1737   {\expandafter\xint_gob_til_exclam
1738   \romannumeral0\expandafter\XINT_div_sub\expandafter
1739   {\romannumeral0\XINT_rev_nounsep {}#6\R!\R!\R!\R!\R!\R!\R!\R!\W}%
1740   {\the\numexpr\XINT_div_smallmul_a 100000000.#1#2#3#4.#5!#71\Z!}}%
1741   {#7}%
1742 }%

1 puis nouveau q sur 8 chiffres, #2=nouvel alpha sur K blocs, #3=B, #4={\{x'y\}, x, K, L} avec L à
ajuster, alpha', BQ\llcorner c \rangle -> {\{x'y\}x, K, L à diminuer de 1, {\alpha}B{q}, alpha', BQ\llcorner c \rangle

1743 \def\XINT_div_II_h 1#1.#2#3#4%
1744 {%
1745   \XINT_div_II_k #4{#2}{#3}{#1}%
1746 }%

{\{x'y\}x, K, L à diminuer de 1, alpha, B{q}\alpha', B\llcorner c \rangle -> nouveau L.K, x', y, x, alpha.B, q, \alpha', B, \llcorner c \rangle
-> {\LK{\{x'y\}x}, x, a, alpha.B, q, \alpha', B, \llcorner c \rangle

1747 \def\XINT_div_II_k #1#2#3#4#5%

```



### 3 Package *xintcore* implementation

```

1748 {%
1749   \expandafter\XINT_div_II_l \the\numexpr #4-\xint_c_i.{#3}#1{#2}#5.%
1750 }%
1751 \def\XINT_div_II_l #1.#2#3#4#51#6!%
1752 {%
1753   \XINT_div_II_m {{#1}{#2}{{#3}{#4}{{#5}{{#5}{{#6}1#6!%
1754 }%

{LK{x'y}x},x,a,alpha.B{q}alpha'B -> a, x, alpha, B, q, L, K, {x'y}, x, alpha', B<c>

1755 \def\XINT_div_II_m #1#2#3#4.#5#6%
1756 {%
1757   \XINT_div_I_a {#3}{#2}{{#4}{{#5}{{#6}#1%
1758 }%

```

This multiplication is exactly like `\XINT_smallmul`, but it always keeps the ending carry. For optimization I duplicated the whole code.

```

1759 \def\XINT_div_minimulwc_a 1#1.#2.#3!#4#5#6#7#8.%
1760 {%
1761   \expandafter\XINT_div_minimulwc_b
1762   \the\numexpr \xint_c_x^ix+#1+#3*#8.#3*#4#5#6#7+#2*#8.#2*#4#5#6#7.%
1763 }%
1764 \def\XINT_div_minimulwc_b 1#1#2#3#4#5#6.#7.%
1765 {%
1766   \expandafter\XINT_div_minimulwc_c
1767   \the\numexpr \xint_c_x^ix+#1#2#3#4#5+#7.#6.%
1768 }%
1769 \def\XINT_div_minimulwc_c 1#1#2#3#4#5#6.#7.#8.%
1770 {%
1771   1#6#7\expandafter!%
1772   \the\numexpr\expandafter\XINT_div_smallmul_a
1773   \the\numexpr \xint_c_x^viii+#1#2#3#4#5+#8.%
1774 }%
1775 \def\XINT_div_smallmul_a #1.#2.#3!1#4!%
1776 {%
1777   \xint_gob_til_Z #4\XINT_div_smallmul_e\Z
1778   \XINT_div_minimulwc_a #1.#2.#3!#4.#2.#3!%
1779 }%
1780 \def\XINT_div_smallmul_e\Z\XINT_div_minimulwc_a 1#1.#2\Z #3!{1\relax #1!}%

```

Special very small multiplication for division. We only need to cater for multiplicands from 1 to 9. The ending is different from standard `verysmallmul`, a zero carry is not suppressed. And no final `1\Z!` is added. If `#1=1` let's not forget to add the `100000000!` at the end.

```

1781 \def\XINT_div_verysmallmul #1%
1782   {\xint_gob_til_one #1\XINT_div_verysmallisone 1\XINT_div_verysmallmul_a 0.#1}%
1783 \def\XINT_div_verysmallisone 1\XINT_div_verysmallmul_a 0.1!1#11\Z!%
1784   {1\relax #1100000000!}%
1785 \def\XINT_div_verysmallmul_a #1.#2!1#3!%
1786 {%
1787   \xint_gob_til_Z #3\XINT_div_verysmallmul_e\Z
1788   \expandafter\XINT_div_verysmallmul_b
1789   \the\numexpr \xint_c_x^ix+#2*#3+#1.#2!%

```

### 3 Package *xintcore* implementation

```
1790 }%
1791 \def\XINT_div_verysmallmul_b 1#1#2.%
1792 {1#2\expandafter!\the\numexpr\XINT_div_verysmallmul_a #1.}%
1793 \def\XINT_div_verysmallmul_e\Z #1\Z +#2#3!{1\relax 0000000#2!}%
```

Special subtraction for division purposes.

```
1794 \def\XINT_div_sub #1#2%
1795 {%
1796   \expandafter\XINT_div_sub_clean
1797   \the\numexpr\expandafter\XINT_div_sub_a\expandafter
1798   1#2\Z!\Z!\Z!\Z!\Z!\W #1\Z!\Z!\Z!\Z!\Z!\W
1799 }%
1800 \def\XINT_div_sub_clean #1-#2#3\W
1801 {%
1802   \if1#2\expandafter\XINT_rev_nounsep\else\expandafter\XINT_div_sub_neg\fi
1803   {}#1\R!\R!\R!\R!\R!\R!\R!\R!\W
1804 }%
1805 \def\XINT_div_sub_neg #1\W { -}%
1806 \def\XINT_div_sub_a #1!#2!#3!#4!#5\W #6!#7!#8!#9!%
1807 {%
1808   \XINT_div_sub_b #1!#6!#2!#7!#3!#8!#4!#9!#5\W
1809 }%
1810 \def\XINT_div_sub_b #1#2#3!#4!%
1811 {%
1812   \xint_gob_til_Z #4\XINT_div_sub_bi \Z
1813   \expandafter\XINT_div_sub_c\the\numexpr#1-#3+1#4-\xint_c_i.%
1814 }%
1815 \def\XINT_div_sub_c 1#1#2.%
1816 {%
1817   1#2\expandafter!\the\numexpr\XINT_div_sub_d #1%
1818 }%
1819 \def\XINT_div_sub_d #1#2#3!#4!%
1820 {%
1821   \xint_gob_til_Z #4\XINT_div_sub_di \Z
1822   \expandafter\XINT_div_sub_e\the\numexpr#1-#3+1#4-\xint_c_i.%
1823 }%
1824 \def\XINT_div_sub_e 1#1#2.%
1825 {%
1826   1#2\expandafter!\the\numexpr\XINT_div_sub_f #1%
1827 }%
1828 \def\XINT_div_sub_f #1#2#3!#4!%
1829 {%
1830   \xint_gob_til_Z #4\XINT_div_sub_fi \Z
1831   \expandafter\XINT_div_sub_g\the\numexpr#1-#3+1#4-\xint_c_i.%
1832 }%
1833 \def\XINT_div_sub_g 1#1#2.%
1834 {%
1835   1#2\expandafter!\the\numexpr\XINT_div_sub_h #1%
1836 }%
1837 \def\XINT_div_sub_h #1#2#3!#4!%
1838 {%
1839   \xint_gob_til_Z #4\XINT_div_sub_hi \Z
```

### 3 Package *xintcore* implementation

```

1840 \expandafter\XINT_div_sub_i\the\numexpr#1-#3+1#4-\xint_c_i.%
1841 }%
1842 \def\XINT_div_sub_i #1#2.%
1843 {%
1844     1#2\expandafter!\the\numexpr\XINT_div_sub_a #1%
1845 }%
1846 \def\XINT_div_sub_bi\Z
1847 \expandafter\XINT_div_sub_c\the\numexpr#1-#2+#3.#4!#5!#6!#7!#8!#9!\Z !\W
1848 {%
1849     \XINT_div_sub_l #1#2!#5!#7!#9!%
1850 }%
1851 \def\XINT_div_sub_di\Z
1852 \expandafter\XINT_div_sub_e\the\numexpr#1-#2+#3.#4!#5!#6!#7!#8\W
1853 {%
1854     \XINT_div_sub_l #1#2!#5!#7!%
1855 }%
1856 \def\XINT_div_sub_fi\Z
1857 \expandafter\XINT_div_sub_g\the\numexpr#1-#2+#3.#4!#5!#6\W
1858 {%
1859     \XINT_div_sub_l #1#2!#5!%
1860 }%
1861 \def\XINT_div_sub_hi\Z
1862 \expandafter\XINT_div_sub_i\the\numexpr#1-#2+#3.#4\W
1863 {%
1864     \XINT_div_sub_l #1#2!%
1865 }%
1866 \def\XINT_div_sub_l #1%
1867 {%
1868     \xint_UDzerofork
1869     #1{-2\relax}%
1870     0\XINT_div_sub_r
1871     \krof
1872 }%
1873 \def\XINT_div_sub_r #1!%
1874 {%
1875     -\ifnum 0#1=\xint_c_ 1\else2\fi\relax
1876 }%
1877 %%%%%%%%%%%
1878 \def\XINT_sdiv_out #1\Z #2\W%
1879     {\expandafter
1880     {\romannumeral0\XINT_unsep_cuzsmall#1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W}%
1881     {#2}}%
1882 \def\XINT_smallldivx_a #1.1#2!1#3!%
1883 {%
1884     \expandafter\XINT_smallldivx_b
1885     \the\numexpr (#3+#1)/#2-\xint_c_i!#1.#2!#3!%
1886 }%
1887 \def\XINT_smallldivx_b #1!%
1888 {%
1889     \if0#1\else
1890         \xint_c_x^viii+#1\xint_afterfi{\expandafter!\the\numexpr}\fi
1891     \XINT_smallldiv_c #1!%

```

### 3 Package *xintcore* implementation

```

1892 }%
1893 \def\XINT_smallldiv_c #1!#2.#3!#4!%
1894 {%
1895     \expandafter\XINT_smallldiv_d\the\numexpr #4-#1*#3!#2.#3!%
1896 }%
1897 \def\XINT_smallldiv_d #1!#2!#3#4!%
1898 {%
1899     \xint_gob_til_Z #4\XINT_smallldiv_end \Z
1900     \XINT_smallldiv_e #1!#2!#3#4!%
1901 }%
1902 \def\XINT_smallldiv_end\Z\XINT_smallldiv_e #1!#2!1\Z!{1!\Z #1\W }%
1903 \def\XINT_smallldiv_e #1!#2.#3!%
1904 {%
1905     \expandafter\XINT_smallldiv_f\the\numexpr
1906     \xint_c_xi_e_viii_mone+#1*\xint_c_x^viii/#3!#2.#3!#1!%
1907 }%
1908 \def\XINT_smallldiv_f 1#1#2#3#4#5#6!#7.#8!%
1909 {%
1910     \xint_gob_til_zero #1\XINT_smallldiv_fz 0%
1911     \expandafter\XINT_smallldiv_g
1912     \the\numexpr\XINT_minimul_a #2#3#4#5.#6!#8!#2#3#4#5#6!#7.#8!%
1913 }%
1914 \def\XINT_smallldiv_fz 0%
1915     \expandafter\XINT_smallldiv_g\the\numexpr\XINT_minimul_a
1916     9999.9999!#1!99999999!#2!0!1#3!%
1917 {%
1918     \XINT_smallldiv_i .#3!\xint_c_!#2!%
1919 }%
1920 \def\XINT_smallldiv_g 1#1!1#2!#3!#4!#5!#6!%
1921 {%
1922     \expandafter\XINT_smallldiv_h
1923     \the\numexpr 1#6-#1.#2!#5!#3!#4!%
1924 }%
1925 \def\XINT_smallldiv_h 1#1#2.#3!#4!%
1926 {%
1927     \expandafter\XINT_smallldiv_i
1928     \the\numexpr #4-#3+#1-\xint_c_i.#2!%
1929 }%
1930 \def\XINT_smallldiv_i #1.#2!#3!#4.#5!%
1931 {%
1932     \expandafter\XINT_smallldiv_j
1933     \the\numexpr (#1#2+#4)/#5-\xint_c_i!#3!#1#2!#4.#5!%
1934 }%
1935 \def\XINT_smallldiv_j #1!#2!%
1936 {%
1937     \xint_c_x^viii+#1+#2\expandafter!\the\numexpr\XINT_smallldiv_k
1938     #1!%
1939 }%
1940 \def\XINT_smallldiv_k #1!#2!#3.#4!%
1941 {%
1942     \expandafter\XINT_smallldiv_d\the\numexpr #2-#1*#4!#3.#4!%
1943 }%

```

### 3 Package *xintcore* implementation

```

1944 %%%%%%%%%%
1945 \def\XINT_div_mini #1.#2!1#3!%
1946 {%
1947   \expandafter\XINT_div_mini_a\the\numexpr
1948   \xint_c_xi_e_viii_mone+#3*\xint_c_x^viii/#1!#1.#2!#3!%
1949}%

```

Note (2015/10/08). Attention à la différence dans l'ordre des arguments avec ce que je vois en comparaison avec `\XINT_smalldiv_f`. Je ne me souviens plus du tout s'il y a une raison quelconque.

```

1950 \def\XINT_div_mini_a 1#1#2#3#4#5#6!#7.#8!%
1951 {%
1952   \xint_gob_til_zero #1\XINT_div_mini_w 0%
1953   \expandafter\XINT_div_mini_b
1954   \the\numexpr\XINT_minimul_a #2#3#4#5.#6!#7!#2#3#4#5#6!#7.#8!%
1955}%
1956 \def\XINT_div_mini_w 0%
1957   \expandafter\XINT_div_mini_b\the\numexpr\XINT_minimul_a
1958   9999.9999!#1!99999999!#2.#3!00000000!#4!%
1959 {%
1960   \xint_c_x^viii_mone+(#4+#3)/#2!%
1961}%
1962 \def\XINT_div_mini_b 1#1!1#2!#3!#4!#5!#6!%
1963 {%
1964   \expandafter\XINT_div_mini_c
1965   \the\numexpr 1#6-#1.#2!#5!#3!#4!%
1966}%
1967 \def\XINT_div_mini_c 1#1#2.#3!#4!%
1968 {%
1969   \expandafter\XINT_div_mini_d
1970   \the\numexpr #4-#3+#1-\xint_c_i.#2!%
1971}%
1972 \def\XINT_div_mini_d #1.#2!#3!#4.#5!%
1973 {%
1974   \xint_c_x^viii_mone+#3+(#1#2+#5)/#4!%
1975}%

```

#### 3.26 `\xintiDivRound`, `\xintiiDivRound`

v1.1, transferred from first release of `bnumexpr`. Rewritten for v1.2.

```

1976 \def\xintiDivRound {\romannumeral0\xintidivround}%
1977 \def\xintidivround #1%
1978   {\expandafter\XINT_idivround\romannumeral0\xintnum{#1}\Z}%
1979 \def\xintiiDivRound {\romannumeral0\xintiidivround}%
1980 \def\xintiidivround #1{\expandafter\XINT_iidivround \romannumeral-`0#1\Z}%
1981 \def\XINT_idivround #1#2\Z #3%
1982   {\expandafter\XINT_iidivround_a\expandafter #1%
1983     \romannumeral0\xintnum{#3}\Z #2\Z}%
1984 \def\XINT_iidivround #1#2\Z #3%
1985   {\expandafter\XINT_iidivround_a\expandafter #1\romannumeral-`0#3\Z #2\Z}%
1986 \def\XINT_iidivround_a #1#2# #1 de A, #2 de B.
1987 {%

```

### 3 Package *xintcore* implementation

```

1988 \if0#2\xint_dothis\XINT_iidivround_divbyzero\fi
1989 \if0#1\xint_dothis\XINT_iidivround_aiszero\fi
1990 \if-#2\xint_dothis{\XINT_iidivround_bneg #1}\fi
1991 \xint_orthat{\XINT_iidivround_bpos #1#2}%
1992 }%
1993 \def\XINT_iidivround_divbyzero #1\Z #2\Z {\xintError:DivisionByZero\space 0}%
1994 \def\XINT_iidivround_aiszero #1\Z #2\Z { 0}%
1995 \def\XINT_iidivround_bpos #1%
1996 {%
1997 \xint_UDsignfork
1998 #1{\xintiiopp\XINT_iidivround_pos {}}%
1999 -{\XINT_iidivround_pos #1}%
2000 \krof
2001 }%
2002 \def\XINT_iidivround_bneg #1%
2003 {%
2004 \xint_UDsignfork
2005 #1{\XINT_iidivround_pos {}}%
2006 -{\xintiiopp\XINT_iidivround_pos #1}%
2007 \krof
2008 }%
2009 \def\XINT_iidivround_pos #1#2\Z #3\Z
2010 {%
2011 \expandafter\XINT_iidivround_pos_a
2012 \romannumeral0\XINT_div_prepare {#2}{#1#30}%
2013 }%
2014 \def\XINT_iidivround_pos_a #1#2%
2015 {%
2016 \expandafter\XINT_iidivround_pos_b
2017 \romannumeral0\expandafter\XINT_sepandrev
2018 \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\{10}0000001\W
2019 #1\XINT_rsepybviii_end_A 2345678\XINT_rsepybviii_end_B 2345678\relax XX%
2020 \R.\R.\R.\R.\R.\R.\R.\R.\W
2021 \Z!\Z!\Z!\Z!\Z!\Z!\W
2022 }%
2023 \def\XINT_iidivround_pos_b 1#1#2#3#4#5#6#7#8!#9%
2024 {%
2025 \xint_gob_til_Z #9\XINT_iidivround_small\Z
2026 \ifnum #8>\xint_c_iv
2027 \expandafter\XINT_iidivround_pos_up
2028 \else \expandafter\XINT_iidivround_pos_finish
2029 \fi
2030 1#1#2#3#4#5#6#70!#9%
2031 }%
2032 \def\XINT_iidivround_pos_up
2033 {%
2034 \expandafter\XINT_iidivround_pos_finish
2035 \the\numexpr\XINT_add_a\xint_c_ii 100000010!\Z!\Z!\Z!\Z!\Z!\Z!\W
2036 }%
2037 \def\XINT_iidivround_pos_finish #10!#2\Z #3\W
2038 {%
2039 \expandafter\XINT_cuz_small\romannumeral0\XINT_unrevbviii {}%

```

```

2040      #1!#21\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W
2041 }%
2042 \def\XINT_iidivround_small\Z\ifnum #1>#2\fi 1#30!#4\W
2043 {%
2044   \ifnum #1>\xint_c_iv
2045       \expandafter\XINT_iidivround_small_up
2046   \else   \expandafter\XINT_iidivround_small_trunc
2047   \fi {#3}%
2048 }%
2049 \edef\XINT_iidivround_small_up #1%
2050   {\noexpand\expandafter\space\noexpand\the\numexpr #1+\xint_c_i\relax }%
2051 \edef\XINT_iidivround_small_trunc #1%
2052   {\noexpand\expandafter\space\noexpand\the\numexpr #1\relax }%

```

### 3.27 \xintiDivTrunc, \xintiiDivTrunc

```

2053 \def\xintiDivTrunc   {\romannumeral0\xintidivtrunc }%
2054 \def\xintidivtrunc   #1{\expandafter\XINT_iidivtrunc\romannumeral0\xintnum{#1}\Z }%
2055 \def\xintiiDivTrunc  {\romannumeral0\xintiidivtrunc }%
2056 \def\xintiidivtrunc  #1{\expandafter\XINT_iidivtrunc \romannumeral-`0#1\Z }%
2057 \def\XINT_iidivtrunc #1#2\Z #3{\expandafter\XINT_iidivtrunc_a\expandafter #1%
2058   \romannumeral-`0#3\Z #2\Z }%
2059 \def\XINT_iidivtrunc_a #1#2% #1 de A, #2 de B.
2060 {%
2061   \if0#2\xint_dothis\XINT_iidivround_divbyzero\fi
2062   \if0#1\xint_dothis\XINT_iidivround_aiszero\fi
2063   \if-#2\xint_dothis{\XINT_iidivtrunc_bneg #1}\fi
2064   \xint_orthat{\XINT_iidivtrunc_bpos #1#2}%
2065 }%
2066 \def\XINT_iidivtrunc_bpos #1%
2067 {%
2068   \xint_UDsignfork
2069     #1{\xintiiopp\XINT_iidivtrunc_pos {}}%
2070     -{\XINT_iidivtrunc_pos #1}%
2071   \krof
2072 }%
2073 \def\XINT_iidivtrunc_bneg #1%
2074 {%
2075   \xint_UDsignfork
2076     #1{\XINT_iidivtrunc_pos {}}%
2077     -{\xintiiopp\XINT_iidivtrunc_pos #1}%
2078   \krof
2079 }%
2080 \def\XINT_iidivtrunc_pos #1#2\Z #3\Z%
2081   {\expandafter\xint_firstoftwo_thenstop
2082   \romannumeral0\XINT_div_prepare {#2}{#1#3}}%

```

### 3.28 \xintiMod, \xintiiMod

```

2083 \def\xintiMod   {\romannumeral0\xintimod }%
2084 \def\xintimod   #1{\expandafter\XINT_iimod\romannumeral0\xintnum{#1}\Z }%
2085 \def\xintiiMod  {\romannumeral0\xintiimod }%
2086 \def\xintiimod  #1{\expandafter\XINT_iimod \romannumeral-`0#1\Z }%
2087 \def\XINT_iimod #1#2\Z #3{\expandafter\XINT_iimod_a\expandafter #1%

```

## 4 Package `xint` implementation

```

2088 \romannumeral-`0#3\Z #2\Z }%
2089 \def\XINT_iimod_a #1#2% #1 de A, #2 de B.
2090 {%
2091   \if0#2\xint_dothis\XINT_iidivround_divbyzero\fi
2092   \if0#1\xint_dothis\XINT_iidivround_aiszero\fi
2093   \if-#2\xint_dothis{\XINT_iimod_bneg #1}\fi
2094   \xint_orthat{\XINT_iimod_bpos #1#2}%
2095 }%
2096 \def\XINT_iimod_bpos #1%
2097 {%
2098   \xint_UDsignfork
2099   #1{\xintiiopp\XINT_iimod_pos {}}%
2100   -{\XINT_iimod_pos #1}%
2101   \krof
2102 }%
2103 \def\XINT_iimod_bneg #1%
2104 {%
2105   \xint_UDsignfork
2106   #1{\xintiiopp\XINT_iimod_pos {}}%
2107   -{\XINT_iimod_pos #1}%
2108   \krof
2109 }%
2110 \def\XINT_iimod_pos #1#2\Z #3\Z%
2111   {\expandafter\xint_seconddoftwo_thenstop\romannumeral0\XINT_div_prepare
2112   {#2}{#1#3}}%

```

### 3.29 “Load `xintfrac`” macros

Originally was used in `\xintiexpr`. Transferred from `xintfrac` for 1.1.

```

2113 \catcode`! 11
2114 \def\xintAbs {\Did_you_mean_iiAbs?or_load_xintfrac!}%
2115 \def\xintOpp {\Did_you_mean_iiOpp?or_load_xintfrac!}%
2116 \def\xintAdd {\Did_you_mean_iiAdd?or_load_xintfrac!}%
2117 \def\xintSub {\Did_you_mean_iiSub?or_load_xintfrac!}%
2118 \def\xintMul {\Did_you_mean_iiMul?or_load_xintfrac!}%
2119 \def\xintPow {\Did_you_mean_iiPow?or_load_xintfrac!}%
2120 \def\xintSqr {\Did_you_mean_iiSqr?or_load_xintfrac!}%
2121 \XINT_restorecatcodes_endinput%

```

## 4 Package `xint` implementation

.1	Package identification . . . . .	82	.10	<code>\xintifOne, \xintiiifOne</code> . . . . .	85
.2	More token management . . . . .	82	.11	<code>\xintifTrueAelseB, \xintifFalseAelseB</code> . . . . .	85
.3	<code>\xintSgnFork</code> . . . . .	82	.12	<code>\xintifCmp, \xintiiifCmp</code> . . . . .	85
.4	<code>\xintIsOne, \xintiiIsOne</code> . . . . .	82	.13	<code>\xintifEq, \xintiiifEq</code> . . . . .	86
.5	<code>\xintRev</code> . . . . .	83	.14	<code>\xintifGt, \xintiiifGt</code> . . . . .	86
.6	<code>\xintLen</code> . . . . .	83	.15	<code>\xintifLt, \xintiiifLt</code> . . . . .	87
.7	<code>\xintBool, \xintToggle</code> . . . . .	83	.16	<code>\xintifOdd, \xintiiifOdd</code> . . . . .	87
.8	<code>\xintifSgn, \xintiiifSgn</code> . . . . .	84	.17	<code>\xintCmp, \xintiiCmp</code> . . . . .	88
.9	<code>\xintifZero, \xintifNotZero, \xintiiifZero, \xintiiifNotZero</code> . . . . .	84	.18	<code>\xintEq, \xintGt, \xintLt</code> . . . . .	91
			.19	<code>\xintNeq, \xintGtorEq, \xintLtorEq</code> . . . . .	91



.20	<code>\xintiiEq, \xintiiGt, \xintiiLt</code>	91	.34	<code>\xintiiPrd</code>	100
.21	<code>\xintiiNeq, \xintiiGtorEq, \xintiiLtorEq</code>	91	.35	<code>\xintMON, \xintMMON, \xintiiMON, \xinti-</code>	
.22	<code>\xintIsZero, \xintIsNotZero, \xintii-</code>			<code>imMON</code>	101
	<code>IsZero, \xintiiIsNotZero</code>	92	.36	<code>\xintOdd, \xintiiOdd, \xintEven, \xinti-</code>	
.23	<code>\xintIsTrue, \xintNot, \xintIsFalse</code>	92		<code>iEven</code>	101
.24	<code>\xintAND, \xintOR, \xintXOR</code>	92	.37	<code>\xintDSL</code>	102
.25	<code>\xintANDof</code>	92	.38	<code>\xintDSR</code>	103
.26	<code>\xintORof</code>	93	.39	<code>\xintDSH, \xintDSHr</code>	103
.27	<code>\xintXORof</code>	93	.40	<code>\xintDSx</code>	104
.28	<code>\xintGeq, \xintiiGeq</code>	93	.41	<code>\xintDecSplit, \xintDecSplitL, \xintDec-</code>	
.29	<code>\xintiMax, \xintiiMax</code>	96		<code>SplitR</code>	107
.30	<code>\xintiMaxof</code>	97	.42	<code>\xintiiSqrt, \xintiiSqrtR, \xintiiSquare-</code>	
.31	<code>\xintiMin, \xintiiMin</code>	98		<code>Root</code>	110
.32	<code>\xintiMinof</code>	99	.43	<code>\xintiiE</code>	114
.33	<code>\xintiiSum</code>	99	.44	"Load <code>xintfrac</code> " macros	114

With release 1.1 the core arithmetic routines `\xintiiAdd`, `\xintiiSub`, `\xintiiMul`, `\xintiiQuo`, `\xintiiPow` were separated to be the main component of the then new `xintcore`.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2  \catcode13=5    % ^^M
3  \endlinechar=13 %
4  \catcode123=1   % {
5  \catcode125=2   % }
6  \catcode64=11  % @
7  \catcode35=6   % #
8  \catcode44=12  % ,
9  \catcode45=12  % -
10 \catcode46=12  % .
11 \catcode58=12  % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xint.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintcore.sty\endcsname
15 \expandafter
16   \ifx\csname PackageInfo\endcsname\relax
17     \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18   \else
19     \def\y#1#2{\PackageInfo{#1}{#2}}%
20   \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23   \y{xint}{\numexpr not available, aborting input}%
24   \aftergroup\endinput
25 \else
26   \ifx\x\relax    % plain-TeX, first loading of xintcore.sty
27     \ifx\w\relax % but xintkernel.sty not yet loaded.
28       \def\z{\endgroup\input xintcore.sty\relax}%
29     \fi
30   \else
31     \def\empty {}%
32     \ifx\x\empty % LaTeX, first loading,
33     % variable is initialized, but \ProvidesPackage not yet seen
34     \ifx\w\relax % xintcore.sty not yet loaded.
35       \def\z{\endgroup\RequirePackage{xintcore}}%

```

```

36         \fi
37     \else
38         \aftergroup\endinput % xint already loaded.
39     \fi
40 \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty (loaded by xintcore.sty)

```

## 4.1 Package identification

```

44 \XINT_providespackage
45 \ProvidesPackage{xint}%
46 [2015/10/10 v1.2 Expandable operations on big integers (jfB)]%

```

## 4.2 More token management

```

47 \long\def\xint_firstofthree #1#2#3{#1}%
48 \long\def\xint_secondofthree #1#2#3{#2}%
49 \long\def\xint_thirdofthree #1#2#3{#3}%
50 \long\def\xint_firstofthree_thenstop #1#2#3{ #1}% 1.09i
51 \long\def\xint_secondofthree_thenstop #1#2#3{ #2}%
52 \long\def\xint_thirdofthree_thenstop #1#2#3{ #3}%
53 \edef\xint_cleanupzeros_andstop #1#2#3#4%
54 {%
55     \noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4\relax
56 }%

```

## 4.3 `\xintSgnFork`

Expandable three-way fork added in 1.07. The argument `#1` must expand to non-self-ending `-1,0` or `1`. 1.09i with `_thenstop`.

```

57 \def\xintSgnFork {\romannumeral0\xintsfnfork }%
58 \def\xintsfnfork #1%
59 {%
60     \ifcase #1 \expandafter\xint_secondofthree_thenstop
61             \or\expandafter\xint_thirdofthree_thenstop
62             \else\expandafter\xint_firstofthree_thenstop
63     \fi
64 }%

```

## 4.4 `\xintIsOne`, `\xintiiIsOne`

Added in 1.03. 1.09a defines `\xintIsOne`. 1.1a adds `\xintiiIsOne`.

```

65 \def\xintiiIsOne {\romannumeral0\xintiiisone }%
66 \def\xintiiisone #1{\expandafter\XINT_isone\romannumeral-`0#1\W\Z }%
67 \def\xintIsOne {\romannumeral0\xintisone }%
68 \def\xintisone #1{\expandafter\XINT_isone\romannumeral0\xintnum{#1}\W\Z }%
69 \def\XINT_isOne #1{\romannumeral0\XINT_isone #1\W\Z }%
70 \def\XINT_isone #1#2%
71 {%
72     \xint_gob_til_one #1\XINT_isone_b 1%

```

```

73   \expandafter\space\expandafter 0\xint_gob_til_Z #2%
74 }%
75 \def\XINT_isone_b #1\xint_gob_til_Z #2%
76 {%
77   \xint_gob_til_W #2\XINT_isone_yes \W
78   \expandafter\space\expandafter 0\xint_gob_til_Z
79 }%
80 \def\XINT_isone_yes #1\Z { 1}%

```

#### 4.5 `\xintRev`

`\xintRev`: expands fully its argument `\romannumeral-`0`, and checks the sign. However this last aspect does not appear like a very useful thing. And despite the fact that a special check is made for a sign, actually the input is not given to `\xintnum`, contrarily to `\xintLen`. This is all a bit incoherent. Should be fixed.

1.2 has `\xintReverseDigits` and I thus make `\xintRev` an alias. Remarks above not addressed.

```

81 \let\xintRev\xintReverseDigits

```

#### 4.6 `\xintLen`

`\xintLen` is ONLY for (possibly long) integers. Gets extended to fractions by `xintfrac.sty`

```

82 \def\xintLen {\romannumeral0\xintlen }%
83 \def\xintlen #1%
84 {%
85   \expandafter\XINT_len_fork
86   \romannumeral0\xintnum{#1}\xint_relax\xint_relax\xint_relax\xint_relax
87   \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
88 }%
89 \def\XINT_Len #1% variant which does not expand via \xintnum.
90 {%
91   \romannumeral0\XINT_len_fork
92   #1\xint_relax\xint_relax\xint_relax\xint_relax
93   \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye
94 }%
95 \def\XINT_len_fork #1%
96 {%
97   \expandafter\XINT_length_loop
98   \xint_UDsignfork
99   #1{0.}%
100   -{0.#1}%
101   \krof
102 }%

```

#### 4.7 `\xintBool`, `\xintToggle`

1.09c

```

103 \def\xintBool #1{\romannumeral-`0%
104   \csname if#1\endcsname\expandafter1\else\expandafter0\fi }%
105 \def\xintToggle #1{\romannumeral-`0\iftoggle{#1}{1}{0}}%

```

## 4.8 `\xintifSgn`, `\xintiiifSgn`

Expandable three-way fork added in 1.09a. Branches expandably depending on whether  $<0$ ,  $=0$ ,  $>0$ . Choice of branch guaranteed in two steps.

1.09i has `\xint_firstofthreeafterstop` (now `_thenstop`) etc for faster expansion.

1.1 adds `\xintiiifSgn` for optimization in `xintexpr`-essions. Should I move them to `xintcore`? (for `bnumexpr`)

```

106 \def\xintifSgn {\romannumeral0\xintifsgn }%
107 \def\xintifsgn #1%
108 {%
109   \ifcase \xintSgn{#1}
110       \expandafter\xint_secondofthree_thenstop
111       \or\expandafter\xint_thirdofthree_thenstop
112       \else\expandafter\xint_firstofthree_thenstop
113   \fi
114 }%
115 \def\xintiiifSgn {\romannumeral0\xintiiifsgn }%
116 \def\xintiiifsgn #1%
117 {%
118   \ifcase \xintiiSgn{#1}
119       \expandafter\xint_secondofthree_thenstop
120       \or\expandafter\xint_thirdofthree_thenstop
121       \else\expandafter\xint_firstofthree_thenstop
122   \fi
123 }%

```

## 4.9 `\xintifZero`, `\xintifNotZero`, `\xintiiifZero`, `\xintiiifNotZero`

Expandable two-way fork added in 1.09a. Branches expandably depending on whether the argument is zero (branch A) or not (branch B). 1.09i restyling. By the way it appears (not thoroughly tested, though) that `\if` tests are faster than `\ifnum` tests. 1.1 adds `ii` versions.

```

124 \def\xintifZero {\romannumeral0\xintifzero }%
125 \def\xintifzero #1%
126 {%
127   \if0\xintSgn{#1}%
128       \expandafter\xint_firstoftwo_thenstop
129   \else
130       \expandafter\xint_secondoftwo_thenstop
131   \fi
132 }%
133 \def\xintifNotZero {\romannumeral0\xintifnotzero }%
134 \def\xintifnotzero #1%
135 {%
136   \if0\xintSgn{#1}%
137       \expandafter\xint_secondoftwo_thenstop
138   \else
139       \expandafter\xint_firstoftwo_thenstop
140   \fi
141 }%
142 \def\xintiiifZero {\romannumeral0\xintiiifzero }%
143 \def\xintiiifzero #1%

```

```

144 {%
145   \if0\xintiiSgn{#1}%
146     \expandafter\xint_firstoftwo_thenstop
147   \else
148     \expandafter\xint_secondoftwo_thenstop
149   \fi
150 }%
151 \def\xintiiifNotZero {\romannumeral0\xintiiifnotzero }%
152 \def\xintiiifnotzero #1%
153 {%
154   \if0\xintiiSgn{#1}%
155     \expandafter\xint_secondoftwo_thenstop
156   \else
157     \expandafter\xint_firstoftwo_thenstop
158   \fi
159 }%

```

#### 4.10 `\xintifOne`, `\xintiiifOne`

added in 1.09i. 1.1a adds `\xintiiifOne`.

```

160 \def\xintiiifOne {\romannumeral0\xintiiifone }%
161 \def\xintiiifone #1%
162 {%
163   \if1\xintiiIsOne{#1}%
164     \expandafter\xint_firstoftwo_thenstop
165   \else
166     \expandafter\xint_secondoftwo_thenstop
167   \fi
168 }%
169 \def\xintifOne {\romannumeral0\xintifone }%
170 \def\xintifone #1%
171 {%
172   \if1\xintIsOne{#1}%
173     \expandafter\xint_firstoftwo_thenstop
174   \else
175     \expandafter\xint_secondoftwo_thenstop
176   \fi
177 }%

```

#### 4.11 `\xintifTrueAelseB`, `\xintifFalseAelseB`

1.09i. Warning, `\xintifTrueFalse`, `\xintifTrue` deprecated, to be removed

```

178 \let\xintifTrueAelseB\xintifNotZero
179 \let\xintifFalseAelseB\xintifZero
180 \let\xintifTrue\xintifNotZero
181 \let\xintifTrueFalse\xintifNotZero

```

#### 4.12 `\xintifCmp`, `\xintiiifCmp`

1.09e `\xintifCmp {n}{m}{if n<m}{if n=m}{if n>m}`. 1.1a adds ii variant

```

182 \def\xintifCmp {\romannumeral0\xintifcmp }%
183 \def\xintifcmp #1#2%
184 {%
185     \ifcase\xintCmp {#1}{#2}
186         \expandafter\xint_secondofthree_thenstop
187         \or\expandafter\xint_thirdofthree_thenstop
188         \else\expandafter\xint_firstofthree_thenstop
189     \fi
190 }%
191 \def\xintiiifCmp {\romannumeral0\xintiiifcmp }%
192 \def\xintiiifcmp #1#2%
193 {%
194     \ifcase\xintiiCmp {#1}{#2}
195         \expandafter\xint_secondofthree_thenstop
196         \or\expandafter\xint_thirdofthree_thenstop
197         \else\expandafter\xint_firstofthree_thenstop
198     \fi
199 }%

```

#### 4.13 \xintifEq, \xintiiifEq

1.09a \xintifEq {n}{m}{YES if n=m}{NO if n<>m}. 1.1a adds ii variant

```

200 \def\xintifEq {\romannumeral0\xintifeq }%
201 \def\xintifeq #1#2%
202 {%
203     \if0\xintCmp{#1}{#2}%
204         \expandafter\xint_firstoftwo_thenstop
205         \else\expandafter\xint_secondoftwo_thenstop
206     \fi
207 }%
208 \def\xintiiifEq {\romannumeral0\xintiiifeq }%
209 \def\xintiiifeq #1#2%
210 {%
211     \if0\xintiiCmp{#1}{#2}%
212         \expandafter\xint_firstoftwo_thenstop
213         \else\expandafter\xint_secondoftwo_thenstop
214     \fi
215 }%

```

#### 4.14 \xintifGt, \xintiiifGt

1.09a \xintifGt {n}{m}{YES if n>m}{NO if n<=m}. 1.1a adds ii variant

```

216 \def\xintifGt {\romannumeral0\xintifgt }%
217 \def\xintifgt #1#2%
218 {%
219     \if1\xintCmp{#1}{#2}%
220         \expandafter\xint_firstoftwo_thenstop
221         \else\expandafter\xint_secondoftwo_thenstop
222     \fi
223 }%
224 \def\xintiiifGt {\romannumeral0\xintiiifgt }%

```

```

225 \def\xintiiifgt #1#2%
226 {%
227   \if1\xintiiCmp{#1}{#2}%
228     \expandafter\xint_firstoftwo_thenstop
229   \else\expandafter\xint_secondoftwo_thenstop
230   \fi
231 }%

```

#### 4.15 `\xintifLt`, `\xintiiifLt`

1.09a `\xintifLt {n}{m}{YES if n<m}{NO if n>=m}`. Restyled in 1.09i. 1.1a adds `ii` variant

```

232 \def\xintifLt {\romannumeral0\xintiflt }%
233 \def\xintiflt #1#2%
234 {%
235   \ifnum\xintCmp{#1}{#2}<\xint_c_
236     \expandafter\xint_firstoftwo_thenstop
237   \else \expandafter\xint_secondoftwo_thenstop
238   \fi
239 }%
240 \def\xintiiifLt {\romannumeral0\xintiiiflt }%
241 \def\xintiiiflt #1#2%
242 {%
243   \ifnum\xintiiCmp{#1}{#2}<\xint_c_
244     \expandafter\xint_firstoftwo_thenstop
245   \else \expandafter\xint_secondoftwo_thenstop
246   \fi
247 }%

```

#### 4.16 `\xintifOdd`, `\xintiiifOdd`

1.09e. Restyled in 1.09i. 1.1a adds `\xintiiifOdd`.

```

248 \def\xintiiifOdd {\romannumeral0\xintiiifodd }%
249 \def\xintiiifodd #1%
250 {%
251   \if\xintiiOdd{#1}1%
252     \expandafter\xint_firstoftwo_thenstop
253   \else
254     \expandafter\xint_secondoftwo_thenstop
255   \fi
256 }%
257 \def\xintifOdd {\romannumeral0\xintifodd }%
258 \def\xintifodd #1%
259 {%
260   \if\xintOdd{#1}1%
261     \expandafter\xint_firstoftwo_thenstop
262   \else
263     \expandafter\xint_secondoftwo_thenstop
264   \fi
265 }%

```

4.17 `\xintCmp`, `\xintiiCmp`

Faster than doing the full subtraction.

```

266 \def\xintCmp      {\romannumeral0\xintcmp }%
267 \def\xintcmp      #1{\expandafter\XINT_icmp\romannumeral0\xintnum{#1}\Z }%
268 \def\xintiiCmp    {\romannumeral0\xintiicmp }%
269 \def\xintiicmp    #1{\expandafter\XINT_iicmp\romannumeral-`0#1\Z }%
270 \def\XINT_iicmp   #1#2\Z #3%
271 {%
272   \expandafter\XINT_cmp_nfork\expandafter #1\romannumeral-`0#3\Z #2\Z
273 }%

```

New fork of 1.2 makes it less convenient here for `\XINT_cmp_pre` and `\XINT_Cmp`, which just avoided the `\romannumeral-`0`. Nanosecond loss ? I vaguely recalled that for `\xintNewExpr` things, I did need another name such as `\XINT_cmp` for `\xintiiCmp`.

```

274 \let\XINT_Cmp      \xintiiCmp
275 \def\XINT_icmp     #1#2\Z #3%
276 {%
277   \expandafter\XINT_cmp_nfork\expandafter #1\romannumeral0\xintnum{#3}\Z #2\Z
278 }%
279 \def\XINT_cmp_nfork #1#2%
280 {%
281   \xint_UDzerofork
282     #1\XINT_cmp_firstiszero
283     #2\XINT_cmp_secondiszero
284     0{ }%
285   \krof
286   \xint_UDsignsfork
287     #1#2\XINT_cmp_minusminus
288     #1-\XINT_cmp_minusplus
289     #2-\XINT_cmp_plusminus
290     --\XINT_cmp_plusplus
291   \krof #1#2%
292 }%
293 \def\XINT_cmp_firstiszero #1\krof 0#2#3\Z #4\Z
294 {%
295   \xint_UDzerominusfork
296     #2-{ 0}%
297     0#2{ 1}%
298     0-{ -1}%
299   \krof
300 }%
301 \def\XINT_cmp_secondiszero #1\krof #20#3\Z #4\Z
302 {%
303   \xint_UDzerominusfork
304     #2-{ 0}%
305     0#2{ -1}%
306     0-{ 1}%
307   \krof
308 }%
309 \def\XINT_cmp_plusminus #1\Z #2\Z{ 1}%
310 \def\XINT_cmp_minusplus #1\Z #2\Z{ -1}%

```



#### 4 Package *xint* implementation

```

311 \def\XINT_cmp_minusminus
312   --{\expandafter\XINT_opp\romannumeral0\XINT_cmp_plusplus {}{}}%
313 \def\XINT_cmp_plusplus #1#2#3\Z
314 {%
315   \expandafter\XINT_cmp_pp
316     \romannumeral0\expandafter\XINT_sepandrev_andcount
317     \romannumeral0\XINT_zeroes_forviii #2#3\R\R\R\R\R\R\R\R{10}0000001\W
318     #2#3\XINT_rsepbyviii_end_A 2345678%
319     \XINT_rsepbyviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
320     \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
321     \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
322   \X #1%
323 }%
324 \def\XINT_cmp_pp #1.#2\X #3\Z
325 {%
326   \expandafter\XINT_cmp_checklengths
327   \the\numexpr #1\expandafter.%
328   \romannumeral0\expandafter\XINT_sepandrev_andcount
329   \romannumeral0\XINT_zeroes_forviii #3\R\R\R\R\R\R\R\R{10}0000001\W
330   #3\XINT_rsepbyviii_end_A 2345678%
331   \XINT_rsepbyviii_end_B 2345678\relax \xint_c_ii\xint_c_iii
332   \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
333   \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
334   \Z!\Z!\Z!\Z!\Z!\W #2\Z!\Z!\Z!\Z!\Z!\W
335 }%
336 \def\XINT_cmp_checklengths #1.#2.%
337 {%
338   \ifnum #1=#2
339     \expandafter\xint_firstoftwo
340   \else
341     \expandafter\xint_secondoftwo
342   \fi
343   \XINT_cmp_aa {\XINT_cmp_distinctlengths {#1}{#2}}%
344 }%
345 \def\XINT_cmp_distinctlengths #1#2#3\W #4\W
346 {%
347   \ifnum #1>#2
348     \expandafter\xint_firstoftwo
349   \else
350     \expandafter\xint_secondoftwo
351   \fi
352   { -1}{ 1}%
353 }%
354 %%%%%%%%%%%
355 \def\XINT_cmp_aa {\expandafter\XINT_cmp_w\the\numexpr\XINT_cmp_a \xint_c_i}%
356 %%%%%%%%%%%
357 \def\XINT_cmp_a #1!#2!#3!#4!#5\W #6!#7!#8!#9!%
358 {%
359   \XINT_cmp_b #1!#6!#2!#7!#3!#8!#4!#9!#5\W
360 }%
361 \def\XINT_cmp_b #1#2#3!#4!%
362 {%

```

#### 4 Package *xint* implementation

```

363 \xint_gob_til_Z #2\XINT_cmp_bi \Z
364 \expandafter\XINT_cmp_c\the\numexpr#1+1#4-#3-\xint_c.i.%
365 }%
366 \def\XINT_cmp_c #1#2.%
367 {%
368 1#2\expandafter!\the\numexpr\XINT_cmp_d #1%
369 }%
370 \def\XINT_cmp_d #1#2#3!#4!%
371 {%
372 \xint_gob_til_Z #2\XINT_cmp_di \Z
373 \expandafter\XINT_cmp_e\the\numexpr#1+1#4-#3-\xint_c.i.%
374 }%
375 \def\XINT_cmp_e #1#2.%
376 {%
377 1#2\expandafter!\the\numexpr\XINT_cmp_f #1%
378 }%
379 \def\XINT_cmp_f #1#2#3!#4!%
380 {%
381 \xint_gob_til_Z #2\XINT_cmp_fi \Z
382 \expandafter\XINT_cmp_g\the\numexpr#1+1#4-#3-\xint_c.i.%
383 }%
384 \def\XINT_cmp_g #1#2.%
385 {%
386 1#2\expandafter!\the\numexpr\XINT_cmp_h #1%
387 }%
388 \def\XINT_cmp_h #1#2#3!#4!%
389 {%
390 \xint_gob_til_Z #2\XINT_cmp_hi \Z
391 \expandafter\XINT_cmp_i\the\numexpr#1+1#4-#3-\xint_c.i.%
392 }%
393 \def\XINT_cmp_i #1#2.%
394 {%
395 1#2\expandafter!\the\numexpr\XINT_cmp_a #1%
396 }%
397 \def\XINT_cmp_bi\Z
398 \expandafter\XINT_cmp_c\the\numexpr#1+1#2-#3.#4!#5!#6!#7!#8!#9!\Z !\W
399 {%
400 \XINT_cmp_k #1#2!#5!#7!#9!%
401 }%
402 \def\XINT_cmp_di\Z
403 \expandafter\XINT_cmp_e\the\numexpr#1+1#2-#3.#4!#5!#6!#7!#8\W
404 {%
405 \XINT_cmp_k #1#2!#5!#7!%
406 }%
407 \def\XINT_cmp_fi\Z
408 \expandafter\XINT_cmp_g\the\numexpr#1+1#2-#3.#4!#5!#6\W
409 {%
410 \XINT_cmp_k #1#2!#5!%
411 }%
412 \def\XINT_cmp_hi\Z
413 \expandafter\XINT_cmp_i\the\numexpr#1+1#2-#3.#4\W
414 {%

```

```

415 \XINT_cmp_k #1#2!%
416 }%
417 %%%%%%%%%%
418 \def\XINT_cmp_k #1#2\W
419 {%
420 \xint_UDzerofork
421 #1{-1\relax \XINT_cmp_greater}%
422 0{-1\relax \XINT_cmp_lessequal}%
423 \krof
424 }%
425 \def\XINT_cmp_w #1-1#2{#2#11\Z!\W}%
426 \def\XINT_cmp_greater #1\Z!\W{ 1}%
427 \def\XINT_cmp_lessequal 1#1!%
428 {\xint_gob_til_Z #1\XINT_cmp_equal\Z
429 \xint_gob_til_eightzeroes #1\XINT_cmp_continue 00000000%
430 \XINT_cmp_less }%
431 \def\XINT_cmp_less #1\W { -1}%
432 \def\XINT_cmp_continue 00000000\XINT_cmp_less {\XINT_cmp_lessequal }%
433 \def\XINT_cmp_equal\Z\xint_gob_til_eightzeroes\Z\XINT_cmp_continue
434 00000000\XINT_cmp_less\W { 0}%

```

#### 4.18 \xintEq, \xintGt, \xintLt

##### 1.09a.

```

435 \def\xintEq {\romannumeral0\xinteq }\def\xinteq #1#2{\xintifeq{#1}{#2}{1}{0}}%
436 \def\xintGt {\romannumeral0\xintgt }\def\xintgt #1#2{\xintifgt{#1}{#2}{1}{0}}%
437 \def\xintLt {\romannumeral0\xintlft }\def\xintlft #1#2{\xintiflt{#1}{#2}{1}{0}}%

```

#### 4.19 \xintNeq, \xintGtorEq, \xintLtorEq

##### 1.1. Pour xintexpr. No lowercase macros

```

438 \def\xintLtorEq #1#2{\romannumeral0\xintifgt {#1}{#2}{0}{1}}%
439 \def\xintGtorEq #1#2{\romannumeral0\xintiflt {#1}{#2}{0}{1}}%
440 \def\xintNeq #1#2{\romannumeral0\xintifeq {#1}{#2}{0}{1}}%

```

#### 4.20 \xintiiEq, \xintiiGt, \xintiiLt

##### 1.1a Pour \xintiiexpr. No lowercase macros.

```

441 \def\xintiiEq #1#2{\romannumeral0\xintiiifeq{#1}{#2}{1}{0}}%
442 \def\xintiiGt #1#2{\romannumeral0\xintiiifgt{#1}{#2}{1}{0}}%
443 \def\xintiiLt #1#2{\romannumeral0\xintiiiflt{#1}{#2}{1}{0}}%

```

#### 4.21 \xintiiNeq, \xintiiGtorEq, \xintiiLtorEq

##### 1.1a. Pour \xintiiexpr. No lowercase macros.

```

444 \def\xintiiLtorEq #1#2{\romannumeral0\xintiiifgt {#1}{#2}{0}{1}}%
445 \def\xintiiGtorEq #1#2{\romannumeral0\xintiiiflt {#1}{#2}{0}{1}}%
446 \def\xintiiNeq #1#2{\romannumeral0\xintiiifeq {#1}{#2}{0}{1}}%

```

## 4.22 `\xintIsZero`, `\xintIsNotZero`, `\xintiIsZero`, `\xintiIsNotZero`

1.09a. restyled in 1.09i. 1.1 adds `\xintiIsZero`, etc... for optimization in `\xintexpr`

```

447 \def\xintIsZero {\romannumeral0\xintiszero }%
448 \def\xintiszero #1{\if0\xintSgn{#1}\xint_afterfi{ 1}\else\xint_afterfi{ 0}\fi}%
449 \def\xintIsNotZero {\romannumeral0\xintisnotzero }%
450 \def\xintisnotzero
451     #1{\if0\xintSgn{#1}\xint_afterfi{ 0}\else\xint_afterfi{ 1}\fi}%
452 \def\xintiIsZero {\romannumeral0\xintiiszero }%
453 \def\xintiiszero #1{\if0\xintiSgn{#1}\xint_afterfi{ 1}\else\xint_afterfi{ 0}\fi}%
454 \def\xintiIsNotZero {\romannumeral0\xintiisnotzero }%
455 \def\xintiisnotzero
456     #1{\if0\xintiSgn{#1}\xint_afterfi{ 0}\else\xint_afterfi{ 1}\fi}%

```

## 4.23 `\xintIsTrue`, `\xintNot`, `\xintIsFalse`

1.09c

```

457 \let\xintIsTrue\xintIsNotZero
458 \let\xintNot\xintIsZero
459 \let\xintIsFalse\xintIsZero

```

## 4.24 `\xintAND`, `\xintOR`, `\xintXOR`

1.09a. Embarrassing bugs in `\xintAND` and `\xintOR` which inserted a space token corrected in 1.09i. `\xintxor` restyled with `\if (faster)` in 1.09i

```

460 \def\xintAND {\romannumeral0\xintand }%
461 \def\xintand #1#2{\if0\xintSgn{#1}\expandafter\xint_firstoftwo
462     \else\expandafter\xint_secondoftwo\fi
463     { 0}{\xintisnotzero{#2}}}%
464 \def\xintOR {\romannumeral0\xintor }%
465 \def\xintor #1#2{\if0\xintSgn{#1}\expandafter\xint_firstoftwo
466     \else\expandafter\xint_secondoftwo\fi
467     {\xintisnotzero{#2}}{ 1}}%
468 \def\xintXOR {\romannumeral0\xintxor }%
469 \def\xintxor #1#2{\if\xintIsZero{#1}\xintIsZero{#2}%
470     \xint_afterfi{ 0}\else\xint_afterfi{ 1}\fi }%

```

## 4.25 `\xintANDof`

New with 1.09a. `\xintANDof` works also with an empty list.

```

471 \def\xintANDof {\romannumeral0\xintandof }%
472 \def\xintandof #1{\expandafter\XINT_andof_a\romannumeral-`0#1\relax }%
473 \def\XINT_andof_a #1{\expandafter\XINT_andof_b\romannumeral-`0#1\Z }%
474 \def\XINT_andof_b #1%
475     {\xint_gob_til_relax #1\XINT_andof_e\relax\XINT_andof_c #1}%
476 \def\XINT_andof_c #1\Z
477     {\xintifTrueAelseB {#1}{\XINT_andof_a}{\XINT_andof_no}}%
478 \def\XINT_andof_no #1\relax { 0}%
479 \def\XINT_andof_e #1\Z { 1}%

```

4.26 `\xintORof`

New with 1.09a. Works also with an empty list.

```

480 \def\xintORof      {\romannumeral0\xintorof }%
481 \def\xintorof      #1{\expandafter\XINT_orof_a\romannumeral-`0#1\relax }%
482 \def\XINT_orof_a #1{\expandafter\XINT_orof_b\romannumeral-`0#1\Z }%
483 \def\XINT_orof_b #1%
484     {\xint_gob_til_relax #1\XINT_orof_e\relax\XINT_orof_c #1}%
485 \def\XINT_orof_c #1\Z
486     {\xintifTrueAelseB {#1}{\XINT_orof_yes}{\XINT_orof_a}}%
487 \def\XINT_orof_yes #1\relax { 1}%
488 \def\XINT_orof_e #1\Z { 0}%

```

4.27 `\xintXORof`

New with 1.09a. Works with an empty list, too. `\XINT_xorof_c` more efficient in 1.09i

```

489 \def\xintXORof      {\romannumeral0\xintxorof }%
490 \def\xintxorof      #1{\expandafter\XINT_xorof_a\expandafter
491     0\romannumeral-`0#1\relax }%
492 \def\XINT_xorof_a #1#2{\expandafter\XINT_xorof_b\romannumeral-`0#2\Z #1}%
493 \def\XINT_xorof_b #1%
494     {\xint_gob_til_relax #1\XINT_xorof_e\relax\XINT_xorof_c #1}%
495 \def\XINT_xorof_c #1\Z #2%
496     {\xintifTrueAelseB {#1}{\if #20\xint_afterfi{\XINT_xorof_a 1}%
497     \else\xint_afterfi{\XINT_xorof_a 0}\fi}%
498     {\XINT_xorof_a #2}%
499     }%
500 \def\XINT_xorof_e #1\Z #2{ #2}%

```

4.28 `\xintGeq`, `\xintiGeq`

PLUS GRAND OU ÉGAL attention compare les **\*\*valeurs absolues\*\***

```

501 \def\xintGeq      {\romannumeral0\xintgeq }%
502 \def\xintgeq      #1{\expandafter\XINT_geq\romannumeral0\xintnum{#1}\Z }%
503 \def\xintiGeq      {\romannumeral0\xintiigeq }%
504 \def\xintiigeq #1{\expandafter\XINT_iigeq\romannumeral-`0#1\Z }%
505 \def\XINT_iigeq #1#2\Z #3%
506 {%
507     \expandafter\XINT_geq_fork\expandafter #1\romannumeral-`0#3\Z #2\Z
508 }%
509 \let\XINT_geq_pre \xintiigeq % TEMPORAIRE
510 \let\XINT_Geq \xintGeq      % TEMPORAIRE ATTENTION FAIT xintNum
511 \def\XINT_geq #1#2\Z #3%
512 {%
513     \expandafter\XINT_geq_fork\expandafter #1\romannumeral0\xintnum{#3}\Z #2\Z
514 }%
515 \def\XINT_geq_fork #1#2%
516 {%
517     \xint_UDzerofork
518     #1\XINT_geq_firstiszero

```

#### 4 Package `xint` implementation

```

519     #2\XINT_geq_secondiszero
520     0{ }%
521     \krof
522     \xint_UDsignsfork
523         #1#2\XINT_geq_minusminus
524         #1-\XINT_geq_minusplus
525         #2-\XINT_geq_plusminus
526         --\XINT_geq_plusplus
527     \krof #1#2%
528 }%
529 \def\XINT_geq_firstiszero #1\krof 0#2#3\Z #4\Z
530     {\xint_UDzerofork #2{ 1}0{ 0}\krof }%
531 \def\XINT_geq_secondiszero #1\krof #20#3\Z #4\Z { 1}%
532 \def\XINT_geq_plusminus #1-{\XINT_geq_plusplus #1{ }}%
533 \def\XINT_geq_minusplus #-1{\XINT_geq_plusplus { }#1}%
534 \def\XINT_geq_minusminus --{\XINT_geq_plusplus { }{ }}%
535 \def\XINT_geq_plusplus #1#2#3\Z #4\Z {\XINT_geq_pp #1#4\Z #2#3\Z }%
536 \def\XINT_geq_pp #1\Z
537 {%
538     \expandafter\XINT_geq_pp_a
539     \romannumeral0\expandafter\XINT_sepandrev_andcount
540     \romannumeral0\XINT_zeroes_forviii #1\R\R\R\R\R\R\R\R{10}0000001\W
541     #1\XINT_rsepbyviii_end_A 2345678%
542     \XINT_rsepbyviii_end_B 2345678\relax\xint_c_ii\xint_c_iii
543     \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
544     \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
545     \X
546 }%
547 \def\XINT_geq_pp_a #1.#2\X #3\Z
548 {%
549     \expandafter\XINT_geq_checklengths
550     \the\numexpr #1\expandafter.%
551     \romannumeral0\expandafter\XINT_sepandrev_andcount
552     \romannumeral0\XINT_zeroes_forviii #3\R\R\R\R\R\R\R\R{10}0000001\W
553     #3\XINT_rsepbyviii_end_A 2345678%
554     \XINT_rsepbyviii_end_B 2345678\relax \xint_c_ii\xint_c_iii
555     \R.\xint_c_vi\R.\xint_c_v\R.\xint_c_iv\R.\xint_c_iii
556     \R.\xint_c_ii\R.\xint_c_i\R.\xint_c_\W
557     \Z!\Z!\Z!\Z!\Z!\W #2\Z!\Z!\Z!\Z!\Z!\W
558 }%
559 \def\XINT_geq_checklengths #1.#2.%
560 {%
561     \ifnum #1=#2
562         \expandafter\xint_firstoftwo
563     \else
564         \expandafter\xint_secondoftwo
565     \fi
566     \XINT_geq_aa {\XINT_geq_distinctlengths {#1}{#2}}
567 }%
568 \def\XINT_geq_distinctlengths #1#2#3\W #4\W
569 {%
570     \ifnum #1>#2

```

#### 4 Package *xint* implementation

```

571      \expandafter\xint_firstoftwo
572  \else
573      \expandafter\xint_secondoftwo
574  \fi
575  { 1}{ 0}%
576 }%
577 %%%%%%%%%%%
578 \def\xint_geq_aa {\expandafter\xint_geq_w\the\numexpr\xint_geq_a \xint_c_i }%
579 %%%%%%%%%%%
580 \def\xint_geq_a #1!#2!#3!#4!#5\W #6!#7!#8!#9!%
581 {%
582     \xint_geq_b #1!#6!#2!#7!#3!#8!#4!#9!#5\W
583 }%
584 \def\xint_geq_b #1#2#3!#4!%
585 {%
586     \xint_gob_til_Z #2\xint_geq_bi \Z
587     \expandafter\xint_geq_c\the\numexpr#1+1#4-#3-\xint_c_i.%
588 }%
589 \def\xint_geq_c 1#1#2.%
590 {%
591     1#2\expandafter!\the\numexpr\xint_geq_d #1%
592 }%
593 \def\xint_geq_d #1#2#3!#4!%
594 {%
595     \xint_gob_til_Z #2\xint_geq_di \Z
596     \expandafter\xint_geq_e\the\numexpr#1+1#4-#3-\xint_c_i.%
597 }%
598 \def\xint_geq_e 1#1#2.%
599 {%
600     1#2\expandafter!\the\numexpr\xint_geq_f #1%
601 }%
602 \def\xint_geq_f #1#2#3!#4!%
603 {%
604     \xint_gob_til_Z #2\xint_geq_fi \Z
605     \expandafter\xint_geq_g\the\numexpr#1+1#4-#3-\xint_c_i.%
606 }%
607 \def\xint_geq_g 1#1#2.%
608 {%
609     1#2\expandafter!\the\numexpr\xint_geq_h #1%
610 }%
611 \def\xint_geq_h #1#2#3!#4!%
612 {%
613     \xint_gob_til_Z #2\xint_geq_hi \Z
614     \expandafter\xint_geq_i\the\numexpr#1+1#4-#3-\xint_c_i.%
615 }%
616 \def\xint_geq_i 1#1#2.%
617 {%
618     1#2\expandafter!\the\numexpr\xint_geq_a #1%
619 }%
620 \def\xint_geq_bi\Z
621     \expandafter\xint_geq_c\the\numexpr#1+1#2-#3.#4!#5!#6!#7!#8!#9!\Z !\W
622 {%

```

```

623 \XINT_geq_k #1#2!#5!#7!#9!%
624 }%
625 \def\XINT_geq_di\Z
626 \expandafter\XINT_geq_e\the\numexpr#1+1#2-#3.#4!#5!#6!#7!#8\W
627 {%
628 \XINT_geq_k #1#2!#5!#7!%
629 }%
630 \def\XINT_geq_fi\Z
631 \expandafter\XINT_geq_g\the\numexpr#1+1#2-#3.#4!#5!#6\W
632 {%
633 \XINT_geq_k #1#2!#5!%
634 }%
635 \def\XINT_geq_hi\Z
636 \expandafter\XINT_geq_i\the\numexpr#1+1#2-#3.#4\W
637 {%
638 \XINT_geq_k #1#2!%
639 }%
640 %%%%%%%%%%
641 \def\XINT_geq_k #1#2\W
642 {%
643 \xint_UDzerofork
644 #1{-1\relax { 0}}%
645 0{-1\relax { 1}}%
646 \krof
647 }%
648 \def\XINT_geq_w #1-1#2{#2}%

```

#### 4.29 `\xintiMax`, `\xintiiMax`

The rationale is that it is more efficient than using `\xintCmp`. 1.03 makes the code a tiny bit slower but easier to re-use for fractions. Note: actually since 1.08a code for fractions does not all reduce to these entry points, so perhaps I should revert the changes made in 1.03. Release 1.09a has `\xintnum` added into `\xintiMax`.

1.1 adds the missing `\xintiiMax`. Using `\xintMax` and not `\xintiMax` in `xint` is deprecated.

1.2 REMOVES `\xintMax`, `\xintMin`, `\xintMaxof`, `\xintMinof`.

```

649 \def\xintiMax {\romannumeral0\xintimax }%
650 \def\xintimax #1%
651 {%
652 \expandafter\xint_max\expandafter {\romannumeral0\xintnum{#1}}%
653 }%
654 \def\xint_max #1#2%
655 {%
656 \expandafter\XINT_max_pre\expandafter {\romannumeral0\xintnum{#2}}{#1}%
657 }%
658 \def\xintiiMax {\romannumeral0\xintiiimax }%
659 \def\xintiiimax #1%
660 {%
661 \expandafter\xint_iiimax\expandafter {\romannumeral-`0#1}%
662 }%
663 \def\xint_iiimax #1#2%
664 {%
665 \expandafter\XINT_max_pre\expandafter {\romannumeral-`0#2}{#1}%

```



#### 4 Package `xint` implementation

```

666 }%
667 \def\XINT_max_pre #1#2{\XINT_max_fork #1\Z #2\Z {#2}{#1}}%
668 \def\XINT_Max #1#2{\romannumeral0\XINT_max_fork #2\Z #1\Z {#1}{#2}}%

#3#4 vient du *premier*, #1#2 vient du *second*

669 \def\XINT_max_fork #1#2\Z #3#4\Z
670 {%
671   \xint_UDsignsfork
672     #1#3\XINT_max_minusminus % A < 0, B < 0
673     #1-\XINT_max_minusplus % B < 0, A >= 0
674     #3-\XINT_max_plusminus % A < 0, B >= 0
675     --{\xint_UDzerosfork
676       #1#3\XINT_max_zerozero % A = B = 0
677       #10\XINT_max_zeropplus % B = 0, A > 0
678       #30\XINT_max_pluszero % A = 0, B > 0
679       00\XINT_max_plusplus % A, B > 0
680     \krof }%
681   \krof
682   {#2}{#4}#1#3%
683 }%

A = #4#2, B = #3#1

684 \def\XINT_max_zerozero #1#2#3#4{\xint_firstoftwo_thenstop }%
685 \def\XINT_max_zeropplus #1#2#3#4{\xint_firstoftwo_thenstop }%
686 \def\XINT_max_pluszero #1#2#3#4{\xint_secondoftwo_thenstop }%
687 \def\XINT_max_minusplus #1#2#3#4{\xint_firstoftwo_thenstop }%
688 \def\XINT_max_plusminus #1#2#3#4{\xint_secondoftwo_thenstop }%
689 \def\XINT_max_plusplus #1#2#3#4%
690 {%
691   \ifodd\XINT_Geq {#4#2}{#3#1}
692     \expandafter\xint_firstoftwo_thenstop
693   \else
694     \expandafter\xint_secondoftwo_thenstop
695   \fi
696 }%

#3=-, #4=-, #1 = |B| = -B, #2 = |A| = -A

697 \def\XINT_max_minusminus #1#2#3#4%
698 {%
699   \ifodd\XINT_Geq {#1}{#2}
700     \expandafter\xint_firstoftwo_thenstop
701   \else
702     \expandafter\xint_secondoftwo_thenstop
703   \fi
704 }%

```

#### 4.30 `\xintiMaxof`

New with 1.09a. 1.2 has NO MORE `\xintMaxof`, requires `\xintfracname`.

```

705 \def\xintiMaxof      {\romannumeral0\xintimaxof }%

```

#### 4 Package `xint` implementation

```

706 \def\xintimaxof #1{\expandafter\XINT_imaxof_a\romannumeral-\`0#1\relax }%
707 \def\XINT_imaxof_a #1{\expandafter\XINT_imaxof_b\romannumeral0\xintnum{#1}\Z }%
708 \def\XINT_imaxof_b #1\Z #2%
709     {\expandafter\XINT_imaxof_c\romannumeral-\`0#2\Z {#1}\Z}%
710 \def\XINT_imaxof_c #1%
711     {\xint_gob_til_relax #1\XINT_imaxof_e\relax\XINT_imaxof_d #1}%
712 \def\XINT_imaxof_d #1\Z
713     {\expandafter\XINT_imaxof_b\romannumeral0\xintimax {#1}}%
714 \def\XINT_imaxof_e #1\Z #2\Z { #2}%

```

#### 4.31 `\xintiMin`, `\xintiiMin`

`\xintnum` added New with 1.09a. I add `\xintiiMin` in 1.1 and mark as deprecated `\xintiMin`, renamed `\xintiMin`. `\xintiMin` NOW REMOVED (1.2, as `\xintMax`, `\xintMaxof`), only provided by `\xintfracnameimp`.

```

715 \def\xintiMin {\romannumeral0\xintimin }%
716 \def\xintimin #1%
717 {%
718     \expandafter\xint_min\expandafter {\romannumeral0\xintnum{#1}}%
719 }%
720 \def\xint_min #1#2%
721 {%
722     \expandafter\XINT_min_pre\expandafter {\romannumeral0\xintnum{#2}}{#1}%
723 }%
724 \def\xintiiMin {\romannumeral0\xintiiimin }%
725 \def\xintiiimin #1%
726 {%
727     \expandafter\xint_iimin\expandafter {\romannumeral-\`0#1}%
728 }%
729 \def\xint_iimin #1#2%
730 {%
731     \expandafter\XINT_min_pre\expandafter {\romannumeral-\`0#2}{#1}%
732 }%
733 \def\XINT_min_pre #1#2{\XINT_min_fork #1\Z #2\Z {#2}{#1}}%
734 \def\XINT_Min #1#2{\romannumeral0\XINT_min_fork #2\Z #1\Z {#1}{#2}}%

```

*#3#4 vient du \*premier\*, #1#2 vient du \*second\**

```

735 \def\XINT_min_fork #1#2\Z #3#4\Z
736 {%
737     \xint_UDsignsfork
738         #1#3\XINT_min_minusminus % A < 0, B < 0
739         #1-\XINT_min_minusplus % B < 0, A >= 0
740         #3-\XINT_min_plusminus % A < 0, B >= 0
741         --{\xint_UDzerosfork
742             #1#3\XINT_min_zerozero % A = B = 0
743             #10\XINT_min_zeropplus % B = 0, A > 0
744             #30\XINT_min_pluszero % A = 0, B > 0
745             00\XINT_min_plusplus % A, B > 0
746         \krof }%
747     \krof
748     {#2}{#4}#1#3%
749 }%

```

$A = \#4\#2$ ,  $B = \#3\#1$

```

750 \def\XINT_min_zerozero #1#2#3#4{\xint_firstoftwo_thenstop }%
751 \def\XINT_min_zeroplus #1#2#3#4{\xint_secondoftwo_thenstop }%
752 \def\XINT_min_pluszero #1#2#3#4{\xint_firstoftwo_thenstop }%
753 \def\XINT_min_minusplus #1#2#3#4{\xint_secondoftwo_thenstop }%
754 \def\XINT_min_plusminus #1#2#3#4{\xint_firstoftwo_thenstop }%
755 \def\XINT_min_plusplus #1#2#3#4%
756 {%
757   \ifodd\XINT_Geq {#4#2}{#3#1}
758   \expandafter\xint_secondoftwo_thenstop
759   \else
760   \expandafter\xint_firstoftwo_thenstop
761   \fi
762 }%

#3=-, #4=-, #1 = |B| = -B, #2 = |A| = -A

763 \def\XINT_min_minusminus #1#2#3#4%
764 {%
765   \ifodd\XINT_Geq {#1}{#2}
766   \expandafter\xint_secondoftwo_thenstop
767   \else
768   \expandafter\xint_firstoftwo_thenstop
769   \fi
770 }%

```

## 4.32 $\backslash$ xintiMinof

1.09a

```

771 \def\xintiMinof {\romannumeral0\xintiminof }%
772 \def\xintiminof #1{\expandafter\XINT_iminof_a\romannumeral-`0#1\relax }%
773 \def\XINT_iminof_a #1{\expandafter\XINT_iminof_b\romannumeral0\xintnum{#1}\Z }%
774 \def\XINT_iminof_b #1\Z #2%
775   {\expandafter\XINT_iminof_c\romannumeral-`0#2\Z {#1}\Z}%
776 \def\XINT_iminof_c #1%
777   {\xint_gob_til_relax #1\XINT_iminof_e\relax\XINT_iminof_d #1}%
778 \def\XINT_iminof_d #1\Z
779   {\expandafter\XINT_iminof_b\romannumeral0\xintimin {#1}}%
780 \def\XINT_iminof_e #1\Z #2\Z { #2}%

```

## 4.33 $\backslash$ xintiiSum

$\backslash$ xintiiSum {a}{b}...{z}

$\backslash$ xintiiSumExpr {a}{b}...{z}\relax

1.03 (drastically) simplifies and makes the routines more efficient (for big computations). Also the way  $\backslash$ xintSum and  $\backslash$ xintSumExpr ... $\backslash$ relax are related. has been modified. Now  $\backslash$ xintSumExpr  $\backslash$ z  $\backslash$ relax is accepted input when  $\backslash$ z expands to a list of braced terms (prior only  $\backslash$ xintSum {z} or  $\backslash$ xintSum  $\backslash$ z was possible).

1.09a does NOT add the  $\backslash$ xintnum overhead. 1.09h renames  $\backslash$ xintiSum to  $\backslash$ xintiiSum to correctly reflect this.

The *xint* 1.0x routine could benefit from the fact that addition and subtraction did not check the lengths of the arguments and were able to do their job independently of the order (but not at equal speed). Thus it was possible to add separately positive and negative summands and do one big subtraction at the end, keeping during all that time the intermediate result in reverse order suitable for both addition and subtraction. The lazy programmer being a bit tired after the 95% rewrite of *xintcore* has not tried to do the same with the new model. Thus we just do stupidly repeated additions. The code is thus much shorter... and in fact I just copied the routine for products and changed products to sums.

```

781 \def\xintiisum {\romannumeral0\xintiisum }%
782 \def\xintiisum #1{\xintiisumexpr #1\relax }%
783 \def\xintiisumExpr {\romannumeral0\xintiisumexpr }%
784 \def\xintiisumexpr {\expandafter\XINT_sumexpr\romannumeral-`0}%
785 \def\XINT_sumexpr {\XINT_sum_loop_a 0\Z }%
786 \def\XINT_sum_loop_a #1\Z #2%
787   {\expandafter\XINT_sum_loop_b \romannumeral-`0#2\Z #1\Z \Z}%
788 \def\XINT_sum_loop_b #1%
789   {\xint_gob_til_relax #1\XINT_sum_finished\relax\XINT_sum_loop_c #1}%
790 \def\XINT_sum_loop_c
791   {\expandafter\XINT_sum_loop_a\romannumeral0\XINT_add_fork }%
792 \def\XINT_sum_finished #1\Z #2\Z \Z { #2}%

```

#### 4.34 \xintiiPrd

```

\xintiiPrd {{a}...{z}}
\xintiiPrdExpr {a}...{z}\relax

```

Release 1.02 modified the product routine. The earlier version was faster in situations where each new term is bigger than the product of all previous terms, a situation which arises in the algorithm for computing powers. The 1.02 version was changed to be more efficient on big products, where the new term is small compared to what has been computed so far (the power algorithm now has its own product routine).

Finally, the 1.03 version just simplifies everything as the multiplication now decides what is best, with the price of a little overhead. So the code has been dramatically reduced here.

In 1.03 I also modify the way `\xintPrd` and `\xintPrdExpr ... \relax` are related. Now `\xintPrdExpr \z \relax` is accepted input when `\z` expands to a list of braced terms (prior only `\xintPrd {z}` or `\xintPrd \z` was possible).

In 1.06a I suddenly decide that `\xintProductExpr` was a silly name, and as the package is new and certainly not used, I decide I may just switch to `\xintPrdExpr` which I should have used from the beginning.

1.09a does NOT add the `\xintnum` overhead. 1.09h renames `\xintiPrd` to `\xintiiPrd` to correctly reflect this.

```

793 \def\xintiiPrd {\romannumeral0\xintiiprd }%
794 \def\xintiiprd #1{\xintiiprdexpr #1\relax }%
795 \def\xintiiPrdExpr {\romannumeral0\xintiiprdexpr }%
796 \def\xintiiprdexpr {\expandafter\XINT_prdexpr\romannumeral-`0}%
797 \def\XINT_prdexpr {\XINT_prod_loop_a 1\Z }%
798 \def\XINT_prod_loop_a #1\Z #2%
799   {\expandafter\XINT_prod_loop_b \romannumeral-`0#2\Z #1\Z \Z}%
800 \def\XINT_prod_loop_b #1%
801   {\xint_gob_til_relax #1\XINT_prod_finished\relax\XINT_prod_loop_c #1}%
802 \def\XINT_prod_loop_c
803   {\expandafter\XINT_prod_loop_a\romannumeral0\XINT_mul_fork }%

```

```
804 \def\XINT_prod_finished\relax\XINT_prod_loop_c #1\Z #2\Z \Z { #2}%
```

-----  
 -----  
 DECIMAL OPERATIONS: FIRST DIGIT, LASTDIGIT, (<- moved to xintcore because xintiLDg need by division macros) ODDNESS, MULTIPLICATION BY TEN, QUOTIENT BY TEN, QUOTIENT OR MULTIPLICATION BY POWER OF TEN, SPLIT OPERATION.

#### 4.35 \xintMON, \xintMMON, \xintiiMON, \xintiiMMON

MINUS ONE TO THE POWER N and  $(-1)^{N-1}$

```
805 \def\xintiiMON {\romannumeral0\xintiimon }%
806 \def\xintiimon #1%
807 {%
808   \ifodd\xintiilDg {#1}
809     \xint_afterfi{ -1}%
810   \else
811     \xint_afterfi{ 1}%
812   \fi
813 }%
814 \def\xintiiMMON {\romannumeral0\xintiimmon }%
815 \def\xintiimmon #1%
816 {%
817   \ifodd\xintiilDg {#1}
818     \xint_afterfi{ 1}%
819   \else
820     \xint_afterfi{ -1}%
821   \fi
822 }%
823 \def\xintMON {\romannumeral0\xintmon }%
824 \def\xintmon #1%
825 {%
826   \ifodd\xintLDg {#1}
827     \xint_afterfi{ -1}%
828   \else
829     \xint_afterfi{ 1}%
830   \fi
831 }%
832 \def\xintMMON {\romannumeral0\xintmmon }%
833 \def\xintmmon #1%
834 {%
835   \ifodd\xintLDg {#1}
836     \xint_afterfi{ 1}%
837   \else
838     \xint_afterfi{ -1}%
839   \fi
840 }%
```

#### 4.36 \xintOdd, \xintiiOdd, \xintEven, \xintiiEven

1.05 has \xintiOdd, whereas \xintOdd parses through \xintNum. Inadvertently, 1.09a redefined \xintiLDg hence \xintiOdd also parsed through \xintNum. Anyway, having a \xintOdd and a \xintiOdd

was silly. Removed in 1.09f, now only `\xintOdd` and `\xintiiOdd`. 1.1: `\xintEven` and `\xintiiEven` added for `\xintiexpr`.

```

841 \def\xintiiOdd {\romannumeral0\xintiiodd }%
842 \def\xintiiodd #1%
843 {%
844     \ifodd\xintiiLDg{#1}
845         \xint_afterfi{ 1}%
846     \else
847         \xint_afterfi{ 0}%
848     \fi
849 }%
850 \def\xintiiEven {\romannumeral0\xintiieven }%
851 \def\xintiieven #1%
852 {%
853     \ifodd\xintiiLDg{#1}
854         \xint_afterfi{ 0}%
855     \else
856         \xint_afterfi{ 1}%
857     \fi
858 }%
859 \def\xintOdd {\romannumeral0\xintodd }%
860 \def\xintodd #1%
861 {%
862     \ifodd\xintLDg{#1}
863         \xint_afterfi{ 1}%
864     \else
865         \xint_afterfi{ 0}%
866     \fi
867 }%
868 \def\xintEven {\romannumeral0\xinteven }%
869 \def\xinteven #1%
870 {%
871     \ifodd\xintLDg{#1}
872         \xint_afterfi{ 0}%
873     \else
874         \xint_afterfi{ 1}%
875     \fi
876 }%

```

#### 4.37 `\xintDSL`

DECIMAL SHIFT LEFT (=MULTIPLICATION PAR 10)

```

877 \def\xintDSL {\romannumeral0\xintdsl }%
878 \def\xintdsl #1%
879 {%
880     \expandafter\XINT_dsl \romannumeral-`0#1\Z
881 }%
882 \def\XINT_DSL #1{\romannumeral0\XINT_dsl #1\Z }%
883 \def\XINT_dsl #1%
884 {%
885     \xint_gob_til_zero #1\xint_dsl_zero 0\XINT_dsl_ #1%

```

```

886 }%
887 \def\xint_dsl_zero 0\XINT_dsl_ 0#1\Z { 0}%
888 \def\XINT_dsl_ #1\Z { #10}%

```

#### 4.38 \xintDSR

DECIMAL SHIFT RIGHT (=DIVISION PAR 10). Release 1.06b which replaced all @'s by underscores left undefined the \xint\_minus used in \XINT\_dsr\_b, and this bug was fixed only later in release 1.09b

```

889 \def\xintDSR {\romannumeral0\xintdsr }%
890 \def\xintdsr #1%
891 {%
892   \expandafter\XINT_dsr_a\expandafter {\romannumeral-`0#1}\W\Z
893 }%
894 \def\XINT_DSR #1{\romannumeral0\XINT_dsr_a {#1}\W\Z }%
895 \def\XINT_dsr_a
896 {%
897   \expandafter\XINT_dsr_b\romannumeral0\xintreverseorder
898 }%
899 \def\XINT_dsr_b #1#2#3\Z
900 {%
901   \xint_gob_til_W #2\xint_dsr_onedigit\W
902   \xint_gob_til_minus #2\xint_dsr_onedigit-%
903   \expandafter\XINT_dsr_removev
904   \romannumeral0\xintreverseorder {#2#3}%
905 }%
906 \def\xint_dsr_onedigit #1\xintreverseorder #2{ 0}%
907 \def\XINT_dsr_removev #1\W { }%

```

#### 4.39 \xintDSH, \xintDSHr

DECIMAL SHIFTS \xintDSH {x}{A}  
 si  $x \leq 0$ , fait  $A \rightarrow A.10^{|x|}$ . v1.03 corrige l'oversight pour  $A=0$ .  
 si  $x > 0$ , et  $A \geq 0$ , fait  $A \rightarrow \text{quo}(A, 10^x)$   
 si  $x > 0$ , et  $A < 0$ , fait  $A \rightarrow -\text{quo}(-A, 10^x)$   
 (donc pour  $x > 0$  c'est comme DSR itéré  $x$  fois)  
 \xintDSHr donne le 'reste' (si  $x \leq 0$  donne zéro).  
 Release 1.06 now feeds  $x$  to a \numexpr first. I will have to revise this code at some point.

```

908 \def\xintDSHr {\romannumeral0\xintdshr }%
909 \def\xintdshr #1%
910 {%
911   \expandafter\XINT_dshr_checkxpositive \the\numexpr #1\relax\Z
912 }%
913 \def\XINT_dshr_checkxpositive #1%
914 {%
915   \xint_UDzerominusfork
916   0#1\XINT_dshr_xzeroorneg
917   #1-\XINT_dshr_xzeroorneg
918   0-\XINT_dshr_xpositive
919   \krof #1%
920 }%
921 \def\XINT_dshr_xzeroorneg #1\Z #2{ 0}%

```

```

922 \def\XINT_dshr_xpositive #1\Z
923 {%
924   \expandafter\xint_secondoftwo_thenstop\romannumeral0\xintdsx {#1}%
925 }%
926 \def\xintDSH {\romannumeral0\xintdsh }%
927 \def\xintdsh #1#2%
928 {%
929   \expandafter\xint_dsh\expandafter {\romannumeral-`0#2}{#1}%
930 }%
931 \def\xint_dsh #1#2%
932 {%
933   \expandafter\XINT_dsh_checksignx \the\numexpr #2\relax\Z {#1}%
934 }%
935 \def\XINT_dsh_checksignx #1%
936 {%
937   \xint_UDzerominusfork
938   #1-\XINT_dsh_xiszero
939   0#1\XINT_dsx_xisNeg_checkA      % on passe direct dans DSx
940   0-\XINT_dsh_xisPos #1}%
941   \krof
942 }%
943 \def\XINT_dsh_xiszero #1\Z #2{ #2}%
944 \def\XINT_dsh_xisPos #1\Z #2%
945 {%
946   \expandafter\xint_firstoftwo_thenstop
947   \romannumeral0\XINT_dsx_checksiga #2\Z {#1}% via DSx
948 }%

```

#### 4.40 *\xintDSx*

Je fais cette routine pour la version 1.01, après modification de *\xintDecSplit*. Dorénavant *\xintDSx* fera appel à *\xintDecSplit* et de même *\xintDSH* fera appel à *\xintDSx*. J'ai donc supprimé entièrement l'ancien code de *\xintDSH* et re-écrit entièrement celui de *\xintDecSplit* pour *x* positif.

--> Attention le cas  $x=0$  est traité dans la même catégorie que  $x > 0$  <--  
si  $x < 0$ , fait  $A \rightarrow A \cdot 10^{|x|}$   
si  $x \geq 0$ , et  $A \geq 0$ , fait  $A \rightarrow \{ \text{quo}(A, 10^x) \} \{ \text{rem}(A, 10^x) \}$   
si  $x \geq 0$ , et  $A < 0$ , d'abord on calcule  $\{ \text{quo}(-A, 10^x) \} \{ \text{rem}(-A, 10^x) \}$   
puis, si le premier n'est pas nul on lui donne le signe -  
si le premier est nul on donne le signe - au second.

On peut donc toujours reconstituer l'original  $A$  par  $10^x Q \pm R$  où il faut prendre le signe plus si  $Q$  est positif ou nul et le signe moins si  $Q$  est strictement négatif.

Release 1.06 has a faster and more compactly coded *\XINT\_dsx\_zeroloop*. Also,  $x$  is now given to a *\numexpr*. The earlier code should be then simplified, but I leave as is for the time being.

Release 1.07 modified the coding of *\XINT\_dsx\_zeroloop*, to avoid impacting the input stack. Indeed the truncating, rounding, and conversion to float routines all use internally *\XINT\_dsx\_zeroloop* (via *\XINT\_dsx\_addzerosnofuss*), and they were thus roughly limited to generating  $N = 8$  times the input save stack size digits. On TL2012 and TL2013, this means  $40000 = 8 \times 5000$  digits. Although generating more than 40000 digits is more like a one shot thing, I wanted to open the possibility of outputting tens of thousands of digits to faille, thus I re-organized *\XINT\_dsx\_zeroloop*.

January 5, 2014: but it is only with the new division implementation of 1.09j and also with its special *\xintXTrunc* routine that the possibility mentioned in the last paragraph has become a



concrete one in terms of computation time.

```

949 \def\xintDSx {\romannumeral0\xintdsx }%
950 \def\xintdsx #1#2%
951 {%
952   \expandafter\xint_dsx\expandafter {\romannumeral-`0#2}{#1}%
953 }%
954 \def\xint_dsx #1#2%
955 {%
956   \expandafter\XINT_dsx_checksignx \the\numexpr #2\relax\Z {#1}%
957 }%
958 \def\XINT_DSx #1#2{\romannumeral0\XINT_dsx_checksignx #1\Z {#2}}%
959 \def\XINT_dsx #1#2{\XINT_dsx_checksignx #1\Z {#2}}%
960 \def\XINT_dsx_checksignx #1%
961 {%
962   \xint_UDzerominusfork
963   #1-\XINT_dsx_xisZero
964   0#1\XINT_dsx_xisNeg_checkA
965   0-{\XINT_dsx_xisPos #1}%
966   \krof
967 }%
968 \def\XINT_dsx_xisZero #1\Z #2{ {#2}{0}}% attention comme x > 0
969 \def\XINT_dsx_xisNeg_checkA #1\Z #2%
970 {%
971   \XINT_dsx_xisNeg_checkA_ #2\Z {#1}%
972 }%
973 \def\XINT_dsx_xisNeg_checkA_ #1#2\Z #3%
974 {%
975   \xint_gob_til_zero #1\XINT_dsx_xisNeg_Azero 0%
976   \XINT_dsx_xisNeg_checkx {#3}{#3}{}\Z {#1#2}%
977 }%
978 \def\XINT_dsx_xisNeg_Azero #1\Z #2{ 0}%
979 \def\XINT_dsx_xisNeg_checkx #1%
980 {%
981   \ifnum #1>10000000
982     \xint_afterfi
983     {\xintError:TooBigDecimalShift
984     \expandafter\space\expandafter 0\xint_gobble_iv }%
985   \else
986     \expandafter \XINT_dsx_zeroloop
987   \fi
988 }%
989 \def\XINT_dsx_addzerosnofuss #1{\XINT_dsx_zeroloop {#1}}\Z }%
990 \def\XINT_dsx_zeroloop #1#2%
991 {%
992   \ifnum #1<\xint_c_ix \XINT_dsx_exita\fi
993   \expandafter\XINT_dsx_zeroloop\expandafter
994   {\the\numexpr #1-\xint_c_viii}{#200000000}%
995 }%
996 \def\XINT_dsx_exita\fi\expandafter\XINT_dsx_zeroloop
997 {%
998   \fi\expandafter\XINT_dsx_exitb
999 }%

```

#### 4 Package `xint` implementation

```

1000 \def\XINT_dsx_exitb #1#2%
1001 {%
1002     \expandafter\expandafter\expandafter
1003     \XINT_dsx_addzeros\csname xint_gobble_\romannumeral -#1\endcsname #2%
1004 }%
1005 \def\XINT_dsx_addzeros #1\Z #2{ #2#1}%
1006 \def\XINT_dsx_xisPos #1\Z #2%
1007 {%
1008     \XINT_dsx_checksiga #2\Z {#1}%
1009 }%
1010 \def\XINT_dsx_checksiga #1%
1011 {%
1012     \xint_UDzerominusfork
1013     #1-\XINT_dsx_AisZero
1014     0#1\XINT_dsx_AisNeg
1015     0-\XINT_dsx_AisPos #1}%
1016     \krof
1017 }%
1018 \def\XINT_dsx_AisZero #1\Z #2{ {0}{0}}%
1019 \def\XINT_dsx_AisNeg #1\Z #2%
1020 {%
1021     \expandafter\XINT_dsx_AisNeg_dosplit_andcheckfirst
1022     \romannumeral0\XINT_split_checksizex {#2}{#1}%
1023 }%
1024 \def\XINT_dsx_AisNeg_dosplit_andcheckfirst #1%
1025 {%
1026     \XINT_dsx_AisNeg_checkiffirstempty #1\Z
1027 }%
1028 \def\XINT_dsx_AisNeg_checkiffirstempty #1%
1029 {%
1030     \xint_gob_til_Z #1\XINT_dsx_AisNeg_finish_zero\Z
1031     \XINT_dsx_AisNeg_finish_notzero #1%
1032 }%
1033 \def\XINT_dsx_AisNeg_finish_zero\Z
1034     \XINT_dsx_AisNeg_finish_notzero\Z #1%
1035 {%
1036     \expandafter\XINT_dsx_end
1037     \expandafter {\romannumeral0\XINT_num {-#1}}{0}%
1038 }%
1039 \def\XINT_dsx_AisNeg_finish_notzero #1\Z #2%
1040 {%
1041     \expandafter\XINT_dsx_end
1042     \expandafter {\romannumeral0\XINT_num {#2}}{-#1}%
1043 }%
1044 \def\XINT_dsx_AisPos #1\Z #2%
1045 {%
1046     \expandafter\XINT_dsx_AisPos_finish
1047     \romannumeral0\XINT_split_checksizex {#2}{#1}%
1048 }%
1049 \def\XINT_dsx_AisPos_finish #1#2%
1050 {%
1051     \expandafter\XINT_dsx_end

```

```

1052 \expandafter {\romannumeral0\XINT_num {#2}}%
1053 {\romannumeral0\XINT_num {#1}}%
1054 }%
1055 \edef\XINT_dsx_end #1#2%
1056 {%
1057 \noexpand\expandafter\space\noexpand\expandafter{#2}{#1}%
1058 }%

```

#### 4.41 \xintDecSplit, \xintDecSplitL, \xintDecSplitR

##### DECIMAL SPLIT

The macro `\xintDecSplit {x}{A}` first replaces `A` with `|A|` (\*) This macro cuts the number into two pieces `L` and `R`. The concatenation `LR` always reproduces `|A|`, and `R` may be empty or have leading zeros. The position of the cut is specified by the first argument `x`. If `x` is zero or positive the cut location is `x` slots to the left of the right end of the number. If `x` becomes equal to or larger than the length of the number then `L` becomes empty. If `x` is negative the location of the cut is `|x|` slots to the right of the left end of the number.

(\*) warning: this may change in a future version. Only the behavior for `A` non-negative is guaranteed to remain the same.

v1.05a: `\XINT_split_checksize` does not compute the length anymore, rather the error will be from a `\numexpr`; but the limit of 999999999 does not make much sense.

v1.06: Improvements in `\XINT_split_fromleft_loop`, `\XINT_split_fromright_loop` and related macros. More readable coding, speed gains. Also, I now feed immediately a `\numexpr` with `x`. Some simplifications should probably be made to the code, which is kept as is for the time being.

1.09e pays attention to the use of `xintiabs` which acquired in 1.09a the `xintnum` overhead. So `xintiabs` rather without that overhead.

```

1059 \def\xintDecSplitL {\romannumeral0\xintdecsplitl }%
1060 \def\xintDecSplitR {\romannumeral0\xintdecsplitr }%
1061 \def\xintdecsplitl
1062 {%
1063 \expandafter\xint_firstoftwo_thenstop
1064 \romannumeral0\xintdecsplit
1065 }%
1066 \def\xintdecsplitr
1067 {%
1068 \expandafter\xint_secondoftwo_thenstop
1069 \romannumeral0\xintdecsplit
1070 }%
1071 \def\xintDecSplit {\romannumeral0\xintdecsplit }%
1072 \def\xintdecsplit #1#2%
1073 {%
1074 \expandafter \xint_split \expandafter
1075 {\romannumeral0\xintiabs {#2}}{#1}% fait expansion de A
1076 }%
1077 \def\xint_split #1#2%
1078 {%
1079 \expandafter\XINT_split_checksize\expandafter{\the\numexpr #2}{#1}%
1080 }%
1081 \def\XINT_split_checksize #1% 999999999 is anyhow very big, could be reduced
1082 {%
1083 \ifnum\numexpr\XINT_Abs{#1}>999999999
1084 \xint_afterfi {\xintError:TooBigDecimalSplit\XINT_split_bigx }%

```

#### 4 Package `xint` implementation

```

1085 \else
1086 \expandafter\XINT_split_xfork
1087 \fi
1088 #1\Z
1089 }%
1090 \def\XINT_split_bigx #1\Z #2%
1091 {%
1092 \ifcase\XINT_cntSgn #1\Z
1093 \or \xint_afterfi { }{#2}% positive big x
1094 \else
1095 \xint_afterfi { }{#2}% negative big x
1096 \fi
1097 }%
1098 \def\XINT_split_xfork #1%
1099 {%
1100 \xint_UDzerominusfork
1101 #1-\XINT_split_zerosplit
1102 0#1\XINT_split_fromleft
1103 0-\XINT_split_fromright #1}%
1104 \krof
1105 }%
1106 \def\XINT_split_zerosplit #1\Z #2{ }{#2}%
1107 \def\XINT_split_fromleft #1\Z #2%
1108 {%
1109 \XINT_split_fromleft_loop {#1}{#2\W\W\W\W\W\W\W\W\Z
1110 }%
1111 \def\XINT_split_fromleft_loop #1%
1112 {%
1113 \ifnum #1<\xint_c_viii\XINT_split_fromleft_exita\fi
1114 \expandafter\XINT_split_fromleft_loop_perhaps\expandafter
1115 {\the\numexpr #1-\xint_c_viii\expandafter}\XINT_split_fromleft_eight
1116 }%
1117 \def\XINT_split_fromleft_eight #1#2#3#4#5#6#7#8#9{#9{#1#2#3#4#5#6#7#8#9}}%
1118 \def\XINT_split_fromleft_loop_perhaps #1#2%
1119 {%
1120 \xint_gob_til_W #2\XINT_split_fromleft_toofar\W
1121 \XINT_split_fromleft_loop {#1}%
1122 }%
1123 \def\XINT_split_fromleft_toofar\W\XINT_split_fromleft_loop #1#2#3\Z
1124 {%
1125 \XINT_split_fromleft_toofar_b #2\Z
1126 }%
1127 \def\XINT_split_fromleft_toofar_b #1\W #2\Z { }{#1}%
1128 \def\XINT_split_fromleft_exita\fi
1129 \expandafter\XINT_split_fromleft_loop_perhaps\expandafter #1#2%
1130 {\fi \XINT_split_fromleft_exitb #1}%
1131 \def\XINT_split_fromleft_exitb\the\numexpr #1-\xint_c_viii\expandafter
1132 {%
1133 \csname XINT_split_fromleft_endsplit_\romannumeral #1\endcsname
1134 }%
1135 \def\XINT_split_fromleft_endsplit_ #1#2\W #3\Z { }{#1}{#2}%
1136 \def\XINT_split_fromleft_endsplit_i #1#2%

```

#### 4 Package `xint` implementation

```

1137         {\XINT_split_fromleft_checkiftoofar #2{#1#2}}%
1138 \def\XINT_split_fromleft_endsplit_ii #1#2#3%
1139         {\XINT_split_fromleft_checkiftoofar #3{#1#2#3}}%
1140 \def\XINT_split_fromleft_endsplit_iii #1#2#3#4%
1141         {\XINT_split_fromleft_checkiftoofar #4{#1#2#3#4}}%
1142 \def\XINT_split_fromleft_endsplit_iv #1#2#3#4#5%
1143         {\XINT_split_fromleft_checkiftoofar #5{#1#2#3#4#5}}%
1144 \def\XINT_split_fromleft_endsplit_v #1#2#3#4#5#6%
1145         {\XINT_split_fromleft_checkiftoofar #6{#1#2#3#4#5#6}}%
1146 \def\XINT_split_fromleft_endsplit_vi #1#2#3#4#5#6#7%
1147         {\XINT_split_fromleft_checkiftoofar #7{#1#2#3#4#5#6#7}}%
1148 \def\XINT_split_fromleft_endsplit_vii #1#2#3#4#5#6#7#8%
1149         {\XINT_split_fromleft_checkiftoofar #8{#1#2#3#4#5#6#7#8}}%
1150 \def\XINT_split_fromleft_checkiftoofar #1#2#3\W #4\Z
1151 {%
1152     \xint_gob_til_W #1\XINT_split_fromleft_wenttoofar\W
1153     \space {#2}{#3}%
1154 }%
1155 \def\XINT_split_fromleft_wenttoofar\W\space #1%
1156 {%
1157     \XINT_split_fromleft_wenttoofar_b #1\Z
1158 }%
1159 \def\XINT_split_fromleft_wenttoofar_b #1\W #2\Z { {#1}}%
1160 \def\XINT_split_fromright #1\Z #2%
1161 {%
1162     \expandafter \XINT_split_fromright_a \expandafter
1163     {\romannumeral0\xintreverseorder {#2}}{#1}{#2}%
1164 }%
1165 \def\XINT_split_fromright_a #1#2%
1166 {%
1167     \XINT_split_fromright_loop {#2}{#1\W\W\W\W\W\W\W\W\Z
1168 }%
1169 \def\XINT_split_fromright_loop #1%
1170 {%
1171     \ifnum #1<\xint_c_viii\XINT_split_fromright_exita\fi
1172     \expandafter\XINT_split_fromright_loop_perhaps\expandafter
1173     {\the\numexpr #1-\xint_c_viii\expandafter }\XINT_split_fromright_eight
1174 }%
1175 \def\XINT_split_fromright_eight #1#2#3#4#5#6#7#8#9{#9{#9#8#7#6#5#4#3#2#1}}%
1176 \def\XINT_split_fromright_loop_perhaps #1#2%
1177 {%
1178     \xint_gob_til_W #2\XINT_split_fromright_toofar\W
1179     \XINT_split_fromright_loop {#1}%
1180 }%
1181 \def\XINT_split_fromright_toofar\W\XINT_split_fromright_loop #1#2#3\Z { {}}%
1182 \def\XINT_split_fromright_exita\fi
1183     \expandafter\XINT_split_fromright_loop_perhaps\expandafter #1#2%
1184     {\fi \XINT_split_fromright_exitb #1}%
1185 \def\XINT_split_fromright_exitb\the\numexpr #1-\xint_c_viii\expandafter
1186 {%
1187     \csname XINT_split_fromright_endsplit_\romannumeral #1\endcsname
1188 }%

```

```

1189 \edef\XINT_split_fromright_endsplit_ #1#2\W #3\Z #4%
1190 {%
1191     \noexpand\expandafter\space\noexpand\expandafter
1192     {\noexpand\romannumeral0\noexpand\xintreverseorder {#2}}{#1}%
1193 }%
1194 \def\XINT_split_fromright_endsplit_i #1#2%
1195     {\XINT_split_fromright_checkiftoofar #2{#2#1}}%
1196 \def\XINT_split_fromright_endsplit_ii #1#2#3%
1197     {\XINT_split_fromright_checkiftoofar #3{#3#2#1}}%
1198 \def\XINT_split_fromright_endsplit_iii #1#2#3#4%
1199     {\XINT_split_fromright_checkiftoofar #4{#4#3#2#1}}%
1200 \def\XINT_split_fromright_endsplit_iv #1#2#3#4#5%
1201     {\XINT_split_fromright_checkiftoofar #5{#5#4#3#2#1}}%
1202 \def\XINT_split_fromright_endsplit_v #1#2#3#4#5#6%
1203     {\XINT_split_fromright_checkiftoofar #6{#6#5#4#3#2#1}}%
1204 \def\XINT_split_fromright_endsplit_vi #1#2#3#4#5#6#7%
1205     {\XINT_split_fromright_checkiftoofar #7{#7#6#5#4#3#2#1}}%
1206 \def\XINT_split_fromright_endsplit_vii #1#2#3#4#5#6#7#8%
1207     {\XINT_split_fromright_checkiftoofar #8{#8#7#6#5#4#3#2#1}}%
1208 \def\XINT_split_fromright_checkiftoofar #1%
1209 {%
1210     \xint_gob_til_W #1\XINT_split_fromright_wenttoofar\W
1211     \XINT_split_fromright_endsplit_
1212 }%
1213 \def\XINT_split_fromright_wenttoofar\W\XINT_split_fromright_endsplit_ #1\Z #2%
1214     { {}{#2}}%

```

#### 4.42 `\xintiiSqrt`, `\xintiiSqrtR`, `\xintiiSquareRoot`

v1.08. 1.09a uses `\xintnum`.

Some overhead was added inadvertently in 1.09a to inner routines when `\xintiquo` and `\xintidivision` were also promoted to use `\xintnum`; release 1.09f thus uses `\xintiiquo` and `\xintiidivision` which avoid this `\xintnum` overhead.

1.09j replaced the previous long `\ifcase` from `\XINT_sqrt_c` by some nested `\ifnum`'s.

1.1 Ajout de `\xintiiSqrt` et `\xintiiSquareRoot`.

1.1a ajoute `\xintiiSqrtR`, which provides the rounded, not truncated square root.

```

1215 \def\xintiiSqrt {\romannumeral0\xintiisqrt }%
1216 \def\xintiiSqrtR {\romannumeral0\xintiisqrtr }%
1217 \def\xintiiSquareRoot {\romannumeral0\xintiisquareroot }%
1218 \def\xintiSqrt {\romannumeral0\xintisqrt }%
1219 \def\xintiSquareRoot {\romannumeral0\xintisquareroot }%
1220 \def\xintisqrt {\expandafter\XINT_sqrt_post\romannumeral0\xintisquareroot }%
1221 \def\xintiisqrt {\expandafter\XINT_sqrt_post\romannumeral0\xintiisquareroot }%
1222 \def\xintiisqrtr {\expandafter\XINT_sqrtr_post\romannumeral0\xintiisquareroot }%
1223 \def\XINT_sqrt_post #1#2{\XINT_dec_pos #1\Z }%

```

$N = (\#1)^2 - \#2$  avec  $\#1$  le plus petit possible et  $\#2 > 0$  (hence  $\#2 < 2 * \#1$ ).  $(\#1 - .5)^2 = \#1^2 - \#1 + .25 = N + \#2 - \#1 + .25$ . Si  $0 < \#2 < \#1$ ,  $\leq N - 0.75 < N$ , donc rounded- $\rightarrow \#1$  si  $\#2 \geq \#1$ ,  $(\#1 - .5)^2 \geq N + .25 > N$ , donc rounded- $\rightarrow \#1 - 1$ .

```

1224 \def\XINT_sqrtr_post #1#2{\xintiiiflt {#2}{#1}{ #1}{\XINT_dec_pos #1\Z}}%
1225 \def\xintisquareroot #1%

```

#### 4 Package *xint* implementation

```

1226 {\expandafter\XINT_sqrt_checkin\romannumeral0\xintnum{#1}\Z}%
1227 \def\xintiissquareroot #1{\expandafter\XINT_sqrt_checkin\romannumeral-`0#1\Z}%
1228 \def\XINT_sqrt_checkin #1%
1229 {%
1230   \xint_UDzerominusfork
1231   #1-\XINT_sqrt_iszero
1232   0#1\XINT_sqrt_isneg
1233   0-\XINT_sqrt #1}%
1234   \krof
1235}%
1236 \def\XINT_sqrt_iszero #1\Z { 11}%
1237 \edef\XINT_sqrt_isneg #1\Z {\noexpand\xintError:RootOfNegative\space 11}%
1238 \def\XINT_sqrt #1\Z
1239 {%
1240   \expandafter\XINT_sqrt_start\expandafter {\romannumeral0\xintlength {#1}}{#1}%
1241}%
1242 \def\XINT_sqrt_start #1%
1243 {%
1244   \ifnum #1<\xint_c_x
1245     \expandafter\XINT_sqrt_small_a
1246   \else
1247     \expandafter\XINT_sqrt_big_a
1248   \fi
1249   {#1}%
1250}%
1251 \def\XINT_sqrt_small_a #1{\XINT_sqrt_a {#1}\XINT_sqrt_small_d}%
1252 \def\XINT_sqrt_big_a #1{\XINT_sqrt_a {#1}\XINT_sqrt_big_d}%
1253 \def\XINT_sqrt_a #1%
1254 {%
1255   \ifodd #1
1256     \expandafter\XINT_sqrt_bB
1257   \else
1258     \expandafter\XINT_sqrt_bA
1259   \fi
1260   {#1}%
1261}%
1262 \def\XINT_sqrt_bA #1#2#3%
1263 {%
1264   \XINT_sqrt_bA_b #3\Z #2{#1}{#3}%
1265}%
1266 \def\XINT_sqrt_bA_b #1#2#3\Z
1267 {%
1268   \XINT_sqrt_c {#1#2}%
1269}%
1270 \def\XINT_sqrt_bB #1#2#3%
1271 {%
1272   \XINT_sqrt_bB_b #3\Z #2{#1}{#3}%
1273}%
1274 \def\XINT_sqrt_bB_b #1#2\Z
1275 {%
1276   \XINT_sqrt_c #1%
1277}%

```

#### 4 Package *xint* implementation

```

1278 \def\XINT_sqrt_c #1#2%
1279 {%
1280   \expandafter #2\expandafter
1281   {\the\numexpr\ifnum #1>\xint_c_iii
1282     \ifnum #1>\xint_c_viii
1283       \ifnum #1>15 \ifnum #1>24 \ifnum #1>35
1284         \ifnum #1>48 \ifnum #1>63 \ifnum #1>80
1285       10\else 9\fi \else 8\fi \else 7\fi \else 6\fi
1286     \else 5\fi \else 4\fi \else 3\fi \else 2\fi \relax }%
1287 }%
1288 \def\XINT_sqrt_small_d #1#2%
1289 {%
1290   \expandafter\XINT_sqrt_small_e\expandafter
1291   {\the\numexpr #1\ifcase \numexpr #2/\xint_c_ii-\xint_c_i\relax
1292     \or 0\or 00\or 000\or 0000\fi }%
1293 }%
1294 \def\XINT_sqrt_small_e #1#2%
1295 {%
1296   \expandafter\XINT_sqrt_small_f\expandafter {\the\numexpr #1*#1-#2}{#1}%
1297 }%
1298 \def\XINT_sqrt_small_f #1#2%
1299 {%
1300   \expandafter\XINT_sqrt_small_g\expandafter
1301   {\the\numexpr ((#1+#2)/(\xint_c_ii*#2))-\xint_c_i}{#1}{#2}%
1302 }%
1303 \def\XINT_sqrt_small_g #1%
1304 {%
1305   \ifnum #1>\xint_c_
1306     \expandafter\XINT_sqrt_small_h
1307   \else
1308     \expandafter\XINT_sqrt_small_end
1309   \fi
1310   {#1}%
1311 }%
1312 \def\XINT_sqrt_small_h #1#2#3%
1313 {%
1314   \expandafter\XINT_sqrt_small_f\expandafter
1315   {\the\numexpr #2-\xint_c_ii*#1*#3+#1*#1\expandafter}\expandafter
1316   {\the\numexpr #3-#1}%
1317 }%
1318 \def\XINT_sqrt_small_end #1#2#3{{#3}{#2}}%
1319 \def\XINT_sqrt_big_d #1#2%
1320 {%
1321   \ifodd #2
1322     \expandafter\expandafter\expandafter\XINT_sqrt_big_eB
1323   \else
1324     \expandafter\expandafter\expandafter\XINT_sqrt_big_eA
1325   \fi
1326   \expandafter {\the\numexpr #2/\xint_c_ii }{#1}%
1327 }%
1328 \def\XINT_sqrt_big_eA #1#2#3%
1329 {%

```



#### 4 Package `xint` implementation

```

1330 \XINT_sqrt_big_eA_a #3\Z {#2}{#1}{#3}%
1331 }%
1332 \def\XINT_sqrt_big_eA_a #1#2#3#4#5#6#7#8#9\Z
1333 {%
1334 \XINT_sqrt_big_eA_b {#1#2#3#4#5#6#7#8}%
1335 }%
1336 \def\XINT_sqrt_big_eA_b #1#2%
1337 {%
1338 \expandafter\XINT_sqrt_big_f
1339 \romannumeral0\XINT_sqrt_small_e {#2000}{#1}{#1}%
1340 }%
1341 \def\XINT_sqrt_big_eB #1#2#3%
1342 {%
1343 \XINT_sqrt_big_eB_a #3\Z {#2}{#1}{#3}%
1344 }%
1345 \def\XINT_sqrt_big_eB_a #1#2#3#4#5#6#7#8#9%
1346 {%
1347 \XINT_sqrt_big_eB_b {#1#2#3#4#5#6#7#8#9}%
1348 }%
1349 \def\XINT_sqrt_big_eB_b #1#2\Z #3%
1350 {%
1351 \expandafter\XINT_sqrt_big_f
1352 \romannumeral0\XINT_sqrt_small_e {#30000}{#1}{#1}%
1353 }%
1354 \def\XINT_sqrt_big_f #1#2#3#4%
1355 {%
1356 \expandafter\XINT_sqrt_big_f_a\expandafter
1357 {\the\numexpr #2+#3\expandafter}\expandafter
1358 {\romannumeral0\XINT_dsx_addzerosnofuss
1359 {\numexpr #4-\xint_c_iv\relax}{#1}}{#4}%
1360 }%
1361 \def\XINT_sqrt_big_f_a #1#2#3#4%
1362 {%
1363 \expandafter\XINT_sqrt_big_g\expandafter
1364 {\romannumeral0\xintiisub
1365 {\XINT_dsx_addzerosnofuss
1366 {\numexpr \xint_c_ii*#3-\xint_c_viii\relax}{#1}}{#4}}%
1367 {#2}{#3}%
1368 }%
1369 \def\XINT_sqrt_big_g #1#2%
1370 {%
1371 \expandafter\XINT_sqrt_big_j
1372 \romannumeral0\xintiidivision{#1}{\romannumeral0\XINT_dbl_pos #2\Z}{#2}%
1373 }%
1374 \def\XINT_sqrt_big_j #1%
1375 {%
1376 \if0\XINT_Sgn #1\Z
1377 \expandafter \XINT_sqrt_big_end
1378 \else \expandafter \XINT_sqrt_big_k
1379 \fi {#1}%
1380 }%
1381 \def\XINT_sqrt_big_k #1#2#3%

```

```

1382 {%
1383   \expandafter\XINT_sqrt_big_l\expandafter
1384   {\romannumeral0\xintiisub {#3}{#1}}%
1385   {\romannumeral0\xintiiadd {#2}{\xintiiSqr {#1}}}%
1386 }%
1387 \def\XINT_sqrt_big_l #1#2%
1388 {%
1389   \expandafter\XINT_sqrt_big_g\expandafter
1390   {#2}{#1}%
1391 }%
1392 \def\XINT_sqrt_big_end #1#2#3#4{ {#3}{#2}}%

```

#### 4.43 *\xintiiE*

Originally was used in *\xintiexpr*. Transferred from *xintfrac* for 1.1.

```

1393 \def\xintiiE {\romannumeral0\xintiiE}% used in \xintMod.
1394 \def\xintiiE #1#2%
1395   {\expandafter\XINT_iiE\the\numexpr #2\expandafter.\expandafter{\romannumeral-`0#1}}%
1396 \def\XINT_iiE #1.#2{\ifnum#1>\xint_c_ \xint_dothis{\xint_dsh {#2}{-#1}}\fi
1397   \xint_orthat{ #2}}%

```

#### 4.44 “Load *xintfrac*” macros

Originally was used in *\xintiexpr*. Transferred from *xintfrac* for 1.1.

```

1398 \catcode`! 11
1399 \def\xintMax {\Did_you_mean_iiMax?or_load_xintfrac!}%
1400 \def\xintMin {\Did_you_mean_iiMin?or_load_xintfrac!}%
1401 \def\xintMaxof {\Did_you_mean_iMaxof?or_load_xintfrac!}%
1402 \def\xintMinof {\Did_you_mean_iMinof?or_load_xintfrac!}%
1403 \def\xintSum {\Did_you_mean_iiSum?or_load_xintfrac!}%
1404 \def\xintPrd {\Did_you_mean_iiPrd?or_load_xintfrac!}%
1405 \def\xintPrdExpr {\Did_you_mean_iiPrdExpr?or_load_xintfrac!}%
1406 \def\xintSumExpr {\Did_you_mean_iiSumExpr?or_load_xintfrac!}%
1407 \XINT_restorecatcodes_endinput%

```

## 5 Package *xintbinhex* implementation

.1	Catcodes, $\varepsilon$ -T <sub>E</sub> X and reload detection	114	.6	<i>\xintHexToDec</i>	121
.2	Package identification	115	.7	<i>\xintBinToDec</i>	123
.3	Constants, etc...	115	.8	<i>\xintBinToHex</i>	125
.4	<i>\XINT_OQ</i>	117	.9	<i>\xintHexToBin</i>	126
.5	<i>\xintDecToHex</i> , <i>\xintDecToBin</i>	118	.10	<i>\xintCHexToBin</i>	126

The commenting is currently (2015/10/10) very sparse.

### 5.1 Catcodes, $\varepsilon$ -T<sub>E</sub>X and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified.  
The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2 \catcode13=5 % ^^M
3 \endlinechar=13 %
4 \catcode123=1 % {
5 \catcode125=2 % }
6 \catcode64=11 % @
7 \catcode35=6 % #
8 \catcode44=12 % ,
9 \catcode45=12 % -
10 \catcode46=12 % .
11 \catcode58=12 % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xintbinhex.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintcore.sty\endcsname
15 \expandafter
16 \ifx\csname PackageInfo\endcsname\relax
17 \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18 \else
19 \def\y#1#2{\PackageInfo{#1}{#2}}%
20 \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23 \y{xintbinhex}{\numexpr not available, aborting input}%
24 \aftergroup\endinput
25 \else
26 \ifx\x\relax % plain-TeX, first loading of xintbinhex.sty
27 \ifx\w\relax % but xintcore.sty not yet loaded.
28 \def\z{\endgroup\input xintcore.sty\relax}%
29 \fi
30 \else
31 \def\empty {}%
32 \ifx\x\empty % LaTeX, first loading,
33 % variable is initialized, but \ProvidesPackage not yet seen
34 \ifx\w\relax % xintcore.sty not yet loaded.
35 \def\z{\endgroup\RequirePackage{xintcore}}%
36 \fi
37 \else
38 \aftergroup\endinput % xintbinhex already loaded.
39 \fi
40 \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty

```

## 5.2 Package identification

```

44 \XINT_providespackage
45 \ProvidesPackage{xintbinhex}%
46 [2015/10/10 v1.2 Expandable binary and hexadecimal conversions (jfb)]%

```

## 5.3 Constants, etc...

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## 5 Package *xintbinhex* implementation

```

47 \newcount\xint_c_ii^xv \xint_c_ii^xv 32768
48 \newcount\xint_c_ii^xvi \xint_c_ii^xvi 65536
49 \newcount\xint_c_x^v \xint_c_x^v 100000
50 \def\xINT_tmpa #1{\ifx\relax#1\else
51 \expandafter\edef\csname XINT_sdth_#1\endcsname
52 {\ifcase #1 0\or 1\or 2\or 3\or 4\or 5\or 6\or 7\or
53 8\or 9\or A\or B\or C\or D\or E\or F\fi}%
54 \expandafter\xINT_tmpa\fi }%
55 \XINT_tmpa {0}{1}{2}{3}{4}{5}{6}{7}{8}{9}{10}{11}{12}{13}{14}{15}\relax
56 \def\xINT_tmpa #1{\ifx\relax#1\else
57 \expandafter\edef\csname XINT_sdtb_#1\endcsname
58 {\ifcase #1
59 0000\or 0001\or 0010\or 0011\or 0100\or 0101\or 0110\or 0111\or
60 1000\or 1001\or 1010\or 1011\or 1100\or 1101\or 1110\or 1111\fi}%
61 \expandafter\xINT_tmpa\fi }%
62 \XINT_tmpa {0}{1}{2}{3}{4}{5}{6}{7}{8}{9}{10}{11}{12}{13}{14}{15}\relax
63 \let\xINT_tmpa\relax
64 \expandafter\def\csname XINT_sbtd_0000\endcsname {0}%
65 \expandafter\def\csname XINT_sbtd_0001\endcsname {1}%
66 \expandafter\def\csname XINT_sbtd_0010\endcsname {2}%
67 \expandafter\def\csname XINT_sbtd_0011\endcsname {3}%
68 \expandafter\def\csname XINT_sbtd_0100\endcsname {4}%
69 \expandafter\def\csname XINT_sbtd_0101\endcsname {5}%
70 \expandafter\def\csname XINT_sbtd_0110\endcsname {6}%
71 \expandafter\def\csname XINT_sbtd_0111\endcsname {7}%
72 \expandafter\def\csname XINT_sbtd_1000\endcsname {8}%
73 \expandafter\def\csname XINT_sbtd_1001\endcsname {9}%
74 \expandafter\def\csname XINT_sbtd_1010\endcsname {10}%
75 \expandafter\def\csname XINT_sbtd_1011\endcsname {11}%
76 \expandafter\def\csname XINT_sbtd_1100\endcsname {12}%
77 \expandafter\def\csname XINT_sbtd_1101\endcsname {13}%
78 \expandafter\def\csname XINT_sbtd_1110\endcsname {14}%
79 \expandafter\def\csname XINT_sbtd_1111\endcsname {15}%
80 \expandafter\let\csname XINT_sbth_0000\expandafter\endcsname
81 \csname XINT_sbtd_0000\endcsname
82 \expandafter\let\csname XINT_sbth_0001\expandafter\endcsname
83 \csname XINT_sbtd_0001\endcsname
84 \expandafter\let\csname XINT_sbth_0010\expandafter\endcsname
85 \csname XINT_sbtd_0010\endcsname
86 \expandafter\let\csname XINT_sbth_0011\expandafter\endcsname
87 \csname XINT_sbtd_0011\endcsname
88 \expandafter\let\csname XINT_sbth_0100\expandafter\endcsname
89 \csname XINT_sbtd_0100\endcsname
90 \expandafter\let\csname XINT_sbth_0101\expandafter\endcsname
91 \csname XINT_sbtd_0101\endcsname
92 \expandafter\let\csname XINT_sbth_0110\expandafter\endcsname
93 \csname XINT_sbtd_0110\endcsname
94 \expandafter\let\csname XINT_sbth_0111\expandafter\endcsname
95 \csname XINT_sbtd_0111\endcsname
96 \expandafter\let\csname XINT_sbth_1000\expandafter\endcsname
97 \csname XINT_sbtd_1000\endcsname
98 \expandafter\let\csname XINT_sbth_1001\expandafter\endcsname

```

## 5 Package *xintbinhex* implementation

```
99      \csname XINT_sbtd_1001\endcsname
100 \expandafter\def\csname XINT_sbth_1010\endcsname {A}%
101 \expandafter\def\csname XINT_sbth_1011\endcsname {B}%
102 \expandafter\def\csname XINT_sbth_1100\endcsname {C}%
103 \expandafter\def\csname XINT_sbth_1101\endcsname {D}%
104 \expandafter\def\csname XINT_sbth_1110\endcsname {E}%
105 \expandafter\def\csname XINT_sbth_1111\endcsname {F}%
106 \expandafter\def\csname XINT_shtb_0\endcsname {0000}%
107 \expandafter\def\csname XINT_shtb_1\endcsname {0001}%
108 \expandafter\def\csname XINT_shtb_2\endcsname {0010}%
109 \expandafter\def\csname XINT_shtb_3\endcsname {0011}%
110 \expandafter\def\csname XINT_shtb_4\endcsname {0100}%
111 \expandafter\def\csname XINT_shtb_5\endcsname {0101}%
112 \expandafter\def\csname XINT_shtb_6\endcsname {0110}%
113 \expandafter\def\csname XINT_shtb_7\endcsname {0111}%
114 \expandafter\def\csname XINT_shtb_8\endcsname {1000}%
115 \expandafter\def\csname XINT_shtb_9\endcsname {1001}%
116 \def\XINT_shtb_A {1010}%
117 \def\XINT_shtb_B {1011}%
118 \def\XINT_shtb_C {1100}%
119 \def\XINT_shtb_D {1101}%
120 \def\XINT_shtb_E {1110}%
121 \def\XINT_shtb_F {1111}%
122 \def\XINT_shtb_G {}%
123 \def\XINT_smallhex #1%
124 {%
125   \expandafter\XINT_smallhex_a\expandafter
126   {\the\numexpr (#1+\xint_c_viii)/\xint_c_xvi-\xint_c_i}{#1}%
127 }%
128 \def\XINT_smallhex_a #1#2%
129 {%
130   \csname XINT_sdth_#1\expandafter\expandafter\expandafter\endcsname
131   \csname XINT_sdth_\the\numexpr #2-\xint_c_xvi*#1\endcsname
132 }%
133 \def\XINT_smallbin #1%
134 {%
135   \expandafter\XINT_smallbin_a\expandafter
136   {\the\numexpr (#1+\xint_c_viii)/\xint_c_xvi-\xint_c_i}{#1}%
137 }%
138 \def\XINT_smallbin_a #1#2%
139 {%
140   \csname XINT_sdtb_#1\expandafter\expandafter\expandafter\endcsname
141   \csname XINT_sdtb_\the\numexpr #2-\xint_c_xvi*#1\endcsname
142 }%
```

### 5.4 \XINT\_OQ

Moved with release 1.2 from xintcore 1.1 as it is used only here. Will be probably suppressed once I review the code of xintbinhex.

```
143 \def\XINT_OQ #1#2#3#4#5#6#7#8#9%
144 {%
145   \xint_gob_til_R #9\XINT_OQ_end_a\R\XINT_OQ {#9#8#7#6#5#4#3#2#1}%

```

```

146 }%
147 \def\XINT_OQ_end_a\R\XINT_OQ #1#2\Z
148 {%
149     \XINT_OQ_end_b #1\Z
150 }%
151 \def\XINT_OQ_end_b #1#2#3#4#5#6#7#8%
152 {%
153     \xint_gob_til_R
154         #8\XINT_OQ_end_viii
155         #7\XINT_OQ_end_vii
156         #6\XINT_OQ_end_vi
157         #5\XINT_OQ_end_v
158         #4\XINT_OQ_end_iv
159         #3\XINT_OQ_end_iii
160         #2\XINT_OQ_end_ii
161         \R\XINT_OQ_end_i
162         \Z #2#3#4#5#6#7#8%
163 }%
164 \def\XINT_OQ_end_viii #1\Z #2#3#4#5#6#7#8#9\Z { #9}%
165 \def\XINT_OQ_end_vii #1\Z #2#3#4#5#6#7#8#9\Z { #8#90000000}%
166 \def\XINT_OQ_end_vi #1\Z #2#3#4#5#6#7#8#9\Z { #7#8#9000000}%
167 \def\XINT_OQ_end_v #1\Z #2#3#4#5#6#7#8#9\Z { #6#7#8#900000}%
168 \def\XINT_OQ_end_iv #1\Z #2#3#4#5#6#7#8#9\Z { #5#6#7#8#9000}%
169 \def\XINT_OQ_end_iii #1\Z #2#3#4#5#6#7#8#9\Z { #4#5#6#7#8#900}%
170 \def\XINT_OQ_end_ii #1\Z #2#3#4#5#6#7#8#9\Z { #3#4#5#6#7#8#90}%
171 \def\XINT_OQ_end_i #1\Z #2#3#4#5#6#7#8#9\Z { #1#2#3#4#5#6#7#8#9}%

```

## 5.5 \xintDecToHex, \xintDecToBin

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```

172 \def\xintDecToHex {\romannumeral0\xintdectohex }%
173 \def\xintdectohex #1%
174     {\expandafter\XINT_dth_checkin\romannumeral-`0#1\W\W\W\W \T}%
175 \def\XINT_dth_checkin #1%
176 {%
177     \xint_UDsignfork
178     #1\XINT_dth_N
179     -{\XINT_dth_P #1}%
180     \krof
181 }%
182 \def\XINT_dth_N {\expandafter\xint_minus_thenstop\romannumeral0\XINT_dth_P }%
183 \def\XINT_dth_P {\expandafter\XINT_dth_III\romannumeral-`0\XINT_dtbh_I {0.}}%
184 \def\xintDecToBin {\romannumeral0\xintdectobin }%
185 \def\xintdectobin #1%
186     {\expandafter\XINT_dtb_checkin\romannumeral-`0#1\W\W\W\W \T}%
187 \def\XINT_dtb_checkin #1%
188 {%
189     \xint_UDsignfork
190     #1\XINT_dtb_N
191     -{\XINT_dtb_P #1}%
192     \krof
193 }%

```

## 5 Package *xintbinhex* implementation

```

194 \def\XINT_dtb_N {\expandafter\xint_minus_thenstop\romannumeral0\XINT_dtb_P }%
195 \def\XINT_dtb_P {\expandafter\XINT_dtb_III\romannumeral-`0\XINT_dtbh_I {0.}}%
196 \def\XINT_dtbh_I #1#2#3#4#5%
197 {%
198   \xint_gob_til_W #5\XINT_dtbh_II_a\W\XINT_dtbh_I_a  {{{#2#3#4#5}#1\Z.%
199 }%
200 \def\XINT_dtbh_II_a\W\XINT_dtbh_I_a #1#2{\XINT_dtbh_II_b #2}%
201 \def\XINT_dtbh_II_b #1#2#3#4%
202 {%
203   \xint_gob_til_W
204     #1\XINT_dtbh_II_c
205     #2\XINT_dtbh_II_ci
206     #3\XINT_dtbh_II_cii
207     \W\XINT_dtbh_II_ciii #1#2#3#4%
208 }%
209 \def\XINT_dtbh_II_c \W\XINT_dtbh_II_ci
210       \W\XINT_dtbh_II_cii
211       \W\XINT_dtbh_II_ciii \W\W\W {{{}%
212 \def\XINT_dtbh_II_ci #1\XINT_dtbh_II_ciii #2\W\W\W
213   {\XINT_dtbh_II_d {{{#2}{0}}}%
214 \def\XINT_dtbh_II_cii\W\XINT_dtbh_II_ciii #1#2\W\W
215   {\XINT_dtbh_II_d {{{#1#2}{00}}}%
216 \def\XINT_dtbh_II_ciii #1#2#3\W
217   {\XINT_dtbh_II_d {{{#1#2#3}{000}}}%
218 \def\XINT_dtbh_I_a #1#2#3.%
219 {%
220   \xint_gob_til_Z #3\XINT_dtbh_I_z\Z
221   \expandafter\XINT_dtbh_I_b\the\numexpr #2+#30000.{#1}%
222 }%
223 \def\XINT_dtbh_I_b #1.%
224 {%
225   \expandafter\XINT_dtbh_I_c\the\numexpr
226   (#1+\xint_c_ii^xv)/\xint_c_ii^xvi-\xint_c_i.#1.%
227 }%
228 \def\XINT_dtbh_I_c #1.#2.%
229 {%
230   \expandafter\XINT_dtbh_I_d\expandafter
231   {\the\numexpr #2-\xint_c_ii^xvi*#1}{#1}%
232 }%
233 \def\XINT_dtbh_I_d #1#2#3{\XINT_dtbh_I_a {#3#1.}{#2}}%
234 \def\XINT_dtbh_I_z\Z\expandafter\XINT_dtbh_I_b\the\numexpr #1+#2.%
235 {%
236   \ifnum #1=\xint_c_ \expandafter\XINT_dtbh_I_end_zb\fi
237   \XINT_dtbh_I_end_za {#1}%
238 }%
239 \def\XINT_dtbh_I_end_za #1#2{\XINT_dtbh_I {#2#1.}}%
240 \def\XINT_dtbh_I_end_zb\XINT_dtbh_I_end_za #1#2{\XINT_dtbh_I {#2}}%
241 \def\XINT_dtbh_II_d #1#2#3#4.%
242 {%
243   \xint_gob_til_Z #4\XINT_dtbh_II_z\Z
244   \expandafter\XINT_dtbh_II_e\the\numexpr #2+#4#3.{#1}{#3}%
245 }%

```

## 5 Package *xintbinhex* implementation

```

246 \def\XINT_dtbh_II_e #1.%
247 {%
248   \expandafter\XINT_dtbh_II_f\the\numexpr
249     (#1+\xint_c_ii^xv)/\xint_c_ii^xvi-\xint_c_i.#1.%
250 }%
251 \def\XINT_dtbh_II_f #1.#2.%
252 {%
253   \expandafter\XINT_dtbh_II_g\expandafter
254   {\the\numexpr #2-\xint_c_ii^xvi*#1}{#1}%
255 }%
256 \def\XINT_dtbh_II_g #1#2#3{\XINT_dtbh_II_d {#3#1.}{#2}}%
257 \def\XINT_dtbh_II_z\Z\expandafter\XINT_dtbh_II_e\the\numexpr #1+#2.%
258 {%
259   \ifnum #1=\xint_c_ \expandafter\XINT_dtbh_II_end_zb\fi
260   \XINT_dtbh_II_end_za {#1}%
261 }%
262 \def\XINT_dtbh_II_end_za #1#2#3{{#2#1.\Z.}%
263 \def\XINT_dtbh_II_end_zb\XINT_dtbh_II_end_za #1#2#3{{#2\Z.}%
264 \def\XINT_dth_III #1#2.%
265 {%
266   \xint_gob_til_Z #2\XINT_dth_end\Z
267   \expandafter\XINT_dth_III\expandafter
268   {\romannumeral-\`0\XINT_dth_small #2.#1}%
269 }%
270 \def\XINT_dth_small #1.%
271 {%
272   \expandafter\XINT_smallhex\expandafter
273   {\the\numexpr (#1+\xint_c_ii^vii)/\xint_c_ii^viii-\xint_c_i\expandafter}%
274   \romannumeral-\`0\expandafter\XINT_smallhex\expandafter
275   {\the\numexpr
276     #1-((#1+\xint_c_ii^vii)/\xint_c_ii^viii-\xint_c_i)*\xint_c_ii^viii}%
277 }%
278 \def\XINT_dth_end\Z\expandafter\XINT_dth_III\expandafter #1#2\T
279 {%
280   \XINT_dth_end_b #1%
281 }%
282 \def\XINT_dth_end_b #1.{\XINT_dth_end_c }%
283 \def\XINT_dth_end_c #1{\xint_gob_til_zero #1\XINT_dth_end_d 0\space #1}%
284 \def\XINT_dth_end_d 0\space 0#1%
285 {%
286   \xint_gob_til_zero #1\XINT_dth_end_e 0\space #1%
287 }%
288 \def\XINT_dth_end_e 0\space 0#1%
289 {%
290   \xint_gob_til_zero #1\XINT_dth_end_f 0\space #1%
291 }%
292 \def\XINT_dth_end_f 0\space 0{ }%
293 \def\XINT_dtb_III #1#2.%
294 {%
295   \xint_gob_til_Z #2\XINT_dtb_end\Z
296   \expandafter\XINT_dtb_III\expandafter
297   {\romannumeral-\`0\XINT_dtb_small #2.#1}%

```



```

298 }%
299 \def\XINT_dtb_small #1.%
300 {%
301   \expandafter\XINT_smallbin\expandafter
302   {\the\numexpr (#1+\xint_c_ii^vii)/\xint_c_ii^viii-\xint_c_i\expandafter}%
303   \romannumeral-\`0\expandafter\XINT_smallbin\expandafter
304   {\the\numexpr
305    #1-((#1+\xint_c_ii^vii)/\xint_c_ii^viii-\xint_c_i)*\xint_c_ii^viii}%
306 }%
307 \def\XINT_dtb_end\Z\expandafter\XINT_dtb_III\expandafter #1#2\T
308 {%
309   \XINT_dtb_end_b #1%
310 }%
311 \def\XINT_dtb_end_b #1.{\XINT_dtb_end_c }%
312 \def\XINT_dtb_end_c #1#2#3#4#5#6#7#8%
313 {%
314   \expandafter\XINT_dtb_end_d\the\numexpr #1#2#3#4#5#6#7#8\relax
315 }%
316 \edef\XINT_dtb_end_d #1#2#3#4#5#6#7#8#9%
317 {%
318   \noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5#6#7#8#9\relax
319 }%

```

## 5.6 *\xintHexToDec*

v1.08

```

320 \def\xintHexToDec {\romannumeral0\xinthextodec }%
321 \def\xinthextodec #1%
322   {\expandafter\XINT_htd_checkin\romannumeral-\`0#1\W\W\W\W \T }%
323 \def\XINT_htd_checkin #1%
324 {%
325   \xint_UDsignfork
326   #1\XINT_htd_neg
327   -{\XINT_htd_I {0000}#1}%
328   \krof
329 }%
330 \def\XINT_htd_neg {\expandafter\xint_minus_thenstop
331   \romannumeral0\XINT_htd_I {0000}}%
332 \def\XINT_htd_I #1#2#3#4#5%
333 {%
334   \xint_gob_til_W #5\XINT_htd_II_a\W
335   \XINT_htd_I_a  {\{"#2#3#4#5}#1\Z\Z\Z\Z
336 }%
337 \def\XINT_htd_II_a \W\XINT_htd_I_a #1#2{\XINT_htd_II_b #2}%
338 \def\XINT_htd_II_b "#1#2#3#4%
339 {%
340   \xint_gob_til_W
341   #1\XINT_htd_II_c
342   #2\XINT_htd_II_ci
343   #3\XINT_htd_II_cii
344   \W\XINT_htd_II_ciii #1#2#3#4%
345 }%

```

## 5 Package *xintbinhex* implementation

```

346 \def\XINT_htd_II_c \W\XINT_htd_II_ci
347         \W\XINT_htd_II_cii
348         \W\XINT_htd_II_ciii \W\W\W #1\Z\Z\Z\T
349 {%
350     \expandafter\xint_cleanupzeros_andstop
351     \romannumeral0\XINT_rord_main {}#1%
352     \xint_relax
353     \xint_bye\xint_bye\xint_bye\xint_bye
354     \xint_bye\xint_bye\xint_bye\xint_bye
355     \xint_relax
356 }%
357 \def\XINT_htd_II_ci #1\XINT_htd_II_ciii
358         #2\W\W\W {\XINT_htd_II_d {}{"#2}{\xint_c_xvi}}%
359 \def\XINT_htd_II_cii\W\XINT_htd_II_ciii
360         #1#2\W\W {\XINT_htd_II_d {}{"#1#2}{\xint_c_ii^viii}}%
361 \def\XINT_htd_II_ciii #1#2#3\W {\XINT_htd_II_d {}{"#1#2#3}{\xint_c_ii^xii}}%
362 \def\XINT_htd_I_a #1#2#3#4#5#6%
363 {%
364     \xint_gob_til_Z #3\XINT_htd_I_end_a\Z
365     \expandafter\XINT_htd_I_b\the\numexpr
366     #2+\xint_c_ii^xvi*#6#5#4#3+\xint_c_x^ix\relax {}#1%
367 }%
368 \def\XINT_htd_I_b 1#1#2#3#4#5#6#7#8#9{\XINT_htd_I_c {#1#2#3#4#5}{#9#8#7#6}}%
369 \def\XINT_htd_I_c #1#2#3{\XINT_htd_I_a {#3#2}{#1}}%
370 \def\XINT_htd_I_end_a\Z\expandafter\XINT_htd_I_b\the\numexpr #1+#2\relax
371 {%
372     \expandafter\XINT_htd_I_end_b\the\numexpr \xint_c_x^v+#1\relax
373 }%
374 \def\XINT_htd_I_end_b 1#1#2#3#4#5%
375 {%
376     \xint_gob_til_zero #1\XINT_htd_I_end_bz0%
377     \XINT_htd_I_end_c #1#2#3#4#5%
378 }%
379 \def\XINT_htd_I_end_c #1#2#3#4#5#6{\XINT_htd_I {#6#5#4#3#2#1000}}%
380 \def\XINT_htd_I_end_bz0\XINT_htd_I_end_c 0#1#2#3#4%
381 {%
382     \xint_gob_til_zeros_iv #1#2#3#4\XINT_htd_I_end_bzz 0000%
383     \XINT_htd_I_end_D {#4#3#2#1}%
384 }%
385 \def\XINT_htd_I_end_D #1#2{\XINT_htd_I {#2#1}}%
386 \def\XINT_htd_I_end_bzz 0000\XINT_htd_I_end_D #1{\XINT_htd_I }%
387 \def\XINT_htd_II_d #1#2#3#4#5#6#7%
388 {%
389     \xint_gob_til_Z #4\XINT_htd_II_end_a\Z
390     \expandafter\XINT_htd_II_e\the\numexpr
391     #2+#3*#7#6#5#4+\xint_c_x^viii\relax {}#1}{#3}%
392 }%
393 \def\XINT_htd_II_e 1#1#2#3#4#5#6#7#8{\XINT_htd_II_f {#1#2#3#4}{#5#6#7#8}}%
394 \def\XINT_htd_II_f #1#2#3{\XINT_htd_II_d {#2#3}{#1}}%
395 \def\XINT_htd_II_end_a\Z\expandafter\XINT_htd_II_e
396     \the\numexpr #1+#2\relax #3#4\T
397 {%

```

```

398 \XINT_htd_II_end_b #1#3%
399 }%
400 \edef\XINT_htd_II_end_b #1#2#3#4#5#6#7#8%
401 {%
402 \noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5#6#7#8\relax
403 }%

```

## 5.7 \xintBinToDec

v1.08

```

404 \def\xintBinToDec {\romannumeral0\xintbintodec }%
405 \def\xintbintodec #1{\expandafter\XINT_btd_checkin
406 \romannumeral-`0#1\W\W\W\W\W\W\W\W \T }%
407 \def\XINT_btd_checkin #1%
408 {%
409 \xint_UDsignfork
410 #1\XINT_btd_neg
411 -{\XINT_btd_I {000000}#1}%
412 \krof
413 }%
414 \def\XINT_btd_neg {\expandafter\xint_minus_thenstop
415 \romannumeral0\XINT_btd_I {000000}}%
416 \def\XINT_btd_I #1#2#3#4#5#6#7#8#9%
417 {%
418 \xint_gob_til_W #9\XINT_btd_II_a {#2#3#4#5#6#7#8#9}\W
419 \XINT_btd_I_a {}{\csname XINT_sbtd_#2#3#4#5\endcsname*\xint_c_xvi+%
420 \csname XINT_sbtd_#6#7#8#9\endcsname}%
421 #1\Z\Z\Z\Z\Z\Z
422 }%
423 \def\XINT_btd_II_a #1\W\XINT_btd_I_a #2#3{\XINT_btd_II_b #1}%
424 \def\XINT_btd_II_b #1#2#3#4#5#6#7#8%
425 {%
426 \xint_gob_til_W
427 #1\XINT_btd_II_c
428 #2\XINT_btd_II_ci
429 #3\XINT_btd_II_cii
430 #4\XINT_btd_II_ciii
431 #5\XINT_btd_II_civ
432 #6\XINT_btd_II_cv
433 #7\XINT_btd_II_cvi
434 \W\XINT_btd_II_cvii #1#2#3#4#5#6#7#8%
435 }%
436 \def\XINT_btd_II_c #1\XINT_btd_II_cvii \W\W\W\W\W\W\W\W #2\Z\Z\Z\Z\Z\Z\T
437 {%
438 \expandafter\XINT_btd_II_c_end
439 \romannumeral0\XINT_rord_main {}#2%
440 \xint_relax
441 \xint_bye\xint_bye\xint_bye\xint_bye
442 \xint_bye\xint_bye\xint_bye\xint_bye
443 \xint_relax
444 }%
445 \edef\XINT_btd_II_c_end #1#2#3#4#5#6%

```

## 5 Package *xintbinhex* implementation

```
446 {%
447   \noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5#6\relax
448 }%
449 \def\XINT_btd_II_ci #1\XINT_btd_II_cvii #2\W\W\W\W\W\W
450   {\XINT_btd_II_d {}{\#2}{\xint_c_ii }}%
451 \def\XINT_btd_II_cii #1\XINT_btd_II_cvii #2\W\W\W\W\W
452   {\XINT_btd_II_d {}{\csname XINT_sbtd_00#2\endcsname }{\xint_c_iv }}%
453 \def\XINT_btd_II_ciii #1\XINT_btd_II_cvii #2\W\W\W\W\W
454   {\XINT_btd_II_d {}{\csname XINT_sbtd_0#2\endcsname }{\xint_c_viii }}%
455 \def\XINT_btd_II_civ #1\XINT_btd_II_cvii #2\W\W\W\W
456   {\XINT_btd_II_d {}{\csname XINT_sbtd_#2\endcsname}{\xint_c_xvi }}%
457 \def\XINT_btd_II_cv #1\XINT_btd_II_cvii #2#3#4#5#6\W\W\W
458 {%
459   \XINT_btd_II_d {}{\csname XINT_sbtd_#2#3#4#5\endcsname*\xint_c_ii+%
460     #6}{\xint_c_ii^v }%
461 }%
462 \def\XINT_btd_II_cvi #1\XINT_btd_II_cvii #2#3#4#5#6#7\W\W
463 {%
464   \XINT_btd_II_d {}{\csname XINT_sbtd_#2#3#4#5\endcsname*\xint_c_iv+%
465     \csname XINT_sbtd_00#6#7\endcsname}{\xint_c_ii^vi }%
466 }%
467 \def\XINT_btd_II_cvii #1#2#3#4#5#6#7\W
468 {%
469   \XINT_btd_II_d {}{\csname XINT_sbtd_#1#2#3#4\endcsname*\xint_c_viii+%
470     \csname XINT_sbtd_0#5#6#7\endcsname}{\xint_c_ii^vii }%
471 }%
472 \def\XINT_btd_II_d #1#2#3#4#5#6#7#8#9%
473 {%
474   \xint_gob_til_Z #4\XINT_btd_II_end_a\Z
475   \expandafter\XINT_btd_II_e\the\numexpr
476   #2+(\xint_c_x^ix+#3*#9#8#7#6#5#4)\relax {#1}{#3}%
477 }%
478 \def\XINT_btd_II_e 1#1#2#3#4#5#6#7#8#9{\XINT_btd_II_f {#1#2#3}{#4#5#6#7#8#9}}%
479 \def\XINT_btd_II_f #1#2#3{\XINT_btd_II_d {#2#3}{#1}}%
480 \def\XINT_btd_II_end_a\Z\expandafter\XINT_btd_II_e
481   \the\numexpr #1+(\#2\relax #3#4\T
482 {%
483   \XINT_btd_II_end_b #1#3%
484 }%
485 \edef\XINT_btd_II_end_b #1#2#3#4#5#6#7#8#9%
486 {%
487   \noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5#6#7#8#9\relax
488 }%
489 \def\XINT_btd_I_a #1#2#3#4#5#6#7#8%
490 {%
491   \xint_gob_til_Z #3\XINT_btd_I_end_a\Z
492   \expandafter\XINT_btd_I_b\the\numexpr
493   #2+\xint_c_ii^viii*#8#7#6#5#4#3+\xint_c_x^ix\relax {#1}%
494 }%
495 \def\XINT_btd_I_b 1#1#2#3#4#5#6#7#8#9{\XINT_btd_I_c {#1#2#3}{#9#8#7#6#5#4}}%
496 \def\XINT_btd_I_c #1#2#3{\XINT_btd_I_a {#3#2}{#1}}%
497 \def\XINT_btd_I_end_a\Z\expandafter\XINT_btd_I_b
```

```

498 \the\numexpr #1+\xint_c_ii^viii #2\relax
499 {%
500 \expandafter\XINT_btd_I_end_b\the\numexpr 1000+#1\relax
501 }%
502 \def\XINT_btd_I_end_b #1#2#3%
503 {%
504 \xint_gob_til_zeros_iii #1#2#3\XINT_btd_I_end_bz 000%
505 \XINT_btd_I_end_c #1#2#3%
506 }%
507 \def\XINT_btd_I_end_c #1#2#3#4{\XINT_btd_I {#4#3#2#1000}}%
508 \def\XINT_btd_I_end_bz 000\XINT_btd_I_end_c 000{\XINT_btd_I }%

```

## 5.8 \xintBinToHex

v1.08

```

509 \def\xintBinToHex {\romannumeral0\xintbinto hex }%
510 \def\xintbinto hex #1%
511 {%
512 \expandafter\XINT_bth_checkin
513 \romannumeral0\expandafter\XINT_num_loop
514 \romannumeral-`0#1\xint_relax\xint_relax
515 \xint_relax\xint_relax
516 \xint_relax\xint_relax\xint_relax\xint_relax\Z
517 \R\R\R\R\R\R\R\Z \W\W\W\W\W\W\W\W
518 }%
519 \def\XINT_bth_checkin #1%
520 {%
521 \xint_UDsignfork
522 #1\XINT_bth_N
523 -{\XINT_bth_P #1}%
524 \krof
525 }%
526 \def\XINT_bth_N {\expandafter\xint_minus_thenstop\romannumeral0\XINT_bth_P }%
527 \def\XINT_bth_P {\expandafter\XINT_bth_I\expandafter{\expandafter}%
528 \romannumeral0\XINT_OQ {}}%
529 \def\XINT_bth_I #1#2#3#4#5#6#7#8#9%
530 {%
531 \xint_gob_til_W #9\XINT_bth_end_a\W
532 \expandafter\expandafter\expandafter
533 \XINT_bth_I
534 \expandafter\expandafter\expandafter
535 {\csname XINT_sbth_#9#8#7#6\expandafter\expandafter\expandafter\endcsname
536 \csname XINT_sbth_#5#4#3#2\endcsname #1}%
537 }%
538 \def\XINT_bth_end_a\W \expandafter\expandafter\expandafter
539 \XINT_bth_I \expandafter\expandafter\expandafter #1%
540 {%
541 \XINT_bth_end_b #1%
542 }%
543 \def\XINT_bth_end_b #1\endcsname #2\endcsname #3%
544 {%
545 \xint_gob_til_zero #3\XINT_bth_end_z 0\space #3%

```

```

546 }%
547 \def\XINT_bth_end_z0\space 0{ }%

```

## 5.9 \xintHexToBin

v1.08

```

548 \def\xintHexToBin {\romannumeral0\xinthextobin }%
549 \def\xinthextobin #1%
550 {%
551   \expandafter\XINT_htb_checkin\romannumeral-`0#1GGGGGGGG\T
552 }%
553 \def\XINT_htb_checkin #1%
554 {%
555   \xint_UDsignfork
556   #1\XINT_htb_N
557   -{\XINT_htb_P #1}%
558   \krof
559 }%
560 \def\XINT_htb_N {\expandafter\xint_minus_thenstop\romannumeral0\XINT_htb_P }%
561 \def\XINT_htb_P {\XINT_htb_I_a {}}%
562 \def\XINT_htb_I_a #1#2#3#4#5#6#7#8#9%
563 {%
564   \xint_gob_til_G #9\XINT_htb_II_a G%
565   \expandafter\expandafter\expandafter
566   \XINT_htb_I_b
567   \expandafter\expandafter\expandafter
568   {\csname XINT_shtb_#2\expandafter\expandafter\expandafter\endcsname
569   \csname XINT_shtb_#3\expandafter\expandafter\expandafter\endcsname
570   \csname XINT_shtb_#4\expandafter\expandafter\expandafter\endcsname
571   \csname XINT_shtb_#5\expandafter\expandafter\expandafter\endcsname
572   \csname XINT_shtb_#6\expandafter\expandafter\expandafter\endcsname
573   \csname XINT_shtb_#7\expandafter\expandafter\expandafter\endcsname
574   \csname XINT_shtb_#8\expandafter\expandafter\expandafter\endcsname
575   \csname XINT_shtb_#9\endcsname }{#1}%
576 }%
577 \def\XINT_htb_I_b #1#2{\XINT_htb_I_a {#2#1}}%
578 \def\XINT_htb_II_a G\expandafter\expandafter\expandafter\XINT_htb_I_b
579 {%
580   \expandafter\expandafter\expandafter \XINT_htb_II_b
581 }%
582 \def\XINT_htb_II_b #1#2#3\T
583 {%
584   \XINT_num_loop #2#1%
585   \xint_relax\xint_relax\xint_relax\xint_relax
586   \xint_relax\xint_relax\xint_relax\xint_relax\Z
587 }%

```

## 5.10 \xintCHexToBin

v1.08

```

588 \def\xintCHexToBin {\romannumeral0\xintchextobin }%

```

```

589 \def\xintchextobin #1%
590 {%
591     \expandafter\XINT_chtb_checkin\romannumeral-`0#1%
592     \R\R\R\R\R\R\R\R\Z \W\W\W\W\W\W\W\W
593 }%
594 \def\XINT_chtb_checkin #1%
595 {%
596     \xint_UDsignfork
597     #1\XINT_chtb_N
598     -{\XINT_chtb_P #1}%
599     \krof
600 }%
601 \def\XINT_chtb_N {\expandafter\xint_minus_thenstop\romannumeral0\XINT_chtb_P }%
602 \def\XINT_chtb_P {\expandafter\XINT_chtb_I\expandafter{\expandafter}%
603     \romannumeral0\XINT_OQ {}}%
604 \def\XINT_chtb_I #1#2#3#4#5#6#7#8#9%
605 {%
606     \xint_gob_til_W #9\XINT_chtb_end_a\W
607     \expandafter\expandafter\expandafter
608     \XINT_chtb_I
609     \expandafter\expandafter\expandafter
610     {\csname XINT_shtb_#9\expandafter\expandafter\expandafter\endcsname
611     \csname XINT_shtb_#8\expandafter\expandafter\expandafter\endcsname
612     \csname XINT_shtb_#7\expandafter\expandafter\expandafter\endcsname
613     \csname XINT_shtb_#6\expandafter\expandafter\expandafter\endcsname
614     \csname XINT_shtb_#5\expandafter\expandafter\expandafter\endcsname
615     \csname XINT_shtb_#4\expandafter\expandafter\expandafter\endcsname
616     \csname XINT_shtb_#3\expandafter\expandafter\expandafter\endcsname
617     \csname XINT_shtb_#2\endcsname
618     #1}%
619 }%
620 \def\XINT_chtb_end_a\W\expandafter\expandafter\expandafter
621     \XINT_chtb_I\expandafter\expandafter\expandafter #1%
622 {%
623     \XINT_chtb_end_b #1%
624     \xint_relax\xint_relax\xint_relax\xint_relax
625     \xint_relax\xint_relax\xint_relax\xint_relax\Z
626 }%
627 \def\XINT_chtb_end_b #1\W#2\W#3\W#4\W#5\W#6\W#7\W#8\W\endcsname
628 {%
629     \XINT_num_loop
630 }%
631 \XINT_restorecatcodes_endinput%

```

## 6 Package *xintgcd* implementation

.1	Catcodes, $\varepsilon$ -TeX and reload detection	128	.7	<code>\xintBezoutAlgorithm</code>	136
.2	Package identification	129	.8	<code>\xintGCDof</code>	137
.3	<code>\xintGCD</code> , <code>\xintiiGCD</code>	129	.9	<code>\xintLCMof</code>	138
.4	<code>\xintLCM</code> , <code>\xintiiLCM</code>	130	.10	<code>\xintTypesetEuclideAlgorithm</code>	138
.5	<code>\xintBezout</code>	130	.11	<code>\xintTypesetBezoutAlgorithm</code>	139
.6	<code>\xintEuclideAlgorithm</code>	134			

The commenting is currently (2015/10/10) very sparse. Release 1.09h has modified a bit the `\xintTypesetEuclideanAlgorithm` and `\xintTypesetBezoutAlgorithm` layout with respect to line indentation in particular. And they use the `xinttools` `\xintloop` rather than the Plain TeX or  $\TeX$ 's `\loop`.

Since 1.1 the package only loads `xintcore`, not `xint`. And for the `\xintTypesetEuclideanAlgorithm` and `\xintTypesetBezoutAlgorithm` macros to be functional the package `xinttools` needs to be loaded explicitly by the user.

## 6.1 Catcodes, $\epsilon$ -TeX and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified.

The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2  \catcode13=5      % ^^M
3  \endlinechar=13 %
4  \catcode123=1     % {
5  \catcode125=2     % }
6  \catcode64=11     % @
7  \catcode35=6      % #
8  \catcode44=12     % ,
9  \catcode45=12     % -
10 \catcode46=12     % .
11 \catcode58=12     % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xintgcd.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintcore.sty\endcsname
15 \expandafter
16   \ifx\csname PackageInfo\endcsname\relax
17     \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18   \else
19     \def\y#1#2{\PackageInfo{#1}{#2}}%
20   \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23   \y{xintgcd}{numexpr not available, aborting input}%
24   \aftergroup\endinput
25 \else
26   \ifx\x\relax    % plain-TeX, first loading of xintgcd.sty
27     \ifx\w\relax % but xintcore.sty not yet loaded.
28       \def\z{\endgroup\input xintcore.sty\relax}%
29     \fi
30   \else
31     \def\empty {}%
32     \ifx\x\empty % LaTeX, first loading,
33     % variable is initialized, but \ProvidesPackage not yet seen
34       \ifx\w\relax % xintcore.sty not yet loaded.
35         \def\z{\endgroup\RequirePackage{xintcore}}%
36       \fi
37     \else
38       \aftergroup\endinput % xintgcd already loaded.
39     \fi
40   \fi
41 \fi

```



```
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty
```

## 6.2 Package identification

```
44 \XINT_providespackage
45 \ProvidesPackage{xintgcd}%
46 [2015/10/10 v1.2 Euclidean algorithm with xint package (jfb)]%
```

## 6.3 *\xintGCD*, *\xintiGCD*

The macros of 1.09a benefits from the *\xintnum* which has been inserted inside *\xintiabs* in *\xintnameimp*; this is a little overhead but is more convenient for the user and also makes it easier to use into *\xintexpr*-essions. 1.1a adds *\xintiGCD* mainly for *\xintiexpr* benefit. Perhaps one should always have had ONLY ii versions from the beginning. And perhaps for sake of consistency, *\xintGCD* should be named *\xintiGCD*? too late.

```
47 \def\xintGCD {\romannumeral0\xintgcd }%
48 \def\xintgcd #1%
49 {%
50   \expandafter\XINT_gcd\expandafter{\romannumeral0\xintiabs {#1}}%
51 }%
52 \def\XINT_gcd #1#2%
53 {%
54   \expandafter\XINT_gcd_fork\romannumeral0\xintiabs {#2}\Z #1\Z
55 }%
56 \def\xintiGCD {\romannumeral0\xintiigcd }%
57 \def\xintiigcd #1%
58 {%
59   \expandafter\XINT_iigcd\expandafter{\romannumeral0\xintiabs {#1}}%
60 }%
61 \def\XINT_iigcd #1#2%
62 {%
63   \expandafter\XINT_gcd_fork\romannumeral0\xintiabs {#2}\Z #1\Z
64 }%
```

*Ici #3#4=A, #1#2=B*

```
65 \def\XINT_gcd_fork #1#2\Z #3#4\Z
66 {%
67   \xint_UDzerofork
68   #1\XINT_gcd_BisZero
69   #3\XINT_gcd_AisZero
70   0\XINT_gcd_loop
71   \krof
72   {#1#2}{#3#4}%
73 }%
74 \def\XINT_gcd_AisZero #1#2{ #1}%
75 \def\XINT_gcd_BisZero #1#2{ #2}%
76 \def\XINT_gcd_CheckRem #1#2\Z
77 {%
78   \xint_gob_til_zero #1\xintgcd_end0\XINT_gcd_loop {#1#2}%
79 }%
80 \def\xintgcd_end0\XINT_gcd_loop #1#2{ #2}%
```

#1=B, #2=A

```

81 \def\XINT_gcd_loop #1#2%
82 {%
83   \expandafter\expandafter\expandafter
84     \XINT_gcd_CheckRem
85   \expandafter\xint_seconddoftwo
86   \romannumeral0\XINT_div_prepare {#1}{#2}\Z
87   {#1}%
88 }%
```

## 6.4 \xintLCM, \xintiLCM

New with 1.09a. Inadvertent use of \xintiQuo which was promoted at the same time to add the \xintnum overhead. So with 1.09f \xintiiQuo without the overhead. However \xintiabs has the \xintnum thing. The advantage is that we can thus use lcm in \xintexpr. The disadvantage is that this has overhead in \xintiiexpr. Thus 1.1a has \xintiLCM.

```

89 \def\xintLCM {\romannumeral0\xintlcm}%
90 \def\xintlcm #1%
91 {%
92   \expandafter\XINT_lcm\expandafter{\romannumeral0\xintiabs {#1}}%
93 }%
94 \def\XINT_lcm #1#2%
95 {%
96   \expandafter\XINT_lcm_fork\romannumeral0\xintiabs {#2}\Z #1\Z
97 }%
98 \def\xintiLCM {\romannumeral0\xintiilcm}%
99 \def\xintiilcm #1%
100 {%
101   \expandafter\XINT_iilcm\expandafter{\romannumeral0\xintiabs {#1}}%
102 }%
103 \def\XINT_iilcm #1#2%
104 {%
105   \expandafter\XINT_lcm_fork\romannumeral0\xintiabs {#2}\Z #1\Z
106 }%
107 \def\XINT_lcm_fork #1#2\Z #3#4\Z
108 {%
109   \xint_UDzerofork
110   #1\XINT_lcm_BisZero
111   #3\XINT_lcm_AisZero
112   0\expandafter
113   \krof
114   \XINT_lcm_notzero\expandafter{\romannumeral0\XINT_gcd_loop {#1#2}{#3#4}}%
115   {#1#2}{#3#4}%
116 }%
117 \def\XINT_lcm_AisZero #1#2#3#4#5{ 0}%
118 \def\XINT_lcm_BisZero #1#2#3#4#5{ 0}%
119 \def\XINT_lcm_notzero #1#2#3{\xintiimul {#2}{\xintiiQuo{#3}{#1}}}%

```

## 6.5 \xintBezout

1.09a inserts use of \xintnum

```

120 \def\xintBezout {\romannumeral0\xintbezout }%
121 \def\xintbezout #1%
122 {%
123   \expandafter\xint_bezout\expandafter {\romannumeral0\xintnum{#1}}%
124 }%
125 \def\xint_bezout #1#2%
126 {%
127   \expandafter\XINT_bezout_fork \romannumeral0\xintnum{#2}\Z #1\Z
128 }%

#3#4 = A, #1#2=B

129 \def\XINT_bezout_fork #1#2\Z #3#4\Z
130 {%
131   \xint_UDzerosfork
132   #1#3\XINT_bezout_botharezero
133   #10\XINT_bezout_secondiszero
134   #30\XINT_bezout_firstiszero
135   00{\xint_UDsignsfork
136     #1#3\XINT_bezout_minusminus % A < 0, B < 0
137     #1-\XINT_bezout_minusplus % A > 0, B < 0
138     #3-\XINT_bezout_plusminus % A < 0, B > 0
139     --\XINT_bezout_plusplus % A > 0, B > 0
140   \krof }%
141   \krof
142   {#2}{#4}#1#3{#3#4}{#1#2}% #1#2=B, #3#4=A
143 }%
144 \edef\XINT_bezout_botharezero #1#2#3#4#5#6%
145 {%
146   \noexpand\xintError:NoBezoutForZeros\space {0}{0}{0}{0}{0}%
147 }%

attention première entrée doit être ici (-1)^n donc 1
#4#2 = 0 = A, B = #3#1

148 \def\XINT_bezout_firstiszero #1#2#3#4#5#6%
149 {%
150   \xint_UDsignfork
151   #3{ {0}{#3#1}{0}{1}{#1}}%
152   -{ {0}{#3#1}{0}{-1}{#1}}%
153   \krof
154 }%

#4#2 = A, B = #3#1 = 0

155 \def\XINT_bezout_secondiszero #1#2#3#4#5#6%
156 {%
157   \xint_UDsignfork
158   #4{ {#4#2}{0}{-1}{0}{#2}}%
159   -{ {#4#2}{0}{1}{0}{#2}}%
160   \krof
161 }%

#4#2= A < 0, #3#1 = B < 0

```

```

162 \def\XINT_bezout_minusminus #1#2#3#4%
163 {%
164   \expandafter\XINT_bezout_mm_post
165   \romannumeral0\XINT_bezout_loop_a 1{#1}{#2}1001%
166 }%
167 \def\XINT_bezout_mm_post #1#2%
168 {%
169   \expandafter\XINT_bezout_mm_postb\expandafter
170   {\romannumeral0\xintiiopp{#2}}{\romannumeral0\xintiiopp{#1}}%
171 }%
172 \def\XINT_bezout_mm_postb #1#2%
173 {%
174   \expandafter\XINT_bezout_mm_postc\expandafter {#2}{#1}%
175 }%
176 \edef\XINT_bezout_mm_postc #1#2#3#4#5%
177 {%
178   \space {#4}{#5}{#1}{#2}{#3}%
179 }%

```

*minusplus*  $A > 0, B < 0$

```

180 \def\XINT_bezout_minusplus #1#2#3#4%
181 {%
182   \expandafter\XINT_bezout_mp_post
183   \romannumeral0\XINT_bezout_loop_a 1{#1}{#4#2}1001%
184 }%
185 \def\XINT_bezout_mp_post #1#2%
186 {%
187   \expandafter\XINT_bezout_mp_postb\expandafter
188   {\romannumeral0\xintiiopp {#2}}{#1}%
189 }%
190 \edef\XINT_bezout_mp_postb #1#2#3#4#5%
191 {%
192   \space {#4}{#5}{#2}{#1}{#3}%
193 }%

```

*plusminus*  $A < 0, B > 0$

```

194 \def\XINT_bezout_plusminus #1#2#3#4%
195 {%
196   \expandafter\XINT_bezout_pm_post
197   \romannumeral0\XINT_bezout_loop_a 1{#3#1}{#2}1001%
198 }%
199 \def\XINT_bezout_pm_post #1%
200 {%
201   \expandafter \XINT_bezout_pm_postb \expandafter
202   {\romannumeral0\xintiiopp{#1}}%
203 }%
204 \edef\XINT_bezout_pm_postb #1#2#3#4#5%
205 {%
206   \space {#4}{#5}{#1}{#2}{#3}%
207 }%

```

*plusplus*

```

208 \def\XINT_bezout_plusplus #1#2#3#4%
209 {%
210   \expandafter\XINT_bezout_pp_post
211   \romannumeral0\XINT_bezout_loop_a 1{#3#1}{#4#2}1001%
212 }%

```

la parité  $(-1)^N$  est en #1, et on la jette ici.

```

213 \edef\XINT_bezout_pp_post #1#2#3#4#5%
214 {%
215   \space {#4}{#5}{#1}{#2}{#3}%
216 }%

```

$n = 0$ : 1BAalpha(0)beta(0)alpha(-1)beta(-1)

$n$  général:  $\{(-1)^n\}\{r(n-1)\}\{r(n-2)\}\{\alpha(n-1)\}\{\beta(n-1)\}\{\alpha(n-2)\}\{\beta(n-2)\}$

#2 = B, #3 = A

```

217 \def\XINT_bezout_loop_a #1#2#3%
218 {%
219   \expandafter\XINT_bezout_loop_b
220   \expandafter{\the\numexpr -#1\expandafter }%
221   \romannumeral0\XINT_div_prepare {#2}{#3}{#2}%
222 }%

```

Le  $q(n)$  a ici une existence éphémère, dans le version Bezout Algorithm il faudra le conserver. On voudra à la fin  $\{q(n)\}\{r(n)\}\{\alpha(n)\}\{\beta(n)\}$ . De plus ce n'est plus  $(-1)^n$  que l'on veut mais  $n$ . (ou dans un autre ordre)

$\{-(-1)^n\}\{q(n)\}\{r(n)\}\{r(n-1)\}\{\alpha(n-1)\}\{\beta(n-1)\}\{\alpha(n-2)\}\{\beta(n-2)\}$

```

223 \def\XINT_bezout_loop_b #1#2#3#4#5#6#7#8%
224 {%
225   \expandafter \XINT_bezout_loop_c \expandafter
226   {\romannumeral0\xintiiadd{\XINT_mul_fork #5\Z #2\Z}{#7}}%
227   {\romannumeral0\xintiiadd{\XINT_mul_fork #6\Z #2\Z}{#8}}%
228   {#1}{#3}{#4}{#5}{#6}%
229 }%

```

$\{\alpha(n)\}\{-\beta(n)\}\{-(-1)^n\}\{r(n)\}\{r(n-1)\}\{\alpha(n-1)\}\{\beta(n-1)\}$

```

230 \def\XINT_bezout_loop_c #1#2%
231 {%
232   \expandafter \XINT_bezout_loop_d \expandafter
233   {#2}{#1}%
234 }%

```

$\{\beta(n)\}\{\alpha(n)\}\{(-1)^{(n+1)}\}\{r(n)\}\{r(n-1)\}\{\alpha(n-1)\}\{\beta(n-1)\}$

```

235 \def\XINT_bezout_loop_d #1#2#3#4#5%
236 {%
237   \XINT_bezout_loop_e #4\Z {#3}{#5}{#2}{#1}%
238 }%

```

$r(n)\Z \{(-1)^{(n+1)}\}\{r(n-1)\}\{\alpha(n)\}\{\beta(n)\}\{\alpha(n-1)\}\{\beta(n-1)\}$

```

239 \def\XINT_bezout_loop_e #1#2\Z
240 {%

```

```

241 \xint_gob_til_zero #1\xint_bezout_loop_exit0\xint_bezout_loop_f
242 {#1#2}%
243 }%

{r(n)}{(-1)^(n+1)}{r(n-1)}{alpha(n)}{beta(n)}{alpha(n-1)}{beta(n-1)}

244 \def\xint_bezout_loop_f #1#2%
245 {%
246 \xint_bezout_loop_a {#2}{#1}%
247 }%

{(-1)^(n+1)}{r(n)}{r(n-1)}{alpha(n)}{beta(n)}{alpha(n-1)}{beta(n-1)} et itération

248 \def\xint_bezout_loop_exit0\xint_bezout_loop_f #1#2%
249 {%
250 \ifcase #2
251 \or \expandafter\xint_bezout_exiteven
252 \else\expandafter\xint_bezout_exitodd
253 \fi
254 }%
255 \edef\xint_bezout_exiteven #1#2#3#4#5%
256 {%
257 \space {#5}{#4}{#1}%
258 }%
259 \edef\xint_bezout_exitodd #1#2#3#4#5%
260 {%
261 \space {-#5}{-#4}{#1}%
262 }%

```

## 6.6 \xintEuclideanAlgorithm

Pour Euclide:  $\{N\}\{A\}\{D=r(n)\}\{B\}\{q_1\}\{r_1\}\{q_2\}\{r_2\}\{q_3\}\{r_3\}\dots\{q_N\}\{r_N=0\}$   
 $u_{<2n>} = u_{<2n+3>}u_{<2n+2>} + u_{<2n+4>}$  à la  $n$  ième étape

```

263 \def\xintEuclideanAlgorithm {\romannumeral0\xinteucclideanalgorithm }%
264 \def\xinteucclideanalgorithm #1%
265 {%
266 \expandafter \XINT_euc \expandafter{\romannumeral0\xintiabs {#1}}%
267 }%
268 \def\XINT_euc #1#2%
269 {%
270 \expandafter\XINT_euc_fork \romannumeral0\xintiabs {#2}\Z #1\Z
271 }%

Ici #3#4=A, #1#2=B

272 \def\XINT_euc_fork #1#2\Z #3#4\Z
273 {%
274 \xint_UDzerofork
275 #1\XINT_euc_BisZero
276 #3\XINT_euc_AisZero
277 0\XINT_euc_a
278 \krof
279 {0}{#1#2}{#3#4}{#3#4}{#1#2}}{\Z
280 }%

```

Le {} pour protéger {{A}{B}} si on s'arrête après une étape (B divise A). On va renvoyer:  
 {N}{A}{D=r(n)}{B}{q1}{r1}{q2}{r2}{q3}{r3}...{qN}{rN=0}

```
281 \def\XINT_euc_AisZero #1#2#3#4#5#6{ {1}{0}{#2}{#2}{0}{0}}%
282 \def\XINT_euc_BisZero #1#2#3#4#5#6{ {1}{0}{#3}{#3}{0}{0}}%
```

{n}{rn}{an}{{qn}{rn}}...{{A}{B}}{}{}Z  
 a(n) = r(n-1). Pour n=0 on a juste {0}{B}{A}{{A}{B}}{}{}Z  
 \XINT\_div\_prepare {u}{v} divise v par u

```
283 \def\XINT_euc_a #1#2#3%
284 {%
285   \expandafter\XINT_euc_b
286   \expandafter {\the\numexpr #1+1\expandafter}%
287   \romannumeral0\XINT_div_prepare {#2}{#3}{#2}%
288 }%
```

{n+1}{q(n+1)}{r(n+1)}{rn}{{qn}{rn}}...

```
289 \def\XINT_euc_b #1#2#3#4%
290 {%
291   \XINT_euc_c #3Z {#1}{#3}{#4}{{#2}{#3}}%
292 }%
```

r(n+1)Z {n+1}{r(n+1)}{r(n)}{{q(n+1)}{r(n+1)}}{{qn}{rn}}...  
 Test si r(n+1) est nul.

```
293 \def\XINT_euc_c #1#2Z
294 {%
295   \xint_gob_til_zero #1\xint_euc_end0\XINT_euc_a
296 }%
```

{n+1}{r(n+1)}{r(n)}{{q(n+1)}{r(n+1)}}...{}Z Ici r(n+1) = 0. On arrête on se prépare à inverser  
 {n+1}{0}{r(n)}{{q(n+1)}{r(n+1)}}...{{q1}{r1}}{{A}{B}}{}{}Z  
 On veut renvoyer: {N=n+1}{A}{D=r(n)}{B}{q1}{r1}{q2}{r2}{q3}{r3}...{qN}{rN=0}

```
297 \def\xint_euc_end0\XINT_euc_a #1#2#3#4Z%
298 {%
299   \expandafter\xint_euc_end_
300   \romannumeral0%
301   \XINT_rord_main {}#4{{#1}{#3}}%
302   \xint_relax
303   \xint_bye\xint_bye\xint_bye\xint_bye
304   \xint_bye\xint_bye\xint_bye\xint_bye
305   \xint_relax
306 }%
307 \edef\xint_euc_end_ #1#2#3%
308 {%
309   \space {#1}{#3}{#2}%
310 }%
```

## 6.7 \xintBezoutAlgorithm

Pour Bezout: objectif, renvoyer

$\{N\}\{A\}\{0\}\{1\}\{D=r(n)\}\{B\}\{1\}\{0\}\{q_1\}\{r_1\}\{\alpha_1=q_1\}\{\beta_1=1\}$   
 $\{q_2\}\{r_2\}\{\alpha_2\}\{\beta_2\}\dots\{q_N\}\{r_N=0\}\{\alpha_N=A/D\}\{\beta_N=B/D\}$   
 $\alpha_0=1, \beta_0=0, \alpha(-1)=0, \beta(-1)=1$

```
311 \def\xintBezoutAlgorithm {\romannumeral0\xintbezoutalgorithm}%
312 \def\xintbezoutalgorithm #1%
313 {%
314   \expandafter \XINT_bezalg \expandafter{\romannumeral0\xintiabs {#1}}%
315}%
316 \def\XINT_bezalg #1#2%
317 {%
318   \expandafter\XINT_bezalg_fork \romannumeral0\xintiabs {#2}\Z #1\Z
319}%

```

Ici #3#4=A, #1#2=B

```
320 \def\XINT_bezalg_fork #1#2\Z #3#4\Z
321 {%
322   \xint_UDzerofork
323   #1\XINT_bezalg_BisZero
324   #3\XINT_bezalg_AisZero
325   0\XINT_bezalg_a
326   \krof
327   0{#1#2}{#3#4}1001{{#3#4}{#1#2}}{\}\Z
328}%
329 \def\XINT_bezalg_AisZero #1#2#3\Z{ {1}{0}{0}{1}{#2}{#2}{1}{0}{0}{0}{0}{1}}%
330 \def\XINT_bezalg_BisZero #1#2#3#4\Z{ {1}{0}{0}{1}{#3}{#3}{1}{0}{0}{0}{0}{1}}%

```

pour préparer l'étape n+1 il faut  $\{n\}\{r(n)\}\{r(n-1)\}\{\alpha(n)\}\{\beta(n)\}\{\alpha(n-1)\}\{\beta(n-1)\}\{q(n)\}\{r(n)\}\{\alpha(n-1)\}\{\beta(n-1)\}\dots$   
 division de #3 par #2

```
331 \def\XINT_bezalg_a #1#2#3%
332 {%
333   \expandafter\XINT_bezalg_b
334   \expandafter {\the\numexpr #1+1\expandafter}%
335   \romannumeral0\XINT_div_prepare {#2}{#3}{#2}%
336}%

```

$\{n+1\}\{q(n+1)\}\{r(n+1)\}\{r(n)\}\{\alpha(n)\}\{\beta(n)\}\{\alpha(n-1)\}\{\beta(n-1)\}\dots$

```
337 \def\XINT_bezalg_b #1#2#3#4#5#6#7#8%
338 {%
339   \expandafter\XINT_bezalg_c\expandafter
340   {\romannumeral0\xintiadd {\xintiiMul {#6}{#2}}{#8}}%
341   {\romannumeral0\xintiadd {\xintiiMul {#5}{#2}}{#7}}%
342   {#1}{#2}{#3}{#4}{#5}{#6}%
343}%

```

$\{\beta(n+1)\}\{\alpha(n+1)\}\{n+1\}\{q(n+1)\}\{r(n+1)\}\{r(n)\}\{\alpha(n)\}\{\beta(n)\}$

```
344 \def\XINT_bezalg_c #1#2#3#4#5#6%
345 {%
346   \expandafter\XINT_bezalg_d\expandafter {#2}{#3}{#4}{#5}{#6}{#1}%
347}%

```



```

{alpha(n+1)}{n+1}{q(n+1)}{r(n+1)}{r(n)}{beta(n+1)}

348 \def\XINT_bezalg_d #1#2#3#4#5#6#7#8%
349 {%
350   \XINT_bezalg_e #4\Z {#2}{#4}{#5}{#1}{#6}{#7}{#8}{#3}{#4}{#1}{#6}}%
351 }%

r(n+1)\Z {n+1}{r(n+1)}{r(n)}{alpha(n+1)}{beta(n+1)}
{alpha(n)}{beta(n)}{q,r,alpha,beta(n+1)}
Test si r(n+1) est nul.

352 \def\XINT_bezalg_e #1#2\Z
353 {%
354   \xint_gob_til_zero #1\xint_bezalg_end0\XINT_bezalg_a
355 }%

Ici r(n+1) = 0. On arrête on se prépare à inverser.
{n+1}{r(n+1)}{r(n)}{alpha(n+1)}{beta(n+1)}{alpha(n)}{beta(n)}
{q,r,alpha,beta(n+1)}...{A}{B}}{\Z
On veut renvoyer
{N}{A}{0}{1}{D=r(n)}{B}{1}{0}{q1}{r1}{alpha1=q1}{beta1=1}
{q2}{r2}{alpha2}{beta2}...{qN}{rN=0}{alphaN=A/D}{betaN=B/D}

356 \def\xint_bezalg_end0\XINT_bezalg_a #1#2#3#4#5#6#7#8\Z
357 {%
358   \expandafter\xint_bezalg_end_
359   \romannumeral0%
360   \XINT_rord_main {}#8{{#1}{#3}}%
361   \xint_relax
362   \xint_bye\xint_bye\xint_bye\xint_bye
363   \xint_bye\xint_bye\xint_bye\xint_bye
364   \xint_relax
365 }%

{N}{D}{A}{B}{q1}{r1}{alpha1=q1}{beta1=1}{q2}{r2}{alpha2}{beta2}
...{qN}{rN=0}{alphaN=A/D}{betaN=B/D}
On veut renvoyer
{N}{A}{0}{1}{D=r(n)}{B}{1}{0}{q1}{r1}{alpha1=q1}{beta1=1}
{q2}{r2}{alpha2}{beta2}...{qN}{rN=0}{alphaN=A/D}{betaN=B/D}

366 \edef\xint_bezalg_end_ #1#2#3#4%
367 {%
368   \space {#1}{#3}{0}{1}{#2}{#4}{1}{0}%
369 }%

```

## 6.8 \xintGCDof

New with 1.09a. I also tried an optimization (not working two by two) which I thought was clever but it seemed to be less efficient ...

```

370 \def\xintGCDof      {\romannumeral0\xintgcdof }%
371 \def\xintgcdof      #1{\expandafter\XINT_gcdof_a\romannumeral-`0#1\relax }%
372 \def\XINT_gcdof_a #1{\expandafter\XINT_gcdof_b\romannumeral-`0#1\Z }%
373 \def\XINT_gcdof_b #1\Z #2{\expandafter\XINT_gcdof_c\romannumeral-`0#2\Z {#1}\Z}%

```

```

374 \def\XINT_gcdof_c #1{\xint_gob_til_relax #1\XINT_gcdof_e\relax\XINT_gcdof_d #1}%
375 \def\XINT_gcdof_d #1\Z {\expandafter\XINT_gcdof_b\romannumeral0\xintgcd {#1}}%
376 \def\XINT_gcdof_e #1\Z #2\Z { #2}%

```

## 6.9 \xintLCMof

New with 1.09a

```

377 \def\xintLCMof      {\romannumeral0\xintlcmof }%
378 \def\xintlcmof      #1{\expandafter\XINT_lcmof_a\romannumeral-`0#1\relax }%
379 \def\XINT_lcmof_a #1{\expandafter\XINT_lcmof_b\romannumeral-`0#1\Z }%
380 \def\XINT_lcmof_b #1\Z #2{\expandafter\XINT_lcmof_c\romannumeral-`0#2\Z {#1}\Z}%
381 \def\XINT_lcmof_c #1{\xint_gob_til_relax #1\XINT_lcmof_e\relax\XINT_lcmof_d #1}%
382 \def\XINT_lcmof_d #1\Z {\expandafter\XINT_lcmof_b\romannumeral0\xintlcm {#1}}%
383 \def\XINT_lcmof_e #1\Z #2\Z { #2}%

```

## 6.10 \xintTypesetEuclideanAlgorithm

### TYPESETTING

Organisation:

$\{N\}\{A\}\{D\}\{B\}\{q_1\}\{r_1\}\{q_2\}\{r_2\}\{q_3\}\{r_3\}\dots\{q_N\}\{r_N=0\}$

$\backslash U1 = N = \text{nombre d'étapes}$ ,  $\backslash U3 = \text{PGCD}$ ,  $\backslash U2 = A$ ,  $\backslash U4=B$   $q_1 = \backslash U5$ ,  $q_2 = \backslash U7 \rightarrow q_n = \backslash U<2n+3>$ ,  $r_n = \backslash U<2n+4>$   $bn = rn$ .  $B = r_0$ .  $A=r(-1)$

$r(n-2) = q(n)r(n-1)+r(n)$  (n e étape)

$\backslash U\{2n\} = \backslash U\{2n+3\} \times \backslash U\{2n+2\} + \backslash U\{2n+4\}$ , n e étape. (avec n entre 1 et N)

1.09h uses `\xintloop`, and `\par` rather than `\endgraf`; and `\par` rather than `\hfill\break`

```

384 \def\xintTypesetEuclideanAlgorithm {%
385   \unless\ifdefined\xintAssignArray
386     \errmessage
387       {xintgcd: package xinttools is required for \string\xintTypesetEuclideanAlgorithm}%
388     \expandafter\xint_gobble_iii
389   \fi
390   \XINT_TypesetEuclideanAlgorithm
391 }%
392 \def\XINT_TypesetEuclideanAlgorithm #1#2%
393 {% l'algo remplace #1 et #2 par |#1| et |#2|
394   \par
395   \begingroup
396     \xintAssignArray\xintEuclideanAlgorithm {#1}{#2}\to\U
397     \edef\A{\U2}\edef\B{\U4}\edef\N{\U1}%
398     \setbox 0 \vbox{\halign {$##$\cr \A\cr \B \cr}}%
399     \count 255 1
400     \xintloop
401       \indent\hbox to \wd 0 {\hfil$\U{\numexpr 2*\count255\relax}$}%
402       ${} = \U{\numexpr 2*\count255 + 3\relax}
403       \times \U{\numexpr 2*\count255 + 2\relax}
404       + \U{\numexpr 2*\count255 + 4\relax}$%
405     \ifnum \count255 < \N
406       \par
407       \advance \count255 1
408     \repeat
409   \endgroup

```

410 }%

## 6.11 \xintTypesetBezoutAlgorithm

Pour Bezout on a:  $\{N\}\{A\}\{0\}\{1\}\{D=r(n)\}\{B\}\{1\}\{0\}\{q_1\}\{r_1\}\{\alpha_1=q_1\}\{\beta_1=1\}$   
 $\{q_2\}\{r_2\}\{\alpha_2\}\{\beta_2\}\dots\{q_N\}\{r_N=0\}\{\alpha_N=A/D\}\{\beta_N=B/D\}$  Donc  $4N+8$  termes:  $U_1 = N$ ,  $U_2 = A$ ,  
 $U_5=D$ ,  $U_6=B$ ,  $q_1 = U_9$ ,  $q_n = U_{4n+5}$ ,  $n$  au moins 1  
 $r_n = U_{4n+6}$ ,  $n$  au moins -1  
 $\alpha(n) = U_{4n+7}$ ,  $n$  au moins -1  
 $\beta(n) = U_{4n+8}$ ,  $n$  au moins -1  
 1.09h uses \xintloop, and \par rather than \endgraf; and no more \parindent0pt

```

411 \def\xintTypesetBezoutAlgorithm {%
412   \unless\ifdefined\xintAssignArray
413     \errmessage
414       {xintgcd: package xinttools is required for \string\xintTypesetBezoutAlgorithm}%
415     \expandafter\xint_gobble_iii
416   \fi
417   \XINT_TypesetBezoutAlgorithm
418 }%
419 \def\XINT_TypesetBezoutAlgorithm #1#2%
420 {%
421   \par
422   \begingroup
423     \xintAssignArray\xintBezoutAlgorithm {#1}{#2}\to\BEZ
424     \edef\A{\BEZ2}\edef\B{\BEZ6}\edef\N{\BEZ1}% A = |#1|, B = |#2|
425     \setbox 0 \vbox{\halign {$##$\cr \A\cr \B \cr}}%
426     \count255 1
427     \xintloop
428       \indent\hbox to \wd 0 {\hfil$\BEZ{4*\count255 - 2}$}%
429       ${} = \BEZ{4*\count255 + 5}
430       \times \BEZ{4*\count255 + 2}
431       + \BEZ{4*\count255 + 6}$\hfill\break
432       \hbox to \wd 0 {\hfil$\BEZ{4*\count255 + 7}$}%
433       ${} = \BEZ{4*\count255 + 5}
434       \times \BEZ{4*\count255 + 3}
435       + \BEZ{4*\count255 - 1}$\hfill\break
436       \hbox to \wd 0 {\hfil$\BEZ{4*\count255 + 8}$}%
437       ${} = \BEZ{4*\count255 + 5}
438       \times \BEZ{4*\count255 + 4}
439       + \BEZ{4*\count255 }$
440     \par
441     \ifnum \count255 < \N
442       \advance \count255 1
443     \repeat
444     \edef\U{\BEZ{4*\N + 4}}%
445     \edef\V{\BEZ{4*\N + 3}}%
446     \edef\D{\BEZ5}%
447     \ifodd\N
448       $\U\times\A - \V\times \B = -\D$%
449     \else
450       $\U\times\A - \V\times\B = \D$%
451     \fi

```

```

452 \par
453 \endgroup
454 }%
455 \XINT_restorecatcodes_endinput%

```

## 7 Package *xintfrac* implementation

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.4	<i>\xintLen</i>	142	.39	<i>\xintSub</i>	178
.5	<i>\XINT_lenrord_loop</i>	142	.40	<i>\xintSum</i>	178
.6	<i>\XINT_outfrac</i>	142	.41	<i>\xintMul</i>	178
.7	<i>\XINT_infrac</i>	143	.42	<i>\xintSqr</i>	179
.8	<i>\XINT_frac_gen</i>	144	.43	<i>\xintPow</i>	179
.9	<i>\XINT_factortens</i> , <i>\XINT_cuz_cnt</i>	146	.44	<i>\xintFac</i>	180
.10	<i>\XINT_addm_A</i>	148	.45	<i>\xintPrd</i>	180
.11	<i>\xintRaw</i>	150	.46	<i>\xintDiv</i>	181
.12	<i>\xintPraw</i>	150	.47	<i>\xintDivFloor</i>	181
.13	<i>\xintRawWithZeros</i>	151	.48	<i>\xintDivTrunc</i>	181
.14	<i>\xintFloor</i> , <i>\xintiFloor</i>	151	.49	<i>\xintDivRound</i>	181
.15	<i>\xintCeil</i> , <i>\xintiCeil</i>	151	.50	<i>\xintMod</i>	182
.16	<i>\xintNumerator</i>	152	.51	<i>\XINTinFloatMod</i>	182
.17	<i>\xintDenominator</i>	152	.52	<i>\xintIsOne</i>	183
.18	<i>\xintFrac</i>	152	.53	<i>\xintGeq</i>	183
.19	<i>\xintSignedFrac</i>	153	.54	<i>\xintMax</i>	184
.20	<i>\xintFwOver</i>	153	.55	<i>\xintMaxof</i>	185
.21	<i>\xintSignedFwOver</i>	154	.56	<i>\xintMin</i>	185
.22	<i>\xintREZ</i>	154	.57	<i>\xintMinof</i>	186
.23	<i>\xintE</i> , <i>\xintFloatE</i> , <i>\XINTinFloatE</i>	155	.58	<i>\xintCmp</i>	186
.24	<i>\xintIrr</i>	156	.59	<i>\xintAbs</i>	187
.25	<i>\xintifInt</i>	157	.60	<i>\xintOpp</i>	187
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.27	<i>\xintTFrac</i>	159	.62	Floating point macros	188
.28	<i>\XINTinFloatFracdigits</i>	159	.63	<i>\xintFloatAdd</i> , <i>\XINTinFloatAdd</i>	188
.29	<i>\xintTrunc</i> , <i>\xintiTrunc</i>	160	.64	<i>\xintFloatSub</i> , <i>\XINTinFloatSub</i>	189
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.31	<i>\xintNum</i>	162	.66	<i>\xintFloatDiv</i> , <i>\XINTinFloatDiv</i>	190
.32	<i>\xintRound</i> , <i>\xintiRound</i>	162	.67	<i>\xintFloatPow</i> , <i>\XINTinFloatPow</i>	191
.33	<i>\xintXTrunc</i>	164	.68	<i>\xintFloatPower</i> , <i>\XINTinFloatPower</i>	194
.34	<i>\xintDigits</i>	169	.69	<i>\xintFloatFac</i> , <i>\XINTFloatFac</i>	196
.35	<i>\xintFloat</i>	169	.70	<i>\xintFloatSqrt</i> , <i>\XINTinFloatSqrt</i>	200

The commenting is currently (2015/10/10) very sparse.

### 7.1 Catcodes, $\varepsilon$ -T<sub>E</sub>X and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified. The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2 \catcode13=5 % ^^M
3 \endlinechar=13 %

```

## 7 Package *xintfrac* implementation

```

4 \catcode123=1 % {
5 \catcode125=2 % }
6 \catcode64=11 % @
7 \catcode35=6 % #
8 \catcode44=12 % ,
9 \catcode45=12 % -
10 \catcode46=12 % .
11 \catcode58=12 % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xintfrac.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xint.sty\endcsname
15 \expandafter
16 \ifx\csname PackageInfo\endcsname\relax
17 \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18 \else
19 \def\y#1#2{\PackageInfo{#1}{#2}}%
20 \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23 \y{xintfrac}{numexpr not available, aborting input}%
24 \aftergroup\endinput
25 \else
26 \ifx\x\relax % plain-TeX, first loading of xintfrac.sty
27 \ifx\w\relax % but xint.sty not yet loaded.
28 \def\z{\endgroup\input xint.sty\relax}%
29 \fi
30 \else
31 \def\empty {}%
32 \ifx\x\empty % LaTeX, first loading,
33 % variable is initialized, but \ProvidesPackage not yet seen
34 \ifx\w\relax % xint.sty not yet loaded.
35 \def\z{\endgroup\RequirePackage{xint}}%
36 \fi
37 \else
38 \aftergroup\endinput % xintfrac already loaded.
39 \fi
40 \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty

```

### 7.2 Package identification

```

44 \XINT_providespackage
45 \ProvidesPackage{xintfrac}%
46 [2015/10/10 v1.2 Expandable operations on fractions (jfb)]%

```

### 7.3 *\XINT\_cntSgnFork*

1.09i. Used internally, #1 must expand to \m@ne, \z@, or \@ne or equivalent. Does not insert a space token to stop a romannumeral0 expansion.

```

47 \def\XINT_cntSgnFork #1%
48 {%

```

```

49 \ifcase #1\expandafter\xint_secondofthree
50 \or\expandafter\xint_thirdofthree
51 \else\expandafter\xint_firstofthree
52 \fi
53 }%

```

#### 7.4 `\xintLen`

```

54 \def\xintLen {\romannumeral0\xintlen }%
55 \def\xintlen #1%
56 {%
57 \expandafter\XINT_flen\romannumeral0\XINT_infrac {#1}%
58 }%
59 \def\XINT_flen #1#2#3%
60 {%
61 \expandafter\space
62 \the\numexpr -1+\XINT_Abs {#1}+\XINT_Len {#2}+\XINT_Len {#3}\relax
63 }%

```

#### 7.5 `\XINT_lenrord_loop`

```

64 \def\XINT_lenrord_loop #1#2#3#4#5#6#7#8#9%
65 {% faire \romannumeral-`0\XINT_lenrord_loop 0{ }#1\Z\W\W\W\W\W\W\W\Z
66 \xint_gob_til_W #9\XINT_lenrord_W\W
67 \expandafter\XINT_lenrord_loop\expandafter
68 {\the\numexpr #1+7}{#9#8#7#6#5#4#3#2}%
69 }%
70 \def\XINT_lenrord_W\W\expandafter\XINT_lenrord_loop\expandafter #1#2#3\Z
71 {%
72 \expandafter\XINT_lenrord_X\expandafter {#1}#2\Z
73 }%
74 \def\XINT_lenrord_X #1#2\Z
75 {%
76 \XINT_lenrord_Y #2\R\R\R\R\R\R\T {#1}%
77 }%
78 \def\XINT_lenrord_Y #1#2#3#4#5#6#7#8\T
79 {%
80 \xint_gob_til_W
81 #7\XINT_lenrord_Z \xint_c_viii
82 #6\XINT_lenrord_Z \xint_c_vii
83 #5\XINT_lenrord_Z \xint_c_vi
84 #4\XINT_lenrord_Z \xint_c_v
85 #3\XINT_lenrord_Z \xint_c_iv
86 #2\XINT_lenrord_Z \xint_c_iii
87 \W\XINT_lenrord_Z \xint_c_ii \Z
88 }%
89 \def\XINT_lenrord_Z #1#2\Z #3% retourne: {longueur}renverse\Z
90 {%
91 \expandafter{\the\numexpr #3-#1\relax}%
92 }%

```

#### 7.6 `\XINT_outfrac`

1.06a version now outputs 0/1[0] and not 0[0] in case of zero. More generally all macros have been checked in *xintfrac*, *xintseries*, *xintcfrac*, to make sure the output format for fractions was

always  $A/B[n]$ . (except `\xintIrr`, `\xintJrr`, `\xintRawWithZeros`)

The problem with statements like those in the previous paragraph is that it is hard to maintain consistencies across releases.

Months later (2014/10/22): perhaps I should document what this macro does before I forget? from `{e}{N}{D}` it outputs  $N/D[e]$ , checking in passing if  $D=0$  or if  $N=0$ . It also makes sure  $D$  is not  $< 0$ . I am not sure but I don't think there is any place in the code which could call `\XINT_outfrac` with a  $D < 0$ , but I should check.

```

93 \def\xINT_outfrac #1#2#3%
94 {%
95   \ifcase\xINT_cntSgn #3\Z
96     \expandafter \XINT_outfrac_divisionbyzero
97   \or
98     \expandafter \XINT_outfrac_P
99   \else
100     \expandafter \XINT_outfrac_N
101   \fi
102   {#2}{#3}[#1]%
103}%
104 \def\xINT_outfrac_divisionbyzero #1#2{\xintError:DivisionByZero\space #1/0}%
105 \edef\xINT_outfrac_P #1#2%
106 {%
107   \noexpand\if0\noexpand\xINT_Sgn #1\noexpand\Z
108     \noexpand\expandafter\noexpand\xINT_outfrac_Zero
109   \noexpand\fi
110   \space #1/#2%
111}%
112 \def\xINT_outfrac_Zero #1[#2]{ 0/1[0]}%
113 \def\xINT_outfrac_N #1#2%
114 {%
115   \expandafter\xINT_outfrac_N_a\expandafter
116   {\romannumeral0\xINT_opp #2}{\romannumeral0\xINT_opp #1}%
117}%
118 \def\xINT_outfrac_N_a #1#2%
119 {%
120   \expandafter\xINT_outfrac_P\expandafter {#2}{#1}%
121}%

```

## 7.7 `\XINT_inFrac`

Extended in 1.07 to accept scientific notation on input. With lowercase  $e$  only. The `\xintexpr` parser does accept uppercase  $E$  also. Ah, by the way, perhaps I should at least say what this macro does? (belated addition 2014/10/22...), before I forget! It prepares the fraction in the internal format `{exponent}{Numerator}{Denominator}` where `Denominator` is at least 1.

2015/10/09: this venerable macro from the early days (1.03, 2013/04/14) has gotten a lifting for release 1.2. There were two kinds of issues:

- 1) use of `\W`, `\Z`, `\T` delimiters was very poor choice as this could clash with user input,
- 2) the new `\XINT_frac_gen` handles macros (possibly empty) in the input as general as `\A.\Be\C/\D.\Ee\F`. The earlier version would not have expanded the `\B` for example (only `\A`, `\D`, `\C`, `\F`).

I wanted to make stricter the restricted  $A/B[N]$  case, doing no expansion of  $B$ , but this clashed with some established uses in the documentation like `1/\xintiiSqr{...}[0]` for example. Thus I

maintained it despite overhead of having to go over A one more time. Careful also here about potential brace removals if one does stuff like  $\#1/\#2\#3[\#4]$  regarding the  $\#3$ . And while I was at it I added `\numexpr` parsing of the N, which earlier was restricted to be only explicit digits, and I even allowed `[]` with an empty N.

This little event makes me think I should read again other remaining portions my early code, as I was still learning TeX coding at that time.

```

122 \def\XINT_inFrac {\romannumeral0\XINT_infrac }%
123 \def\XINT_infrac #1%
124 {%
125   \expandafter\XINT_infrac_fork\romannumeral-`0#1/\XINT_W[\XINT_W\XINT_T
126 }%
127 \def\XINT_infrac_fork #1[#2%
128 {%
129   \xint_UDXINTWfork
130   #2\XINT_frac_gen
131   \XINT_W\XINT_infrac_res_a % strict A[N] or A/B[N] input
132   \krof
133   #1[#2%
134 }%
135 \def\XINT_infrac_res_a #1%
136 {%
137   \xint_gob_til_zero #1\XINT_infrac_res_zero 0\XINT_infrac_res_b #1%
138 }%
139 \def\XINT_infrac_res_zero 0\XINT_infrac_res_b #1\XINT_T {{0}{0}{1}}%
140 \def\XINT_infrac_res_b #1/#2%
141 {%
142   \xint_UDXINTWfork
143   #2\XINT_infrac_res_ca
144   \XINT_W\XINT_infrac_res_cb
145   \krof
146   #1/#2%
147 }%
148 \def\XINT_infrac_res_ca #1[#2]/\XINT_W[\XINT_W\XINT_T
149   {\expandafter{\the\numexpr 0#2}{#1}{1}}%
150 \def\XINT_infrac_res_cb #1/#2[%
151   {\expandafter\XINT_infrac_res_cc\romannumeral-`0#2~#1[%
152 \def\XINT_infrac_res_cc #1~#2[#3]/\XINT_W[\XINT_W\XINT_T
153   {\expandafter{\the\numexpr 0#3}{#2}{#1}}%

```

## 7.8 `\XINT_frac_gen`

Extended in 1.07 to recognize and accept scientific notation both at the numerator and (possible) denominator. Only a lowercase e will do here, but uppercase E is possible within an `\xintexpr..relax`

Completely rewritten for 1.2 2015/10/10. It now is able to handles inputs such as `\A.\Be\C/\D.\Ee\F` where each of `\A`, `\B`, `\D`, and `\E` may need `\fexpan sion` and `\C` and `\F` will end up in `\numexpr`.

```

154 \def\XINT_frac_gen #1/#2%
155 {%
156   \xint_UDXINTWfork
157   #2\XINT_frac_gen_A
158   \XINT_W\XINT_frac_gen_B

```



## 7 Package *xintfrac* implementation

```

159 \krof
160 #1/#2%
161 }%
162 \def\XINT_frac_gen_A #1/\XINT_W [\XINT_W {\XINT_frac_gen_C 0~1!#1ee.\XINT_W }%
163 \def\XINT_frac_gen_B #1/#2/\XINT_W[%\XINT_W
164 {%
165 \expandafter\XINT_frac_gen_Ba
166 \romannumeral-`0#2ee.\XINT_W\XINT_Z #1ee.%\XINT_W
167 }%
168 \def\XINT_frac_gen_Ba #1.#2%
169 {%
170 \xint_UDXINTWfork
171 #2\XINT_frac_gen_Bb
172 \XINT_W\XINT_frac_gen_Bc
173 \krof
174 #1.#2%
175 }%
176 \def\XINT_frac_gen_Bb #1e#2e#3\XINT_Z
177 {\expandafter\XINT_frac_gen_C\the\numexpr 0#2~#1!}%
178 \def\XINT_frac_gen_Bc #1.#2e%
179 {%
180 \expandafter\XINT_frac_gen_Bd\romannumeral-`0#2.#1e%
181 }%
182 \def\XINT_frac_gen_Bd #1.#2e#3e#4\XINT_Z
183 {%
184 \expandafter\XINT_frac_gen_C\the\numexpr 0#3-\romannumeral0\expandafter
185 \XINT_length_loop
186 0.#1\xint_relax\xint_relax\xint_relax\xint_relax
187 \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye~#2#1!%
188 }%
189 \def\XINT_frac_gen_C #1!#2.#3%
190 {%
191 \xint_UDXINTWfork
192 #3\XINT_frac_gen_Ca
193 \XINT_W\XINT_frac_gen_Cb
194 \krof
195 #1!#2.#3%
196 }%
197 \def\XINT_frac_gen_Ca #1~#2!#3e#4e#5\XINT_T
198 {%
199 \expandafter\XINT_frac_gen_F\the\numexpr #4-#1\expandafter
200 ~\romannumeral0\XINT_num_loop
201 #2\xint_relax\xint_relax\xint_relax\xint_relax
202 \xint_relax\xint_relax\xint_relax\xint_relax\Z~#3~%
203 }%
204 \def\XINT_frac_gen_Cb #1.#2e%
205 {%
206 \expandafter\XINT_frac_gen_Cc\romannumeral-`0#2.#1e%
207 }%
208 \def\XINT_frac_gen_Cc #1.#2~#3!#4e#5e#6\XINT_T
209 {%
210 \expandafter\XINT_frac_gen_F\the\numexpr #5-#2-%

```

```

211 \romannumeral0\XINT_length_loop
212 0.#1\xint_relax\xint_relax\xint_relax\xint_relax
213 \xint_relax\xint_relax\xint_relax\xint_relax\xint_bye\expandafter
214 ~\romannumeral0\XINT_num_loop
215 #3\xint_relax\xint_relax\xint_relax\xint_relax
216 \xint_relax\xint_relax\xint_relax\xint_relax\Z
217 ~#4#1~%
218 }%
219 \def\XINT_frac_gen_F #1~#2%
220 {%
221 \xint_UDzerominusfork
222 #2-\XINT_frac_gen_Gdivbyzero
223 0#2{\XINT_frac_gen_G -{}}%
224 0-{\XINT_frac_gen_G {}#2}%
225 \krof #1~%
226 }%
227 \def\XINT_frac_gen_Gdivbyzero #1~~#2~%
228 {%
229 \expandafter\XINT_frac_gen_Gdivbyzero_a
230 \romannumeral0\XINT_num_loop
231 #2\xint_relax\xint_relax\xint_relax\xint_relax
232 \xint_relax\xint_relax\xint_relax\xint_relax\Z~#1~%
233 }%
234 \def\XINT_frac_gen_Gdivbyzero_a #1~#2~%
235 {%
236 \xintError:DivisionByZero {#2}{#1}{0}%
237 }%
238 \def\XINT_frac_gen_G #1#2#3~#4~#5~%
239 {%
240 \expandafter\XINT_frac_gen_Ga
241 \romannumeral0\XINT_num_loop
242 #1#5\xint_relax\xint_relax\xint_relax\xint_relax
243 \xint_relax\xint_relax\xint_relax\xint_relax\Z~#3~{#2#4}%
244 }%
245 \def\XINT_frac_gen_Ga #1#2~#3~%
246 {%
247 \xint_gob_til_zero #1\XINT_frac_gen_zero 0%
248 {#3}{#1#2}%
249 }%
250 \def\XINT_frac_gen_zero 0#1#2#3{{0}{0}{1}}%

```

## 7.9 \XINT\_factortens, \XINT\_cuz\_cnt

```

251 \def\XINT_factortens #1%
252 {%
253 \expandafter\XINT_cuz_cnt_loop\expandafter
254 {\expandafter}\romannumeral0\XINT_rord_main {}#1%
255 \xint_relax
256 \xint_bye\xint_bye\xint_bye\xint_bye
257 \xint_bye\xint_bye\xint_bye\xint_bye
258 \xint_relax
259 \R\R\R\R\R\R\R\Z
260 }%

```

```

261 \def\XINT_cuz_cnt #1%
262 {%
263   \XINT_cuz_cnt_loop {}#1\R\R\R\R\R\R\R\Z
264 }%
265 \def\XINT_cuz_cnt_loop #1#2#3#4#5#6#7#8#9%
266 {%
267   \xint_gob_til_R #9\XINT_cuz_cnt_toofara \R
268   \expandafter\XINT_cuz_cnt_checka\expandafter
269   {\the\numexpr #1+8\relax}{#2#3#4#5#6#7#8#9}%
270 }%
271 \def\XINT_cuz_cnt_toofara\R
272   \expandafter\XINT_cuz_cnt_checka\expandafter #1#2%
273 {%
274   \XINT_cuz_cnt_toofarb {}#1}#2%
275 }%
276 \def\XINT_cuz_cnt_toofarb #1#2\Z {\XINT_cuz_cnt_toofarc #2\Z {}#1}}%
277 \def\XINT_cuz_cnt_toofarc #1#2#3#4#5#6#7#8%
278 {%
279   \xint_gob_til_R #2\XINT_cuz_cnt_toofard 7%
280     #3\XINT_cuz_cnt_toofard 6%
281     #4\XINT_cuz_cnt_toofard 5%
282     #5\XINT_cuz_cnt_toofard 4%
283     #6\XINT_cuz_cnt_toofard 3%
284     #7\XINT_cuz_cnt_toofard 2%
285     #8\XINT_cuz_cnt_toofard 1%
286     \Z #1#2#3#4#5#6#7#8%
287 }%
288 \def\XINT_cuz_cnt_toofard #1#2\Z #3\R #4\Z #5%
289 {%
290   \expandafter\XINT_cuz_cnt_toofare
291   \the\numexpr #3\relax \R\R\R\R\R\R\R\Z
292   {\the\numexpr #5-#1\relax}\R\Z
293 }%
294 \def\XINT_cuz_cnt_toofare #1#2#3#4#5#6#7#8%
295 {%
296   \xint_gob_til_R #2\XINT_cuz_cnt_stopc 1%
297     #3\XINT_cuz_cnt_stopc 2%
298     #4\XINT_cuz_cnt_stopc 3%
299     #5\XINT_cuz_cnt_stopc 4%
300     #6\XINT_cuz_cnt_stopc 5%
301     #7\XINT_cuz_cnt_stopc 6%
302     #8\XINT_cuz_cnt_stopc 7%
303     \Z #1#2#3#4#5#6#7#8%
304 }%
305 \def\XINT_cuz_cnt_checka #1#2%
306 {%
307   \expandafter\XINT_cuz_cnt_checkb\the\numexpr #2\relax \Z {}#1}%
308 }%
309 \def\XINT_cuz_cnt_checkb #1%
310 {%
311   \xint_gob_til_zero #1\expandafter\XINT_cuz_cnt_loop\xint_gob_til_Z
312   0\XINT_cuz_cnt_stopa #1%

```

```

313 }%
314 \def\XINT_cuz_cnt_stopa #1\Z
315 {%
316   \XINT_cuz_cnt_stopb #1\R\R\R\R\R\R\R\Z %
317 }%
318 \def\XINT_cuz_cnt_stopb #1#2#3#4#5#6#7#8#9%
319 {%
320   \xint_gob_til_R #2\XINT_cuz_cnt_stopc 1%
321     #3\XINT_cuz_cnt_stopc 2%
322     #4\XINT_cuz_cnt_stopc 3%
323     #5\XINT_cuz_cnt_stopc 4%
324     #6\XINT_cuz_cnt_stopc 5%
325     #7\XINT_cuz_cnt_stopc 6%
326     #8\XINT_cuz_cnt_stopc 7%
327     #9\XINT_cuz_cnt_stopc 8%
328   \Z #1#2#3#4#5#6#7#8#9%
329 }%
330 \def\XINT_cuz_cnt_stopc #1#2\Z #3\R #4\Z #5%
331 {%
332   \expandafter\XINT_cuz_cnt_stopd\expandafter
333   {\the\numexpr #5-#1}\#3%
334 }%
335 \def\XINT_cuz_cnt_stopd #1#2\R #3\Z
336 {%
337   \expandafter\space\expandafter
338   {\romannumeral0\XINT_rord_main }\#2%
339   \xint_relax
340   \xint_bye\xint_bye\xint_bye\xint_bye
341   \xint_bye\xint_bye\xint_bye\xint_bye
342   \xint_relax }\#1}%
343 }%

```

### 7.10 \XINT\_addm\_A

This is a routine from *xintcore* 1.0x, which is needed by `\xintFloat`, `\XINTinFloat` and `\xintRound`, for the time being. I should moved it here, now that *xintcore* has been entirely rewritten with release 1.2.

```

344 \def\XINT_addm_A #1#2#3#4#5#6%
345 {%
346   \xint_gob_til_W #3\xint_addm_az\W
347   \XINT_addm_AB #1{\#3#4#5#6}\#2}%
348 }%
349 \def\xint_addm_az\W\XINT_addm_AB #1#2%
350 {%
351   \XINT_addm_AC_checkcarry #1%
352 }%
353 \def\XINT_addm_AB #1#2#3#4\W\X\Y\Z #5#6#7#8%
354 {%
355   \XINT_addm_ABE #1#2{\#8#7#6#5}\#3}\#4\W\X\Y\Z
356 }%
357 \def\XINT_addm_ABE #1#2#3#4#5#6%
358 {%
359   \expandafter\XINT_addm_ABEA\the\numexpr #1+10#5#4#3#2+#6.%

```

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```

360 }%
361 \def\XINT_addm_ABEA #1#2#3.#4%
362 {%
363     \XINT_addm_A #2{#3#4}%
364 }%
365 \def\XINT_addm_AC_checkcarry #1%
366 {%
367     \xint_gob_til_zero #1\xint_addm_AC_nocarry 0\XINT_addm_C
368 }%
369 \def\xint_addm_AC_nocarry 0\XINT_addm_C #1#2\W\X\Y\Z
370 {%
371     \expandafter
372     \xint_cleanupzeros_andstop
373     \romannumeral0%
374     \XINT_rord_main {}#2%
375     \xint_relax
376     \xint_bye\xint_bye\xint_bye\xint_bye
377     \xint_bye\xint_bye\xint_bye\xint_bye
378     \xint_relax
379     #1%
380 }%
381 \def\XINT_addm_C #1#2#3#4#5%
382 {%
383     \xint_gob_til_W
384     #5\xint_addm_cw
385     #4\xint_addm_cx
386     #3\xint_addm_cy
387     #2\xint_addm_cz
388     \W\XINT_addm_CD {#5#4#3#2}{#1}%
389 }%
390 \def\XINT_addm_CD #1%
391 {%
392     \expandafter\XINT_addm_CD\the\numexpr 1+10#1.%
393 }%
394 \def\XINT_addm_CC #1#2#3.#4%
395 {%
396     \XINT_addm_AC_checkcarry #2{#3#4}%
397 }%
398 \def\xint_addm_cw
399     #1\xint_addm_cx
400     #2\xint_addm_cy
401     #3\xint_addm_cz
402     \W\XINT_addm_CD
403 {%
404     \expandafter\XINT_addm_CD\the\numexpr 1+#1#2#3.%
405 }%
406 \def\XINT_addm_CDw #1.#2#3\X\Y\Z
407 {%
408     \XINT_addm_end #1#3%
409 }%
410 \def\xint_addm_cx
411     #1\xint_addm_cy

```

```

412   #2\xint_addm_cz
413   \W\XINT_addm_CD
414 {%
415   \expandafter\XINT_addm_CDx\the\numexpr 1+#1#2.%
416 }%
417 \def\XINT_addm_CDx #1.#2#3\Y\Z
418 {%
419   \XINT_addm_end #1#3%
420 }%
421 \def\xint_addm_cy
422   #1\xint_addm_cz
423   \W\XINT_addm_CD
424 {%
425   \expandafter\XINT_addm_CDy\the\numexpr 1+#1.%
426 }%
427 \def\XINT_addm_CDy #1.#2#3\Z
428 {%
429   \XINT_addm_end #1#3%
430 }%
431 \def\xint_addm_cz\W\XINT_addm_CD #1#2#3{\XINT_addm_end #1#3}%
432 \edef\XINT_addm_end #1#2#3#4#5%
433   {\noexpand\expandafter\space\noexpand\the\numexpr #1#2#3#4#5\relax}%

```

### 7.11 \xintRaw

1.07: this macro simply prints in a user readable form the fraction after its initial scanning. Useful when put inside braces in an `\xintexpr`, when the input is not yet in the `A/B[n]` form.

```

434 \def\xintRaw {\romannumeral0\xintraw }%
435 \def\xintraw
436 {%
437   \expandafter\XINT_raw\romannumeral0\XINT_infrac
438 }%
439 \def\XINT_raw #1#2#3{ #2/#3[#1]}%

```

### 7.12 \xintPraw

1.09b

```

440 \def\xintPraw {\romannumeral0\xintpraw }%
441 \def\xintpraw
442 {%
443   \expandafter\XINT_praw\romannumeral0\XINT_infrac
444 }%
445 \def\XINT_praw #1%
446 {%
447   \ifnum #1=\xint_c_ \expandafter\XINT_praw_a\fi \XINT_praw_A {#1}%
448 }%
449 \def\XINT_praw_A #1#2#3%
450 {%
451   \if\XINT_isOne{#3}1\expandafter\xint_firstoftwo
452   \else\expandafter\xint_secondoftwo
453   \fi { #2[#1]}{ #2/#3[#1]}%

```

```

454 }%
455 \def\XINT_praw_a\XINT_praw_A #1#2#3%
456 {%
457   \if\XINT_isOne{#3}1\expandafter\xint_firstoftwo
458       \else\expandafter\xint_secondoftwo
459   \fi { #2}{ #2/#3}%
460 }%

```

### 7.13 `\xintRawWithZeros`

This was called `\xintRaw` in versions earlier than 1.07

```

461 \def\xintRawWithZeros {\romannumeral0\xinrawwithzeros }%
462 \def\xinrawwithzeros
463 {%
464   \expandafter\XINT_rawz\romannumeral0\XINT_infrac
465 }%
466 \def\XINT_rawz #1%
467 {%
468   \ifcase\XINT_cntSgn #1\Z
469     \expandafter\XINT_rawz_Ba
470   \or
471     \expandafter\XINT_rawz_A
472   \else
473     \expandafter\XINT_rawz_Ba
474   \fi
475   {#1}%
476 }%
477 \def\XINT_rawz_A #1#2#3{\xint_dsh {#2}{-#1}/#3}%
478 \def\XINT_rawz_Ba #1#2#3{\expandafter\XINT_rawz_Bb
479   \expandafter{\romannumeral0\xint_dsh {#3}{#1}}{#2}}%
480 \def\XINT_rawz_Bb #1#2{ #2/#1}%

```

### 7.14 `\xintFloor`, `\xintiFloor`

1.09a, 1.1 for `\xintiFloor`/`\xintFloor`. Not efficient if big negative decimal exponent. Also sub-efficient if big positive decimal exponent.

```

481 \def\xintFloor {\romannumeral0\xintfloor }%
482 \def\xintfloor #1% devrais-je faire \xintREZ?
483   {\expandafter\XINT_ifloor \romannumeral0\xinrawwithzeros {#1}./1[0]}%
484 \def\xintiFloor {\romannumeral0\xintifloor }%
485 \def\xintifloor #1%
486   {\expandafter\XINT_ifloor \romannumeral0\xinrawwithzeros {#1}.}%
487 \def\XINT_ifloor #1/#2.{\xinti quo {#1}{#2}}%

```

### 7.15 `\xintCeil`, `\xintiCeil`

1.09a

```

488 \def\xintCeil {\romannumeral0\xintceil }%
489 \def\xintceil #1{\xintiopp {\xintFloor {\xintOpp{#1}}}}%
490 \def\xintiCeil {\romannumeral0\xinticeil }%
491 \def\xinticeil #1{\xintiopp {\xintiFloor {\xintOpp{#1}}}}%

```

**7.16 \xintNumerator**

```

492 \def\xintNumerator {\romannumeral0\xintnumerator }%
493 \def\xintnumerator
494 {%
495   \expandafter\XINT_numer\romannumeral0\XINT_infrac
496 }%
497 \def\XINT_numer #1%
498 {%
499   \ifcase\XINT_cntSgn #1\Z
500     \expandafter\XINT_numer_B
501   \or
502     \expandafter\XINT_numer_A
503   \else
504     \expandafter\XINT_numer_B
505   \fi
506   {#1}%
507 }%
508 \def\XINT_numer_A #1#2#3{\xint_dsh {#2}{-#1}}%
509 \def\XINT_numer_B #1#2#3{ #2}%

```

**7.17 \xintDenominator**

```

510 \def\xintDenominator {\romannumeral0\xintdenominator }%
511 \def\xintdenominator
512 {%
513   \expandafter\XINT_denom\romannumeral0\XINT_infrac
514 }%
515 \def\XINT_denom #1%
516 {%
517   \ifcase\XINT_cntSgn #1\Z
518     \expandafter\XINT_denom_B
519   \or
520     \expandafter\XINT_denom_A
521   \else
522     \expandafter\XINT_denom_B
523   \fi
524   {#1}%
525 }%
526 \def\XINT_denom_A #1#2#3{ #3}%
527 \def\XINT_denom_B #1#2#3{\xint_dsh {#3}{#1}}%

```

**7.18 \xintFrac**

```

528 \def\xintFrac {\romannumeral0\xintfrac }%
529 \def\xintfrac #1%
530 {%
531   \expandafter\XINT_fracfrac_A\romannumeral0\XINT_infrac {#1}%
532 }%
533 \def\XINT_fracfrac_A #1{\XINT_fracfrac_B #1\Z }%
534 \catcode`^=7
535 \def\XINT_fracfrac_B #1#2\Z
536 {%
537   \xint_gob_til_zero #1\XINT_fracfrac_C 0\XINT_fracfrac_D {10^{#1#2}}%
538 }%

```



```

539 \def\XINT_fracfrac_C 0\XINT_fracfrac_D #1#2#3%
540 {%
541   \if1\XINT_isOne {#3}%
542     \xint_afterfi {\expandafter\xint_firstoftwo_thenstop\xint_gobble_ii }%
543   \fi
544   \space
545   \frac {#2}{#3}%
546 }%
547 \def\XINT_fracfrac_D #1#2#3%
548 {%
549   \if1\XINT_isOne {#3}\XINT_fracfrac_E\fi
550   \space
551   \frac {#2}{#3}#1%
552 }%
553 \def\XINT_fracfrac_E \fi\space\frac #1#2{\fi \space #1\cdot }%

```

### 7.19 \xintSignedFrac

```

554 \def\xintSignedFrac {\romannumeral0\xintsignedfrac }%
555 \def\xintsignedfrac #1%
556 {%
557   \expandafter\XINT_sgnfrac_a\romannumeral0\XINT_infrac {#1}%
558 }%
559 \def\XINT_sgnfrac_a #1#2%
560 {%
561   \XINT_sgnfrac_b #2\Z {#1}%
562 }%
563 \def\XINT_sgnfrac_b #1%
564 {%
565   \xint_UDsignfork
566   #1\XINT_sgnfrac_N
567   -{\XINT_sgnfrac_P #1}%
568   \krof
569 }%
570 \def\XINT_sgnfrac_P #1\Z #2%
571 {%
572   \XINT_fracfrac_A {#2}{#1}%
573 }%
574 \def\XINT_sgnfrac_N
575 {%
576   \expandafter\xint_minus_thenstop\romannumeral0\XINT_sgnfrac_P
577 }%

```

### 7.20 \xintFwOver

```

578 \def\xintFwOver {\romannumeral0\xintfwover }%
579 \def\xintfwover #1%
580 {%
581   \expandafter\XINT_fwover_A\romannumeral0\XINT_infrac {#1}%
582 }%
583 \def\XINT_fwover_A #1{\XINT_fwover_B #1\Z }%
584 \def\XINT_fwover_B #1#2\Z
585 {%
586   \xint_gob_til_zero #1\XINT_fwover_C 0\XINT_fwover_D {10^{#1#2}}%
587 }%

```

```

588 \catcode`^=11
589 \def\XINT_fwover_C #1#2#3#4#5%
590 {%
591   \if0\XINT_isOne {#5}\xint_afterfi { {#4\over #5}}%
592   \else\xint_afterfi { #4}%
593   \fi
594 }%
595 \def\XINT_fwover_D #1#2#3%
596 {%
597   \if0\XINT_isOne {#3}\xint_afterfi { {#2\over #3}}%
598   \else\xint_afterfi { #2\cdot }%
599   \fi
600   #1%
601 }%

```

### 7.21 \xintSignedFwOver

```

602 \def\xintSignedFwOver {\romannumeral0\xintsignedfwover }%
603 \def\xintsignedfwover #1%
604 {%
605   \expandafter\XINT_sgnfwover_a\romannumeral0\XINT_infrac {#1}%
606 }%
607 \def\XINT_sgnfwover_a #1#2%
608 {%
609   \XINT_sgnfwover_b #2\Z {#1}%
610 }%
611 \def\XINT_sgnfwover_b #1%
612 {%
613   \xint_UDsignfork
614   #1\XINT_sgnfwover_N
615   -{\XINT_sgnfwover_P #1}%
616   \krof
617 }%
618 \def\XINT_sgnfwover_P #1\Z #2%
619 {%
620   \XINT_fwover_A {#2}{#1}%
621 }%
622 \def\XINT_sgnfwover_N
623 {%
624   \expandafter\xint_minus_thenstop\romannumeral0\XINT_sgnfwover_P
625 }%

```

### 7.22 \xintREZ

```

626 \def\xintREZ {\romannumeral0\xintrez }%
627 \def\xintrez
628 {%
629   \expandafter\XINT_rez_A\romannumeral0\XINT_infrac
630 }%
631 \def\XINT_rez_A #1#2%
632 {%
633   \XINT_rez_AB #2\Z {#1}%
634 }%
635 \def\XINT_rez_AB #1%
636 {%

```

```

637 \xint_UDzerominusfork
638 #1-\XINT_rez_zero
639 0#1\XINT_rez_neg
640 0-\XINT_rez_B #1}%
641 \krof
642 }%
643 \def\XINT_rez_zero #1\Z #2#3{ 0/1[0]}%
644 \def\XINT_rez_neg {\expandafter\xint_minus_thenstop\romannumeral0\XINT_rez_B }%
645 \def\XINT_rez_B #1\Z
646 {%
647 \expandafter\XINT_rez_C\romannumeral0\XINT_factortens {#1}%
648 }%
649 \def\XINT_rez_C #1#2#3#4%
650 {%
651 \expandafter\XINT_rez_D\romannumeral0\XINT_factortens {#4}{#3}{#2}{#1}%
652 }%
653 \def\XINT_rez_D #1#2#3#4#5%
654 {%
655 \expandafter\XINT_rez_E\expandafter
656 {\the\numexpr #3+#4-#2}{#1}{#5}%
657 }%
658 \def\XINT_rez_E #1#2#3{ #3/#2[#1]}%

```

### 7.23 `\xintE`, `\xintFloatE`, `\XINTinFloatE`

1.07: The fraction is the first argument contrarily to `\xintTrunc` and `\xintRound`.

`\xintfE` (1.07) and `\xintiE` (1.09i) are for `\xintexpr` and cousins. It is quite annoying that `\numexpr` does not know how to deal correctly with a minus sign - as prefix: `\numexpr -(1)\relax` is illegal! (one can do `\numexpr 0-(1)\relax`).

the 1.07 `\xintE` puts directly its second argument in a `\numexpr`. The `\xintfE` first uses `\xintNum` on it, this is necessary for use in `\xintexpr`. (but one cannot use directly infix notation in the second argument of `\xintfE`)

1.09i also adds `\xintFloatE` and modifies `\XINTinFloatE`, although currently the latter is only used from `\xintfloatexpr` hence always with `\XINTdigits`, it comes equipped with its first argument within brackets as the other `\XINTinFloat...` macros.

1.09m ceases here and elsewhere, also in `\xintcfracname`, to use `\Z` as delimiter in the code for the optional argument, as this is unsafe (it makes impossible to the user to employ `\Z` as argument to the macro). Replaced by `\xint_relax`. 1.09e had already done that in `\xintSeq`, but this should have been systematic.

1.1 modifies and moves `\xintiiE` to `xint.sty`, and cleans up some unneeded stuff, now that expressions implement scientific notation directly at the number parsing level.

```

659 \def\xintE {\romannumeral0\xinte }%
660 \def\xinte #1%
661 {%
662 \expandafter\XINT_e \romannumeral0\XINT_infrac {#1}%
663 }%
664 \def\XINT_e #1#2#3#4%
665 {%
666 \expandafter\XINT_e_end\expandafter{\the\numexpr #1+#4}{#2}{#3}%
667 }%
668 \def\XINT_e_end #1#2#3{ #2/#3[#1]}%
669 \def\xintFloatE {\romannumeral0\xintfloate }%

```

```

670 \def\xintfloate #1{\XINT_floate_chkopt #1\xint_relax }%
671 \def\XINT_floate_chkopt #1%
672 {%
673   \ifx [#1\expandafter\XINT_floate_opt
674     \else\expandafter\XINT_floate_noopt
675   \fi #1%
676 }%
677 \def\XINT_floate_noopt #1\xint_relax
678 {%
679   \expandafter\XINT_floate_a\expandafter\XINTdigits
680     \romannumeral0\XINT_infrac {#1}%
681 }%
682 \def\XINT_floate_opt [\xint_relax #1]#2%
683 {%
684   \expandafter\XINT_floate_a\expandafter
685     {\the\numexpr #1\expandafter}\romannumeral0\XINT_infrac {#2}%
686 }%
687 \def\XINT_floate_a #1#2#3#4#5%
688 {%
689   \expandafter\expandafter\expandafter\XINT_float_a
690   \expandafter\xint_exchangetwo_keepbraces\expandafter
691     {\the\numexpr #2+#5}{#1}{#3}{#4}\XINT_float_Q
692 }%
693 \def\XINTinFloateE {\romannumeral0\XINTinfloate }%
694 \def\XINTinfloate {\expandafter\XINT_infloate\romannumeral0\XINTinfloat [\XINTdigits]}%
695 \def\XINT_infloate #1[#2]#3%
696   {\expandafter\XINT_infloate_end\expandafter {\the\numexpr #3+#2}{#1}}%
697 \def\XINT_infloate_end #1#2{ #2[#1]}%

```

## 7.24 \xintIrr

1.04 fixes a buggy \xintIrr {0}. 1.05 modifies the initial parsing and post-processing to use \xintrawithzeros and to more quickly deal with an input denominator equal to 1. 1.08 version does not remove a /1 denominator.

```

698 \def\xintIrr {\romannumeral0\xintirr }%
699 \def\xintirr #1%
700 {%
701   \expandafter\XINT_irr_start\romannumeral0\xintrawithzeros {#1}\Z
702 }%
703 \def\XINT_irr_start #1#2/#3\Z
704 {%
705   \if0\XINT_isOne {#3}%
706     \xint_afterfi
707       {\xint_UDsignfork
708         #1\XINT_irr_negative
709         -{\XINT_irr_nonneg #1}%
710       \krof}%
711   \else
712     \xint_afterfi{\XINT_irr_denomisone #1}%
713   \fi
714   #2\Z {#3}%
715 }%

```

```

716 \def\XINT_irr_denomisine #1\Z #2{ #1/1}% changed in 1.08
717 \def\XINT_irr_negative #1\Z #2{\XINT_irr_D #1\Z #2\Z \xint_minus_thenstop}%
718 \def\XINT_irr_nonneg #1\Z #2{\XINT_irr_D #1\Z #2\Z \space}%
719 \def\XINT_irr_D #1#2\Z #3#4\Z
720 {%
721   \xint_UDzerosfork
722     #3#1\XINT_irr_indeterminate
723     #30\XINT_irr_divisionbyzero
724     #10\XINT_irr_zero
725     00\XINT_irr_loop_a
726   \krof
727   {#3#4}{#1#2}{#3#4}{#1#2}%
728 }%
729 \def\XINT_irr_indeterminate #1#2#3#4#5{\xintError:NaN\space 0/0}%
730 \def\XINT_irr_divisionbyzero #1#2#3#4#5{\xintError:DivisionByZero #5#2/0}%
731 \def\XINT_irr_zero #1#2#3#4#5{ 0/1}% changed in 1.08
732 \def\XINT_irr_loop_a #1#2%
733 {%
734   \expandafter\XINT_irr_loop_d
735   \romannumeral0\XINT_div_prepare {#1}{#2}{#1}%
736 }%
737 \def\XINT_irr_loop_d #1#2%
738 {%
739   \XINT_irr_loop_e #2\Z
740 }%
741 \def\XINT_irr_loop_e #1#2\Z
742 {%
743   \xint_gob_til_zero #1\xint_irr_loop_exit0\XINT_irr_loop_a {#1#2}%
744 }%
745 \def\xint_irr_loop_exit0\XINT_irr_loop_a #1#2#3#4%
746 {%
747   \expandafter\XINT_irr_loop_exitb\expandafter
748   {\romannumeral0\xintiique {#3}{#2}}%
749   {\romannumeral0\xintiique {#4}{#2}}%
750 }%
751 \def\XINT_irr_loop_exitb #1#2%
752 {%
753   \expandafter\XINT_irr_finish\expandafter {#2}{#1}%
754 }%
755 \def\XINT_irr_finish #1#2#3{#3#1/#2}% changed in 1.08

```

## 7.25 \xintifInt

1.09e. *xintfrac.sty* only. Fixed in 1.1 to not use `\xintIrr` anymore as it was really stupid overhead.

```

756 \def\xintifInt {\romannumeral0\xintifint}%
757 \def\xintifint #1{\expandafter\XINT_ifint\romannumeral0\xintrawwithzeros {#1}.}%
758 \def\XINT_ifint #1/#2.%
759 {%
760   \if 0\xintiiRem {#1}{#2}%
761   \expandafter\xint_firstoftwo_thenstop
762   \else

```

```

763 \expandafter\xint_secondoftwo_thenstop
764 \fi
765 }%

```

## 7.26 \xintJrr

Modified similarly as \xintIrr in release 1.05. 1.08 version does not remove a /1 denominator.

```

766 \def\xintJrr {\romannumeral0\xintjrr }%
767 \def\xintjrr #1%
768 {%
769 \expandafter\XINT_jrr_start\romannumeral0\xintraewithzeros {#1}\Z
770 }%
771 \def\XINT_jrr_start #1#2/#3\Z
772 {%
773 \if0\XINT_isOne {#3}\xint_afterfi
774 {\xint_UDsignfork
775 #1\XINT_jrr_negative
776 -{\XINT_jrr_nonneg #1}%
777 \krof}%
778 \else
779 \xint_afterfi{\XINT_jrr_denomisine #1}%
780 \fi
781 #2\Z {#3}%
782 }%
783 \def\XINT_jrr_denomisine #1\Z #2{ #1/1}% changed in 1.08
784 \def\XINT_jrr_negative #1\Z #2{\XINT_jrr_D #1\Z #2\Z \xint_minus_thenstop }%
785 \def\XINT_jrr_nonneg #1\Z #2{\XINT_jrr_D #1\Z #2\Z \space}%
786 \def\XINT_jrr_D #1#2\Z #3#4\Z
787 {%
788 \xint_UDzerosfork
789 #3#1\XINT_jrr_indeterminate
790 #30\XINT_jrr_divisionbyzero
791 #10\XINT_jrr_zero
792 00\XINT_jrr_loop_a
793 \krof
794 {#3#4}{#1#2}1001%
795 }%
796 \def\XINT_jrr_indeterminate #1#2#3#4#5#6#7{\xintError:NaN\space 0/0}%
797 \def\XINT_jrr_divisionbyzero #1#2#3#4#5#6#7{\xintError:DivisionByZero #7#2/0}%
798 \def\XINT_jrr_zero #1#2#3#4#5#6#7{ 0/1}% changed in 1.08
799 \def\XINT_jrr_loop_a #1#2%
800 {%
801 \expandafter\XINT_jrr_loop_b
802 \romannumeral0\XINT_div_prepare {#1}{#2}{#1}%
803 }%
804 \def\XINT_jrr_loop_b #1#2#3#4#5#6#7%
805 {%
806 \expandafter \XINT_jrr_loop_c \expandafter
807 {\romannumeral0\xintiiadd{\XINT_mul_fork #4\Z #1\Z}{#6}}%
808 {\romannumeral0\xintiiadd{\XINT_mul_fork #5\Z #1\Z}{#7}}%
809 {#2}{#3}{#4}{#5}%
810 }%

```

```

811 \def\XINT_jrr_loop_c #1#2%
812 {%
813   \expandafter \XINT_jrr_loop_d \expandafter{#2}{#1}%
814 }%
815 \def\XINT_jrr_loop_d #1#2#3#4%
816 {%
817   \XINT_jrr_loop_e #3\Z {#4}{#2}{#1}%
818 }%
819 \def\XINT_jrr_loop_e #1#2\Z
820 {%
821   \xint_gob_til_zero #1\xint_jrr_loop_exit0\XINT_jrr_loop_a {#1#2}%
822 }%
823 \def\xint_jrr_loop_exit0\XINT_jrr_loop_a #1#2#3#4#5#6%
824 {%
825   \XINT_irr_finish {#3}{#4}%
826 }%

```

## 7.27 \xintTFrac

1.09i, for frac in \xintexpr. And \xintFrac is already assigned. T for truncation. However, potentially not very efficient with numbers in scientific notations, with big exponents. Will have to think it again some day. I hesitated how to call the macro. Same convention as in maple, but some people reserve fractional part to  $x - \text{floor}(x)$ . Also, not clear if I had to make it negative (or zero) if  $x < 0$ , or rather always positive. There should be in fact such a thing for each rounding function, trunc, round, floor, ceil.

```

827 \def\xintTFrac {\romannumeral0\xinttfrac }%
828 \def\xinttfrac #1{\expandafter\XINT_tfrac_fork\romannumeral0\xintrawithzeros {#1}\Z }%
829 \def\XINT_tfrac_fork #1%
830 {%
831   \xint_UDzerominusfork
832   #1-\XINT_tfrac_zero
833   0#1{\xintiiopt\XINT_tfrac_P }%
834   0-{\XINT_tfrac_P #1}%
835   \krof
836 }%
837 \def\XINT_tfrac_zero #1\Z { 0/1[0]}%
838 \def\XINT_tfrac_P #1/#2\Z {\expandafter\XINT_rez_AB
839   \romannumeral0\xintiirem{#1}{#2}\Z {0}{#2}}%

```

## 7.28 \XINTinFloatFracdigits

1.09i, for frac in \xintfloatexpr. This version computes exactly from the input the fractional part and then only converts it into a float with the asked-for number of digits. I will have to think it again some day, certainly.

1.1 removes optional argument for which there was anyhow no interface, for technical reasons having to do with \xintNewExpr.

1.1a renames the macro as \XINTinFloatFracdigits (from \XINTinFloatFrac) to be synchronous with the \XINTinFloatSqrt and \XINTinFloat habits related to \xintNewExpr problems.

Note to myself: I still have to rethink the whole thing about what is the best to do, the initial way of going through \xinttfrac was just a first implementation.

```

840 \def\XINTinFloatFracdigits {\romannumeral0\XINTinfloatfracdigits }%

```

```

841 \def\XINTinfloatfracdigits #1%
842 {%
843   \expandafter\XINT_infloatfracdg_a\expandafter {\romannumeral0\xinttfrac{#1}}%
844 }%
845 \def\XINT_infloatfracdg_a {\XINTinfloat [\XINTdigits]]%

```

## 7.29 \xintTrunc, \xintiTrunc

Modified in 1.06 to give the first argument to a \numexpr.

1.09f fixes the overhead added in 1.09a to some inner routines when \xintiquo was redefined to use \xintnum. Now uses \xintiiquo, rather.

1.09j: minor improvements, \XINT\_trunc\_E was very strange and defined two never occurring branches; also, optimizes the call to the division routine, and the zero loops.

1.1 adds \xintTTrunc as a shortcut to what \xintiTrunc 0 does, and maps \xintNum to it.

```

846 \def\xintTrunc {\romannumeral0\xinttrunc}%
847 \def\xintiTrunc {\romannumeral0\xintitrunc}%
848 \def\xinttrunc #1%
849 {%
850   \expandafter\XINT_trunc\expandafter {\the\numexpr #1}%
851 }%
852 \def\XINT_trunc #1#2%
853 {%
854   \expandafter\XINT_trunc_G
855   \romannumeral0\expandafter\XINT_trunc_A
856   \romannumeral0\XINT_infrac {#2}{#1}{#1}%
857 }%
858 \def\xintitrunc #1%
859 {%
860   \expandafter\XINT_itrunc\expandafter {\the\numexpr #1}%
861 }%
862 \def\XINT_itrunc #1#2%
863 {%
864   \expandafter\XINT_itrunc_G
865   \romannumeral0\expandafter\XINT_trunc_A
866   \romannumeral0\XINT_infrac {#2}{#1}{#1}%
867 }%
868 \def\XINT_trunc_A #1#2#3#4%
869 {%
870   \expandafter\XINT_trunc_checkifzero
871   \expandafter{\the\numexpr #1+#4}#2\Z {#3}%
872 }%
873 \def\XINT_trunc_checkifzero #1#2#3\Z
874 {%
875   \xint_gob_til_zero #2\XINT_trunc_iszero0\XINT_trunc_B {#1}{#2#3}%
876 }%
877 \def\XINT_trunc_iszero0\XINT_trunc_B #1#2#3{ 0\Z 0}%
878 \def\XINT_trunc_B #1%
879 {%
880   \ifcase\XINT_cntSgn #1\Z
881     \expandafter\XINT_trunc_D
882   \or
883     \expandafter\XINT_trunc_D

```



## 7 Package *xintfrac* implementation

```

884 \else
885 \expandafter\XINT_trunc_C
886 \fi
887 {#1}%
888 }%
889 \def\XINT_trunc_C #1#2#3%
890 {%
891 \expandafter\XINT_trunc_CE\expandafter
892 {\romannumeral0\XINT_dsx_zeroloop {-#1}{}\Z {#3}}{#2}%
893 }%
894 \def\XINT_trunc_CE #1#2{\XINT_trunc_E #2.{#1}}%
895 \def\XINT_trunc_D #1#2%
896 {%
897 \expandafter\XINT_trunc_E
898 \romannumeral0\XINT_dsx_zeroloop {#1}{}\Z {#2}.%
899 }%
900 \def\XINT_trunc_E #1%
901 {%
902 \xint_UDsignfork
903 #1\XINT_trunc_Fneg
904 -{\XINT_trunc_Fpos #1}%
905 \krof
906 }%
907 \def\XINT_trunc_Fneg #1.#2{\expandafter\xint_firstoftwo_thenstop
908 \romannumeral0\XINT_div_prepare {#2}{#1}\Z \xint_minus_thenstop}%
909 \def\XINT_trunc_Fpos #1.#2{\expandafter\xint_firstoftwo_thenstop
910 \romannumeral0\XINT_div_prepare {#2}{#1}\Z \space }%
911 \def\XINT_itrunc_G #1#2\Z #3#4%
912 {%
913 \xint_gob_til_zero #1\XINT_trunc_zero 0#3#1#2%
914 }%
915 \def\XINT_trunc_zero 0#1#20{ 0}%
916 \def\XINT_trunc_G #1\Z #2#3%
917 {%
918 \xint_gob_til_zero #2\XINT_trunc_zero 0%
919 \expandafter\XINT_trunc_H\expandafter
920 {\the\numexpr\romannumeral0\xintlength {#1}-#3}{#3}{#1}#2%
921 }%
922 \def\XINT_trunc_H #1#2%
923 {%
924 \ifnum #1 > \xint_c_
925 \xint_afterfi {\XINT_trunc_Ha {#2}}%
926 \else
927 \xint_afterfi {\XINT_trunc_Hb {-#1}}% -0,--1,--2, ....
928 \fi
929 }%
930 \def\XINT_trunc_Ha
931 {%
932 \expandafter\XINT_trunc_Haa\romannumeral0\xintdecsplit
933 }%
934 \def\XINT_trunc_Haa #1#2#3%
935 {%

```

```

936      #3#1.#2%
937 }%
938 \def\XINT_trunc_Hb #1#2#3%
939 {%
940   \expandafter #3\expandafter0\expandafter.%
941   \romannumeral0\XINT_dsx_zeroloop {#1}{}\Z {}#2% #1=-0 autoris\'e !
942 }%

```

### 7.30 `\xintTTrunc`

1.1, a tiny bit more efficient than doing `\xintiTrunc0`. I map `\xintNum` to it, and I use it in `\xintexpr` for various things. Faster I guess than the `\xintiFloor`.

```

943 \def\xintTTrunc {\romannumeral0\xintttrunc }%
944 \def\xintttrunc #1%
945 {%
946   \expandafter\XINT_itrunc_G
947   \romannumeral0\expandafter\XINT_ttrunc_A
948   \romannumeral0\XINT_infrac {#1}0% this last 0 to let \XINT_itrunc_G be happy
949 }%
950 \def\XINT_ttrunc_A #1#2#3{\XINT_trunc_checkifzero {#1}#2\Z {#3}}%

```

### 7.31 `\xintNum`

This extension of the `xint` original `xintNum` is added in 1.05, as a synonym to `\xintIrr`, but raising an error when the input does not evaluate to an integer. Usable with not too much overhead on integer input as `\xintIrr` checks quickly for a denominator equal to 1 (which will be put there by the `\XINT_infrac` called by `\xintrawwithzeros`). This way, macros such as `\xintQuo` can be modified with minimal overhead to accept fractional input as long as it evaluates to an integer.

22 june 2014 (dev 1.1) I just don't understand what was the point of going through `\xintIrr` if to raise an error afterwards... and raising errors is silly, so let's do it sanely at last. In between I added `\xintiFloor`, thus, let's just let it to it.

24 october 2014 (final 1.1) (I left it taking dust since June...), I did `\xintTTrunc`, and will thus map `\xintNum` to it

```

951 \let\xintNum \xintTTrunc
952 \let\xintnum \xintttrunc

```

### 7.32 `\xintRound`, `\xintiRound`

Modified in 1.06 to give the first argument to a `\numexpr`.

```

953 \def\xintRound {\romannumeral0\xintround }%
954 \def\xintiRound {\romannumeral0\xintiround }%
955 \def\xintround #1%
956 {%
957   \expandafter\XINT_round\expandafter {\the\numexpr #1}%
958 }%
959 \def\XINT_round
960 {%
961   \expandafter\XINT_trunc_G\romannumeral0\XINT_round_A
962 }%
963 \def\xintiround #1%

```

```

964 {%
965   \expandafter\XINT_iround\expandafter {\the\numexpr #1}%
966 }%
967 \def\XINT_iround
968 {%
969   \expandafter\XINT_itrunc_G\romannumeral0\XINT_round_A
970 }%
971 \def\XINT_round_A #1#2%
972 {%
973   \expandafter\XINT_round_B
974   \romannumeral0\expandafter\XINT_trunc_A
975   \romannumeral0\XINT_infrac {#2}{\the\numexpr #1+1\relax}{#1}%
976 }%
977 \def\XINT_round_B #1\Z
978 {%
979   \expandafter\XINT_round_C
980   \romannumeral0\XINT_rord_main {}#1%
981   \xint_relax
982   \xint_bye\xint_bye\xint_bye\xint_bye
983   \xint_bye\xint_bye\xint_bye\xint_bye
984   \xint_relax
985   \Z
986 }%
987 \def\XINT_round_C #1%
988 {%
989   \ifnum #1<5
990     \expandafter\XINT_round_Daa
991   \else
992     \expandafter\XINT_round_Dba
993   \fi
994 }%
995 \def\XINT_round_Daa #1%
996 {%
997   \xint_gob_til_Z #1\XINT_round_Daz\Z \XINT_round_Da #1%
998 }%
999 \def\XINT_round_Daz\Z \XINT_round_Da \Z { 0\Z }%
1000 \def\XINT_round_Da #1\Z
1001 {%
1002   \XINT_rord_main {}#1%
1003   \xint_relax
1004   \xint_bye\xint_bye\xint_bye\xint_bye
1005   \xint_bye\xint_bye\xint_bye\xint_bye
1006   \xint_relax \Z
1007 }%
1008 \def\XINT_round_Dba #1%
1009 {%
1010   \xint_gob_til_Z #1\XINT_round_Dbz\Z \XINT_round_Db #1%
1011 }%
1012 \def\XINT_round_Dbz\Z \XINT_round_Db \Z { 1\Z }%
1013 \def\XINT_round_Db #1\Z
1014 {%
1015   \XINT_addm_A 0{}1000\W\X\Y\Z #1000\W\X\Y\Z \Z

```

1016 }%

### 7.33 `\xintXTrunc`

1.09j [2014/01/06] This is completely expandable but not f-expandable. Designed be used inside an `\edef` or a `\write`, if one is interested in getting tens of thousands of digits from the decimal expansion of some fraction... it is not worth using it rather than `\xintTrunc` if for less than \*hundreds\* of digits. For efficiency it clones part of the preparatory division macros, as the same denominator will be used again and again. The `D` parameter which says how many digits to keep after decimal mark must be at least 1 (and it is forcefully set to such a value if found negative or zero, to avoid an eternal loop).

For reasons of efficiency I try to use the shortest possible denominator, so if the fraction is  $A/B[N]$ , I want to use  $B$ . For  $N$  at least zero, just immediately replace  $A$  by  $A \cdot 10^N$ . The first division then may be a little longish but the next ones will be fast (if  $B$  is not too big). For  $N < 0$ , this is a bit more complicated. I thought somewhat about this, and I would need a rather complicated approach going through a long division algorithm, forcing me to essentially clone the actual division with some differences; a side thing is that as this would use blocks of four digits I would have a hard time allowing a non-multiple of four number of post decimal mark digits.

Thus, for  $N < 0$ , another method is followed. First the euclidean division  $A/B = Q + R/B$  is done. The number of digits of  $Q$  is  $M$ . If  $|N| \leq D$ , we launch inside a `\csname` the routine for obtaining  $D - |N|$  next digits (this may impact TeX's memory if  $D$  is very big), call them  $T$ . We then need to position the decimal mark  $D$  slots from the right of  $QT$ , which has length  $M + D - |N|$ , hence  $|N|$  slots from the right of  $Q$ . We thus avoid having to work with the  $T$ , as  $D$  may be very very big (`\xintXTrunc`'s only goal is to make it possible to learn by hearts decimal expansions with thousands of digits). We can use the `\xintDecSplit` for that on  $Q$ . Computing the length  $M$  of  $Q$  was a more or less unavoidable step. If  $|N| > D$ , the `\csname` step is skipped we need to remove the  $D - |N|$  last digits from  $Q$ , etc.. we compare  $D - |N|$  with the length  $M$  of  $Q$  etc... (well in this last, very uncommon, branch, I stopped trying to optimize things and I even do an `\xintnum` to ensure a 0 if something comes out empty from `\xintDecSplit`).

[2015/10/04] Although the explanations above are extremely clear, there are just too complicated for me to be now able to understand them fully. I miraculously managed to do the minimal changes (all happens between `\XINT_xtrunc_Q` and `\XINT_xtrunc_Pa`) in order for `\xintXTrunc` to use the 1.2 division routine. Seems to work. But some thought should be given to how to adapt `\xintXTrunc` for it to better use the abilities and characteristics of the new division routines in `xincore`.

```

1017 \def\xintXTrunc #1#2%
1018 {%
1019   \expandafter\XINT_xtrunc_a\expandafter
1020   {\the\numexpr #1\expandafter}\romannumeral0\xintra #2}%
1021 }%
1022 \def\XINT_xtrunc_a #1%
1023 {%
1024   \expandafter\XINT_xtrunc_b\expandafter
1025   {\the\numexpr ifnum#1<\xint_c_i \xint_c_i-\fi #1}%
1026 }%
1027 \def\XINT_xtrunc_b #1%
1028 {%
1029   \expandafter\XINT_xtrunc_c\expandafter
1030   {\the\numexpr (#1+\xint_c_ii^v)/\xint_c_ii^vi-\xint_c_i}\{#1}%
1031 }%
1032 \def\XINT_xtrunc_c #1#2%
1033 {%

```

[illegible]

#1=D- |N|<=0, #2=|N|, #3=D, #4=R, #5=B, #6=Q

## 7 Package `xintfrac` implementation

[illegible]

## 7 Package `xintfrac` implementation

[illegible]



```

1234 }%
1235 \def\XINT_xtrunc_D #1#2#3%
1236 {%
1237   \romannumeral0\expandafter\XINT_dsx_zeroloop\expandafter
1238     {\the\numexpr \xint_c_ii^vi-\xintLength{#1}}}\Z {}#1%
1239   \XINT_xtrunc_A {#3}{#2}%
1240 }%
1241 \def\XINT_xtrunc_transition\fi
1242   \expandafter\XINT_xtrunc_B\expandafter #1#2#3#4%
1243 {%
1244   \fi
1245   \ifnum #4=\xint_c_ \XINT_xtrunc_abort\fi
1246   \expandafter\XINT_xtrunc_x\expandafter
1247     {\romannumeral0\XINT_dsx_zeroloop {#4}}\Z {#2}}{#3}{#4}%
1248 }%
1249 \def\XINT_xtrunc_x #1#2%
1250 {%
1251   \expandafter\XINT_xtrunc_y\romannumeral0#2{#1}%
1252 }%
1253 \def\XINT_xtrunc_y #1#2#3%
1254 {%
1255   \romannumeral0\expandafter\XINT_dsx_zeroloop\expandafter
1256     {\the\numexpr #3-\xintLength{#1}}}\Z {}#1%
1257 }%
1258 \def\XINT_xtrunc_abort\fi\expandafter\XINT_xtrunc_x\expandafter #1#2#3{\fi}%

```

### 7.34 \xintDigits

The `mathchardef` used to be called `\XINT_digits`, but for reasons originating in `\xintNewExpr` (and now obsolete), release 1.09a uses `\XINTdigits` without underscore.

```

1259 \mathchardef\XINTdigits 16
1260 \def\xintDigits #1#2%
1261   {\afterassignment \xint_gobble_i \mathchardef\XINTdigits=}%
1262 \def\xinttheDigits {\number\XINTdigits }%

```

### 7.35 \xintFloat

1.07. Completely re-written in 1.08a, with spectacular speed gains. The earlier version was seriously silly when dealing with inputs having a big power of ten. Again some modifications in 1.08b for a better treatment of cases with long explicit numerators or denominators.

```

1263 \def\xintFloat {\romannumeral0\xintfloat }%
1264 \def\xintfloat #1{\XINT_float_chkopt #1\xint_relax }%
1265 \def\XINT_float_chkopt #1%
1266 {%
1267   \ifx [#1\expandafter\XINT_float_opt
1268     \else\expandafter\XINT_float_noopt
1269   \fi #1%
1270 }%
1271 \def\XINT_float_noopt #1\xint_relax
1272 {%
1273   \expandafter\XINT_float_a\expandafter\XINTdigits

```

```

1274 \romannumeral0\XINT_infrac {#1}\XINT_float_Q
1275 }%
1276 \def\XINT_float_opt [\xint_relax #1]#2%
1277 {%
1278 \expandafter\XINT_float_a\expandafter
1279 {\the\numexpr #1\expandafter}%
1280 \romannumeral0\XINT_infrac {#2}\XINT_float_Q
1281 }%
1282 \def\XINT_float_a #1#2#3% #1=P, #2=n, #3=A, #4=B
1283 {%
1284 \XINT_float_fork #3\Z {#1}{#2}% #1 = precision, #2=n
1285 }%
1286 \def\XINT_float_fork #1%
1287 {%
1288 \xint_UDzerominusfork
1289 #1-\XINT_float_zero
1290 0#1\XINT_float_J
1291 0-\XINT_float_K #1}%
1292 \krof
1293 }%
1294 \def\XINT_float_zero #1\Z #2#3#4#5{ 0.e0}%
1295 \def\XINT_float_J {\expandafter\xint_minus_thenstop\romannumeral0\XINT_float_K }%
1296 \def\XINT_float_K #1\Z #2% #1=A, #2=P, #3=n, #4=B
1297 {%
1298 \expandafter\XINT_float_L\expandafter
1299 {\the\numexpr\xintLength{#1}\expandafter}\expandafter
1300 {\the\numexpr #2+\xint_c_ii}{#1}{#2}%
1301 }%
1302 \def\XINT_float_L #1#2%
1303 {%
1304 \ifnum #1>#2
1305 \expandafter\XINT_float_Ma
1306 \else
1307 \expandafter\XINT_float_Mc
1308 \fi {#1}{#2}%
1309 }%
1310 \def\XINT_float_Ma #1#2#3%
1311 {%
1312 \expandafter\XINT_float_Mb\expandafter
1313 {\the\numexpr #1-#2\expandafter\expandafter\expandafter}%
1314 \expandafter\expandafter\expandafter
1315 {\expandafter\xint_firstoftwo
1316 \romannumeral0\XINT_split_fromleft_loop {#2}{#3}\W\W\W\W\W\W\W\W\Z
1317 }{#2}%
1318 }%
1319 \def\XINT_float_Mb #1#2#3#4#5#6% #2=A', #3=P+2, #4=P, #5=n, #6=B
1320 {%
1321 \expandafter\XINT_float_N\expandafter
1322 {\the\numexpr\xintLength{#6}\expandafter}\expandafter
1323 {\the\numexpr #3\expandafter}\expandafter
1324 {\the\numexpr #1+#5}%
1325 {#6}{#3}{#2}{#4}%

```

```

1326 }% long de B, P+2, n', B, |A'|=P+2, A', P
1327 \def\XINT_float_Mc #1#2#3#4#5#6%
1328 {%
1329   \expandafter\XINT_float_N\expandafter
1330   {\romannumeral0\xintlength{#6}}{#2}{#5}{#6}{#1}{#3}{#4}%
1331 }% long de B, P+2, n, B, |A|, A, P
1332 \def\XINT_float_N #1#2%
1333 {%
1334   \ifnum #1>#2
1335     \expandafter\XINT_float_0
1336   \else
1337     \expandafter\XINT_float_P
1338   \fi {#1}{#2}%
1339 }%
1340 \def\XINT_float_0 #1#2#3#4%
1341 {%
1342   \expandafter\XINT_float_P\expandafter
1343   {\the\numexpr #2\expandafter}\expandafter
1344   {\the\numexpr #2\expandafter}\expandafter
1345   {\the\numexpr #3-#1+#2\expandafter\expandafter\expandafter}%
1346   \expandafter\expandafter\expandafter
1347   {\expandafter\xint_firstoftwo
1348     \romannumeral0\XINT_split_fromleft_loop {#2}}{#4\W\W\W\W\W\W\W\W\Z
1349   }%
1350 }% |B|,P+2,n,B,|A|,A,P
1351 \def\XINT_float_P #1#2#3#4#5#6#7#8%
1352 {%
1353   \expandafter #8\expandafter {\the\numexpr #1-#5+#2-\xint_c_i}%
1354   {#6}{#4}{#7}{#3}%
1355 }% |B|-|A|+P+1,A,B,P,n
1356 \def\XINT_float_Q #1%
1357 {%
1358   \ifnum #1<\xint_c_
1359     \expandafter\XINT_float_Ri
1360   \else
1361     \expandafter\XINT_float_Rii
1362   \fi {#1}%
1363 }%
1364 \def\XINT_float_Ri #1#2#3%
1365 {%
1366   \expandafter\XINT_float_Sa
1367   \romannumeral0\xintiique {#2}%
1368   {\XINT_dsx_addzerosnofuss {-#1}{#3}}\Z {#1}%
1369 }%
1370 \def\XINT_float_Rii #1#2#3%
1371 {%
1372   \expandafter\XINT_float_Sa
1373   \romannumeral0\xintiique
1374   {\XINT_dsx_addzerosnofuss {#1}{#2}}{#3}\Z {#1}%
1375 }%
1376 \def\XINT_float_Sa #1%
1377 {%

```

```

1378 \if #19%
1379 \xint_afterfi {\XINT_float_Sb\XINT_float_Wb }%
1380 \else
1381 \xint_afterfi {\XINT_float_Sb\XINT_float_Wa }%
1382 \fi #1%
1383 }%
1384 \def\XINT_float_Sb #1#2\Z #3#4%
1385 {%
1386 \expandafter\XINT_float_T\expandafter
1387 {\the\numexpr #4+\xint_c_i\expandafter}%
1388 \romannumeral-\`0\XINT_lenrord_loop 0{}\#2\Z\W\W\W\W\W\W\W\Z #1{\#3}{\#4}%
1389 }%
1390 \def\XINT_float_T #1#2#3%
1391 {%
1392 \ifnum #2>#1
1393 \xint_afterfi{\XINT_float_U\XINT_float_Xb}%
1394 \else
1395 \xint_afterfi{\XINT_float_U\XINT_float_Xa #3}%
1396 \fi
1397 }%
1398 \def\XINT_float_U #1#2%
1399 {%
1400 \ifnum #2<\xint_c_v
1401 \expandafter\XINT_float_Va
1402 \else
1403 \expandafter\XINT_float_Vb
1404 \fi #1%
1405 }%
1406 \def\XINT_float_Va #1#2\Z #3%
1407 {%
1408 \expandafter#1%
1409 \romannumeral0\expandafter\XINT_float_Wa
1410 \romannumeral0\XINT_rord_main {}#2%
1411 \xint_relax
1412 \xint_bye\xint_bye\xint_bye\xint_bye
1413 \xint_bye\xint_bye\xint_bye\xint_bye
1414 \xint_relax \Z
1415 }%
1416 \def\XINT_float_Vb #1#2\Z #3%
1417 {%
1418 \expandafter #1%
1419 \romannumeral0\expandafter #3%
1420 \romannumeral0\XINT_addm_A 0{}\1000\W\X\Y\Z #2000\W\X\Y\Z \Z
1421 }%
1422 \def\XINT_float_Wa #1{ #1.}%
1423 \def\XINT_float_Wb #1#2%
1424 {\if #11\xint_afterfi{ 10.}\else\xint_afterfi{ #1.#2}\fi }%
1425 \def\XINT_float_Xa #1\Z #2#3#4%
1426 {%
1427 \expandafter\XINT_float_Y\expandafter
1428 {\the\numexpr #3+#4-#2}{\#1}%
1429 }%

```

```

1430 \def\XINT_float_Xb #1\Z #2#3#4%
1431 {%
1432   \expandafter\XINT_float_Y\expandafter
1433   {\the\numexpr #3+#4+\xint_c_i-#2}{#1}%
1434 }%
1435 \def\XINT_float_Y #1#2{ #2e#1}%

```

## 7.36 \xintPFloat

### 1.1

```

1436 \def\xintPFloat {\romannumeral0\xintpfloat }%
1437 \def\xintpfloat #1{\XINT_pfloat_chkopt #1\xint_relax }%
1438 \def\XINT_pfloat_chkopt #1%
1439 {%
1440   \ifx [#1\expandafter\XINT_pfloat_opt
1441     \else\expandafter\XINT_pfloat_noopt
1442   \fi #1%
1443 }%
1444 \def\XINT_pfloat_noopt #1\xint_relax
1445 {%
1446   \expandafter\XINT_pfloat_a\expandafter\XINTdigits
1447   \romannumeral0\XINTinfloat [\XINTdigits]{#1}%
1448 }%
1449 \def\XINT_pfloat_opt [\xint_relax #1]#2%
1450 {%
1451   \expandafter\XINT_pfloat_a\expandafter {\the\numexpr #1\expandafter}%
1452   \romannumeral0\XINTinfloat [\numexpr #1\relax]#2}%
1453 }%
1454 \def\XINT_pfloat_a #1#2%
1455 {%
1456   \xint_UDzerominusfork
1457                                     #2-\XINT_pfloat_zero
1458                                     0#2\XINT_pfloat_neg
1459                                     0-{\XINT_pfloat_pos #2}%
1460   \krof {#1}%
1461 }%
1462 \def\XINT_pfloat_zero #1[#2]{ 0}%
1463 \def\XINT_pfloat_neg
1464   {\expandafter\xint_minus_thenstop\romannumeral0\XINT_pfloat_pos {}}%
1465 \def\XINT_pfloat_pos #1#2#3[#4]%
1466 {%
1467   \ifnum#4>0 \xint_dothis\XINT_pfloat_no\fi
1468   \ifnum#4>\numexpr-#2\relax \xint_dothis\XINT_pfloat_b\fi
1469   \ifnum#4>\numexpr-#2-\xint_c_v\relax \xint_dothis\XINT_pfloat_B\fi
1470   \xint_orthat\XINT_pfloat_no {#2}{#4}{#1#3}%
1471 }%
1472 \def\XINT_pfloat_no #1#2%
1473 {%
1474   \expandafter\XINT_pfloat_no_b\expandafter{\the\numexpr #2+#1-\xint_c_i\relax}%
1475 }%
1476 \def\XINT_pfloat_no_b #1#2{\XINT_pfloat_no_c #2e#1}%
1477 \def\XINT_pfloat_no_c #1{ #1.}%

```

```

1478 \def\XINT_pfloat_b #1#2#3%
1479   {\expandafter\XINT_pfloat_c
1480     \romannumeral0\expandafter\XINT_split_fromleft_loop
1481     \expandafter {\the\numexpr #1+#2-\xint_c_i}\#3\W\W\W\W\W\W\W\W\Z }%
1482 \def\XINT_pfloat_c #1#2{ #1.#2}% #2 peut \^etre vide
1483 \def\XINT_pfloat_B #1#2#3%
1484   {\expandafter\XINT_pfloat_C
1485     \romannumeral0\XINT_dsx_zeroloop {\numexpr -#1-#2}\Z {}#3}%
1486 \def\XINT_pfloat_C { 0.}%

```

### 7.37 \XINTinFloat

1.07. Completely rewritten in 1.08a for immensely greater efficiency when the power of ten is big: previous version had some very serious bottlenecks arising from the creation of long strings of zeros, which made things such as  $2^{999999}$  completely impossible, but now even  $2^{999999999}$  with 24 significant digits is no problem! Again (slightly) improved in 1.08b.

I decide in 1.09a not to use anymore `\romannumeral`-0` mais `\romannumeral0` also in the float routines, for consistency of style.

Here again some inner macros used the `\xintiquo` with extra `\xintnum` overhead in 1.09a, 1.09f fixed that to use `\xintiiquo` for example.

1.09i added a stupid bug to `\XINT_infloat_zero` when it changed `0[0]` to a silly `0/1[0]`, breaking in particular `\xintFloatAdd` when one of the argument is zero :(((

1.09j fixes this. Besides, for notational coherence `\XINT_inFloat` and `\XINT_infloat` have been renamed respectively `\XINTinFloat` and `\XINTinfloat` in release 1.09j.

```

1487 \def\XINTinFloat {\romannumeral0\XINTinfloat }%
1488 \def\XINTinfloat [#1]#2%
1489 {%
1490   \expandafter\XINT_infloat_a\expandafter
1491   {\the\numexpr #1\expandafter}%
1492   \romannumeral0\XINT_infrac {#2}\XINT_infloat_Q
1493 }%
1494 \def\XINT_infloat_a #1#2#3% #1=P, #2=n, #3=A, #4=B
1495 {%
1496   \XINT_infloat_fork #3\Z {#1}{#2}% #1 = precision, #2=n
1497 }%
1498 \def\XINT_infloat_fork #1%
1499 {%
1500   \xint_UDzerominusfork
1501   #1-\XINT_infloat_zero
1502   0#1\XINT_infloat_J
1503   0-\XINT_float_K #1}%
1504   \krof
1505 }%
1506 \def\XINT_infloat_zero #1\Z #2#3#4#5{ 0[0]}%

```

the `0[0]` was stupidly changed to `0/1[0]` in 1.09i, with the result that the Float addition would crash when an operand was zero.

```

1507 \def\XINT_infloat_J {\expandafter-\romannumeral0\XINT_float_K }%
1508 \def\XINT_infloat_Q #1%
1509 {%
1510   \ifnum #1<\xint_c_

```

```

1511     \expandafter\XINT_infloat_Ri
1512   \else
1513     \expandafter\XINT_infloat_Rii
1514   \fi {#1}%
1515 }%
1516 \def\XINT_infloat_Ri #1#2#3%
1517 {%
1518   \expandafter\XINT_infloat_S\expandafter
1519   {\romannumeral0\xintiigo {#2}%
1520     {\XINT_dsx_addzerosnofuss {-#1}{#3}}}{#1}%
1521 }%
1522 \def\XINT_infloat_Rii #1#2#3%
1523 {%
1524   \expandafter\XINT_infloat_S\expandafter
1525   {\romannumeral0\xintiigo
1526     {\XINT_dsx_addzerosnofuss {#1}{#2}}{#3}}{#1}%
1527 }%
1528 \def\XINT_infloat_S #1#2#3%
1529 {%
1530   \expandafter\XINT_infloat_T\expandafter
1531   {\the\numexpr #3+\xint_c_i\expandafter}%
1532   \romannumeral-\XINT_lenrord_loop 0{#1\Z\W\W\W\W\W\W\W\Z
1533   {#2}%
1534 }%
1535 \def\XINT_infloat_T #1#2#3%
1536 {%
1537   \ifnum #2>#1
1538     \xint_afterfi{\XINT_infloat_U\XINT_infloat_Wb}%
1539   \else
1540     \xint_afterfi{\XINT_infloat_U\XINT_infloat_Wa #3}%
1541   \fi
1542 }%
1543 \def\XINT_infloat_U #1#2%
1544 {%
1545   \ifnum #2<\xint_c_v
1546     \expandafter\XINT_infloat_Va
1547   \else
1548     \expandafter\XINT_infloat_Vb
1549   \fi #1%
1550 }%
1551 \def\XINT_infloat_Va #1#2\Z
1552 {%
1553   \expandafter#1%
1554   \romannumeral0\XINT_rord_main {}#2%
1555   \xint_relax
1556   \xint_bye\xint_bye\xint_bye\xint_bye
1557   \xint_bye\xint_bye\xint_bye\xint_bye
1558   \xint_relax \Z
1559 }%
1560 \def\XINT_infloat_Vb #1#2\Z
1561 {%
1562   \expandafter #1%

```

```

1563 \romannumeral0\XINT_addm_A 0{}1000\W\X\Y\Z #2000\W\X\Y\Z \Z
1564 }%
1565 \def\XINT_infloat_Wa #1\Z #2#3%
1566 {%
1567 \expandafter\XINT_infloat_X\expandafter
1568 {\the\numexpr #3+\xint_c_i-#2}{#1}%
1569 }%
1570 \def\XINT_infloat_Wb #1\Z #2#3%
1571 {%
1572 \expandafter\XINT_infloat_X\expandafter
1573 {\the\numexpr #3+\xint_c_ii-#2}{#1}%
1574 }%
1575 \def\XINT_infloat_X #1#2{ #2[#1]}%

```

### 7.38 \xintAdd

modified in v1.1. Et aussi 25 juin pour interceptor summand nul.

```

1576 \def\xintAdd {\romannumeral0\xintadd }%
1577 \def\xintadd #1{\expandafter\xint_fadd\romannumeral0\xintra {#1}}%
1578 \def\xint_fadd #1{\xint_gob_til_zero #1\XINT_fadd_Azero 0\XINT_fadd_a #1}%
1579 \def\XINT_fadd_Azero #1]{\xintra }%
1580 \def\XINT_fadd_a #1/#2[#3]#4%
1581 {\expandafter\XINT_fadd_b\romannumeral0\xintra {#4}{#3}{#1}{#2}}%
1582 \def\XINT_fadd_b #1{\xint_gob_til_zero #1\XINT_fadd_Bzero 0\XINT_fadd_c #1}%
1583 \def\XINT_fadd_Bzero #1]#2#3#4{ #3/#4[#2]}%
1584 \def\XINT_fadd_c #1/#2[#3]#4%
1585 {%
1586 \expandafter\XINT_fadd_Aa\expandafter{\the\numexpr #4-#3}{#3}{#4}{#1}{#2}%
1587 }%
1588 \def\XINT_fadd_Aa #1%
1589 {%
1590 \ifcase\XINT_cntSgn #1\Z
1591 \expandafter\XINT_fadd_B
1592 \or
1593 \expandafter \XINT_fadd_Ba
1594 \else
1595 \expandafter \XINT_fadd_Bb
1596 \fi {#1}%
1597 }%
1598 \def\XINT_fadd_B #1#2#3#4#5#6#7{\XINT_fadd_C {#4}{#5}{#7}{#6}[#3]}%
1599 \def\XINT_fadd_Ba #1#2#3#4#5#6#7%
1600 {%
1601 \expandafter\XINT_fadd_C\expandafter
1602 {\romannumeral0\XINT_dsx_zeroloop {#1}}{\Z {#6}}%
1603 {#7}{#5}{#4}[#2}%
1604 }%
1605 \def\XINT_fadd_Bb #1#2#3#4#5#6#7%
1606 {%
1607 \expandafter\XINT_fadd_C\expandafter
1608 {\romannumeral0\XINT_dsx_zeroloop {-#1}}{\Z {#4}}%
1609 {#5}{#7}{#6}[#3}%
1610 }%

```



```

1611 \def\XINT_fadd_C #1#2#3%
1612 {%
1613   \ifcase\romannumeral0\xintiicmp {#2}{#3} %<- intentional space here.
1614     \expandafter\XINT_fadd_eq
1615   \or\expandafter\XINT_fadd_D
1616   \else\expandafter\XINT_fadd_Da
1617   \fi {#2}{#3}{#1}%
1618 }%
1619 \def\XINT_fadd_eq #1#2#3#4#5%
1620 {%
1621   \expandafter\XINT_fadd_G
1622   \romannumeral0\xintiiadd {#3}{#4}/#1%[#5]%
1623 }%
1624 \def\XINT_fadd_D #1#2%
1625 {%
1626   \expandafter\XINT_fadd_E\romannumeral0\XINT_div_prepare {#2}{#1}{#1}{#2}%
1627 }%
1628 \def\XINT_fadd_E #1#2%
1629 {%
1630   \if0\XINT_Sgn #2\Z
1631     \expandafter\XINT_fadd_F
1632   \else\expandafter\XINT_fadd_K
1633   \fi {#1}%
1634 }%
1635 \def\XINT_fadd_F #1#2#3#4#5#6%
1636 {%
1637   \expandafter\XINT_fadd_G
1638   \romannumeral0\xintiiadd {\xintiiMul {#5}{#1}}{#4}/#2%[#6]%
1639 }%
1640 \def\XINT_fadd_Da #1#2%
1641 {%
1642   \expandafter\XINT_fadd_Ea\romannumeral0\XINT_div_prepare {#1}{#2}{#1}{#2}%
1643 }%
1644 \def\XINT_fadd_Ea #1#2%
1645 {%
1646   \if0\XINT_Sgn #2\Z
1647     \expandafter\XINT_fadd_Fa
1648   \else\expandafter\XINT_fadd_K
1649   \fi {#1}%
1650 }%
1651 \def\XINT_fadd_Fa #1#2#3#4#5#6%
1652 {%
1653   \expandafter\XINT_fadd_G
1654   \romannumeral0\xintiiadd {\xintiiMul {#4}{#1}}{#5}/#3%[#6]%
1655 }%
1656 \def\XINT_fadd_G #1{\if0#1\XINT_fadd_iszero\fi\space #1}%
1657 \def\XINT_fadd_K #1#2#3#4#5%
1658 {%
1659   \expandafter\XINT_fadd_L
1660   \romannumeral0\xintiiadd {\xintiiMul {#2}{#5}}{\xintiiMul {#3}{#4}}.%
1661   {{#2}{#3}}%
1662 }%

```

```

1663 \def\XINT_fadd_L #1{\if0#1\XINT_fadd_iszero\fi \XINT_fadd_M #1}%
1664 \def\XINT_fadd_M #1.#2{\expandafter\XINT_fadd_N \expandafter
1665     {\romannumeral0\xintiimul #2}{#1}}%
1666 \def\XINT_fadd_N #1#2{ #2/#1}%
1667 \edef\XINT_fadd_iszero\fi #1[#2]{\noexpand\fi\space 0/1[0]}% ou [#2] originel?

```

### 7.39 \xintSub

refait dans 1.1 pour vérifier si summands nuls.

```

1668 \def\xintSub {\romannumeral0\xintsub }%
1669 \def\xintsub #1{\expandafter\xint_fsub\romannumeral0\xintra {#1}}%
1670 \def\xint_fsub #1{\xint_gob_til_zero #1\XINT_fsub_Azero 0\XINT_fsub_a #1}%
1671 \def\XINT_fsub_Azero #1]{\xintopp }%
1672 \def\XINT_fsub_a #1/#2[#3]#4%
1673     {\expandafter\XINT_fsub_b\romannumeral0\xintra {#4}{#3}{#1}{#2}}%
1674 \def\XINT_fsub_b #1{\xint_UDzerominusfork
1675     #1-\XINT_fadd_Bzero
1676     0#1\XINT_fadd_c
1677     0-\XINT_fadd_c -#1}%
1678     \krof }%

```

### 7.40 \xintSum

```

1679 \def\xintSum {\romannumeral0\xintsum }%
1680 \def\xintsum #1{\xintsumexpr #1\relax }%
1681 \def\xintSumExpr {\romannumeral0\xintsumexpr }%
1682 \def\xintsumexpr {\expandafter\XINT_fsumexpr\romannumeral-`0}%
1683 \def\XINT_fsumexpr {\XINT_fsum_loop_a {0/1[0]}}%
1684 \def\XINT_fsum_loop_a #1#2%
1685 {%
1686     \expandafter\XINT_fsum_loop_b \romannumeral-`0#2\Z {#1}%
1687 }%
1688 \def\XINT_fsum_loop_b #1%
1689 {%
1690     \xint_gob_til_relax #1\XINT_fsum_finished\relax
1691     \XINT_fsum_loop_c #1%
1692 }%
1693 \def\XINT_fsum_loop_c #1\Z #2%
1694 {%
1695     \expandafter\XINT_fsum_loop_a\expandafter{\romannumeral0\xintadd {#2}{#1}}%
1696 }%
1697 \def\XINT_fsum_finished #1\Z #2{ #2}%

```

### 7.41 \xintMul

modif 1.1 25-juin-14 pour vérifier plus tôt si nul

```

1698 \def\xintMul {\romannumeral0\xintmul }%
1699 \def\xintmul #1{\expandafter\xint_fmula\romannumeral0\xintra {#1}.}%
1700 \def\xint_fmula #1{\xint_gob_til_zero #1\XINT_fmula_zero 0\XINT_fmula_a #1}%
1701 \def\XINT_fmula_a #1[#2].#3%
1702     {\expandafter\XINT_fmula_b\romannumeral0\xintra {#3}#1[#2.]}%
1703 \def\XINT_fmula_b #1{\xint_gob_til_zero #1\XINT_fmula_zero 0\XINT_fmula_c #1}%

```

```

1704 \def\XINT_fmula_c #1/#2[#3]#4/#5[#6.]%
1705 {%
1706   \expandafter\XINT_fmula_d
1707   \expandafter{\the\numexpr #3+#6\expandafter}%
1708   \expandafter{\romannumeral0\xintiimul {#5}{#2}}%
1709   {\romannumeral0\xintiimul {#4}{#1}}%
1710 }%
1711 \def\XINT_fmula_d #1#2#3%
1712 {%
1713   \expandafter \XINT_fmula_e \expandafter{#3}{#1}{#2}%
1714 }%
1715 \def\XINT_fmula_e #1#2{\XINT_outfrac {#2}{#1}}%
1716 \def\XINT_fmula_zero #1.#2{ 0/1[0]}%

```

## 7.42 \xintSqr

### 1.1 modifs comme xintMul

```

1717 \def\xintSqr {\romannumeral0\xintsqr }%
1718 \def\xintsqr #1{\expandafter\xint_fsqr\romannumeral0\xintra {#1}}%
1719 \def\xint_fsqr #1{\xint_gob_til_zero #1\XINT_fsqr_zero 0\XINT_fsqr_a #1}%
1720 \def\xint_fsqr_a #1/#2[#3]%
1721 {%
1722   \expandafter\XINT_fsqr_b
1723   \expandafter{\the\numexpr #3+#3\expandafter}%
1724   \expandafter{\romannumeral0\xintiisqr {#2}}%
1725   {\romannumeral0\xintiisqr {#1}}%
1726 }%
1727 \def\XINT_fsqr_b #1#2#3{\expandafter \XINT_fmula_e \expandafter{#3}{#1}{#2}}%
1728 \def\XINT_fsqr_zero #1[{ 0/1[0]}%

```

## 7.43 \xintPow

Modified in 1.06 to give the exponent to a \numexpr.

With 1.07 and for use within the \xintexpr parser, we must allow fractions (which are integers in disguise) as input to the exponent, so we must have a variant which uses \xintNum and not only \numexpr for normalizing the input. Hence the \xintfPow here.

1.08b: well actually I think that with xintfrac.sty loaded the exponent should always be allowed to be a fraction giving an integer. So I do as for \xintFac, and remove here the duplicated. Then \xintexpr can use the \xintPow as defined here.

```

1729 \def\xintPow {\romannumeral0\xintpow }%
1730 \def\xintpow #1%
1731 {%
1732   \expandafter\xint_fpow\expandafter {\romannumeral0\XINT_infrac {#1}}%
1733 }%
1734 \def\xint_fpow #1#2%
1735 {%
1736   \expandafter\XINT_fpow_fork\the\numexpr \xintNum{#2}\relax\Z #1%
1737 }%
1738 \def\XINT_fpow_fork #1#2\Z
1739 {%
1740   \xint_UDzerominusfork

```

```

1741      #1-\XINT_fpow_zero
1742      0#1\XINT_fpow_neg
1743      0-\XINT_fpow_pos #1}%
1744      \krof
1745      {#2}%
1746 }%
1747 \def\XINT_fpow_zero #1#2#3#4{ 1/1[0]}%
1748 \def\XINT_fpow_pos #1#2#3#4#5%
1749 {%
1750      \expandafter\XINT_fpow_pos_A\expandafter
1751      {\the\numexpr #1#2*#3\expandafter}\expandafter
1752      {\romannumeral0\xintiipow {#5}{#1#2}}%
1753      {\romannumeral0\xintiipow {#4}{#1#2}}%
1754 }%
1755 \def\XINT_fpow_neg #1#2#3#4%
1756 {%
1757      \expandafter\XINT_fpow_pos_A\expandafter
1758      {\the\numexpr -#1*#2\expandafter}\expandafter
1759      {\romannumeral0\xintiipow {#3}{#1}}%
1760      {\romannumeral0\xintiipow {#4}{#1}}%
1761 }%
1762 \def\XINT_fpow_pos_A #1#2#3%
1763 {%
1764      \expandafter\XINT_fpow_pos_B\expandafter {#3}{#1}{#2}%
1765 }%
1766 \def\XINT_fpow_pos_B #1#2{\XINT_outfrac {#2}{#1}}%

```

#### 7.44 \xintFac

1.07: to be used by the `\xintexpr` scanner which needs to be able to apply `\xintFac` to a fraction which is an integer in disguise; so we use `\xintNum` and not only `\numexpr`. Je modifie cela dans 1.08b, au lieu d'avoir un `\xintfFac` spécialement pour `\xintexpr`, tout simplement j'étends `\xintFac` comme les autres macros, pour qu'elle utilise `\xintNum`.

```

1767 \def\xintFac {\romannumeral0\xintfac }%
1768 \def\xintfac #1%
1769 {%
1770      \expandafter\XINT_fac_fork\expandafter{\the\numexpr \xintNum{#1}}%
1771 }%

```

#### 7.45 \xintPrd

```

1772 \def\xintPrd {\romannumeral0\xintprd }%
1773 \def\xintprd #1{\xintprdexpr #1\relax }%
1774 \def\xintPrdExpr {\romannumeral0\xintprdexpr }%
1775 \def\xintprdexpr {\expandafter\XINT_fprdexpr \romannumeral-`0}%
1776 \def\XINT_fprdexpr {\XINT_fprod_loop_a {1/1[0]}}%
1777 \def\XINT_fprod_loop_a #1#2%
1778 {%
1779      \expandafter\XINT_fprod_loop_b \romannumeral-`0#2\Z {#1}%
1780 }%
1781 \def\XINT_fprod_loop_b #1%
1782 {%

```

```

1783 \xint_gob_til_relax #1\XINT_fprod_finished\relax
1784 \XINT_fprod_loop_c #1%
1785 }%
1786 \def\XINT_fprod_loop_c #1\Z #2%
1787 {%
1788 \expandafter\XINT_fprod_loop_a\expandafter{\romannumeral0\xintmul {#1}{#2}}%
1789 }%
1790 \def\XINT_fprod_finished #1\Z #2{ #2}%

```

#### 7.46 \xintDiv

```

1791 \def\xintDiv {\romannumeral0\xintdiv }%
1792 \def\xintdiv #1%
1793 {%
1794 \expandafter\xint_fdiv\expandafter {\romannumeral0\XINT_infrac {#1}}%
1795 }%
1796 \def\xint_fdiv #1#2%
1797 {\expandafter\XINT_fdiv_A\romannumeral0\XINT_infrac {#2}#1}%
1798 \def\XINT_fdiv_A #1#2#3#4#5#6%
1799 {%
1800 \expandafter\XINT_fdiv_B
1801 \expandafter{\the\numexpr #4-#1\expandafter}%
1802 \expandafter{\romannumeral0\xintiimul {#2}{#6}}%
1803 {\romannumeral0\xintiimul {#3}{#5}}%
1804 }%
1805 \def\XINT_fdiv_B #1#2#3%
1806 {%
1807 \expandafter\XINT_fdiv_C
1808 \expandafter{#3}{#1}{#2}%
1809 }%
1810 \def\XINT_fdiv_C #1#2{\XINT_outfrac {#2}{#1}}%

```

#### 7.47 \xintDivFloor

##### 1.1

```

1811 \def\xintDivFloor {\romannumeral0\xintdivfloor }%
1812 \def\xintdivfloor #1#2{\xintfloor{\xintDiv {#1}{#2}}}%

```

#### 7.48 \xintDivTrunc

##### 1.1. \xintttrunc rather than \xintitrunc0 in 1.1a

```

1813 \def\xintDivTrunc {\romannumeral0\xintdivtrunc }%
1814 \def\xintdivtrunc #1#2{\xintttrunc {\xintDiv {#1}{#2}}}%

```

#### 7.49 \xintDivRound

##### 1.1

```

1815 \def\xintDivRound {\romannumeral0\xintdivround }%
1816 \def\xintdivround #1#2{\xintiround 0{\xintDiv {#1}{#2}}}%

```

## 7.50 \xintMod

1.1. `\xintMod {q1}{q2}` computes  $q2 \cdot t(q1/q2)$  with  $t(q1/q2)$  equal to the truncated division of two arbitrary fractions  $q1$  and  $q2$ . We put some efforts into minimizing the amount of computations.

```

1817 \def\xintMod {\romannumeral0\xintmod}%
1818 \def\xintmod #1{\expandafter\XINT_mod_a\romannumeral0\xintra{#1}.}%
1819 \def\XINT_mod_a #1#2.#3%
1820   {\expandafter\XINT_mod_b\expandafter #1\romannumeral0\xintra{#3}#2.}%
1821 \def\XINT_mod_b #1#2% #1 de A, #2 de B.
1822 {%
1823   \if0#2\xint_dothis\XINT_mod_divbyzero\fi
1824   \if0#1\xint_dothis\XINT_mod_aiszero\fi
1825   \if-#2\xint_dothis{\XINT_mod_bneg #1}\fi
1826   \xint_orthat{\XINT_mod_bpos #1#2}%
1827 }%
1828 \def\XINT_mod_bpos #1%
1829 {%
1830   \xint_UDsignfork
1831     #1{\xintiiopp\XINT_mod_pos {}}%
1832     -{\XINT_mod_pos #1}%
1833   \krof
1834 }%
1835 \def\XINT_mod_bneg #1%
1836 {%
1837   \xint_UDsignfork
1838     #1{\xintiiopp\XINT_mod_pos {}}%
1839     -{\XINT_mod_pos #1}%
1840   \krof
1841 }%
1842 \def\XINT_mod_divbyzero #1.{\xintError:DivisionByZero\space 0/1[0]}%
1843 \def\XINT_mod_aiszero #1.{ 0/1[0]}%
1844 \def\XINT_mod_pos #1#2/#3[#4]#5/#6[#7].%
1845 {%
1846   \expandafter\XINT_mod_pos_a
1847   \the\numexpr\ifnum#7>#4 #4\else #7\fi\expandafter.\expandafter
1848   {\romannumeral0\xintiimul {#6}{#3}}%      n fois u
1849   {\xintiiE{\xintiiMul {#1#5}{#3}}{#7-#4}}% m fois u
1850   {\xintiiE{\xintiiMul {#2}{#6}}{#4-#7}}%   t fois n
1851 }%
1852 \def\XINT_mod_pos_a #1.#2#3#4{\xintiiirem {#3}{#4}/#2[#1]}%

```

## 7.51 \XINTinFloatMod

Pour emploi dans `xintexpr 1.1`

```

1853 \def\XINTinFloatMod {\romannumeral0\XINTinfloatmod [\XINTdigits]}%
1854 \def\XINTinfloatmod [#1]#2#3{\expandafter\XINT_infloatmod\expandafter
1855   {\romannumeral0\XINTinfloat[#1]{#2}}%
1856   {\romannumeral0\XINTinfloat[#1]{#3}}{#1}}%
1857 \def\XINT_infloatmod #1#2{\expandafter\XINT_infloatmod_a\expandafter {#2}{#1}}%
1858 \def\XINT_infloatmod_a #1#2#3{\XINTinfloat [#3]{\xintMod {#2}{#1}}}%

```

## 7.52 `\xintIsOne`

New with 1.09a. Could be more efficient. For fractions with big powers of tens, it is better to use `\xintCmp{f}{1}`. Restyled in 1.09i.

```

1859 \def\xintIsOne    {\romannumeral0\xintisone }%
1860 \def\xintisone #1{\expandafter\XINT_fracisone
1861                \romannumeral0\xintrawithzeros{#1}\Z }%
1862 \def\XINT_fracisone #1/#2\Z
1863     {\if0\XINT_Cmp {#1}{#2}\xint_afterfi{ 1}\else\xint_afterfi{ 0}\fi}%

```

## 7.53 `\xintGeq`

Rewritten completely in 1.08a to be less dumb when comparing fractions having big powers of tens.

```

1864 \def\xintGeq {\romannumeral0\xintgeq }%
1865 \def\xintgeq #1%
1866 {%
1867     \expandafter\xint_fgeq\expandafter {\romannumeral0\xintabs {#1}}%
1868 }%
1869 \def\xint_fgeq #1#2%
1870 {%
1871     \expandafter\XINT_fgeq_A \romannumeral0\xintabs {#2}#1%
1872 }%
1873 \def\XINT_fgeq_A #1%
1874 {%
1875     \xint_gob_til_zero #1\XINT_fgeq_Zii 0%
1876     \XINT_fgeq_B #1%
1877 }%
1878 \def\XINT_fgeq_Zii 0\XINT_fgeq_B #1[#2]#3[#4]{ 1}%
1879 \def\XINT_fgeq_B #1/#2[#3]#4#5/#6[#7]%
1880 {%
1881     \xint_gob_til_zero #4\XINT_fgeq_Zi 0%
1882     \expandafter\XINT_fgeq_C\expandafter
1883     {\the\numexpr #7-#3\expandafter}\expandafter
1884     {\romannumeral0\xintiimul {#4#5}{#2}}%
1885     {\romannumeral0\xintiimul {#6}{#1}}%
1886 }%
1887 \def\XINT_fgeq_Zi 0#1#2#3#4#5#6#7{ 0}%
1888 \def\XINT_fgeq_C #1#2#3%
1889 {%
1890     \expandafter\XINT_fgeq_D\expandafter
1891     {#3}{#1}{#2}%
1892 }%
1893 \def\XINT_fgeq_D #1#2#3%
1894 {%
1895     \expandafter\XINT_cntSgnFork\romannumeral-`0\expandafter\XINT_cntSgn
1896     \the\numexpr #2+\xintLength{#3}-\xintLength{#1}\relax\Z
1897     { 0}{\XINT_fgeq_E #2\Z {#3}{#1}}{ 1}%
1898 }%
1899 \def\XINT_fgeq_E #1%
1900 {%
1901     \xint_UDsignfork

```

```

1902      #1\XINT_fgeq_Fd
1903      -{\XINT_fgeq_Fn #1}%
1904      \krof
1905 }%
1906 \def\XINT_fgeq_Fd #1\Z #2#3%
1907 {%
1908     \expandafter\XINT_fgeq_Fe\expandafter
1909     {\romannumeral0\XINT_dsx_addzerosnofuss {#1}{#3}}{#2}%
1910 }%
1911 \def\XINT_fgeq_Fe #1#2{\XINT_geq_pre {#2}{#1}}%
1912 \def\XINT_fgeq_Fn #1\Z #2#3%
1913 {%
1914     \expandafter\XINT_geq_pre\expandafter
1915     {\romannumeral0\XINT_dsx_addzerosnofuss {#1}{#2}}{#3}%
1916 }%

```

## 7.54 \xintMax

Rewritten completely in 1.08a.

```

1917 \def\xintMax {\romannumeral0\xintmax }%
1918 \def\xintmax #1%
1919 {%
1920     \expandafter\xint_fmax\expandafter {\romannumeral0\xintra #1}%
1921 }%
1922 \def\xint_fmax #1#2%
1923 {%
1924     \expandafter\XINT_fmax_A\romannumeral0\xintra #2}%1%
1925 }%
1926 \def\XINT_fmax_A #1#2/#3[#4]#5#6/#7[#8]%
1927 {%
1928     \xint_UDsignsfork
1929     #1#5\XINT_fmax_minusminus
1930     -#5\XINT_fmax_firstneg
1931     #1-\XINT_fmax_secondneg
1932     --\XINT_fmax_nonneg_a
1933     \krof
1934     #1#5{#2/#3[#4]}{#6/#7[#8]}%
1935 }%
1936 \def\XINT_fmax_minusminus --%
1937     {\expandafter\xint_minus_thenstop\romannumeral0\XINT_fmin_nonneg_b }%
1938 \def\XINT_fmax_firstneg #1-#2#3{ #1#2}%
1939 \def\XINT_fmax_secondneg -#1#2#3{ #1#3}%
1940 \def\XINT_fmax_nonneg_a #1#2#3#4%
1941 {%
1942     \XINT_fmax_nonneg_b {#1#3}{#2#4}%
1943 }%
1944 \def\XINT_fmax_nonneg_b #1#2%
1945 {%
1946     \if0\romannumeral0\XINT_fgeq_A #1#2%
1947         \xint_afterfi{ #1}%
1948     \else \xint_afterfi{ #2}%
1949     \fi

```



1950 }%

### 7.55 `\xintMaxof`

```

1951 \def\xintMaxof      {\romannumeral0\xintmaxof }%
1952 \def\xintmaxof      #1{\expandafter\XINT_maxof_a\romannumeral-\`0#1\relax }%
1953 \def\XINT_maxof_a   #1{\expandafter\XINT_maxof_b\romannumeral0\xintra{#1}\Z }%
1954 \def\XINT_maxof_b   #1\Z #2%
1955                   {\expandafter\XINT_maxof_c\romannumeral-\`0#2\Z {#1}\Z}%
1956 \def\XINT_maxof_c   #1%
1957                   {\xint_gob_til_relax #1\XINT_maxof_e\relax\XINT_maxof_d #1}%
1958 \def\XINT_maxof_d   #1\Z
1959                   {\expandafter\XINT_maxof_b\romannumeral0\xintmax {#1}}%
1960 \def\XINT_maxof_e   #1\Z #2\Z { #2}%

```

### 7.56 `\xintMin`

Rewritten completely in 1.08a.

```

1961 \def\xintMin {\romannumeral0\xintmin }%
1962 \def\xintmin #1%
1963 {%
1964   \expandafter\xint_fmin\expandafter {\romannumeral0\xintra{#1}}%
1965 }%
1966 \def\xint_fmin #1#2%
1967 {%
1968   \expandafter\XINT_fmin_A\romannumeral0\xintra{#2}#1%
1969 }%
1970 \def\XINT_fmin_A #1#2/#3[#4]#5#6/#7[#8]%
1971 {%
1972   \xint_UDsignsfork
1973     #1#5\XINT_fmin_minusminus
1974     -#5\XINT_fmin_firstneg
1975     #1-\XINT_fmin_secondneg
1976     --\XINT_fmin_nonneg_a
1977   \krof
1978   #1#5{#2/#3[#4]}{#6/#7[#8]}%
1979 }%
1980 \def\XINT_fmin_minusminus --%
1981   {\expandafter\xint_minus_thenstop\romannumeral0\XINT_fmax_nonneg_b }%
1982 \def\XINT_fmin_firstneg #1-#2#3{ -#3}%
1983 \def\XINT_fmin_secondneg -#1#2#3{ -#2}%
1984 \def\XINT_fmin_nonneg_a #1#2#3#4%
1985 {%
1986   \XINT_fmin_nonneg_b {#1#3}{#2#4}%
1987 }%
1988 \def\XINT_fmin_nonneg_b #1#2%
1989 {%
1990   \if0\romannumeral0\XINT_fgeq_A #1#2%
1991     \xint_afterfi{ #2}%
1992   \else \xint_afterfi{ #1}%
1993   \fi
1994 }%

```

7.57 `\xintMinof`

```

1995 \def\xintMinof      {\romannumeral0\xintminof }%
1996 \def\xintminof      #1{\expandafter\XINT_minof_a\romannumeral-`0#1\relax }%
1997 \def\XINT_minof_a #1{\expandafter\XINT_minof_b\romannumeral0\xintra{#1}\Z }%
1998 \def\XINT_minof_b #1\Z #2%
1999      {\expandafter\XINT_minof_c\romannumeral-`0#2\Z {#1}\Z}%
2000 \def\XINT_minof_c #1%
2001      {\xint_gob_til_relax #1\XINT_minof_e\relax\XINT_minof_d #1}%
2002 \def\XINT_minof_d #1\Z
2003      {\expandafter\XINT_minof_b\romannumeral0\xintmin {#1}}%
2004 \def\XINT_minof_e #1\Z #2\Z { #2}%

```

7.58 `\xintCmp`

Rewritten completely in 1.08a to be less dumb when comparing fractions having big powers of tens.

```

2005 %\def\xintCmp {\romannumeral0\xintcmp }%
2006 \def\xintcmp #1%
2007 {%
2008     \expandafter\xint_fcmp\expandafter {\romannumeral0\xintra{#1}}%
2009 }%
2010 \def\xint_fcmp #1#2%
2011 {%
2012     \expandafter\XINT_fcmp_A\romannumeral0\xintra{#2}#1%
2013 }%
2014 \def\XINT_fcmp_A #1#2/#3[#4]#5#6/#7[#8]%
2015 {%
2016     \xint_UDsignsfork
2017     #1#5\XINT_fcmp_minusminus
2018     -#5\XINT_fcmp_firstneg
2019     #1-\XINT_fcmp_secondneg
2020     --\XINT_fcmp_nonneg_a
2021     \krof
2022     #1#5{#2/#3[#4]}{#6/#7[#8]}%
2023 }%
2024 \def\XINT_fcmp_minusminus --#1#2{\XINT_fcmp_B #2#1}%
2025 \def\XINT_fcmp_firstneg #1-#2#3{ -1}%
2026 \def\XINT_fcmp_secondneg -#1#2#3{ 1}%
2027 \def\XINT_fcmp_nonneg_a #1#2%
2028 {%
2029     \xint_UDzerosfork
2030     #1#2\XINT_fcmp_zerozero
2031     0#2\XINT_fcmp_firstzero
2032     #10\XINT_fcmp_secondzero
2033     00\XINT_fcmp_pos
2034     \krof
2035     #1#2%
2036 }%
2037 \def\XINT_fcmp_zerozero #1#2#3#4{ 0}% 1.08b had some [ and ] here!!!
2038 \def\XINT_fcmp_firstzero #1#2#3#4{ -1}% incredibly I never saw that until
2039 \def\XINT_fcmp_secondzero #1#2#3#4{ 1}% preparing 1.09a.
2040 \def\XINT_fcmp_pos #1#2#3#4%
2041 {%

```

```

2042 \XINT_fcmp_B #1#3#2#4%
2043 }%
2044 \def\XINT_fcmp_B #1/#2[#3]#4/#5[#6]%
2045 {%
2046 \expandafter\XINT_fcmp_C\expandafter
2047 {\the\numexpr #6-#3\expandafter}\expandafter
2048 {\romannumeral0\xintiimul {#4}{#2}}%
2049 {\romannumeral0\xintiimul {#5}{#1}}%
2050 }%
2051 \def\XINT_fcmp_C #1#2#3%
2052 {%
2053 \expandafter\XINT_fcmp_D\expandafter
2054 {#3}{#1}{#2}%
2055 }%
2056 \def\XINT_fcmp_D #1#2#3%
2057 {%
2058 \expandafter\XINT_cntSgnFork\romannumeral-`0\expandafter\XINT_cntSgn
2059 \the\numexpr #2+\xintLength{#3}-\xintLength{#1}\relax\Z
2060 { -1}{\XINT_fcmp_E #2\Z {#3}{#1}}{ 1}%
2061 }%
2062 \def\XINT_fcmp_E #1%
2063 {%
2064 \xint_UDsignfork
2065 #1\XINT_fcmp_Fd
2066 -{\XINT_fcmp_Fn #1}%
2067 \krof
2068 }%
2069 \def\XINT_fcmp_Fd #1\Z #2#3%
2070 {%
2071 \expandafter\XINT_fcmp_Fe\expandafter
2072 {\romannumeral0\XINT_dsx_addzerosnofuss {#1}{#3}}{#2}%
2073 }%
2074 \def\XINT_fcmp_Fe #1#2{\xintiicmp {#2}{#1}}%
2075 \def\XINT_fcmp_Fn #1\Z #2#3%
2076 {%
2077 \expandafter\xintiicmp\expandafter
2078 {\romannumeral0\XINT_dsx_addzerosnofuss {#1}{#2}}{#3}%
2079 }%

```

### 7.59 \xintAbs

```

2080 \def\xintAbs {\romannumeral0\xintabs }%
2081 \def\xintabs #1{\expandafter\XINT_abs\romannumeral0\xintraw {#1}}%

```

### 7.60 \xintOpp

```

2082 \def\xintOpp {\romannumeral0\xintopp }%
2083 \def\xintopp #1{\expandafter\XINT_opp\romannumeral0\xintraw {#1}}%

```

### 7.61 \xintSgn

```

2084 \def\xintSgn {\romannumeral0\xintsgn }%
2085 \def\xintsgn #1{\expandafter\XINT_sgn\romannumeral0\xintraw {#1}\Z }%

```

## 7.62 Floating point macros

1.2 release has not touched the floating point routines apart from adding the new `\xintFloatFac`. The others should be revised for some optimizations related to the underlying model of the new core routines. This is particularly the case for `\xintFloatPow` and `\xintFloatPower` which should keep intermediate results in a suitable format, like `\xintiiPow` does.

The switch to 1.2 was smooth (apart from the writing up of the new `\xintFloatFac`), as I didn't have to change a single line of code anywhere here !

## 7.63 `\xintFloatAdd`, `\XINTinFloatAdd`

1.07; 1.09ka improves a bit the efficiency of the coding of `\XINT_FL_Add_d`.

```

2086 \def\xintFloatAdd      {\romannumeral0\xintfloatadd }%
2087 \def\xintfloatadd      #1{\XINT_fladd_chkopt \xintfloat #1\xint_relax }%
2088 \def\XINTinFloatAdd    {\romannumeral0\XINTinfloatadd }%
2089 \def\XINTinfloatadd    #1{\XINT_fladd_chkopt \XINTinfloat #1\xint_relax }%
2090 \def\XINT_fladd_chkopt #1#2%
2091 {%
2092   \ifx [#2\expandafter\XINT_fladd_opt
2093     \else\expandafter\XINT_fladd_noopt
2094   \fi #1#2%
2095 }%
2096 \def\XINT_fladd_noopt #1#2\xint_relax #3%
2097 {%
2098   #1[\XINTdigits]{\XINT_FL_Add {\XINTdigits+\xint_c_ii}{#2}{#3}}%
2099 }%
2100 \def\XINT_fladd_opt #1[\xint_relax #2]#3#4%
2101 {%
2102   #1[#2]{\XINT_FL_Add {#2+\xint_c_ii}{#3}{#4}}%
2103 }%
2104 \def\XINT_FL_Add #1#2%
2105 {%
2106   \expandafter\XINT_FL_Add_a\expandafter{\the\numexpr #1\expandafter}%
2107   \expandafter{\romannumeral0\XINTinfloat [#1]{#2}}%
2108 }%
2109 \def\XINT_FL_Add_a #1#2#3%
2110 {%
2111   \expandafter\XINT_FL_Add_b\romannumeral0\XINTinfloat [#1]{#3}#2{#1}%
2112 }%
2113 \def\XINT_FL_Add_b #1%
2114 {%
2115   \xint_gob_til_zero #1\XINT_FL_Add_zero 0\XINT_FL_Add_c #1%
2116 }%
2117 \def\XINT_FL_Add_c #1[#2]#3%
2118 {%
2119   \xint_gob_til_zero #3\XINT_FL_Add_zerobis 0\XINT_FL_Add_d #1[#2]#3%
2120 }%
2121 \def\XINT_FL_Add_d #1[#2]#3[#4]#5%
2122 {%
2123   \ifnum \numexpr #2-#4-#5>\xint_c_i
2124     \expandafter \xint_secondofthree_thenstop

```

```

2125 \else
2126 \ifnum \numexpr #4-#2-#5>\xint_c_i
2127 \expandafter\expandafter\expandafter\xint_thirdofthree_thenstop
2128 \fi
2129 \fi
2130 \xintadd {#1[#2]}{#3[#4]}%
2131 }%
2132 \def\xint_FL_Add_zero 0\xint_FL_Add_c 0[0]#1[#2]#3{#1[#2]}%
2133 \def\xint_FL_Add_zerobis 0\xint_FL_Add_d #1[#2]0[0]#3{#1[#2]}%

```

## 7.64 \xintFloatSub, \XINTinFloatSub

1.07

```

2134 \def\xintFloatSub {\romannumeral0\xintfloatsub }%
2135 \def\xintfloatsub #1{\XINT_flsb_chkopt \xintfloat #1\xint_relax }%
2136 \def\XINTinFloatSub {\romannumeral0\XINTinfloatsub }%
2137 \def\XINTinfloatsub #1{\XINT_flsb_chkopt \XINTinfloat #1\xint_relax }%
2138 \def\XINT_flsb_chkopt #1#2%
2139 {%
2140 \ifx [#2\expandafter\XINT_flsb_opt
2141 \else\expandafter\XINT_flsb_noopt
2142 \fi #1#2%
2143 }%
2144 \def\XINT_flsb_noopt #1#2\xint_relax #3%
2145 {%
2146 #1[\XINTdigits]{\XINT_FL_Add {\XINTdigits+\xint_c_ii}{#2}{\xintOpp{#3}}}%
2147 }%
2148 \def\XINT_flsb_opt #1[\xint_relax #2]#3#4%
2149 {%
2150 #1[#2]{\XINT_FL_Add {#2+\xint_c_ii}{#3}{\xintOpp{#4}}}%
2151 }%

```

## 7.65 \xintFloatMul, \XINTinFloatMul

It is a long-standing issue here that I must at some point revise the code and avoid compute with 2P digits the exact intermediate result.

1.07

```

2152 \def\xintFloatMul {\romannumeral0\xintfloatmul}%
2153 \def\xintfloatmul #1{\XINT_flmul_chkopt \xintfloat #1\xint_relax }%
2154 \def\XINTinFloatMul {\romannumeral0\XINTinfloatmul}%
2155 \def\XINTinfloatmul #1{\XINT_flmul_chkopt \XINTinfloat #1\xint_relax }%
2156 \def\XINT_flmul_chkopt #1#2%
2157 {%
2158 \ifx [#2\expandafter\XINT_flmul_opt
2159 \else\expandafter\XINT_flmul_noopt
2160 \fi #1#2%
2161 }%
2162 \def\XINT_flmul_noopt #1#2\xint_relax #3%

```

```

2163 {%
2164     #1[\XINTdigits]{\XINT_FL_Mul {\XINTdigits+\xint_c_ii}{#2}{#3}}%
2165 }%
2166 \def\XINT_flmul_opt #1[\xint_relax #2]#3#4%
2167 {%
2168     #1[#2]{\XINT_FL_Mul {\xint_c_ii}{#3}{#4}}%
2169 }%
2170 \def\XINT_FL_Mul #1#2%
2171 {%
2172     \expandafter\XINT_FL_Mul_a\expandafter{\the\numexpr #1\expandafter}%
2173     \expandafter{\romannumeral0\XINTinfloat [#1]{#2}}%
2174 }%
2175 \def\XINT_FL_Mul_a #1#2#3%
2176 {%
2177     \expandafter\XINT_FL_Mul_b\romannumeral0\XINTinfloat [#1]{#3}#2%
2178 }%
2179 \def\XINT_FL_Mul_b #1[#2]#3[#4]{\xintE{\xintiiMul {#1}{#3}}{#2+#4}}%

```

## 7.66 \xintFloatDiv, \XINTinFloatDiv

### 1.07

```

2180 \def\xintFloatDiv {\romannumeral0\xintfloatdiv}%
2181 \def\xintfloatdiv #1{\XINT_fldiv_chkopt \xintfloat #1\xint_relax }%
2182 \def\XINTinFloatDiv {\romannumeral0\XINTinfloatdiv }%
2183 \def\XINTinfloatdiv #1{\XINT_fldiv_chkopt \XINTinfloat #1\xint_relax }%
2184 \def\XINT_fldiv_chkopt #1#2%
2185 {%
2186     \ifx [#2]\expandafter\XINT_fldiv_opt
2187     \else\expandafter\XINT_fldiv_noopt
2188     \fi #1#2%
2189 }%
2190 \def\XINT_fldiv_noopt #1#2\xint_relax #3%
2191 {%
2192     #1[\XINTdigits]{\XINT_FL_Div {\XINTdigits+\xint_c_ii}{#2}{#3}}%
2193 }%
2194 \def\XINT_fldiv_opt #1[\xint_relax #2]#3#4%
2195 {%
2196     #1[#2]{\XINT_FL_Div {\xint_c_ii}{#3}{#4}}%
2197 }%
2198 \def\XINT_FL_Div #1#2%
2199 {%
2200     \expandafter\XINT_FL_Div_a\expandafter{\the\numexpr #1\expandafter}%
2201     \expandafter{\romannumeral0\XINTinfloat [#1]{#2}}%
2202 }%
2203 \def\XINT_FL_Div_a #1#2#3%
2204 {%
2205     \expandafter\XINT_FL_Div_b\romannumeral0\XINTinfloat [#1]{#3}#2%
2206 }%
2207 \def\XINT_FL_Div_b #1[#2]#3[#4]{\xintE{#3/#1}{#4-#2}}%

```

7.67 `\xintFloatPow`, `\XINTinFloatPow`

This definitely should be revised to better take into account the new multiplication to maintain through intermediate states a suitable internal format, optimized for calls to `\XINT_mul_loop`.

1.07. Release 1.09j has re-organized the core loop, and `\XINT_flpow_prd` sub-routine has been removed.

```

2208 \def\xintFloatPow {\romannumeral0\xintfloatpow}%
2209 \def\xintfloatpow #1{\XINT_flpow_chkopt \xintfloat #1\xint_relax }%
2210 \def\XINTinFloatPow {\romannumeral0\XINTinfloatpow }%
2211 \def\XINTinfloatpow #1{\XINT_flpow_chkopt \XINTinfloat #1\xint_relax }%
2212 \def\XINT_flpow_chkopt #1#2%
2213 {%
2214   \ifx [#2\expandafter\XINT_flpow_opt
2215     \else\expandafter\XINT_flpow_noopt
2216   \fi
2217   #1#2%
2218 }%
2219 \def\XINT_flpow_noopt #1#2\xint_relax #3%
2220 {%
2221   \expandafter\XINT_flpow_checkB_start\expandafter
2222     {\the\numexpr #3\expandafter}\expandafter
2223     {\the\numexpr \XINTdigits}{#2}{#1[\XINTdigits]}%
2224 }%
2225 \def\XINT_flpow_opt #1[\xint_relax #2]#3#4%
2226 {%
2227   \expandafter\XINT_flpow_checkB_start\expandafter
2228     {\the\numexpr #4\expandafter}\expandafter
2229     {\the\numexpr #2}{#3}{#1[#2]}%
2230 }%
2231 \def\XINT_flpow_checkB_start #1{\XINT_flpow_checkB_a #1\Z }%
2232 \def\XINT_flpow_checkB_a #1%
2233 {%
2234   \xint_UDzerominusfork
2235   #1-\XINT_flpow_BisZero
2236   0#1{\XINT_flpow_checkB_b 1}%
2237   0-{\XINT_flpow_checkB_b 0#1}%
2238   \krof
2239 }%
2240 \def\XINT_flpow_BisZero \Z #1#2#3{#3{1/1[0]}}%
2241 \def\XINT_flpow_checkB_b #1#2\Z #3%
2242 {%
2243   \expandafter\XINT_flpow_checkB_c \expandafter
2244     {\romannumeral0\xintlength{#2}}{#3}{#2}#1%
2245 }%
2246 \def\XINT_flpow_checkB_c #1#2%
2247 {%
2248   \expandafter\XINT_flpow_checkB_d \expandafter
2249     {\the\numexpr \expandafter\xintlength\expandafter
2250       {\the\numexpr #1*20/\xint_c_iii }+#1+#2+\xint_c_i }%

```

```

2251 }%
2252 \def\XINT_flpow_checkB_d #1#2#3#4%
2253 {%
2254   \expandafter \XINT_flpow_a
2255   \romannumeral0\XINTinfloat [#1]{#4}{#1}{#2}#3%
2256 }%
2257 \def\XINT_flpow_a #1%
2258 {%
2259   \xint_UDzerominusfork
2260   #1-\XINT_flpow_zero
2261   0#1{\XINT_flpow_b 1}%
2262   0-{\XINT_flpow_b 0#1}%
2263   \krof
2264 }%
2265 \def\XINT_flpow_b #1#2[#3]#4#5%
2266 {%
2267   \XINT_flpow_loopI {#5}{#2[#3]}\romannumeral0\XINTinfloatmul [#4]}%
2268   {#1*\ifodd #5 1\else 0\fi}%
2269 }%
2270 \def\XINT_flpow_zero [#1]#2#3#4#5%

  xint is not equipped to signal infinity, the 2^31 will provoke deliberately a number too big and
  arithmetic overflow in \XINT_float_Xb

2271 {%
2272   \if #41\xint_afterfi {\xintError:DivisionByZero #5{1[2147483648]}}}%
2273   \else \xint_afterfi {#5{0[0]}}\fi
2274 }%
2275 \def\XINT_flpow_loopI #1%
2276 {%
2277   \ifnum #1=\xint_c_i\XINT_flpow_ItoIII\fi
2278   \ifodd #1
2279     \expandafter\XINT_flpow_loopI_odd
2280   \else
2281     \expandafter\XINT_flpow_loopI_even
2282   \fi
2283   {#1}%
2284 }%
2285 \def\XINT_flpow_ItoIII\fi #1\fi #2#3#4#5%
2286 {%
2287   \fi\expandafter\XINT_flpow_III\the\numexpr #5\relax #3%
2288 }%
2289 \def\XINT_flpow_loopI_even #1#2#3%
2290 {%
2291   \expandafter\XINT_flpow_loopI\expandafter
2292   {\the\numexpr #1/\xint_c_ii\expandafter}\expandafter
2293   {#3{#2}{#2}}{#3}%
2294 }%
2295 \def\XINT_flpow_loopI_odd #1#2#3%
2296 {%
2297   \expandafter\XINT_flpow_loopII\expandafter
2298   {\the\numexpr #1/\xint_c_ii-\xint_c_i\expandafter}\expandafter
2299   {#3{#2}{#2}}{#3}{#2}%

```



```

2300 }%
2301 \def\XINT_flpow_loopII #1%
2302 {%
2303   \ifnum #1 = \xint_c_i\XINT_flpow_IItoIII\fi
2304   \ifodd #1
2305     \expandafter\XINT_flpow_loopII_odd
2306   \else
2307     \expandafter\XINT_flpow_loopII_even
2308   \fi
2309   {#1}%
2310 }%
2311 \def\XINT_flpow_loopII_even #1#2#3%
2312 {%
2313   \expandafter\XINT_flpow_loopII\expandafter
2314   {\the\numexpr #1/\xint_c_ii\expandafter}\expandafter
2315   {#3{#2}{#2}}{#3}%
2316 }%
2317 \def\XINT_flpow_loopII_odd #1#2#3#4%
2318 {%
2319   \expandafter\XINT_flpow_loopII_odda\expandafter
2320   {#3{#2}{#4}}{#1}{#2}{#3}%
2321 }%
2322 \def\XINT_flpow_loopII_odda #1#2#3#4%
2323 {%
2324   \expandafter\XINT_flpow_loopII\expandafter
2325   {\the\numexpr #2/\xint_c_ii-\xint_c_i\expandafter}\expandafter
2326   {#4{#3}{#3}}{#4}{#1}%
2327 }%
2328 \def\XINT_flpow_IItoIII\fi #1\fi #2#3#4#5#6%
2329 {%
2330   \fi\expandafter\XINT_flpow_III\the\numexpr #6\expandafter\relax
2331   #4{#3}{#5}%
2332 }%
2333 \def\XINT_flpow_III #1#2[#3]#4%
2334 {%
2335   \expandafter\XINT_flpow_IIIend\expandafter
2336   {\the\numexpr\if #41-\fi#3\expandafter}%
2337   \xint_UDzerofork
2338   #4{{#2}}%
2339   0{{1/#2}}%
2340   \krof #1%
2341 }%
2342 \def\XINT_flpow_IIIend #1#2#3#4%
2343 {%
2344   \xint_UDzerofork
2345   #3{#4{#2[#1]}}%
2346   0{#4{-#2[#1]}}%
2347   \krof
2348 }%

```

## 7.68 `\xintFloatPower`, `\XINTinFloatPower`

1.07. The core loop has been re-organized in 1.09j for some slight efficiency gain.

```

2349 \def\xintFloatPower {\romannumeral0\xintfloatpower}%
2350 \def\xintfloatpower #1{\XINT_flpower_chkopt \xintfloat #1\xint_relax }%
2351 \def\XINTinFloatPower {\romannumeral0\XINTinfloatpower}%
2352 \def\XINTinfloatpower #1{\XINT_flpower_chkopt \XINTinfloat #1\xint_relax }%
2353 \def\XINT_flpower_chkopt #1#2%
2354 {%
2355   \ifx [#2\expandafter\XINT_flpower_opt
2356     \else\expandafter\XINT_flpower_noopt
2357   \fi
2358   #1#2%
2359 }%
2360 \def\XINT_flpower_noopt #1#2\xint_relax #3%
2361 {%
2362   \expandafter\XINT_flpower_checkB_start\expandafter
2363     {\the\numexpr \XINTdigits\expandafter}\expandafter
2364     {\romannumeral0\xintnum{#3}}{#2}{#1[\XINTdigits]}%
2365 }%
2366 \def\XINT_flpower_opt #1[\xint_relax #2]#3#4%
2367 {%
2368   \expandafter\XINT_flpower_checkB_start\expandafter
2369     {\the\numexpr #2\expandafter}\expandafter
2370     {\romannumeral0\xintnum{#4}}{#3}{#1[#2]}%
2371 }%
2372 \def\XINT_flpower_checkB_start #1#2{\XINT_flpower_checkB_a #2\Z {#1}}%
2373 \def\XINT_flpower_checkB_a #1%
2374 {%
2375   \xint_UDzerominusfork
2376   #1-\XINT_flpower_BisZero
2377   0#1{\XINT_flpower_checkB_b 1}%
2378   0-{\XINT_flpower_checkB_b 0#1}%
2379   \krof
2380 }%
2381 \def\XINT_flpower_BisZero \Z #1#2#3{#3{1/1[0]}}%
2382 \def\XINT_flpower_checkB_b #1#2\Z #3%
2383 {%
2384   \expandafter\XINT_flpower_checkB_c \expandafter
2385     {\romannumeral0\xintlenth{#2}}{#3}{#2}#1%
2386 }%
2387 \def\XINT_flpower_checkB_c #1#2%
2388 {%
2389   \expandafter\XINT_flpower_checkB_d \expandafter
2390     {\the\numexpr \expandafter\xintLength\expandafter
2391       {\the\numexpr #1*20/\xint_c_iii }+#1+#2+\xint_c_i }%
2392 }%
2393 \def\XINT_flpower_checkB_d #1#2#3#4%
2394 {%
2395   \expandafter \XINT_flpower_a
2396   \romannumeral0\XINTinfloat [#1]{#4}{#1}{#2}#3%
2397 }%

```

## 7 Package *xintfrac* implementation

```

2398 \def\XINT_flpower_a #1%
2399 {%
2400   \xint_UDzerominusfork
2401   #1-\XINT_flpow_zero
2402   0#1{\XINT_flpower_b 1}%
2403   0-{\XINT_flpower_b 0#1}%
2404   \krof
2405 }%
2406 \def\XINT_flpower_b #1#2[#3]#4#5%
2407 {%
2408   \XINT_flpower_loopI {#5}{#2[#3]}\romannumeral0\XINTinfloatmul [#4]}%
2409   {#1*\xintiiOdd {#5}}%
2410 }%
2411 \def\XINT_flpower_loopI #1%
2412 {%
2413   \if1\XINT_isOne {#1}\XINT_flpower_ItoIII\fi
2414   \if1\xintiiOdd{#1}%
2415     \expandafter\expandafter\expandafter\XINT_flpower_loopI_odd
2416   \else
2417     \expandafter\expandafter\expandafter\XINT_flpower_loopI_even
2418   \fi
2419   \expandafter {\romannumeral0\xinthalff{#1}}%
2420 }%
2421 \def\XINT_flpower_ItoIII\fi #1\fi\expandafter #2#3#4#5%
2422 {%
2423   \fi\expandafter\XINT_flpow_III \the\numexpr #5\relax #3%
2424 }%
2425 \def\XINT_flpower_loopI_even #1#2#3%
2426 {%
2427   \expandafter\XINT_flpower_toI\expandafter {#3{#2}{#2}}{#1}{#3}%
2428 }%
2429 \def\XINT_flpower_loopI_odd #1#2#3%
2430 {%
2431   \expandafter\XINT_flpower_toII\expandafter {#3{#2}{#2}}{#1}{#3}{#2}%
2432 }%
2433 \def\XINT_flpower_toI #1#2{\XINT_flpower_loopI {#2}{#1}}%
2434 \def\XINT_flpower_toII #1#2{\XINT_flpower_loopII {#2}{#1}}%
2435 \def\XINT_flpower_loopII #1%
2436 {%
2437   \if1\XINT_isOne {#1}\XINT_flpower_IItoIII\fi
2438   \if1\xintiiOdd{#1}%
2439     \expandafter\expandafter\expandafter\XINT_flpower_loopII_odd
2440   \else
2441     \expandafter\expandafter\expandafter\XINT_flpower_loopII_even
2442   \fi
2443   \expandafter {\romannumeral0\xinthalff{#1}}%
2444 }%
2445 \def\XINT_flpower_loopII_even #1#2#3%
2446 {%
2447   \expandafter\XINT_flpower_toII\expandafter
2448   {#3{#2}{#2}}{#1}{#3}%
2449 }%

```

```

2450 \def\XINT_flpower_loopII_odd #1#2#3#4%
2451 {%
2452   \expandafter\XINT_flpower_loopII_odda\expandafter
2453   {#3{#2}{#4}}{#2}{#3}{#1}%
2454 }%
2455 \def\XINT_flpower_loopII_odda #1#2#3#4%
2456 {%
2457   \expandafter\XINT_flpower_toII\expandafter
2458   {#3{#2}{#2}}{#4}{#3}{#1}%
2459 }%
2460 \def\XINT_flpower_IItoIII\fi #1\fi\expandafter #2#3#4#5#6%
2461 {%
2462   \fi\expandafter\XINT_flpow_III\the\numexpr #6\expandafter\relax
2463   #4{#3}{#5}%
2464 }%

```

## 7.69 \xintFloatFac, \XINTFloatFac

1.2. Je dois documenter le raisonnement sur la précision à imposer pour les calculs par blocs de huit faits en sous-main. Par ailleurs j'ai été amené à une routine `smallmul` spéciale.

```

2465 \def\xintFloatFac {\romannumeral0\xintfloatfac}%
2466 \def\xintfloatfac #1{\XINT_flfac_chkopt \xintfloat #1\xint_relax }%
2467 \def\XINTinFloatFac {\romannumeral0\XINTinfloatfac }%
2468 \def\XINTinfloatfac #1{\XINT_flfac_chkopt \XINTinfloat #1\xint_relax }%
2469 \def\XINT_flfac_chkopt #1#2%
2470 {%
2471   \ifx [#2\expandafter\XINT_flfac_opt
2472   \else\expandafter\XINT_flfac_noopt
2473   \fi
2474   #1#2%
2475 }%
2476 \def\XINT_flfac_noopt #1#2\xint_relax
2477 {%
2478   \expandafter\XINT_FL_fac_start\expandafter
2479   {\the\numexpr #2}{\XINTdigits}{#1[\XINTdigits]}%
2480 }%
2481 \def\XINT_flfac_opt #1[\xint_relax #2]#3%
2482 {%
2483   \expandafter\XINT_FL_fac_start\expandafter
2484   {\the\numexpr #3\expandafter}\expandafter{\the\numexpr#2}{#1[#2]}%
2485 }%
2486 \def\XINT_FL_fac_start #1%
2487 {%
2488   \ifcase\XINT_cntSgn #1\Z
2489     \expandafter\XINT_FL_fac_iszero
2490   \or
2491     \expandafter\XINT_FL_fac_increaseP
2492   \else
2493     \expandafter\XINT_FL_fac_isneg
2494   \fi {#1}%
2495 }%
2496 \def\XINT_FL_fac_iszero #1#2#3{#3{1/1[0]}}%

```

## 7 Package *xintfrac* implementation

```

2497 \def\XINT_FL_fac_isneg #1#2#3%
2498   {\expandafter\xintError:FactorialOfNegativeNumber #3{1/1[0]}}%
2499 \def\XINT_FL_fac_increaseP #1#2%
2500 {%
2501   \expandafter\XINT_FL_fac_fork
2502   \the\numexpr \xint_c_viii*%
2503   ((\xint_c_v+#2+\XINT_FL_fac_extradigits #187654321\Z)/\xint_c_viii).%
2504   #1.%
2505 }%
2506 \def\XINT_FL_fac_extradigits #1#2#3#4#5#6#7#8{\XINT_FL_fac_extra_a }%
2507 \def\XINT_FL_fac_extra_a #1#2\Z {#1}%
2508 \def\XINT_FL_fac_fork #1.#2.#3%
2509 {%
2510   \ifnum #2>999999999 \xint_dothis{\XINT_FL_fac_toobig } \fi
2511   \ifnum #2>9999 \xint_dothis{\XINT_FL_fac_vbigloop_a } \fi
2512   \ifnum #2>465 \xint_dothis{\XINT_FL_fac_bigloop_a } \fi
2513   \ifnum #2>101 \xint_dothis{\XINT_FL_fac_medloop_a } \fi
2514   \xint_orthat{\XINT_FL_fac_smallloop_a }%
2515   #2.#1.{\XINT_FL_fac_out}{#3}%
2516 }%
2517 \def\XINT_FL_fac_toobig #1.#2.#3#4%
2518   {\expandafter\xintError:FactorialOfTooBigNumber #4{1/1[0]}}%
2519 \def\XINT_FL_fac_out #1\Z![#2]#3#3{\romannumeral0\XINT_mul_out
2520   #1\Z!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!1\R!\W [#2]}}%
2521 \def\XINT_FL_fac_vbigloop_a #1.#2.%
2522 {%
2523   \XINT_FL_fac_bigloop_a 9999.#2.%
2524   {\expandafter\XINT_FL_fac_vbigloop_loop\the\numexpr 100010000\expandafter.%
2525     \the\numexpr \xint_c_x^viii+#1.}%
2526 }%
2527 \def\XINT_FL_fac_vbigloop_loop #1.#2.%
2528 {%
2529   \ifnum #1>#2 \expandafter\XINT_FL_fac_loop_exit\fi
2530   \expandafter\XINT_FL_fac_vbigloop_loop
2531   \the\numexpr #1+\xint_c_i\expandafter.%
2532   \the\numexpr #2\expandafter.\the\numexpr\XINT_FL_fac_mul #1!%
2533 }%
2534 \def\XINT_FL_fac_bigloop_a #1.%
2535 {%
2536   \expandafter\XINT_FL_fac_bigloop_b \the\numexpr
2537   #1+\xint_c_i-\xint_c_ii*((#1-464)/\xint_c_ii).#1.%
2538 }%
2539 \def\XINT_FL_fac_bigloop_b #1.#2.#3.%
2540 {%
2541   \expandafter\XINT_FL_fac_medloop_a
2542   \the\numexpr #1-\xint_c_i.#3.{\XINT_FL_fac_bigloop_loop #1.#2.}%
2543 }%
2544 \def\XINT_FL_fac_bigloop_loop #1.#2.%
2545 {%
2546   \ifnum #1>#2 \expandafter\XINT_FL_fac_loop_exit\fi
2547   \expandafter\XINT_FL_fac_bigloop_loop
2548   \the\numexpr #1+\xint_c_ii\expandafter.%

```

## 7 Package *xintfrac* implementation

```

2549 \the\numexpr #2\expandafter.\the\numexpr\XINT_FL_fac_bigloop_mul #1!%
2550 }%
2551 \def\XINT_FL_fac_bigloop_mul #1!%
2552 {%
2553 \expandafter\XINT_FL_fac_mul
2554 \the\numexpr \xint_c_x^viii+#1*(#1+\xint_c_i)!%
2555 }%
2556 \def\XINT_FL_fac_medloop_a #1.%
2557 {%
2558 \expandafter\XINT_FL_fac_medloop_b
2559 \the\numexpr #1+\xint_c_i-\xint_c_iii*((#1-100)/\xint_c_iii).#1.%
2560 }%
2561 \def\XINT_FL_fac_medloop_b #1.#2.#3.%
2562 {%
2563 \expandafter\XINT_FL_fac_smallloop_a
2564 \the\numexpr #1-\xint_c_i.#3.{\XINT_FL_fac_medloop_loop #1.#2.}%
2565 }%
2566 \def\XINT_FL_fac_medloop_loop #1.#2.%
2567 {%
2568 \ifnum #1>#2 \expandafter\XINT_FL_fac_loop_exit\fi
2569 \expandafter\XINT_FL_fac_medloop_loop
2570 \the\numexpr #1+\xint_c_iii\expandafter.%
2571 \the\numexpr #2\expandafter.\the\numexpr\XINT_FL_fac_medloop_mul #1!%
2572 }%
2573 \def\XINT_FL_fac_medloop_mul #1!%
2574 {%
2575 \expandafter\XINT_FL_fac_mul
2576 \the\numexpr
2577 \xint_c_x^viii+#1*(#1+\xint_c_i)*(#1+\xint_c_ii)!%
2578 }%
2579 \def\XINT_FL_fac_smallloop_a #1.%
2580 {%
2581 \csname
2582 XINT_FL_fac_smallloop_\the\numexpr #1-\xint_c_iv*(#1/\xint_c_iv)\relax
2583 \endcsname #1.%
2584 }%
2585 \expandafter\def\csname XINT_FL_fac_smallloop_1\endcsname #1.#2.%
2586 {%
2587 \XINT_FL_fac_addzeros #2.100000001!.{2.#1.}{#2}%
2588 }%
2589 \expandafter\def\csname XINT_FL_fac_smallloop_-2\endcsname #1.#2.%
2590 {%
2591 \XINT_FL_fac_addzeros #2.100000002!.{3.#1.}{#2}%
2592 }%
2593 \expandafter\def\csname XINT_FL_fac_smallloop_-1\endcsname #1.#2.%
2594 {%
2595 \XINT_FL_fac_addzeros #2.100000006!.{4.#1.}{#2}%
2596 }%
2597 \expandafter\def\csname XINT_FL_fac_smallloop_0\endcsname #1.#2.%
2598 {%
2599 \XINT_FL_fac_addzeros #2.100000024!.{5.#1.}{#2}%
2600 }%

```

## 7 Package *xintfrac* implementation

```

2601 \def\XINT_FL_fac_addzeros #1.%
2602 {%
2603   \ifnum #1=\xint_c_viii \expandafter\XINT_FL_fac_addzeros_exit\fi
2604   \expandafter\XINT_FL_fac_addzeros\the\numexpr #1-\xint_c_viii.100000000!%
2605 }%
2606 \def\XINT_FL_fac_addzeros_exit #1.#2.#3#4%
2607   {\XINT_FL_fac_smallloop_loop #3#2\Z![-#4]}%
2608 \def\XINT_FL_fac_smallloop_loop #1.#2.%
2609 {%
2610   \ifnum #1>#2 \expandafter\XINT_FL_fac_loop_exit\fi
2611   \expandafter\XINT_FL_fac_smallloop_loop
2612   \the\numexpr #1+\xint_c_iv\expandafter.%
2613   \the\numexpr #2\expandafter.\romannumeral0\XINT_FL_fac_smallloop_mul #1!%
2614 }%
2615 \def\XINT_FL_fac_smallloop_mul #1!%
2616 {%
2617   \expandafter\XINT_FL_fac_mul
2618   \the\numexpr
2619     \xint_c_x^viii+#1*(#1+\xint_c_i)*(#1+\xint_c_ii)*(#1+\xint_c_iii)!%
2620 }%[
2621 \def\XINT_FL_fac_loop_exit #1!#2]#3{#3#2]}%
2622 \def\XINT_FL_fac_mul 1#1!%
2623   {\expandafter\XINT_FL_fac_mul_a\the\numexpr\XINT_FL_fac_smallmul 10!{#1}}%
2624 \def\XINT_FL_fac_mul_a #1-#2%
2625 {%
2626   \if#21\xint_afterfi{\expandafter\space\xint_gob_til_exclam}\else
2627   \expandafter\space\fi #11\Z!%
2628 }%
2629 \def\XINT_FL_fac_minimulwc_a #1#2#3#4#5!#6#7#8#9%
2630 {%
2631   \XINT_FL_fac_minimulwc_b {#1#2#3#4}{#5}{#6#7#8#9}%
2632 }%
2633 \def\XINT_FL_fac_minimulwc_b #1#2#3#4!#5%
2634 {%
2635   \expandafter\XINT_FL_fac_minimulwc_c
2636   \the\numexpr \xint_c_x^ix+#5+#2*#4.{#1}{#2}{#3}{#4}}%
2637 }%
2638 \def\XINT_FL_fac_minimulwc_c 1#1#2#3#4#5#6.#7%
2639 {%
2640   \expandafter\XINT_FL_fac_minimulwc_d {#1#2#3#4#5}#7{#6}%
2641 }%
2642 \def\XINT_FL_fac_minimulwc_d #1#2#3#4#5%
2643 {%
2644   \expandafter\XINT_FL_fac_minimulwc_e
2645   \the\numexpr \xint_c_x^ix+#1+#2*#5+#3*#4.{#2}{#4}%
2646 }%
2647 \def\XINT_FL_fac_minimulwc_e 1#1#2#3#4#5#6.#7#8#9%
2648 {%
2649   1#6#9\expandafter!%
2650   \the\numexpr\expandafter\XINT_FL_fac_smallmul
2651   \the\numexpr \xint_c_x^viii+#1#2#3#4#5+#7*#8!%
2652 }%

```

```

2653 \def\XINT_FL_fac_smallmul 1#1!#21#3!%
2654 {%
2655   \xint_gob_til_Z #3\XINT_FL_fac_smallmul_end\Z
2656   \XINT_FL_fac_minimulwc_a #2!#3!{#1}{#2}%
2657 }%
2658 \def\XINT_FL_fac_smallmul_end\Z\XINT_FL_fac_minimulwc_a #1!\Z!#2#3[#4]%
2659 {%
2660   \ifnum #2=\xint_c_
2661     \expandafter\xint_firstoftwo\else
2662     \expandafter\xint_secondoftwo
2663   \fi
2664   {-2\relax[#4]}%
2665   {1#2\expandafter!\expandafter-\expandafter1\expandafter
2666     [\the\numexpr #4+\xint_c_viii]}%
2667 }%

```

## 7.70 \xintFloatSqrt, \XINTinFloatSqrt

### 1.08

```

2668 \def\xintFloatSqrt {\romannumeral0\xintfloatsqrt }%
2669 \def\xintfloatsqrt #1{\XINT_flsqrt_chkopt \xintfloat #1\xint_relax }%
2670 \def\XINTinFloatSqrt {\romannumeral0\XINTinfloatsqrt }%
2671 \def\XINTinfloatsqrt #1{\XINT_flsqrt_chkopt \XINTinfloat #1\xint_relax }%
2672 \def\XINT_flsqrt_chkopt #1#2%
2673 {%
2674   \ifx [#2\expandafter\XINT_flsqrt_opt
2675   \else\expandafter\XINT_flsqrt_noopt
2676   \fi #1#2%
2677 }%
2678 \def\XINT_flsqrt_noopt #1#2\xint_relax
2679 {%
2680   #1[\XINTdigits]{\XINT_FL_sqrt \XINTdigits {#2}}%
2681 }%
2682 \def\XINT_flsqrt_opt #1[\xint_relax #2]#3%
2683 {%
2684   #1[#2]{\XINT_FL_sqrt {#2}{#3}}%
2685 }%
2686 \def\XINT_FL_sqrt #1%
2687 {%
2688   \ifnum\numexpr #1<\xint_c_xviii
2689     \xint_afterfi {\XINT_FL_sqrt_a\xint_c_xviii}%
2690   \else
2691     \xint_afterfi {\XINT_FL_sqrt_a {#1+\xint_c_i}}%
2692   \fi
2693 }%
2694 \def\XINT_FL_sqrt_a #1#2%
2695 {%
2696   \expandafter\XINT_FL_sqrt_checkifzeroorneg
2697   \romannumeral0\XINTinfloat [#1]{#2}%
2698 }%
2699 \def\XINT_FL_sqrt_checkifzeroorneg #1%
2700 {%

```



```

2701 \xint_UDzerominusfork
2702 #1-\XINT_FL_sqrt_iszero
2703 0#1\XINT_FL_sqrt_isneg
2704 0-\XINT_FL_sqrt_b #1}%
2705 \krof
2706 }%
2707 \def\XINT_FL_sqrt_iszero #1[#2]{0[0]}%
2708 \def\XINT_FL_sqrt_isneg #1[#2]{\xintError:RootOfNegative 0[0]}%
2709 \def\XINT_FL_sqrt_b #1[#2]%
2710 {%
2711 \ifodd #2
2712 \xint_afterfi{\XINT_FL_sqrt_c 01}%
2713 \else
2714 \xint_afterfi{\XINT_FL_sqrt_c {}0}%
2715 \fi
2716 {#1}{#2}%
2717 }%
2718 \def\XINT_FL_sqrt_c #1#2#3#4%
2719 {%
2720 \expandafter\XINT_flsqrt\expandafter {\the\numexpr #4-#2}{#3#1}%
2721 }%
2722 \def\XINT_flsqrt #1#2%
2723 {%
2724 \expandafter\XINT_sqrt_a
2725 \expandafter{\romannumeral0\xintlength {#2}}\XINT_flsqrt_big_d {#2}{#1}%
2726 }%
2727 \def\XINT_flsqrt_big_d #1#2%
2728 {%
2729 \ifodd #2
2730 \expandafter\expandafter\expandafter\XINT_flsqrt_big_eB
2731 \else
2732 \expandafter\expandafter\expandafter\XINT_flsqrt_big_eA
2733 \fi
2734 \expandafter {\the\numexpr (#2-\xint_c_i)/\xint_c_ii }{#1}%
2735 }%
2736 \def\XINT_flsqrt_big_eA #1#2#3%
2737 {%
2738 \XINT_flsqrt_big_eA_a #3\Z {#2}{#1}{#3}%
2739 }%
2740 \def\XINT_flsqrt_big_eA_a #1#2#3#4#5#6#7#8#9\Z
2741 {%
2742 \XINT_flsqrt_big_eA_b {#1#2#3#4#5#6#7#8}%
2743 }%
2744 \def\XINT_flsqrt_big_eA_b #1#2%
2745 {%
2746 \expandafter\XINT_flsqrt_big_f
2747 \romannumeral0\XINT_flsqrt_small_e {#2001}{#1}%
2748 }%
2749 \def\XINT_flsqrt_big_eB #1#2#3%
2750 {%
2751 \XINT_flsqrt_big_eB_a #3\Z {#2}{#1}{#3}%
2752 }%

```

## 7 Package *xintfrac* implementation

```

2753 \def\XINT_flsqrt_big_eB_a #1#2#3#4#5#6#7#8#9%
2754 {%
2755     \XINT_flsqrt_big_eB_b {#1#2#3#4#5#6#7#8#9}%
2756 }%
2757 \def\XINT_flsqrt_big_eB_b #1#2\Z #3%
2758 {%
2759     \expandafter\XINT_flsqrt_big_f
2760     \romannumeral0\XINT_flsqrt_small_e {#30001}{#1}%
2761 }%
2762 \def\XINT_flsqrt_small_e #1#2%
2763 {%
2764     \expandafter\XINT_flsqrt_small_f\expandafter
2765     {\the\numexpr #1*#1-#2-\xint_c_i}{#1}%
2766 }%
2767 \def\XINT_flsqrt_small_f #1#2%
2768 {%
2769     \expandafter\XINT_flsqrt_small_g\expandafter
2770     {\the\numexpr (#1+#2)/(2*#2)-\xint_c_i }{#1}{#2}%
2771 }%
2772 \def\XINT_flsqrt_small_g #1%
2773 {%
2774     \ifnum #1>\xint_c_
2775         \expandafter\XINT_flsqrt_small_h
2776     \else
2777         \expandafter\XINT_flsqrt_small_end
2778     \fi
2779     {#1}%
2780 }%
2781 \def\XINT_flsqrt_small_h #1#2#3%
2782 {%
2783     \expandafter\XINT_flsqrt_small_f\expandafter
2784     {\the\numexpr #2-\xint_c_ii*#1*#3+#1*#1\expandafter}\expandafter
2785     {\the\numexpr #3-#1}%
2786 }%
2787 \def\XINT_flsqrt_small_end #1#2#3%
2788 {%
2789     \expandafter\space\expandafter
2790     {\the\numexpr \xint_c_i+#3*\xint_c_x^iv-
2791         (#2*\xint_c_x^iv+#3)/(\xint_c_ii*#3)}%
2792 }%
2793 \def\XINT_flsqrt_big_f #1%
2794 {%
2795     \expandafter\XINT_flsqrt_big_fa\expandafter
2796     {\romannumeral0\xintiisqr {#1}}{#1}%
2797 }%
2798 \def\XINT_flsqrt_big_fa #1#2#3#4%
2799 {%
2800     \expandafter\XINT_flsqrt_big_fb\expandafter
2801     {\romannumeral0\XINT_dsx_addzerosnofuss
2802         {\numexpr #3-\xint_c_viii\relax}{#2}}%
2803     {\romannumeral0\xintiisub
2804         {\XINT_dsx_addzerosnofuss

```

```

2805      {\numexpr \xint_c_ii*(#3-\xint_c_viii)\relax}{#1}}{#4}}%
2806      {#3}}%
2807 }%
2808 \def\xINT_flsqrt_big_fb #1#2%
2809 {%
2810   \expandafter\xINT_flsqrt_big_g\expandafter {#2}{#1}%
2811 }%
2812 \def\xINT_flsqrt_big_g #1#2%
2813 {%
2814   \expandafter\xINT_flsqrt_big_j
2815   \romannumeral0\xintiidivision
2816   {#1}{\romannumeral0\xINT_dbl_pos #2\Z}{#2}%
2817 }%
2818 \def\xINT_flsqrt_big_j #1%
2819 {%
2820   \if0\xINT_Sgn #1\Z
2821     \expandafter \xINT_flsqrt_big_end_a
2822   \else \expandafter \xINT_flsqrt_big_k
2823   \fi {#1}%
2824 }%
2825 \def\xINT_flsqrt_big_k #1#2#3%
2826 {%
2827   \expandafter\xINT_flsqrt_big_l\expandafter
2828   {\romannumeral0\xintiisub {#3}{#1}}%
2829   {\romannumeral0\xintiiaadd {#2}{\romannumeral0\xINT_sqr #1\Z}}%
2830 }%
2831 \def\xINT_flsqrt_big_l #1#2%
2832 {%
2833   \expandafter\xINT_flsqrt_big_g\expandafter
2834   {#2}{#1}%
2835 }%
2836 \def\xINT_flsqrt_big_end_a #1#2#3#4#5%
2837 {%
2838   \expandafter\xINT_flsqrt_big_end_b\expandafter
2839   {\the\numexpr -#4+#5/\xint_c_ii\expandafter}\expandafter
2840   {\romannumeral0\xintiisub
2841     {\XINT_dsx_addzerosnofuss {#4}{#3}}%
2842     {\xintHalf{\xintiiQuo{\XINT_dsx_addzerosnofuss {#4}{#2}}{#3}}}%
2843 }%
2844 \def\xINT_flsqrt_big_end_b #1#2{#2[#1]}%
2845 \XINT_restorecatcodes_endinput%

```

## 8 Package *xintseries* implementation

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The commenting is currently (2015/10/10) very sparse.

## 8.1 Catcodes, $\epsilon$ -TeX and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified.

The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2 \catcode13=5 % ^^M
3 \endlinechar=13 %
4 \catcode123=1 % {
5 \catcode125=2 % }
6 \catcode64=11 % @
7 \catcode35=6 % #
8 \catcode44=12 % ,
9 \catcode45=12 % -
10 \catcode46=12 % .
11 \catcode58=12 % :
12 \let\z\endgroup
13 \expandafter\let\expandafter\x\csname ver@xintseries.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintfrac.sty\endcsname
15 \expandafter
16 \ifx\csname PackageInfo\endcsname\relax
17 \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18 \else
19 \def\y#1#2{\PackageInfo{#1}{#2}}%
20 \fi
21 \expandafter
22 \ifx\csname numexpr\endcsname\relax
23 \y{xintseries}{\numexpr not available, aborting input}%
24 \aftergroup\endinput
25 \else
26 \ifx\x\relax % plain-TeX, first loading of xintseries.sty
27 \ifx\w\relax % but xintfrac.sty not yet loaded.
28 \def\z{\endgroup\input xintfrac.sty\relax}%
29 \fi
30 \else
31 \def\empty {}%
32 \ifx\x\empty % LaTeX, first loading,
33 % variable is initialized, but \ProvidesPackage not yet seen
34 \ifx\w\relax % xintfrac.sty not yet loaded.
35 \def\z{\endgroup\RequirePackage{xintfrac}}%
36 \fi
37 \else
38 \aftergroup\endinput % xintseries already loaded.
39 \fi
40 \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty

```

## 8.2 Package identification

```

44 \XINT_providespackage
45 \ProvidesPackage{xintseries}%
46 [2015/10/10 v1.2 Expandable partial sums with xint package (jfb)]%

```

### 8.3 `\xintSeries`

Modified in 1.06 to give the indices first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

47 \def\xintSeries {\romannumeral0\xintseries }%
48 \def\xintseries #1#2%
49 {%
50   \expandafter\XINT_series\expandafter
51   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
52 }%
53 \def\XINT_series #1#2#3%
54 {%
55   \ifnum #2<#1
56     \xint_afterfi { 0/1[0]}%
57   \else
58     \xint_afterfi {\XINT_series_loop {#1}{0}{#2}{#3}}%
59   \fi
60 }%
61 \def\XINT_series_loop #1#2#3#4%
62 {%
63   \ifnum #3>#1 \else \XINT_series_exit \fi
64   \expandafter\XINT_series_loop\expandafter
65   {\the\numexpr #1+1\expandafter }\expandafter
66   {\romannumeral0\xintadd {#2}{#4{#1}}}%
67   {#3}{#4}%
68 }%
69 \def\XINT_series_exit \fi #1#2#3#4#5#6#7#8%
70 {%
71   \fi\xint_gobble_ii #6%
72 }%

```

### 8.4 `\xintiSeries`

Modified in 1.06 to give the indices first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

73 \def\xintiSeries {\romannumeral0\xintiseries }%
74 \def\xintiseries #1#2%
75 {%
76   \expandafter\XINT_iseries\expandafter
77   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
78 }%
79 \def\XINT_iseries #1#2#3%
80 {%
81   \ifnum #2<#1
82     \xint_afterfi { 0}%
83   \else
84     \xint_afterfi {\XINT_iseries_loop {#1}{0}{#2}{#3}}%
85   \fi
86 }%

```

```

87 \def\XINT_iseries_loop #1#2#3#4%
88 {%
89   \ifnum #3>#1 \else \XINT_iseries_exit \fi
90   \expandafter\XINT_iseries_loop\expandafter
91   {\the\numexpr #1+1\expandafter }\expandafter
92   {\romannumeral0\xintiadd {#2}{#4{#1}}}%
93   {#3}{#4}%
94 }%
95 \def\XINT_iseries_exit \fi #1#2#3#4#5#6#7#8%
96 {%
97   \fi\xint_gobble_ii #6%
98 }%

```

## 8.5 \xintPowerSeries

The 1.03 version was very lame and created a build-up of denominators. (this was at a time \xintAdd always multiplied denominators, by the way) The Horner scheme for polynomial evaluation is used in 1.04, this cures the denominator problem and drastically improves the efficiency of the macro. Modified in 1.06 to give the indices first to a \numexpr rather than expanding twice. I just use \the\numexpr and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

99 \def\xintPowerSeries {\romannumeral0\xintpowerseries }%
100 \def\xintpowerseries #1#2%
101 {%
102   \expandafter\XINT_powseries\expandafter
103   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
104 }%
105 \def\XINT_powseries #1#2#3#4%
106 {%
107   \ifnum #2<#1
108     \xint_afterfi { 0/1[0]}%
109   \else
110     \xint_afterfi
111     {\XINT_powseries_loop_i {#3{#2}}{#1}{#2}{#3}{#4}}%
112   \fi
113 }%
114 \def\XINT_powseries_loop_i #1#2#3#4#5%
115 {%
116   \ifnum #3>#2 \else\XINT_powseries_exit_i\fi
117   \expandafter\XINT_powseries_loop_ii\expandafter
118   {\the\numexpr #3-1\expandafter}\expandafter
119   {\romannumeral0\xintmul {#1}{#5}}{#2}{#4}{#5}%
120 }%
121 \def\XINT_powseries_loop_ii #1#2#3#4%
122 {%
123   \expandafter\XINT_powseries_loop_i\expandafter
124   {\romannumeral0\xintadd {#4{#1}}{#2}}{#3}{#1}{#4}%
125 }%
126 \def\XINT_powseries_exit_i\fi #1#2#3#4#5#6#7#8#9%
127 {%
128   \fi \XINT_powseries_exit_ii #6{#7}%
129 }%

```

```

130 \def\XINT_powseries_exit_ii #1#2#3#4#5#6%
131 {%
132   \xintmul{\xintPow {#5}{#6}}{#4}%
133 }%

```

## 8.6 \xintPowerSeriesX

Same as `\xintPowerSeries` except for the initial expansion of the `x` parameter. Modified in 1.06 to give the indices first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

134 \def\xintPowerSeriesX {\romannumeral0\xintpowerseriesx }%
135 \def\xintpowerseriesx #1#2%
136 {%
137   \expandafter\XINT_powseriesx\expandafter
138   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
139 }%
140 \def\XINT_powseriesx #1#2#3#4%
141 {%
142   \ifnum #2<#1
143     \xint_afterfi { 0/1[0]}%
144   \else
145     \xint_afterfi
146     {\expandafter\XINT_powseriesx_pre\expandafter
147      {\romannumeral-`0#4}{#1}{#2}{#3}%
148     }%
149   \fi
150 }%
151 \def\XINT_powseriesx_pre #1#2#3#4%
152 {%
153   \XINT_powseries_loop_i {#4}{#3}{#2}{#3}{#4}{#1}%
154 }%

```

## 8.7 \xintRationalSeries

This computes  $F(a) + \dots + F(b)$  on the basis of the value of  $F(a)$  and the ratios  $F(n)/F(n-1)$ . As in `\xintPowerSeries` we use an iterative scheme which has the great advantage to avoid denominator build-up. This makes exact computations possible with exponential type series, which would be completely inaccessible to `\xintSeries`. #1=a, #2=b, #3=F(a), #4=ratio function Modified in 1.06 to give the indices first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

155 \def\xintRationalSeries {\romannumeral0\xintratseries }%
156 \def\xintratseries #1#2%
157 {%
158   \expandafter\XINT_ratseries\expandafter
159   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
160 }%
161 \def\XINT_ratseries #1#2#3#4%
162 {%
163   \ifnum #2<#1

```

```

164     \xint_afterfi { 0/1[0]}%
165   \else
166     \xint_afterfi
167     {\XINT_ratseries_loop {#2}{1}{#1}{#4}{#3}}%
168   \fi
169}%
170 \def\XINT_ratseries_loop #1#2#3#4%
171 {%
172   \ifnum #1>#3 \else\XINT_ratseries_exit_i\fi
173   \expandafter\XINT_ratseries_loop\expandafter
174   {\the\numexpr #1-1\expandafter}\expandafter
175   {\romannumeral0\xintadd {1}{\xintMul {#2}{#4{#1}}}{#3}{#4}}%
176}%
177 \def\XINT_ratseries_exit_i\fi #1#2#3#4#5#6#7#8%
178 {%
179   \fi \XINT_ratseries_exit_ii #6%
180}%
181 \def\XINT_ratseries_exit_ii #1#2#3#4#5%
182 {%
183   \XINT_ratseries_exit_iii #5%
184}%
185 \def\XINT_ratseries_exit_iii #1#2#3#4%
186 {%
187   \xintmul{#2}{#4}%
188}%

```

## 8.8 \xintRationalSeriesX

*a,b,initial,ratiofunction,x*

This computes  $F(a,x)+\dots+F(b,x)$  on the basis of the value of  $F(a,x)$  and the ratios  $F(n,x)/F(n-1,x)$ . The argument  $x$  is first expanded and it is the value resulting from this which is used then throughout. The initial term  $F(a,x)$  must be defined as one-parameter macro which will be given  $x$ . Modified in 1.06 to give the indices first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

189 \def\xintRationalSeriesX {\romannumeral0\xintratseriesx}%
190 \def\xintratseriesx #1#2%
191 {%
192   \expandafter\XINT_ratseriesx\expandafter
193   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
194}%
195 \def\XINT_ratseriesx #1#2#3#4#5%
196 {%
197   \ifnum #2<#1
198     \xint_afterfi { 0/1[0]}%
199   \else
200     \xint_afterfi
201     {\expandafter\XINT_ratseriesx_pre\expandafter
202      {\romannumeral-`0#5}{#2}{#1}{#4}{#3}}%
203  }%
204   \fi
205}%

```



```

206 \def\XINT_ratseriesx_pre #1#2#3#4#5%
207 {%
208   \XINT_ratseries_loop {#2}{1}{#3}{#4{#1}}{#5{#1}}%
209 }%

```

## 8.9 \xintFxpPowerSeries

I am not two happy with this piece of code. Will make it more economical another day. Modified in 1.06 to give the indices first to a \numexpr rather than expanding twice. I just use \the\numexpr and maintain the previous code after that. 1.08a: forgot last time some optimization from the change to \numexpr.

```

210 \def\xintFxpPowerSeries {\romannumeral0\xintfxptpowerseries }%
211 \def\xintfxptpowerseries #1#2%
212 {%
213   \expandafter\XINT_fppowseries\expandafter
214   {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
215 }%
216 \def\XINT_fppowseries #1#2#3#4#5%
217 {%
218   \ifnum #2<#1
219     \xint_afterfi { 0}%
220   \else
221     \xint_afterfi
222     {\expandafter\XINT_fppowseries_loop_pre\expandafter
223      {\romannumeral0\xinttrunc {#5}{\xintPow {#4}{#1}}}%
224      {#1}{#4}{#2}{#3}{#5}%
225     }%
226   \fi
227 }%
228 \def\XINT_fppowseries_loop_pre #1#2#3#4#5#6%
229 {%
230   \ifnum #4>#2 \else\XINT_fppowseries_dont_i \fi
231   \expandafter\XINT_fppowseries_loop_i\expandafter
232   {\the\numexpr #2+\xint_c_i\expandafter}\expandafter
233   {\romannumeral0\xintitrunc {#6}{\xintMul {#5{#2}}{#1}}}%
234   {#1}{#3}{#4}{#5}{#6}%
235 }%
236 \def\XINT_fppowseries_dont_i \fi\expandafter\XINT_fppowseries_loop_i
237   {\fi \expandafter\XINT_fppowseries_dont_ii }%
238 \def\XINT_fppowseries_dont_ii #1#2#3#4#5#6#7{\xinttrunc {#7}{#2[-#7]}}%
239 \def\XINT_fppowseries_loop_i #1#2#3#4#5#6#7%
240 {%
241   \ifnum #5>#1 \else \XINT_fppowseries_exit_i \fi
242   \expandafter\XINT_fppowseries_loop_ii\expandafter
243   {\romannumeral0\xinttrunc {#7}{\xintMul {#3}{#4}}}%
244   {#1}{#4}{#2}{#5}{#6}{#7}%
245 }%
246 \def\XINT_fppowseries_loop_ii #1#2#3#4#5#6#7%
247 {%
248   \expandafter\XINT_fppowseries_loop_i\expandafter
249   {\the\numexpr #2+\xint_c_i\expandafter}\expandafter
250   {\romannumeral0\xintiadd {#4}{\xintiTrunc {#7}{\xintMul {#6{#2}}{#1}}}}%

```

```

251      {#1}{#3}{#5}{#6}{#7}%
252 }%
253 \def\XINT_fppowseries_exit_i\fi\expandafter\XINT_fppowseries_loop_ii
254      {\fi \expandafter\XINT_fppowseries_exit_ii }%
255 \def\XINT_fppowseries_exit_ii #1#2#3#4#5#6#7%
256 {%
257     \xinttrunc {#7}
258     {\xintiiadd {#4}{\xintiTrunc {#7}{\xintMul {#6{#2}}{#1}}}{-#7}}%
259 }%

```

## 8.10 \xintFxFtPowerSeriesX

*a,b,coeff,x,D*

Modified in 1.06 to give the indices first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that. 1.08a adds the forgotten optimization following that previous change.

```

260 \def\xintFxFtPowerSeriesX {\romannumeral0\xintfxptpowerseriesx }%
261 \def\xintfxptpowerseriesx #1#2%
262 {%
263     \expandafter\XINT_fppowseriesx\expandafter
264     {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
265 }%
266 \def\XINT_fppowseriesx #1#2#3#4#5%
267 {%
268     \ifnum #2<#1
269         \xint_afterfi { 0}%
270     \else
271         \xint_afterfi
272         {\expandafter \XINT_fppowseriesx_pre \expandafter
273         {\romannumeral-`0#4}{#1}{#2}{#3}{#5}%
274         }%
275     \fi
276 }%
277 \def\XINT_fppowseriesx_pre #1#2#3#4#5%
278 {%
279     \expandafter\XINT_fppowseries_loop_pre\expandafter
280     {\romannumeral0\xinttrunc {#5}{\xintPow {#1}{#2}}}%
281     {#2}{#1}{#3}{#4}{#5}%
282 }%

```

## 8.11 \xintFloatPowerSeries

1.08a. I still have to re-visit `\xintFxFtPowerSeries`; temporarily I just adapted the code to the case of floats.

```

283 \def\xintFloatPowerSeries {\romannumeral0\xintfloatpowerseries }%
284 \def\xintfloatpowerseries #1{\XINT_flpowseries_chkopt #1\xint_relax }%
285 \def\XINT_flpowseries_chkopt #1%
286 {%
287     \ifx [#1\expandafter\XINT_flpowseries_opt
288     \else\expandafter\XINT_flpowseries_noopt
289     \fi

```

```

290   #1%
291 }%
292 \def\XINT_flpowseries_noopt #1\xint_relax #2%
293 {%
294   \expandafter\XINT_flpowseries\expandafter
295   {\the\numexpr #1\expandafter}\expandafter
296   {\the\numexpr #2}\XINTdigits
297 }%
298 \def\XINT_flpowseries_opt [\xint_relax #1]#2#3%
299 {%
300   \expandafter\XINT_flpowseries\expandafter
301   {\the\numexpr #2\expandafter}\expandafter
302   {\the\numexpr #3\expandafter}{\the\numexpr #1}%
303 }%
304 \def\XINT_flpowseries #1#2#3#4#5%
305 {%
306   \ifnum #2<#1
307     \xint_afterfi { 0.e0}%
308   \else
309     \xint_afterfi
310     {\expandafter\XINT_flpowseries_loop_pre\expandafter
311      {\romannumeral0\XINTinfloatpow [#3]{#5}{#1}}%
312      {#1}{#5}{#2}{#4}{#3}%
313     }%
314   \fi
315 }%
316 \def\XINT_flpowseries_loop_pre #1#2#3#4#5#6%
317 {%
318   \ifnum #4>#2 \else\XINT_flpowseries_dont_i \fi
319   \expandafter\XINT_flpowseries_loop_i\expandafter
320   {\the\numexpr #2+\xint_c_i\expandafter}\expandafter
321   {\romannumeral0\XINTinfloatmul [#6]{#5}{#2}}{#1}%
322   {#1}{#3}{#4}{#5}{#6}%
323 }%
324 \def\XINT_flpowseries_dont_i \fi\expandafter\XINT_flpowseries_loop_i
325   {\fi \expandafter\XINT_flpowseries_dont_ii }%
326 \def\XINT_flpowseries_dont_ii #1#2#3#4#5#6#7{\xintfloat [#7]{#2}}%
327 \def\XINT_flpowseries_loop_i #1#2#3#4#5#6#7%
328 {%
329   \ifnum #5>#1 \else \XINT_flpowseries_exit_i \fi
330   \expandafter\XINT_flpowseries_loop_ii\expandafter
331   {\romannumeral0\XINTinfloatmul [#7]{#3}{#4}}%
332   {#1}{#4}{#2}{#5}{#6}{#7}%
333 }%
334 \def\XINT_flpowseries_loop_ii #1#2#3#4#5#6#7%
335 {%
336   \expandafter\XINT_flpowseries_loop_i\expandafter
337   {\the\numexpr #2+\xint_c_i\expandafter}\expandafter
338   {\romannumeral0\XINTinfloatadd [#7]{#4}%
339    {\XINTinfloatmul [#7]{#6}{#2}}{#1}}}%
340   {#1}{#3}{#5}{#6}{#7}%
341 }%

```

```

342 \def\XINT_flpowseries_exit_i\fi\expandafter\XINT_flpowseries_loop_ii
343   {\fi \expandafter\XINT_flpowseries_exit_ii }%
344 \def\XINT_flpowseries_exit_ii #1#2#3#4#5#6#7%
345 {%
346   \xintfloatadd [#7]{#4}{\XINTinfloatmul [#7]{#6{#2}}{#1}}%
347 }%

```

## 8.12 \xintFloatPowerSeriesX

### 1.08a

```

348 \def\xintFloatPowerSeriesX {\romannumeral0\xintfloatpowerseriesx }%
349 \def\xintfloatpowerseriesx #1{\XINT_flpowseriesx_chkopt #1\xint_relax }%
350 \def\XINT_flpowseriesx_chkopt #1%
351 {%
352   \ifx [#1\expandafter\XINT_flpowseriesx_opt
353     \else\expandafter\XINT_flpowseriesx_noopt
354   \fi
355   #1%
356 }%
357 \def\XINT_flpowseriesx_noopt #1\xint_relax #2%
358 {%
359   \expandafter\XINT_flpowseriesx\expandafter
360   {\the\numexpr #1\expandafter}\expandafter
361   {\the\numexpr #2}\XINTdigits
362 }%
363 \def\XINT_flpowseriesx_opt [\xint_relax #1]#2#3%
364 {%
365   \expandafter\XINT_flpowseriesx\expandafter
366   {\the\numexpr #2\expandafter}\expandafter
367   {\the\numexpr #3\expandafter}{\the\numexpr #1}%
368 }%
369 \def\XINT_flpowseriesx #1#2#3#4#5%
370 {%
371   \ifnum #2<#1
372     \xint_afterfi { 0.e0}%
373   \else
374     \xint_afterfi
375     {\expandafter \XINT_flpowseriesx_pre \expandafter
376      {\romannumeral-`0#5}{#1}{#2}{#4}{#3}%
377     }%
378   \fi
379 }%
380 \def\XINT_flpowseriesx_pre #1#2#3#4#5%
381 {%
382   \expandafter\XINT_flpowseries_loop_pre\expandafter
383   {\romannumeral0\XINTinfloatpow [#5]{#1}{#2}}%
384   {#2}{#1}{#3}{#4}{#5}%
385 }%
386 \XINT_restorecatcodes_endinput%

```

## 9 Package *xintcfrac* implementation

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The commenting is currently (2015/10/10) very sparse. Release 1.09m (2014/02/26) has modified a few things: `\xintFtoCs` and `\xintCntoCs` insert spaces after the commas, `\xintCstoF` and `\xintCstoCv` authorize spaces in the input also before the commas, `\xintCntoCs` does not brace the produced coefficients, new macros `\xintFtoC`, `\xintCtoF`, `\xintCtoCv`, `\xintFGtoC`, and `\xintGGCFrac`.

### 9.1 Catcodes, $\varepsilon$ -T<sub>E</sub>X and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified.

The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2   \catcode13=5      % ^^M
3   \endlinechar=13 %
4   \catcode123=1     % {
5   \catcode125=2     % }
6   \catcode64=11    % @
7   \catcode35=6     % #
8   \catcode44=12    % ,
9   \catcode45=12    % -
10  \catcode46=12    % .
11  \catcode58=12    % :
12  \let\z\endgroup
13  \expandafter\let\expandafter\x\csname ver@xintcfrac.sty\endcsname
14  \expandafter\let\expandafter\w\csname ver@xintfrac.sty\endcsname
15  \expandafter
16    \ifx\csname PackageInfo\endcsname\relax
17      \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
18    \else
19      \def\y#1#2{\PackageInfo{#1}{#2}}%
20    \fi
21  \expandafter
22  \ifx\csname numexpr\endcsname\relax
23    \y{xintcfrac}{\numexpr not available, aborting input}%
24    \aftergroup\endinput
25  \else

```

```

26 \ifx\x\relax % plain-TeX, first loading of xintcfrac.sty
27 \ifx\w\relax % but xintfrac.sty not yet loaded.
28 \def\z{\endgroup\input xintfrac.sty\relax}%
29 \fi
30 \else
31 \def\empty {}%
32 \ifx\x\empty % LaTeX, first loading,
33 % variable is initialized, but \ProvidesPackage not yet seen
34 \ifx\w\relax % xintfrac.sty not yet loaded.
35 \def\z{\endgroup\RequirePackage{xintfrac}}%
36 \fi
37 \else
38 \aftergroup\endinput % xintcfrac already loaded.
39 \fi
40 \fi
41 \fi
42 \z%
43 \XINTsetupcatcodes% defined in xintkernel.sty

```

## 9.2 Package identification

```

44 \XINT_providespackage
45 \ProvidesPackage{xintcfrac}%
46 [2015/10/10 v1.2 Expandable continued fractions with xint package (jfb)]%

```

## 9.3 *\xintCFrac*

```

47 \def\xintCFrac {\romannumeral0\xintcfrac }%
48 \def\xintcfrac #1%
49 {%
50 \XINT_cfrac_opt_a #1\xint_relax
51 }%
52 \def\XINT_cfrac_opt_a #1%
53 {%
54 \ifx[#1\XINT_cfrac_opt_b\fi \XINT_cfrac_noopt #1%
55 }%
56 \def\XINT_cfrac_noopt #1\xint_relax
57 {%
58 \expandafter\XINT_cfrac_A\romannumeral0\xintraawithzeros {#1}\Z
59 \relax\relax
60 }%
61 \def\XINT_cfrac_opt_b\fi\XINT_cfrac_noopt [\xint_relax #1]%
62 {%
63 \fi\csname XINT_cfrac_opt#1\endcsname
64 }%
65 \def\XINT_cfrac_optl #1%
66 {%
67 \expandafter\XINT_cfrac_A\romannumeral0\xintraawithzeros {#1}\Z
68 \relax\hfill
69 }%
70 \def\XINT_cfrac_optc #1%
71 {%
72 \expandafter\XINT_cfrac_A\romannumeral0\xintraawithzeros {#1}\Z
73 \relax\relax

```

```

74 }%
75 \def\XINT_cfrac_optr #1%
76 {%
77   \expandafter\XINT_cfrac_A\romannumeral0\xintraewithzeros {#1}\Z
78   \hfill\relax
79 }%
80 \def\XINT_cfrac_A #1/#2\Z
81 {%
82   \expandafter\XINT_cfrac_B\romannumeral0\xintiidivision {#1}{#2}{#2}%
83 }%
84 \def\XINT_cfrac_B #1#2%
85 {%
86   \XINT_cfrac_C #2\Z {#1}%
87 }%
88 \def\XINT_cfrac_C #1%
89 {%
90   \xint_gob_til_zero #1\XINT_cfrac_integer 0\XINT_cfrac_D #1%
91 }%
92 \def\XINT_cfrac_integer 0\XINT_cfrac_D 0#1\Z #2#3#4#5{ #2}%
93 \def\XINT_cfrac_D #1\Z #2#3{\XINT_cfrac_loop_a {#1}{#3}{#1}{#2}}%
94 \def\XINT_cfrac_loop_a
95 {%
96   \expandafter\XINT_cfrac_loop_d\romannumeral0\XINT_div_prepare
97 }%
98 \def\XINT_cfrac_loop_d #1#2%
99 {%
100   \XINT_cfrac_loop_e #2.{#1}%
101 }%
102 \def\XINT_cfrac_loop_e #1%
103 {%
104   \xint_gob_til_zero #1\xint_cfrac_loop_exit0\XINT_cfrac_loop_f #1%
105 }%
106 \def\XINT_cfrac_loop_f #1.#2#3#4%
107 {%
108   \XINT_cfrac_loop_a {#1}{#3}{#1}{#2#4}%
109 }%
110 \def\xint_cfrac_loop_exit0\XINT_cfrac_loop_f #1.#2#3#4#5#6%
111   {\XINT_cfrac_T #5#6{#2#4}\Z }%
112 \def\XINT_cfrac_T #1#2#3#4%
113 {%
114   \xint_gob_til_Z #4\XINT_cfrac_end\Z\XINT_cfrac_T #1#2{#4+\cfrac{#1#2}{#3}}%
115 }%
116 \def\XINT_cfrac_end\Z\XINT_cfrac_T #1#2#3%
117 {%
118   \XINT_cfrac_end_b #3%
119 }%
120 \def\XINT_cfrac_end_b \Z+\cfrac{#1#2}{ #2}%

```

#### 9.4 *\xintGCFrac*

```

121 \def\xintGCFrac {\romannumeral0\xintgcfrac }%
122 \def\xintgcfrac #1{\XINT_gcfrac_opt_a #1\xint_relax }%
123 \def\XINT_gcfrac_opt_a #1%
124 {%

```

```

125 \ifx[#1\XINT_gcfrac_opt_b\fi \XINT_gcfrac_noopt #1%
126 }%
127 \def\XINT_gcfrac_noopt #1\xint_relax
128 {%
129 \XINT_gcfrac #1+\xint_relax/\relax\relax
130 }%
131 \def\XINT_gcfrac_opt_b\fi\XINT_gcfrac_noopt [\xint_relax #1]%
132 {%
133 \fi\csname XINT_gcfrac_opt#1\endcsname
134 }%
135 \def\XINT_gcfrac_optl #1%
136 {%
137 \XINT_gcfrac #1+\xint_relax/\relax\hfill
138 }%
139 \def\XINT_gcfrac_optc #1%
140 {%
141 \XINT_gcfrac #1+\xint_relax/\relax\relax
142 }%
143 \def\XINT_gcfrac_optr #1%
144 {%
145 \XINT_gcfrac #1+\xint_relax/\hfill\relax
146 }%
147 \def\XINT_gcfrac
148 {%
149 \expandafter\XINT_gcfrac_enter\romannumeral-`0%
150 }%
151 \def\XINT_gcfrac_enter {\XINT_gcfrac_loop {}}%
152 \def\XINT_gcfrac_loop #1#2+#3/%
153 {%
154 \xint_gob_til_xint_relax #3\XINT_gcfrac_endloop\xint_relax
155 \XINT_gcfrac_loop {{#3}{#2}{#1}}%
156 }%
157 \def\XINT_gcfrac_endloop\xint_relax\XINT_gcfrac_loop #1#2#3%
158 {%
159 \XINT_gcfrac_T #2#3#1\xint_relax\xint_relax
160 }%
161 \def\XINT_gcfrac_T #1#2#3#4{\XINT_gcfrac_U #1#2{\xintFrac{#4}}}%
162 \def\XINT_gcfrac_U #1#2#3#4#5%
163 {%
164 \xint_gob_til_xint_relax #5\XINT_gcfrac_end\xint_relax\XINT_gcfrac_U
165 #1#2{\xintFrac{#5}}%
166 \ifcase\xintSgn{#4}
167 +\or+\else-\fi
168 \cfrac{#1\xintFrac{\xintAbs{#4}}#2}{#3}}%
169 }%
170 \def\XINT_gcfrac_end\xint_relax\XINT_gcfrac_U #1#2#3%
171 {%
172 \XINT_gcfrac_end_b #3%
173 }%
174 \def\XINT_gcfrac_end_b #1\cfrac#2#3{ #3}%

```



9.5 *\xintGGCFrac*

New with 1.09m

```

175 \def\xintGGCFrac {\romannumeral0\xintggcfrac }%
176 \def\xintggcfrac #1{\XINT_ggcfrac_opt_a #1\xint_relax }%
177 \def\XINT_ggcfrac_opt_a #1%
178 {%
179   \ifx[#1\XINT_ggcfrac_opt_b\fi \XINT_ggcfrac_noopt #1%
180 }%
181 \def\XINT_ggcfrac_noopt #1\xint_relax
182 {%
183   \XINT_ggcfrac #1+\xint_relax/\relax\relax
184 }%
185 \def\XINT_ggcfrac_opt_b\fi\XINT_ggcfrac_noopt [\xint_relax #1]%
186 {%
187   \fi\csname XINT_ggcfrac_opt#1\endcsname
188 }%
189 \def\XINT_ggcfrac_optl #1%
190 {%
191   \XINT_ggcfrac #1+\xint_relax/\relax\hfill
192 }%
193 \def\XINT_ggcfrac_optc #1%
194 {%
195   \XINT_ggcfrac #1+\xint_relax/\relax\relax
196 }%
197 \def\XINT_ggcfrac_optr #1%
198 {%
199   \XINT_ggcfrac #1+\xint_relax/\hfill\relax
200 }%
201 \def\XINT_ggcfrac
202 {%
203   \expandafter\XINT_ggcfrac_enter\romannumeral-`0%
204 }%
205 \def\XINT_ggcfrac_enter {\XINT_ggcfrac_loop {}}%
206 \def\XINT_ggcfrac_loop #1#2+#3/%
207 {%
208   \xint_gob_til_xint_relax #3\XINT_ggcfrac_endloop\xint_relax
209   \XINT_ggcfrac_loop {{#3}{#2}{#1}}%
210 }%
211 \def\XINT_ggcfrac_endloop\xint_relax\XINT_ggcfrac_loop #1#2#3%
212 {%
213   \XINT_ggcfrac_T #2#3#1\xint_relax\xint_relax
214 }%
215 \def\XINT_ggcfrac_T #1#2#3#4{\XINT_ggcfrac_U #1#2{#4}}%
216 \def\XINT_ggcfrac_U #1#2#3#4#5%
217 {%
218   \xint_gob_til_xint_relax #5\XINT_ggcfrac_end\xint_relax\XINT_ggcfrac_U
219   #1#2{#5+\cfrac{#1#4#2}{#3}}%
220 }%
221 \def\XINT_ggcfrac_end\xint_relax\XINT_ggcfrac_U #1#2#3%
222 {%
223   \XINT_ggcfrac_end_b #3%

```

```

224 }%
225 \def\XINT_ggcfrac_end_b #1\cfrac#2#3{ #3}%

```

## 9.6 \xintGctoGCx

```

226 \def\xintGctoGCx {\romannumeral0\xintgctogcx }%
227 \def\xintgctogcx #1#2#3%
228 {%
229   \expandafter\XINT_gctgcx_start\expandafter {\romannumeral-`0#3}{#1}{#2}%
230 }%
231 \def\XINT_gctgcx_start #1#2#3{\XINT_gctgcx_loop_a {}{#2}{#3}#1+\xint_relax/}%
232 \def\XINT_gctgcx_loop_a #1#2#3#4+#5/%
233 {%
234   \xint_gob_til_xint_relax #5\XINT_gctgcx_end\xint_relax
235   \XINT_gctgcx_loop_b {#1{#4}}{#2{#5}#3}{#2}{#3}%
236 }%
237 \def\XINT_gctgcx_loop_b #1#2%
238 {%
239   \XINT_gctgcx_loop_a {#1#2}%
240 }%
241 \def\XINT_gctgcx_end\xint_relax\XINT_gctgcx_loop_b #1#2#3#4{ #1}%

```

## 9.7 \xintFtoCs

Modified in 1.09m: a space is added after the inserted commas.

```

242 \def\xintFtoCs {\romannumeral0\xintftocs }%
243 \def\xintftocs #1%
244 {%
245   \expandafter\XINT_ftc_A\romannumeral0\xintrawwithzeros {#1}\Z
246 }%
247 \def\XINT_ftc_A #1/#2\Z
248 {%
249   \expandafter\XINT_ftc_B\romannumeral0\xintiidivision {#1}{#2}{#2}%
250 }%
251 \def\XINT_ftc_B #1#2%
252 {%
253   \XINT_ftc_C #2.{#1}%
254 }%
255 \def\XINT_ftc_C #1%
256 {%
257   \xint_gob_til_zero #1\XINT_ftc_integer 0\XINT_ftc_D #1%
258 }%
259 \def\XINT_ftc_integer 0\XINT_ftc_D 0#1.#2#3{ #2}%
260 \def\XINT_ftc_D #1.#2#3{\XINT_ftc_loop_a {#1}{#3}{#1}{#2, }}% 1.09m adds a space
261 \def\XINT_ftc_loop_a
262 {%
263   \expandafter\XINT_ftc_loop_d\romannumeral0\XINT_div_prepare
264 }%
265 \def\XINT_ftc_loop_d #1#2%
266 {%
267   \XINT_ftc_loop_e #2.{#1}%
268 }%
269 \def\XINT_ftc_loop_e #1%

```

```

270 {%
271   \xint_gob_til_zero #1\xint_ftc_loop_exit0\XINT_ftc_loop_f #1%
272 }%
273 \def\XINT_ftc_loop_f #1.#2#3#4%
274 {%
275   \XINT_ftc_loop_a {#1}{#3}{#1}{#4#2, }% 1.09m has an added space here
276 }%
277 \def\xint_ftc_loop_exit0\XINT_ftc_loop_f #1.#2#3#4{ #4#2}%

```

## 9.8 \xintFtoCx

```

278 \def\xintFtoCx {\romannumeral0\xintftocx }%
279 \def\xintftocx #1#2%
280 {%
281   \expandafter\XINT_ftcx_A\romannumeral0\xintrawithzeros {#2}\Z {#1}%
282 }%
283 \def\XINT_ftcx_A #1/#2\Z
284 {%
285   \expandafter\XINT_ftcx_B\romannumeral0\xintiidivision {#1}{#2}{#2}%
286 }%
287 \def\XINT_ftcx_B #1#2%
288 {%
289   \XINT_ftcx_C #2.{#1}%
290 }%
291 \def\XINT_ftcx_C #1%
292 {%
293   \xint_gob_til_zero #1\XINT_ftcx_integer 0\XINT_ftcx_D #1%
294 }%
295 \def\XINT_ftcx_integer 0\XINT_ftcx_D 0#1.#2#3#4{ #2}%
296 \def\XINT_ftcx_D #1.#2#3#4{\XINT_ftcx_loop_a {#1}{#3}{#1}{#2#4}{#4}}%
297 \def\XINT_ftcx_loop_a
298 {%
299   \expandafter\XINT_ftcx_loop_d\romannumeral0\XINT_div_prepare
300 }%
301 \def\XINT_ftcx_loop_d #1#2%
302 {%
303   \XINT_ftcx_loop_e #2.{#1}%
304 }%
305 \def\XINT_ftcx_loop_e #1%
306 {%
307   \xint_gob_til_zero #1\xint_ftcx_loop_exit0\XINT_ftcx_loop_f #1%
308 }%
309 \def\XINT_ftcx_loop_f #1.#2#3#4#5%
310 {%
311   \XINT_ftcx_loop_a {#1}{#3}{#1}{#4#2#5}{#5}%
312 }%
313 \def\xint_ftcx_loop_exit0\XINT_ftcx_loop_f #1.#2#3#4#5{ #4#2}%

```

## 9.9 \xintFtoC

New in 1.09m: this is the same as `\xintFtoCx` with empty separator. I had temporarily during preparation of 1.09m removed braces from `\xintFtoCx`, but I recalled later why that was useful (see doc), thus let's just here do `\xintFtoCx {}`

```

314 \def\xintFtoC {\romannumeral0\xintftoc}%
315 \def\xintftoc {\xintftocx {}}%

```

### 9.10 $\backslash$ xintFtoGC

```

316 \def\xintFtoGC {\romannumeral0\xintftogc}%
317 \def\xintftogc {\xintftocx {+1/}}%

```

### 9.11 $\backslash$ xintFGtoC

New with 1.09m of 2014/02/26. Computes the common initial coefficients for the two fractions  $f$  and  $g$ , and outputs them as a sequence of braced items.

```

318 \def\xintFGtoC {\romannumeral0\xintfgtoc}%
319 \def\xintfgtoc#1%
320 {%
321   \expandafter\XINT_fgtc_a\romannumeral0\xintraewithzeros {#1}\Z
322 }%
323 \def\XINT_fgtc_a #1/#2\Z #3%
324 {%
325   \expandafter\XINT_fgtc_b\romannumeral0\xintraewithzeros {#3}\Z #1/#2\Z { }%
326 }%
327 \def\XINT_fgtc_b #1/#2\Z
328 {%
329   \expandafter\XINT_fgtc_c\romannumeral0\xintiidivision {#1}{#2}{#2}%
330 }%
331 \def\XINT_fgtc_c #1#2#3#4/#5\Z
332 {%
333   \expandafter\XINT_fgtc_d\romannumeral0\xintiidivision
334     {#4}{#5}{#5}{#1}{#2}{#3}%
335 }%
336 \def\XINT_fgtc_d #1#2#3#4#5#6#7%
337 {%
338   \xintifEq {#1}{#4}{\XINT_fgtc_da {#1}{#2}{#3}{#4}}%
339     {\xint_thirdofthree}%
340 }%
341 \def\XINT_fgtc_da #1#2#3#4#5#6#7%
342 {%
343   \XINT_fgtc_e {#2}{#5}{#3}{#6}{#7}{#1}}%
344 }%
345 \def\XINT_fgtc_e #1%
346 {%
347   \xintifZero {#1}{\expandafter\xint_firstofone\xint_gobble_iii}%
348     {\XINT_fgtc_f {#1}}%
349 }%
350 \def\XINT_fgtc_f #1#2%
351 {%
352   \xintifZero {#2}{\xint_thirdofthree}{\XINT_fgtc_g {#1}{#2}}%
353 }%
354 \def\XINT_fgtc_g #1#2#3%
355 {%
356   \expandafter\XINT_fgtc_h\romannumeral0\XINT_div_prepare {#1}{#3}{#1}{#2}%
357 }%
358 \def\XINT_fgtc_h #1#2#3#4#5%

```

```

359 {%
360   \expandafter\XINT_fgtd\romannumeral0\XINT_div_prepare
361   {#4}{#5}{#4}{#1}{#2}{#3}%
362 }%

```

## 9.12 \xintFtoCC

```

363 \def\xintFtoCC {\romannumeral0\xintftocc }%
364 \def\xintftocc #1%
365 {%
366   \expandafter\XINT_ftcc_A\expandafter {\romannumeral0\xintrawwithzeros {#1}}%
367 }%
368 \def\XINT_ftcc_A #1%
369 {%
370   \expandafter\XINT_ftcc_B
371   \romannumeral0\xintrawwithzeros {\xintAdd {1/2[0]}{#1[0]}}\Z {#1[0]}%
372 }%
373 \def\XINT_ftcc_B #1/#2\Z
374 {%
375   \expandafter\XINT_ftcc_C\expandafter {\romannumeral0\xintiiquo {#1}{#2}}%
376 }%
377 \def\XINT_ftcc_C #1#2%
378 {%
379   \expandafter\XINT_ftcc_D\romannumeral0\xintsub {#2}{#1}\Z {#1}%
380 }%
381 \def\XINT_ftcc_D #1%
382 {%
383   \xint_UDzerominusfork
384   #1-\XINT_ftcc_integer
385   0#1\XINT_ftcc_En
386   0-{\XINT_ftcc_Ep #1}%
387   \krof
388 }%
389 \def\XINT_ftcc_Ep #1\Z #2%
390 {%
391   \expandafter\XINT_ftcc_loop_a\expandafter
392   {\romannumeral0\xintdiv {1[0]}{#1}}{#2+1/}%
393 }%
394 \def\XINT_ftcc_En #1\Z #2%
395 {%
396   \expandafter\XINT_ftcc_loop_a\expandafter
397   {\romannumeral0\xintdiv {1[0]}{#1}}{#2+-1/}%
398 }%
399 \def\XINT_ftcc_integer #1\Z #2{ #2}%
400 \def\XINT_ftcc_loop_a #1%
401 {%
402   \expandafter\XINT_ftcc_loop_b
403   \romannumeral0\xintrawwithzeros {\xintAdd {1/2[0]}{#1}}\Z {#1}%
404 }%
405 \def\XINT_ftcc_loop_b #1/#2\Z
406 {%
407   \expandafter\XINT_ftcc_loop_c\expandafter
408   {\romannumeral0\xintiiquo {#1}{#2}}%

```

```

409 }%
410 \def\XINT_ftcc_loop_c #1#2%
411 {%
412   \expandafter\XINT_ftcc_loop_d
413   \romannumeral0\xintsub {#2}{#1[0]}\Z {#1}%
414 }%
415 \def\XINT_ftcc_loop_d #1%
416 {%
417   \xint_UDzerominusfork
418   #1-\XINT_ftcc_end
419   0#1\XINT_ftcc_loop_N
420   0-\XINT_ftcc_loop_P #1}%
421   \krof
422 }%
423 \def\XINT_ftcc_end #1\Z #2#3{ #3#2}%
424 \def\XINT_ftcc_loop_P #1\Z #2#3%
425 {%
426   \expandafter\XINT_ftcc_loop_a\expandafter
427   {\romannumeral0\xintdiv {1[0]}\{#1}\{#3#2+1/}%
428 }%
429 \def\XINT_ftcc_loop_N #1\Z #2#3%
430 {%
431   \expandafter\XINT_ftcc_loop_a\expandafter
432   {\romannumeral0\xintdiv {1[0]}\{#1}\{#3#2+-1/}%
433 }%

```

### 9.13 `\xintCtoF`, `\xintCstof`

1.09m uses `\xintCSVtoList` on the argument of `\xintCstof` to allow spaces also before the commas. And the original `\xintCstof` code became the one of the new `\xintCtoF` dealing with a braced rather than comma separated list.

```

434 \def\xintCstof {\romannumeral0\xintcstof }%
435 \def\xintcstof #1%
436 {%
437   \expandafter\XINT_ctf_prep \romannumeral0\xintcsvtoList{#1}\xint_relax
438 }%
439 \def\xintCtoF {\romannumeral0\xintctof }%
440 \def\xintctof #1%
441 {%
442   \expandafter\XINT_ctf_prep \romannumeral-`0#1\xint_relax
443 }%
444 \def\XINT_ctf_prep
445 {%
446   \XINT_ctf_loop_a 1001%
447 }%
448 \def\XINT_ctf_loop_a #1#2#3#4#5%
449 {%
450   \xint_gob_til_xint_relax #5\XINT_ctf_end\xint_relax
451   \expandafter\XINT_ctf_loop_b
452   \romannumeral0\xintraewithzeros {#5}.\{#1}\{#2}\{#3}\{#4}%
453 }%
454 \def\XINT_ctf_loop_b #1/#2.#3#4#5#6%
455 {%

```

```

456 \expandafter\XINT_ctf_loop_c\expandafter
457 {\romannumeral0\XINT_mul_fork #2\Z #4\Z}%
458 {\romannumeral0\XINT_mul_fork #2\Z #3\Z}%
459 {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #6\Z}{\XINT_mul_fork #1\Z #4\Z}}%
460 {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #5\Z}{\XINT_mul_fork #1\Z #3\Z}}%
461}%
462 \def\XINT_ctf_loop_c #1#2%
463 {%
464 \expandafter\XINT_ctf_loop_d\expandafter {\expandafter{#2}{#1}}%
465}%
466 \def\XINT_ctf_loop_d #1#2%
467 {%
468 \expandafter\XINT_ctf_loop_e\expandafter {\expandafter{#2}{#1}}%
469}%
470 \def\XINT_ctf_loop_e #1#2%
471 {%
472 \expandafter\XINT_ctf_loop_a\expandafter{#2}{#1}%
473}%
474 \def\XINT_ctf_end #1.#2#3#4#5{\xintrawithzeros {#2/#3}}% 1.09b removes [0]

```

#### 9.14 *\xintiCstoF*

```

475 \def\xintiCstoF {\romannumeral0\xinticstof}%
476 \def\xinticstof #1%
477 {%
478 \expandafter\XINT_icstf_prep \romannumeral-`0#1,\xint_relax,%
479}%
480 \def\XINT_icstf_prep
481 {%
482 \XINT_icstf_loop_a 1001%
483}%
484 \def\XINT_icstf_loop_a #1#2#3#4#5,%
485 {%
486 \xint_gob_til_xint_relax #5\XINT_icstf_end\xint_relax
487 \expandafter
488 \XINT_icstf_loop_b \romannumeral-`0#5.{#1}{#2}{#3}{#4}%
489}%
490 \def\XINT_icstf_loop_b #1.#2#3#4#5%
491 {%
492 \expandafter\XINT_icstf_loop_c\expandafter
493 {\romannumeral0\xintiiadd {#5}{\XINT_mul_fork #1\Z #3\Z}}%
494 {\romannumeral0\xintiiadd {#4}{\XINT_mul_fork #1\Z #2\Z}}%
495 {#2}{#3}%
496}%
497 \def\XINT_icstf_loop_c #1#2%
498 {%
499 \expandafter\XINT_icstf_loop_a\expandafter {#2}{#1}%
500}%
501 \def\XINT_icstf_end#1.#2#3#4#5{\xintrawithzeros {#2/#3}}% 1.09b removes [0]

```

#### 9.15 *\xintGctoF*

```

502 \def\xintGctoF {\romannumeral0\xintgctof}%
503 \def\xintgctof #1%

```

```

504 {%
505   \expandafter\XINT_gctf_prep \romannumeral-`0#1+\xint_relax/%
506 }%
507 \def\XINT_gctf_prep
508 {%
509   \XINT_gctf_loop_a 1001%
510 }%
511 \def\XINT_gctf_loop_a #1#2#3#4#5+%
512 {%
513   \expandafter\XINT_gctf_loop_b
514   \romannumeral0\xintraawithzeros {#5}.{#1}{#2}{#3}{#4}%
515 }%
516 \def\XINT_gctf_loop_b #1/#2.#3#4#5#6%
517 {%
518   \expandafter\XINT_gctf_loop_c\expandafter
519   {\romannumeral0\XINT_mul_fork #2\Z #4\Z }%
520   {\romannumeral0\XINT_mul_fork #2\Z #3\Z }%
521   {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #6\Z}{\XINT_mul_fork #1\Z #4\Z}}%
522   {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #5\Z}{\XINT_mul_fork #1\Z #3\Z}}%
523 }%
524 \def\XINT_gctf_loop_c #1#2%
525 {%
526   \expandafter\XINT_gctf_loop_d\expandafter {\expandafter{#2}{#1}}%
527 }%
528 \def\XINT_gctf_loop_d #1#2%
529 {%
530   \expandafter\XINT_gctf_loop_e\expandafter {\expandafter{#2}#1}%
531 }%
532 \def\XINT_gctf_loop_e #1#2%
533 {%
534   \expandafter\XINT_gctf_loop_f\expandafter {\expandafter{#2}#1}%
535 }%
536 \def\XINT_gctf_loop_f #1#2/%
537 {%
538   \xint_gob_til_xint_relax #2\XINT_gctf_end\xint_relax
539   \expandafter\XINT_gctf_loop_g
540   \romannumeral0\xintraawithzeros {#2}.#1%
541 }%
542 \def\XINT_gctf_loop_g #1/#2.#3#4#5#6%
543 {%
544   \expandafter\XINT_gctf_loop_h\expandafter
545   {\romannumeral0\XINT_mul_fork #1\Z #6\Z }%
546   {\romannumeral0\XINT_mul_fork #1\Z #5\Z }%
547   {\romannumeral0\XINT_mul_fork #2\Z #4\Z }%
548   {\romannumeral0\XINT_mul_fork #2\Z #3\Z }%
549 }%
550 \def\XINT_gctf_loop_h #1#2%
551 {%
552   \expandafter\XINT_gctf_loop_i\expandafter {\expandafter{#2}{#1}}%
553 }%
554 \def\XINT_gctf_loop_i #1#2%
555 {%

```



```

556 \expandafter\XINT_gctf_loop_j\expandafter {\expandafter{#2}#1}%
557 }%
558 \def\XINT_gctf_loop_j #1#2%
559 {%
560 \expandafter\XINT_gctf_loop_a\expandafter {#2}#1%
561 }%
562 \def\XINT_gctf_end #1.#2#3#4#5{\xintrawithzeros {#2/#3}}% 1.09b removes [0]

```

### 9.16 \xintiGctoF

```

563 \def\xintiGctoF {\romannumeral0\xintigctof }%
564 \def\xintigctof #1%
565 {%
566 \expandafter\XINT_igctf_prep \romannumeral-`0#1+\xint_relax/%
567 }%
568 \def\XINT_igctf_prep
569 {%
570 \XINT_igctf_loop_a 1001%
571 }%
572 \def\XINT_igctf_loop_a #1#2#3#4#5+%
573 {%
574 \expandafter\XINT_igctf_loop_b
575 \romannumeral-`0#5.{#1}{#2}{#3}{#4}%
576 }%
577 \def\XINT_igctf_loop_b #1.#2#3#4#5%
578 {%
579 \expandafter\XINT_igctf_loop_c\expandafter
580 {\romannumeral0\xintiiadd {#5}{\XINT_mul_fork #1\Z #3\Z}}%
581 {\romannumeral0\xintiiadd {#4}{\XINT_mul_fork #1\Z #2\Z}}%
582 {#2}{#3}%
583 }%
584 \def\XINT_igctf_loop_c #1#2%
585 {%
586 \expandafter\XINT_igctf_loop_f\expandafter {\expandafter{#2}{#1}}%
587 }%
588 \def\XINT_igctf_loop_f #1#2#3#4/%
589 {%
590 \xint_gob_til_xint_relax #4\XINT_igctf_end\xint_relax
591 \expandafter\XINT_igctf_loop_g
592 \romannumeral-`0#4.{#2}{#3}#1%
593 }%
594 \def\XINT_igctf_loop_g #1.#2#3%
595 {%
596 \expandafter\XINT_igctf_loop_h\expandafter
597 {\romannumeral0\XINT_mul_fork #1\Z #3\Z }%
598 {\romannumeral0\XINT_mul_fork #1\Z #2\Z }%
599 }%
600 \def\XINT_igctf_loop_h #1#2%
601 {%
602 \expandafter\XINT_igctf_loop_i\expandafter {#2}{#1}%
603 }%
604 \def\XINT_igctf_loop_i #1#2#3#4%
605 {%
606 \XINT_igctf_loop_a {#3}{#4}{#1}{#2}%

```

```
607 }%
608 \def\XINT_igctf_end #1.#2#3#4#5{\xintrawithzeros {#4/#5}}% 1.09b removes [0]
```

### 9.17 `\xintCtoCv`, `\xintCstoCv`

1.09m uses `\xintCSVtoList` on the argument of `\xintCstoCv` to allow spaces also before the commas. The original `\xintCstoCv` code became the one of the new `\xintCtoF` dealing with a braced rather than comma separated list.

```
609 \def\xintCstoCv {\romannumeral0\xintcstocv }%
610 \def\xintcstocv #1%
611 {%
612   \expandafter\XINT_ctcv_prep\romannumeral0\xintcsvtolist{#1}\xint_relax
613 }%
614 \def\xintCtoCv {\romannumeral0\xintctocv }%
615 \def\xintctocv #1%
616 {%
617   \expandafter\XINT_ctcv_prep\romannumeral-`0#1\xint_relax
618 }%
619 \def\XINT_ctcv_prep
620 {%
621   \XINT_ctcv_loop_a {}1001%
622 }%
623 \def\XINT_ctcv_loop_a #1#2#3#4#5#6%
624 {%
625   \xint_gob_til_xint_relax #6\XINT_ctcv_end\xint_relax
626   \expandafter\XINT_ctcv_loop_b
627   \romannumeral0\xintrawithzeros {#6}.{#2}{#3}{#4}{#5}{#1}%
628 }%
629 \def\XINT_ctcv_loop_b #1/#2.#3#4#5#6%
630 {%
631   \expandafter\XINT_ctcv_loop_c\expandafter
632   {\romannumeral0\XINT_mul_fork #2\Z #4\Z }%
633   {\romannumeral0\XINT_mul_fork #2\Z #3\Z }%
634   {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #6\Z}{\XINT_mul_fork #1\Z #4\Z}}%
635   {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #5\Z}{\XINT_mul_fork #1\Z #3\Z}}%
636 }%
637 \def\XINT_ctcv_loop_c #1#2%
638 {%
639   \expandafter\XINT_ctcv_loop_d\expandafter {\expandafter{#2}{#1}}%
640 }%
641 \def\XINT_ctcv_loop_d #1#2%
642 {%
643   \expandafter\XINT_ctcv_loop_e\expandafter {\expandafter{#2}{#1}}%
644 }%
645 \def\XINT_ctcv_loop_e #1#2%
646 {%
647   \expandafter\XINT_ctcv_loop_f\expandafter{#2}{#1}%
648 }%
649 \def\XINT_ctcv_loop_f #1#2#3#4#5%
650 {%
651   \expandafter\XINT_ctcv_loop_g\expandafter
652   {\romannumeral0\xintrawithzeros {#1/#2}}{#5}{#1}{#2}{#3}{#4}%
653 }%
```

```

654 \def\XINT_ctcv_loop_g #1#2{\XINT_ctcv_loop_a {#2{#1}}}% 1.09b removes [0]
655 \def\XINT_ctcv_end #1.#2#3#4#5#6{ #6}%

```

### 9.18 \xintiCstoCv

```

656 \def\xintiCstoCv {\romannumeral0\xinticstocv }%
657 \def\xinticstocv #1%
658 {%
659   \expandafter\XINT_icstcv_prep \romannumeral-`0#1,\xint_relax,%
660 }%
661 \def\XINT_icstcv_prep
662 {%
663   \XINT_icstcv_loop_a {}1001%
664 }%
665 \def\XINT_icstcv_loop_a #1#2#3#4#5#6,%
666 {%
667   \xint_gob_til_xint_relax #6\XINT_icstcv_end\xint_relax
668   \expandafter
669   \XINT_icstcv_loop_b \romannumeral-`0#6.{#2}{#3}{#4}{#5}{#1}%
670 }%
671 \def\XINT_icstcv_loop_b #1.#2#3#4#5%
672 {%
673   \expandafter\XINT_icstcv_loop_c\expandafter
674   {\romannumeral0\xintiiadd {#5}{\XINT_mul_fork #1\Z #3\Z}}%
675   {\romannumeral0\xintiiadd {#4}{\XINT_mul_fork #1\Z #2\Z}}%
676   {{#2}{#3}}}%
677 }%
678 \def\XINT_icstcv_loop_c #1#2%
679 {%
680   \expandafter\XINT_icstcv_loop_d\expandafter {#2}{#1}%
681 }%
682 \def\XINT_icstcv_loop_d #1#2%
683 {%
684   \expandafter\XINT_icstcv_loop_e\expandafter
685   {\romannumeral0\xintraawithzeros {#1/#2}}{#1}{#2}}%
686 }%
687 \def\XINT_icstcv_loop_e #1#2#3#4{\XINT_icstcv_loop_a {#4{#1}}#2#3}%
688 \def\XINT_icstcv_end #1.#2#3#4#5#6{ #6}% 1.09b removes [0]

```

### 9.19 \xintGctoCv

```

689 \def\xintGctoCv {\romannumeral0\xintgctocv }%
690 \def\xintgctocv #1%
691 {%
692   \expandafter\XINT_gctcv_prep \romannumeral-`0#1+\xint_relax/%
693 }%
694 \def\XINT_gctcv_prep
695 {%
696   \XINT_gctcv_loop_a {}1001%
697 }%
698 \def\XINT_gctcv_loop_a #1#2#3#4#5#6+%
699 {%
700   \expandafter\XINT_gctcv_loop_b
701   \romannumeral0\xintraawithzeros {#6}.{#2}{#3}{#4}{#5}{#1}%

```

```

702 }%
703 \def\XINT_gctcv_loop_b #1/#2.#3#4#5#6%
704 {%
705   \expandafter\XINT_gctcv_loop_c\expandafter
706   {\romannumeral0\XINT_mul_fork #2\Z #4\Z }%
707   {\romannumeral0\XINT_mul_fork #2\Z #3\Z }%
708   {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #6\Z}{\XINT_mul_fork #1\Z #4\Z}}%
709   {\romannumeral0\xintiiadd {\XINT_mul_fork #2\Z #5\Z}{\XINT_mul_fork #1\Z #3\Z}}%
710 }%
711 \def\XINT_gctcv_loop_c #1#2%
712 {%
713   \expandafter\XINT_gctcv_loop_d\expandafter {\expandafter{#2}{#1}}%
714 }%
715 \def\XINT_gctcv_loop_d #1#2%
716 {%
717   \expandafter\XINT_gctcv_loop_e\expandafter {\expandafter{#2}{#1}}%
718 }%
719 \def\XINT_gctcv_loop_e #1#2%
720 {%
721   \expandafter\XINT_gctcv_loop_f\expandafter {#2}#1%
722 }%
723 \def\XINT_gctcv_loop_f #1#2%
724 {%
725   \expandafter\XINT_gctcv_loop_g\expandafter
726   {\romannumeral0\xintraewithzeros {#1/#2}}{\{#1}{#2}}%
727 }%
728 \def\XINT_gctcv_loop_g #1#2#3#4%
729 {%
730   \XINT_gctcv_loop_h {#4{#1}}{#2#3}% 1.09b removes [0]
731 }%
732 \def\XINT_gctcv_loop_h #1#2#3/%
733 {%
734   \xint_gob_til_xint_relax #3\XINT_gctcv_end\xint_relax
735   \expandafter\XINT_gctcv_loop_i
736   \romannumeral0\xintraewithzeros {#3}.#2{#1}%
737 }%
738 \def\XINT_gctcv_loop_i #1/#2.#3#4#5#6%
739 {%
740   \expandafter\XINT_gctcv_loop_j\expandafter
741   {\romannumeral0\XINT_mul_fork #1\Z #6\Z }%
742   {\romannumeral0\XINT_mul_fork #1\Z #5\Z }%
743   {\romannumeral0\XINT_mul_fork #2\Z #4\Z }%
744   {\romannumeral0\XINT_mul_fork #2\Z #3\Z }%
745 }%
746 \def\XINT_gctcv_loop_j #1#2%
747 {%
748   \expandafter\XINT_gctcv_loop_k\expandafter {\expandafter{#2}{#1}}%
749 }%
750 \def\XINT_gctcv_loop_k #1#2%
751 {%
752   \expandafter\XINT_gctcv_loop_l\expandafter {\expandafter{#2}#1}%
753 }%

```

```

754 \def\XINT_gctcv_loop_l #1#2%
755 {%
756   \expandafter\XINT_gctcv_loop_m\expandafter {\expandafter{#2}#1}%
757 }%
758 \def\XINT_gctcv_loop_m #1#2{\XINT_gctcv_loop_a {#2}#1}%
759 \def\XINT_gctcv_end #1.#2#3#4#5#6{ #6}%

```

## 9.20 \xintiGctoCv

```

760 \def\xintiGctoCv {\romannumeral0\xintigctocv }%
761 \def\xintigctocv #1%
762 {%
763   \expandafter\XINT_igctcv_prep \romannumeral-`0#1+\xint_relax/%
764 }%
765 \def\XINT_igctcv_prep
766 {%
767   \XINT_igctcv_loop_a {}1001%
768 }%
769 \def\XINT_igctcv_loop_a #1#2#3#4#5#6+%
770 {%
771   \expandafter\XINT_igctcv_loop_b
772   \romannumeral-`0#6.{#2}{#3}{#4}{#5}{#1}%
773 }%
774 \def\XINT_igctcv_loop_b #1.#2#3#4#5%
775 {%
776   \expandafter\XINT_igctcv_loop_c\expandafter
777   {\romannumeral0\xintiiadd {#5}{\XINT_mul_fork #1\Z #3\Z}}%
778   {\romannumeral0\xintiiadd {#4}{\XINT_mul_fork #1\Z #2\Z}}%
779   {{#2}{#3}}%
780 }%
781 \def\XINT_igctcv_loop_c #1#2%
782 {%
783   \expandafter\XINT_igctcv_loop_f\expandafter {\expandafter{#2}{#1}}%
784 }%
785 \def\XINT_igctcv_loop_f #1#2#3#4/%
786 {%
787   \xint_gob_til_xint_relax #4\XINT_igctcv_end_a\xint_relax
788   \expandafter\XINT_igctcv_loop_g
789   \romannumeral-`0#4.#1#2{#3}%
790 }%
791 \def\XINT_igctcv_loop_g #1.#2#3#4#5%
792 {%
793   \expandafter\XINT_igctcv_loop_h\expandafter
794   {\romannumeral0\XINT_mul_fork #1\Z #5\Z }%
795   {\romannumeral0\XINT_mul_fork #1\Z #4\Z }%
796   {{#2}{#3}}%
797 }%
798 \def\XINT_igctcv_loop_h #1#2%
799 {%
800   \expandafter\XINT_igctcv_loop_i\expandafter {\expandafter{#2}{#1}}%
801 }%
802 \def\XINT_igctcv_loop_i #1#2{\XINT_igctcv_loop_k #2{#2#1}}%
803 \def\XINT_igctcv_loop_k #1#2%
804 {%

```

```

805 \expandafter\XINT_igctcv_loop_l\expandafter
806 {\romannumeral0\xintraewithzeros {#1/#2}}}%
807 }%
808 \def\XINT_igctcv_loop_l #1#2#3{\XINT_igctcv_loop_a {#3{#1}}#2}%1.09i removes [0]
809 \def\XINT_igctcv_end_a #1.#2#3#4#5%
810 {%
811 \expandafter\XINT_igctcv_end_b\expandafter
812 {\romannumeral0\xintraewithzeros {#2/#3}}}%
813 }%
814 \def\XINT_igctcv_end_b #1#2{ #2{#1}}% 1.09b removes [0]

```

### 9.21 \xintFtoCv

Still uses \xinticstocv \xintFtoCs rather than \xintctocv \xintFtoC.

```

815 \def\xintFtoCv {\romannumeral0\xintftocv }%
816 \def\xintftocv #1%
817 {%
818 \xinticstocv {\xintFtoCs {#1}}}%
819 }%

```

### 9.22 \xintFtoCCv

```

820 \def\xintFtoCCv {\romannumeral0\xintftoccv }%
821 \def\xintftoccv #1%
822 {%
823 \xintigctocv {\xintFtoCC {#1}}}%
824 }%

```

### 9.23 \xintCntoF

Modified in 1.06 to give the N first to a \numexpr rather than expanding twice. I just use \the\numexpr and maintain the previous code after that.

```

825 \def\xintCntoF {\romannumeral0\xintcntof }%
826 \def\xintcntof #1%
827 {%
828 \expandafter\XINT_cntf\expandafter {\the\numexpr #1}%
829 }%
830 \def\XINT_cntf #1#2%
831 {%
832 \ifnum #1>\xint_c_
833 \xint_afterfi {\expandafter\XINT_cntf_loop\expandafter
834 {\the\numexpr #1-1\expandafter}\expandafter
835 {\romannumeral-`0#2{#1}}{#2}}}%
836 \else
837 \xint_afterfi
838 {\ifnum #1=\xint_c_
839 \xint_afterfi {\expandafter\space \romannumeral-`0#2{0}}}%
840 \else \xint_afterfi { }% 1.09m now returns nothing.
841 \fi}%
842 \fi
843 }%
844 \def\XINT_cntf_loop #1#2#3%

```

```

845 {%
846   \ifnum #1>\xint_c_ \else \XINT_cntf_exit \fi
847   \expandafter\XINT_cntf_loop\expandafter
848   {\the\numexpr #1-1\expandafter }\expandafter
849   {\romannumeral0\xintadd {\xintDiv {1[0]}\{#2}\{#3\{#1}\}}%
850   {#3}%
851 }%
852 \def\XINT_cntf_exit \fi
853   \expandafter\XINT_cntf_loop\expandafter
854   #1\expandafter #2#3%
855 {%
856   \fi\xint_gobble_ii #2%
857 }%

```

## 9.24 \xintGCntoF

Modified in 1.06 to give the N argument first to a \numexpr rather than expanding twice. I just use \the\numexpr and maintain the previous code after that.

```

858 \def\xintGCntoF {\romannumeral0\xintgcntof }%
859 \def\xintgcntof #1%
860 {%
861   \expandafter\XINT_gcntf\expandafter {\the\numexpr #1}%
862 }%
863 \def\XINT_gcntf #1#2#3%
864 {%
865   \ifnum #1>\xint_c_
866     \xint_afterfi {\expandafter\XINT_gcntf_loop\expandafter
867                   {\the\numexpr #1-1\expandafter}\expandafter
868                   {\romannumeral-`0#2\{#1}\{#2}\{#3}\}}%
869   \else
870     \xint_afterfi
871     {\ifnum #1=\xint_c_
872       \xint_afterfi {\expandafter\space\romannumeral-`0#2\{0}\}%
873       \else \xint_afterfi { }% 1.09m now returns nothing rather than 0/1[0]
874       \fi}%
875   \fi
876 }%
877 \def\XINT_gcntf_loop #1#2#3#4%
878 {%
879   \ifnum #1>\xint_c_ \else \XINT_gcntf_exit \fi
880   \expandafter\XINT_gcntf_loop\expandafter
881   {\the\numexpr #1-1\expandafter }\expandafter
882   {\romannumeral0\xintadd {\xintDiv {#4\{#1}\{#2}\{#3\{#1}\}}%
883   {#3}\{#4}%
884 }%
885 \def\XINT_gcntf_exit \fi
886   \expandafter\XINT_gcntf_loop\expandafter
887   #1\expandafter #2#3#4%
888 {%
889   \fi\xint_gobble_ii #2%
890 }%

```

## 9.25 `\xintCntoCs`

Modified in 1.09m: added spaces after the commas in the produced list. Moreover the coefficients are not braced anymore. A slight induced limitation is that the macro argument should not contain some explicit comma (cf. `\XINT_cntcs_exit_b`), hence `\xintCntoCs {\macro,}` with `\def\macro,#1{<stuff>}` would crash. Not a very serious limitation, I believe.

```

891 \def\xintCntoCs {\romannumeral0\xintcntocs }%
892 \def\xintcntocs #1%
893 {%
894   \expandafter\XINT_cntcs\expandafter {\the\numexpr #1}%
895 }%
896 \def\XINT_cntcs #1#2%
897 {%
898   \ifnum #1<0
899     \xint_afterfi { }% 1.09i: a 0/1[0] was here, now the macro returns nothing
900   \else
901     \xint_afterfi {\expandafter\XINT_cntcs_loop\expandafter
902                   {\the\numexpr #1-\xint_c_i\expandafter}\expandafter
903                   {\romannumeral-`0#2{#1}}{#2}}% produced coeff not braced
904   \fi
905 }%
906 \def\XINT_cntcs_loop #1#2#3%
907 {%
908   \ifnum #1>-\xint_c_i \else \XINT_cntcs_exit \fi
909   \expandafter\XINT_cntcs_loop\expandafter
910   {\the\numexpr #1-\xint_c_i\expandafter}\expandafter
911   {\romannumeral-`0#3{#1}, #2}{#3}% space added, 1.09m
912 }%
913 \def\XINT_cntcs_exit \fi
914   \expandafter\XINT_cntcs_loop\expandafter
915   #1\expandafter #2#3%
916 {%
917   \fi\XINT_cntcs_exit_b #2%
918 }%
919 \def\XINT_cntcs_exit_b #1,{}% romannumeral stopping space already there

```

## 9.26 `\xintCntoGC`

Modified in 1.06 to give the N first to a `\numexpr` rather than expanding twice. I just use `\the\numexpr` and maintain the previous code after that.

1.09m maintains the braces, as the coeff are allowed to be fraction and the slash can not be naked in the GC format, contrarily to what happens in `\xintCntoCs`. Also the separators given to `\xintGctoGCx` may then fetch the coefficients as argument, as they are braced.

```

920 \def\xintCntoGC {\romannumeral0\xintcntogc }%
921 \def\xintcntogc #1%
922 {%
923   \expandafter\XINT_cntgc\expandafter {\the\numexpr #1}%
924 }%
925 \def\XINT_cntgc #1#2%
926 {%
927   \ifnum #1<0

```



```

928 \xint_afterfi { }% 1.09i there was as strange 0/1[0] here, removed
929 \else
930 \xint_afterfi {\expandafter\XINT_cntgc_loop\expandafter
931               {\the\numexpr #1-\xint_c_i\expandafter}\expandafter
932               {\expandafter{\romannumeral-`0#2{#1}}{#2}}}%
933 \fi
934 }%
935 \def\XINT_cntgc_loop #1#2#3%
936 {%
937   \ifnum #1>-\xint_c_i \else \XINT_cntgc_exit \fi
938   \expandafter\XINT_cntgc_loop\expandafter
939   {\the\numexpr #1-\xint_c_i\expandafter }\expandafter
940   {\expandafter{\romannumeral-`0#3{#1}}+1/#2}{#3}%
941 }%
942 \def\XINT_cntgc_exit \fi
943 \expandafter\XINT_cntgc_loop\expandafter
944 #1\expandafter #2#3%
945 {%
946   \fi\XINT_cntgc_exit_b #2%
947 }%
948 \def\XINT_cntgc_exit_b #1+1/{ }%

```

## 9.27 \xintGCntoGC

Modified in 1.06 to give the N first to a \numexpr rather than expanding twice. I just use \the\numexpr and maintain the previous code after that.

```

949 \def\xintGCntoGC {\romannumeral0\xintgcntogc }%
950 \def\xintgcntogc #1%
951 {%
952   \expandafter\XINT_gcntgc\expandafter {\the\numexpr #1}%
953 }%
954 \def\XINT_gcntgc #1#2#3%
955 {%
956   \ifnum #1<0
957     \xint_afterfi { }% 1.09i now returns nothing
958   \else
959     \xint_afterfi {\expandafter\XINT_gcntgc_loop\expandafter
960                   {\the\numexpr #1-\xint_c_i\expandafter}\expandafter
961                   {\expandafter{\romannumeral-`0#2{#1}}{#2}{#3}}}%
962   \fi
963 }%
964 \def\XINT_gcntgc_loop #1#2#3#4%
965 {%
966   \ifnum #1>-\xint_c_i \else \XINT_gcntgc_exit \fi
967   \expandafter\XINT_gcntgc_loop_b\expandafter
968   {\expandafter{\romannumeral-`0#4{#1}}/#2}{#3{#1}}{#1}{#3}{#4}%
969 }%
970 \def\XINT_gcntgc_loop_b #1#2#3%
971 {%
972   \expandafter\XINT_gcntgc_loop\expandafter
973   {\the\numexpr #3-\xint_c_i \expandafter}\expandafter
974   {\expandafter{\romannumeral-`0#2}{#1}}%

```

```

975 }%
976 \def\XINT_gcntgc_exit \fi
977   \expandafter\XINT_gcntgc_loop_b\expandafter #1#2#3#4#5%
978 {%
979   \fi\XINT_gcntgc_exit_b #1%
980 }%
981 \def\XINT_gcntgc_exit_b #1/{ }%

```

## 9.28 \xintCstoGC

```

982 \def\xintCstoGC {\romannumeral0\xintcstogc }%
983 \def\xintcstogc #1%
984 {%
985   \expandafter\XINT_cstc_prep \romannumeral-`0#1,\xint_relax,%
986 }%
987 \def\XINT_cstc_prep #1,{\XINT_cstc_loop_a {{#1}}}%
988 \def\XINT_cstc_loop_a #1#2,%
989 {%
990   \xint_gob_til_xint_relax #2\XINT_cstc_end\xint_relax
991   \XINT_cstc_loop_b {#1}{#2}%
992 }%
993 \def\XINT_cstc_loop_b #1#2{\XINT_cstc_loop_a {#1+1/{#2}}}%
994 \def\XINT_cstc_end\xint_relax\XINT_cstc_loop_b #1#2{ #1}%

```

## 9.29 \xintGctoGC

```

995 \def\xintGctoGC {\romannumeral0\xintgctogc }%
996 \def\xintgctogc #1%
997 {%
998   \expandafter\XINT_gctgc_start \romannumeral-`0#1+\xint_relax/%
999 }%
1000 \def\XINT_gctgc_start {\XINT_gctgc_loop_a {}}%
1001 \def\XINT_gctgc_loop_a #1#2+#3/%
1002 {%
1003   \xint_gob_til_xint_relax #3\XINT_gctgc_end\xint_relax
1004   \expandafter\XINT_gctgc_loop_b\expandafter
1005   {\romannumeral-`0#2}{#3}{#1}%
1006 }%
1007 \def\XINT_gctgc_loop_b #1#2%
1008 {%
1009   \expandafter\XINT_gctgc_loop_c\expandafter
1010   {\romannumeral-`0#2}{#1}%
1011 }%
1012 \def\XINT_gctgc_loop_c #1#2#3%
1013 {%
1014   \XINT_gctgc_loop_a {#3{#2}+{#1}}/%
1015 }%
1016 \def\XINT_gctgc_end\xint_relax\expandafter\XINT_gctgc_loop_b
1017 {%
1018   \expandafter\XINT_gctgc_end_b
1019 }%
1020 \def\XINT_gctgc_end_b #1#2#3{ #3{#1}}%
1021 \XINT_restorecatcodes_endinput%

```

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The first version was released in June 2013. I was greatly helped in this task of writing an expandable parser of infix operations by the comments provided in `l3fp-parse.dtx` (in its version as available in April–May 2013). One will recognize in particular the idea of the ``until'` macros; I have not looked into the actual `l3fp` code beyond the very useful comments provided in its documentation.

A main worry was that my data has no a priori bound on its size; to keep the code reasonably efficient, I experimented with a technique of storing and retrieving data expandably as *names* of control sequences. Intermediate computation results are stored as control sequences `\.=a/b[n]`.

Release `1.2 [2015/10/10]` has the following changes:

**not anymore limited to 5000 digits:** `1.2` replaces chains of `\romannumeral-`0` used earlier to gather digits by `\csname` governed expansions. The use of `\csname.=A/B[N]\endcsname` storage has been part of the design from the start, hence it was very natural and not too hard to gather the number directly inside `\csname`. With the chains of `\romannumeral-`0` gone, there is no more a limit at about 5000 (with the standard settings of the maximal expansion depth at 10000) on the maximal number of digits for each gathered number.

**faster gathering of digits:** the previous item and some other changes have accelerated the building up of numbers.

**optional accelerated parsing:** the new functions `qint`, `qfrac`, `qfloat` allow to skip entirely the digit by digit parsing and hand over directly responsibility to `\xintiNum`, `\xintRaw`, or `\xintFloat` respectively.

**float factorial:** the factorial operator `!` maps to the new macro `\xintFloatFac` inside `\xintfloatexpr`.

**isolated dot now illegal:** the decimal mark must have digits either before or after it, an isolated `.` is now illegal input.

**more recognized tokens:** `\ht`, `\dp`, `\wd`, `\fontcharht`, `\fontcharwd`, `\fontchardp` and `\fontcharit` are recognized and prefixed with `\number` automatically.

Release `1.1 [2014/10/28]` has made many extensions, some bug fixes, and some breaking changes:

- bug fixes**
- `\xintiexpr` did not strip leading zeroes,
  - `\xinttheexpr \xintiexpr 1.23\relax\relax` should have produced `1`, but it produced `1.23`
  - the catcode of `;` was not set at package launching time.

**breaking changes** • in `\xintiexpr`, `/` does *rounded* division, rather than the Euclidean division (for positive arguments, this is truncated division). The new `//` operator does truncated division,

- the `:` operator for three-way branching is gone, replaced with `??`,
- `1e(3+5)` is now illegal. The number parser identifies `e` and `E` in the same way it does for the decimal mark, earlier versions treated `e` as `E` rather as postfix operators,
- the `add` and `mul` have a new syntax, old syntax is with ``+`` and ``*`` (quotes mandatory), `sum` and `prd` are gone,
- no more special treatment for encountered brace pairs `{..}` by the number scanner, `a/b[N]` notation can be used without use of braces (the `N` will end up as is in a `\numexpr`, it is not parsed by the `\xintexpr`-ession scanner).
- although `&` and `|` are still available as Boolean operators the use of `&&` and `||` is strongly recommended. The single letter operators might be assigned some other meaning in later releases (bitwise operations, perhaps). Do not use them.
- place holders for `\xintNewExpr` could be denoted `#1`, `#2`, ... or also, for special purposes `$1`, `$2`, ... Only the first form is now accepted and the special cases previously treated via the second form are now managed via a `protect(...)` function.

**novelties** They are quite a few.

- `\xintiexpr`, `\xinttheiexpr` admit an optional argument within brackets `[d]`, they round the computation result (or results, if comma separated) to `d` digits after decimal mark, (the whole computation is done exactly, as in `xintexpr`),
- `\xintfloatexpr`, `\xintthefloatexpr` similarly admit an optional argument which serves to keep only `d` digits of precision, getting rid of cumulated uncertainties in the last digits (the whole computation is done according to the precision set via `\xintDigits`),
- `\xinttheexpr` and `\xintthefloatexpr` 'pretty-print' if possible, the former removing unit denominator or `[0]` brackets, the latter avoiding scientific notation if decimal notation is practical,
- the `//` does truncated division and `/:` is the associated modulo,
- multi-character operators `&&`, `||`, `==`, `<=`, `>=`, `!=`, `**`,
- multi-letter infix binary words `'and'`, `'or'`, `'xor'`, `'mod'` (quotes mandatory),
- functions `even`, `odd`,
- `\xintdefvar A3:=3.1415;` for variable definitions (non expandable, naturally), usable in subsequent expressions; variable names may contain letters, digits, underscores. They should not start with a digit, the `@` is reserved, and single lowercase and uppercase Latin letters are predefined to work as dummy variables (see next),
- generation of comma separated lists `a..b`, `a..[d]..b`,
- Python syntax-like list extractors `[list][n:]`, `[list][:n]`, `[list][a:b]` allowing negative indices, but no optional step argument, and `[list][n]` (`n=0` for the number of items in the list),
- functions `first`, `last`, `reversed`,
- itemwise operations on comma separated lists `a*[list]`, etc., possible on both sides `a*[list]^b`, an obeying the same precedence rules as with numbers,
- `add` and `mul` must use a dummy variable: `add(x(x+1)(x-1), x=-10..10)`,
- variable substitutions with `subs`: `subs(subs(add(x^2+y^2,x=1..y),y=t),t=20)`,
- sequence generation using `seq` with a dummy variable: `seq(x^3, x=-10..10)`,

- simple recursive lists with `rseq`, with `@` given the last value, `rseq(1;2@+1,i=1..10)`,
- higher recursion with `rrseq`, `@1`, `@2`, `@3`, `@4`, and `@@(n)` for earlier values, up to `n=K` where `K` is the number of terms of the initial stretch `rrseq(0,1;@1+@2,i=2..100)`,
- iteration with `iter` which is like `rrseq` but outputs only the last `K` terms, where `K` was the number of initial terms,
- inside `seq`, `rseq`, `rrseq`, `iter`, possibility to use `omit`, `abort` and `break` to control termination,
- `n++` potentially infinite index generation for `seq`, `rseq`, `rrseq`, and `iter`, it is advised to use `abort` or `break(..)` at some point,
- the `add`, `mul`, `seq`, ... are nestable,
- `\xintthecoords` converts a comma separated list of an even number of items to the format as expected by the `TikZ coordinates` syntax,
- completely rewritten `\xintNewExpr`, `protect` function to handle external macros. However not all constructs are compatible with `\xintNewExpr`.

Comments dating back to earlier releases:

Roughly speaking, the parser mechanism is as follows: at any given time the last found ``operator'' has its associated `until` macro awaiting some news from the token flow; first `getnext` expands forward in the hope to construct some number, which may come from a parenthesized sub-expression, from some braced material, or from a digit by digit scan. After this number has been formed the next operator is looked for by the `getop` macro. Once `getop` has finished its job, `until` is presented with three tokens: the first one is the precedence level of the new found operator (which may be an end of expression marker), the second is the operator character token (earlier versions had here already some macro name, but in order to keep as much common code to `expr` and `floatexpr` common as possible, this was modified) of the new found operator, and the third one is the newly found number (which was encountered just before the new operator).

The `until` macro of the earlier operator examines the precedence level of the new found one, and either executes the earlier operator (in the case of a binary operation, with the found number and a previously stored one) or it delays execution, giving the hand to the `until` macro of the operator having been found of higher precedence.

A minus sign acting as prefix gets converted into a (unary) operator inheriting the precedence level of the previous operator.

Once the end of the expression is found (it has to be marked by a `\relax`) the final result is output as four tokens (five tokens since 1.09j) the first one a catcode 11 exclamation mark, the second one an error generating macro, the third one is a protection mechanism, the fourth one a printing macro and the fifth is `\.=a/b[n]`. The prefix `\xintthe` makes the output printable by killing the first three tokens.

**1.08b [2013/06/14]** corrected a problem originating in the attempt to attribute a special rôle to braces: expansion could be stopped by space tokens, as various macros tried to expand without grabbing what came next. They now have a doubled `\romannumeral-`0`.

**1.09a [2013/09/24]** has a better mechanism regarding `\xintthe`, more commenting and better organization of the code, and most importantly it implements functions, comparison operators, logic operators, conditionals. The code was reorganized and expansion proceeds a bit differently in order to have the `_getnext` and `_getop` codes entirely shared by `\xintexpr` and `\xintfloatexpr`. `\xintNewExpr` was rewritten in order to work with the standard macro parameter character `#`, to be catcode protected and to also allow comma separated expressions.

**1.09c [2013/10/09]** added the `bool` and `togl` operators, `\xintboolexpr`, and `\xintNewNumExpr`, `\xintNewBoolExpr`. The code for `\xintNewExpr` is shared with `float`, `num`, and `bool`-expressions. Also the precedence level of the postfix operators `!`, `?` and `:` has been made lower than the one of functions.



**1.09i [2013/12/18]** unpacks count and dimen registers and control sequences, with tacit multiplication. It has also made small improvements. (speed gains in macro expansions in quite a few places.)

Also, 1.09i implements `\xintiexpr`, `\xinttheiexpr`. New function `frac`. And encapsulation in `\csname..\endcsname` is done with `.=` as first tokens, so unpacking with `\string` can be done in a completely escape char agnostic way.

**1.09j [2014/01/09]** extends the tacit multiplication to the case of a sub `\xintexpr`-essions. Also, it now `\xint_protects` the result of the `\xintexpr` full expansions, thus, an `\xintexpr` without `\xintthe` prefix can be used not only as the first item within an ```\fdef''` as previously but also now anywhere within an `\edef`. Five tokens are used to pack the computation result rather than the possibly hundreds or thousands of digits of an `\xintthe` unlocked result. I deliberately omit a second `\xint_protect` which, however would be necessary if some macro `\.=digits/digits[digits]` had acquired some expandable meaning elsewhere. But this seems not that probable, and adding the protection would mean impacting everything only to allow some crazy user which has loaded something else than xint to do an `\edef...` the `\xintexpr` computations are otherwise in no way affected if such control sequences have a meaning.

**1.09k [2014/01/21]** does tacit multiplication also for an opening parenthesis encountered during the scanning of a number, or at a time when the parser expects an infix operator.

And it adds to the syntax recognition of hexadecimal numbers starting with a `"`, and having possibly a fractional part (except in `\xintiexpr`, naturally).

**1.09kb [2014/02/13]** fixes the bug introduced in `\xintNewExpr` in 1.09i of December 2013: an `\endlinechar -1` was removed, but without it there is a spurious trailing space token in the outputs of the created macros, and nesting is then impossible.

This is release 1.2 of [2015/10/10].

## 10.1 Catcodes, $\varepsilon$ -TeX and reload detection

The code for reload detection was initially copied from HEIKO OBERDIEK's packages, then modified.

The method for catcodes was also initially directly inspired by these packages.

```

1 \begingroup\catcode61\catcode48\catcode32=10\relax%
2 \catcode13=5 % ^^M
3 \endlinechar=13 %
4 \catcode123=1 % {
5 \catcode125=2 % }
6 \catcode64=11 % @
7 \catcode35=6 % #
8 \catcode44=12 % ,
9 \catcode45=12 % -
10 \catcode46=12 % .
11 \catcode58=12 % :
12 \def\z {\endgroup}%
13 \expandafter\let\expandafter\x\csname ver@xintexpr.sty\endcsname
14 \expandafter\let\expandafter\w\csname ver@xintfrac.sty\endcsname
15 \expandafter\let\expandafter\t\csname ver@xinttools.sty\endcsname
16 \expandafter
17 \ifx\csname PackageInfo\endcsname\relax
18 \def\y#1#2{\immediate\write-1{Package #1 Info: #2.}}%
19 \else
20 \def\y#1#2{\PackageInfo{#1}{#2}}%
```



```

21   \fi
22   \expandafter
23   \ifx\csname numexpr\endcsname\relax
24     \y{xintexpr}{\numexpr not available, aborting input}%
25     \aftergroup\endinput
26   \else
27     \ifx\x\relax % plain-TeX, first loading of xintexpr.sty
28       \ifx\w\relax % but xintfrac.sty not yet loaded.
29         \expandafter\def\expandafter\z\expandafter
30           {\z\input xintfrac.sty\relax}%
31       \fi
32       \ifx\t\relax % but xinttools.sty not yet loaded.
33         \expandafter\def\expandafter\z\expandafter
34           {\z\input xinttools.sty\relax}%
35       \fi
36     \else
37       \def\empty {}%
38       \ifx\x\empty % LaTeX, first loading,
39       % variable is initialized, but \ProvidesPackage not yet seen
40       \ifx\w\relax % xintfrac.sty not yet loaded.
41         \expandafter\def\expandafter\z\expandafter
42           {\z\RequirePackage{xintfrac}}%
43       \fi
44       \ifx\t\relax % xinttools.sty not yet loaded.
45         \expandafter\def\expandafter\z\expandafter
46           {\z\RequirePackage{xinttools}}%
47       \fi
48     \else
49       \aftergroup\endinput % xintexpr already loaded.
50     \fi
51   \fi
52 \fi
53 \z%
54 \XINTsetupcatcodes%

```

## 10.2 Package identification

```

55 \XINT_providespackage
56 \ProvidesPackage{xintexpr}%
57 [2015/10/10 v1.2 Expandable expression parser (jfb)]%
58 \catcode`! 11

```

## 10.3 Locking and unlocking

Some renaming and modifications here with release 1.2 to switch from using chains of `\romannumeral-`0` in order to gather numbers, possibly hexadecimal, to using a `\csname` governed expansion. In this way no more limit at 5000 digits, and besides this is a logical move because the `\xintexpr` parser is already based on `\csname...\endcsname` storage of numbers as one token.

The limitation at 5000 digits didn't worry me too much because it was not very realistic to launch computations with thousands of digits... such computations are still slow with 1.2 but less so now. Chains or `\romannumeral` are still used for the gathering of function names and other stuff which I have half-forgotten because the parser does many things.

In the earlier versions we used the `lockscan` macro after a chain of `\romannumeral-`0` had ended

gathering digits; this uses has been replaced by direct processing inside a `\csname...\endcsname` and the macro is kept only for matters of dummy variables.

Currently, the parsing of hexadecimal numbers needs two nested `\csname...\endcsname`, first to gather the letters (possibly with a hexadecimal fractional part), and in a second stage to apply `\xintHexToDec` to do the actual conversion. This should be faster than updating on the fly the number (which would be hard for the fraction part...). The macro `\xintHexToDec` could probably be made faster by using techniques similar as the ones v1.2 uses in `xintcore.sty`.

```

59 \def\xint_gob_til_! #1!{% catcode 11 ! default in xintexpr.sty code.
60 \edef\XINT_expr_lockscan#1!% not used for decimal numbers in xintexpr 1.2
61   {\noexpand\expandafter\space\noexpand\csname .=#1\endcsname }%
62 \edef\XINT_expr_lockit
63   #1{\noexpand\expandafter\space\noexpand\csname .=#1\endcsname }%
64 \def\XINT_expr_unlock_hex_in #1% expanded inside \csname..\endcsname
65   {\expandafter\XINT_expr_inhex\romannumeral-`0\XINT_expr_unlock#1;%}
66 \def\XINT_expr_inhex #1.#2#3;% expanded inside \csname..\endcsname
67 {%
68   \if#2>\xintHexToDec{#1}%
69   \else
70     \xintiiMul{\xintiiPow{625}{\xintLength{#3}}}{\xintHexToDec{#1#3}}%
71     [\the\numexpr-4*\xintLength{#3}]%
72   \fi
73 }%
74 %%%%%%%%%%%
75 \def\XINT_expr_unlock {\expandafter\XINT_expr_unlock_a\string }%
76 \def\XINT_expr_unlock_a #1.={}%
77 \def\XINT_expr_unexpectedtoken {\xintError:ignored }%
78 \let\XINT_expr_done\space

```

#### 10.4 `\XINT_expr_wrap`, `\XINT_iiexpr_wrap`

```

79 \def\XINT_expr_wrap { !\XINT_expr_usethe\XINT_protectii\XINT_expr_print }%
80 \def\XINT_iiexpr_wrap { !\XINT_expr_usethe\XINT_protectii\XINT_iiexpr_print }%

```

#### 10.5 `\XINT_protectii`, `\XINT_expr_usethe`

```

81 \def\XINT_protectii #1{\noexpand\XINT_protectii\noexpand #1\noexpand }%
82 \protected\def\XINT_expr_usethe\XINT_protectii {\xintError:missing_xinthe!}%

```

#### 10.6 `\XINT_expr_print`, `\XINT_iiexpr_print`, `\XINT_boolexpr_print`

See also the `\XINT_flexpr_print` which is special, below.

```

83 \def\XINT_expr_print #1{\xintSPRaw::csv {\XINT_expr_unlock #1}}%
84 \def\XINT_iiexpr_print #1{\xintCSV::csv {\XINT_expr_unlock #1}}%
85 \def\XINT_boolexpr_print #1{\xintIsTrue::csv {\XINT_expr_unlock #1}}%

```

#### 10.7 `\xintexpr`, `\xintiexpr`, `\xintfloatexpr`, `\xintiexpr`, `\xinttheexpr`, etc...

```

86 \def\xintexpr {\romannumeral0\xinteval }%
87 \def\xintiexpr {\romannumeral0\xintieval }%
88 \def\xintfloatexpr {\romannumeral0\xintfloateval }%
89 \def\xintiexpr {\romannumeral0\xintiieval }%
90 \def\xinttheexpr
91   {\romannumeral-`0\expandafter\XINT_expr_print\romannumeral0\xintbareeval }%

```

```

92 \def\xinttheiexpr      {\romannumeral-`0\xintthe\xintiexpr }%
93 \def\xintthefloatexpr {\romannumeral-`0\xintthe\xintfloatexpr }%
94 \def\xinttheiieexpr
95   {\romannumeral-`0\expandafter\XINT_iieexpr_print\romannumeral0\xintbareiieval }%

```

## 10.8 \xintthe

```

96 \def\xintthe #1{\romannumeral-`0\expandafter\xint_gobble_iii\romannumeral-`0#1}%

```

## 10.9 \xintthecoords

1.1 Wraps up an even number of comma separated items into pairs of TikZ coordinates; for use in the following way:

```
coordinates {\xintthecoords\xintfloatexpr ... \relax}
```

The craziness with the \csname and unlock is due to TikZ somewhat STRANGE control of the TOTAL number of expansions which should not exceed the very low value of 100 !! As we implemented \XINT\_thecoords\_b in an "inline" style for efficiency, we need to hide its expansions.

Not to be used as \xintthecoords\xintthefloatexpr, only as \xintthecoords\xintfloatexpr (or \xintiexpr etc...). Perhaps \xintthecoords could make an extra check, but one should not accustome users to too loose requirements!

```

97 \def\xintthecoords #1{\romannumeral-`0\expandafter\expandafter\expandafter
98   \XINT_thecoords_a
99   \expandafter\xint_gobble_iii\romannumeral0#1}%
100 \def\XINT_thecoords_a #1#2% #1=print macro, indispensable for scientific notation
101   {\expandafter\XINT_expr_unlock\csname.=\expandafter\XINT_thecoords_b
102     \romannumeral-`0#1#2,!,!,^ \endcsname }%
103 \def\XINT_thecoords_b #1#2,#3#4,%
104   {\xint_gob_til_! #3\XINT_thecoords_c ! (#1#2, #3#4)\XINT_thecoords_b }%
105 \def\XINT_thecoords_c #1^{}%

```

## 10.10 \xintbareeval, \xintbarefloateval, \xintbareiieval

```

106 \def\xintbareeval
107   {\expandafter\XINT_expr_until_end_a\romannumeral-`0\XINT_expr_getnext }%
108 \def\xintbarefloateval
109   {\expandafter\XINT_flexpr_until_end_a\romannumeral-`0\XINT_expr_getnext }%
110 \def\xintbareiieval
111   {\expandafter\XINT_iieexpr_until_end_a\romannumeral-`0\XINT_expr_getnext }%

```

## 10.11 \xintieval, \xintiieval

```

112 \def\xintieval   {\expandafter\XINT_expr_wrap\romannumeral0\xintbareeval }%
113 \def\xintiieval  {\expandafter\XINT_iieexpr_wrap\romannumeral0\xintbareiieval }%

```

## 10.12 \xintieval, \XINT\_iexpr\_wrap

Optional argument since 1.1.

```

114 \def\xintieval #1%
115   {\ifx [#1\expandafter\XINT_iexpr_withopt\else\expandafter\XINT_iexpr_noopt \fi #1}%
116 \def\XINT_iexpr_noopt
117   {\expandafter\XINT_iexpr_wrap \expandafter 0\romannumeral0\xintbareeval }%
118 \def\XINT_iexpr_withopt [#1]%
119   {%
120     \expandafter\XINT_iexpr_wrap\expandafter

```

```

121    {\the\numexpr \xint_zapspace #1 \xint_gobble_i\expandafter}%
122    \romannumeral0\xintbareeval
123 }%
124 \def\xint_iexpr_wrap #1#2%
125 {%
126     \expandafter\xint_expr_wrap
127     \csname .=\xintRound::csv {#1}{\XINT_expr_unlock #2}\endcsname
128 }%

```

### 10.13 \xintfloateval, \XINT\_flexpr\_wrap, \XINT\_flexpr\_print

Optional argument since 1.1

```

129 \def\xintfloateval #1%
130 {%
131     \ifx [#1\expandafter\XINT_flexpr_withopt_a\else\expandafter\XINT_flexpr_noopt
132     \fi #1%
133 }%
134 \def\XINT_flexpr_noopt
135 {%
136     \expandafter\XINT_flexpr_withopt_b\expandafter\xinttheDigits
137     \romannumeral0\xintbarefloateval
138 }%
139 \def\XINT_flexpr_withopt_a [#1]%
140 {%
141     \expandafter\XINT_flexpr_withopt_b\expandafter
142     {\the\numexpr\xint_zapspace #1 \xint_gobble_i\expandafter}%
143     \romannumeral0\xintbarefloateval
144 }%
145 \def\XINT_flexpr_withopt_b #1#2%
146 {%
147     \expandafter\XINT_flexpr_wrap\csname .;#1.= ; and not : as before b'cause NewExpr
148     \XINTinFloat::csv {#1}{\XINT_expr_unlock #2}\endcsname
149 }%
150 \def\XINT_flexpr_wrap { !\XINT_expr_usethe\XINT_protectii\XINT_flexpr_print }%
151 \def\XINT_flexpr_print #1%
152 {%
153     \expandafter\xintPFloat::csv
154     \romannumeral-\0\expandafter\XINT_expr_unlock_sp\string #1!%
155 }%
156 \catcode`: 12
157     \def\XINT_expr_unlock_sp #1.;#2.=#3!{{#2}{#3}}%
158 \catcode`: 11

```

### 10.14 \xintboolexpr, \xinttheboolexpr

```

159 \def\xintboolexpr    {\romannumeral0\expandafter\expandafter\expandafter
160     \XINT_boolexpr_done \expandafter\xint_gobble_iv\romannumeral0\xinteval }%
161 \def\xinttheboolexpr  {\romannumeral-\0\expandafter\expandafter\expandafter
162     \XINT_boolexpr_print\expandafter\xint_gobble_iv\romannumeral0\xinteval }%
163 \def\XINT_boolexpr_done { !\XINT_expr_usethe\XINT_protectii\XINT_boolexpr_print }%

```

## 10.15 `\xintifboolexpr`, `\xintifboolfloatexpr`, `\xintifboolliexpr`

Do not work with comma separated expressions.

```
164 \def\xintifboolexpr      #1{\romannumeral0\xintifnotzero {\xinttheexpr #1\relax}}%
165 \def\xintifboolfloatexpr #1{\romannumeral0\xintifnotzero {\xintthefloatexpr #1\relax}}%
166 \def\xintifboolliexpr    #1{\romannumeral0\xintifnotzero {\xinttheiiexpr #1\relax}}%
```

## 10.16 Macros handling csv lists on output (for `\XINT_expr_print` et al. routines)

Changed completely for 1.1, which adds the optional arguments to `\xintexpr` and `\xintfloatexpr`.

### 10.16.1 `\XINT_::_end`

Le mécanisme est le suivant, #2 est dans des accolades et commence par `,<sp>`. Donc le gobble se débarrasse du, et le `<sp>` après brace stripping arrête un `\romannumeral0` ou `\romannumeral-`0`

```
167 \def\XINT_::_end #1,#2{\xint_gobble_i #2}%
```

### 10.16.2 `\xintCSV:::csv`

pour `\xinttheiiexpr`. 1.1a adds the `\romannumeral-`0` for each item, which have no use for `\xintiexpr` etc..., but are necessary for `\xintNewExpr` to be able to handle comma separated inputs. I am not sure but I think I had them just prior to releasing 1.1 but removed them foolishly.

```
168 \def\xintCSV:::csv #1{\expandafter\XINT_csv:::_a\romannumeral-`0#1,^,}%
169 \def\XINT_csv:::_a {\XINT_csv:::_b {}}%
170 \def\XINT_csv:::_b #1#2,{\expandafter\XINT_csv:::_c \romannumeral-`0#2,{#1}}%
171 \def\XINT_csv:::_c #1{\if ^#1\expandafter\XINT_::_end\fi\XINT_csv:::_d #1}%
172 \def\XINT_csv:::_d #1,#2{\XINT_csv:::_b {#2, #1}}% possibly, item #1 is empty.
```

### 10.16.3 `\xintSPRaw`, `\xintSPRaw:::csv`

Pour `\xinttheexpr`. J'avais voulu optimiser en testant si présence ou non de [N], cependant `reduce()` produit résultat sans, et du coup, le /1 peut ne pas être retiré. Bon je rajoute un [0] dans `reduce`. 14/10/25 au moment de boucler.

Same added `\romannumeral-`0` in 1.1a for `\xintNewExpr` purposes.

```
173 \def\xintSPRaw    {\romannumeral0\xintspraw}%
174 \def\xintspraw    #1{\expandafter\XINT_spraw\romannumeral-`0#1[\W]}%
175 \def\XINT_spraw #1[#2#3]{\xint_gob_til_W #2\XINT_spraw_a\W\XINT_spraw_p #1[#2#3]}%
176 \def\XINT_spraw_a\W\XINT_spraw_p #1[\W]{ #1}%
177 \def\XINT_spraw_p #1[\W]{\xintprap {#1}}%
178 \def\xintSPRaw:::csv #1{\romannumeral0\expandafter\XINT_spraw:::_a\romannumeral-`0#1,^,}%
179 \def\XINT_spraw:::_a {\XINT_spraw:::_b {}}%
180 \def\XINT_spraw:::_b #1#2,{\expandafter\XINT_spraw:::_c \romannumeral-`0#2,{#1}}%
181 \def\XINT_spraw:::_c #1{\if ,#1\xint_dothis\XINT_spraw:::_e\fi
182     \if ^#1\xint_dothis\XINT_::_end\fi
183     \xint_orthat\XINT_spraw:::_d #1}%
184 \def\XINT_spraw:::_d #1,{\expandafter\XINT_spraw:::_e\romannumeral0\XINT_spraw #1[\W],}%
185 \def\XINT_spraw:::_e #1,#2{\XINT_spraw:::_b {#2, #1}}%
```

**10.16.4 \xintIsTrue::csv**

```

186 \def\xintIsTrue::csv #1{\romannumeral0\expandafter\xint_istrue::_a\romannumeral-`0#1,^,%}
187 \def\xint_istrue::_a {\xint_istrue::_b {}}%
188 \def\xint_istrue::_b #1#2,{\expandafter\xint_istrue::_c \romannumeral-`0#2,{#1}}%
189 \def\xint_istrue::_c #1{\if ,#1\xint_dothis\xint_istrue::_e\fi
190     \if ^#1\xint_dothis\xint_istrue::_d #1}%
191     \xint_orthat\xint_istrue::_d #1}%
192 \def\xint_istrue::_d #1,{\expandafter\xint_istrue::_e\romannumeral0\xintisnotzero {#1},}%
193 \def\xint_istrue::_e #1,#2{\xint_istrue::_b {#2, #1}}%

```

**10.16.5 \xintRound::csv**

Pour `\xintexpr` avec argument optionnel (finalement, malgré un certain overhead lors de l'exécution, pour économiser du code je ne distingue plus les deux cas). Reason for annoying expansion bridge is related to `\xintNewExpr`. Attention utilise `\XINT_:::_end`.

```

194 \def\xint_:::_end #1,#2#3{\xint_gobble_i #3}%
195 \def\xintRound::csv #1#2{\romannumeral0\expandafter\xint_round::_b\expandafter
196     {\the\numexpr#1\expandafter}\expandafter{\expandafter}\romannumeral-`0#2,^,%}
197 \def\xint_round::_b #1#2#3,{\expandafter\xint_round::_c \romannumeral-`0#3,{#1}{#2}}%
198 \def\xint_round::_c #1{\if ,#1\xint_dothis\xint_round::_e\fi
199     \if ^#1\xint_dothis\xint_:::_end\fi
200     \xint_orthat\xint_round::_d #1}%
201 \def\xint_round::_d #1,#2{%
202     \expandafter\xint_round::_e\romannumeral0\ifnum#2>\xint_c_
203     \expandafter\xintround\else\expandafter\xintiround\fi {#2}{#1},{#2}}%
204 \def\xint_round::_e #1,#2#3{\xint_round::_b {#2}{#3, #1}}%

```

**10.16.6 \XINTinFloat::csv**

Pour `\xintfloatexpr`. Attention, prépare sous la forme `digits[N]` pour traitement par les macros. Pas utilisé en sortie. Utilise `\XINT_:::_end`.

1.1a I believe this is not needed for `\xintNewExpr`, as it is removed by re-defined by `\XINT_flexpr_wrap` code, hence no need to add the extra `\romannumeral-`0`. Sub-expressions in `\xintNewExpr` are not supported.

I didn't start and don't want now to think about it at all.

```

205 \def\XINTinFloat::csv #1#2{\romannumeral0\expandafter\XINT_infloat::_b\expandafter
206     {\the\numexpr #1\expandafter}\expandafter{\expandafter}\romannumeral-`0#2,^,%}
207 \def\XINT_infloat::_b #1#2#3,{\XINT_infloat::_c #3,{#1}{#2}}%
208 \def\XINT_infloat::_c #1{\if ,#1\xint_dothis\XINT_infloat::_e\fi
209     \if ^#1\xint_dothis\XINT_:::_end\fi
210     \xint_orthat\XINT_infloat::_d #1}%
211 \def\XINT_infloat::_d #1,#2%
212     {\expandafter\XINT_infloat::_e\romannumeral0\XINTinfloat [#2]{#1},{#2}}%
213 \def\XINT_infloat::_e #1,#2#3{\XINT_infloat::_b {#2}{#3, #1}}%

```

**10.16.7 \xintPFloat::csv**

Expansion à cause de `\xintNewExpr`. Attention à l'ordre, pas le même que pour `\XINTinFloat::csv`. Donc c'est cette routine qui imprime. Utilise `\XINT_:::_end`

```

214 \def\xintPFloat::csv #1#2{\romannumeral0\expandafter\XINT_pfloat::_b\expandafter

```

```

215 {\the\numexpr #1\expandafter}\expandafter{\expandafter}\romannumeral-`0#2,^,%}
216 \def\XINT_pfloat::_b #1#2#3,{\expandafter\XINT_pfloat::_c \romannumeral-`0#3,{#1}{#2}}%
217 \def\XINT_pfloat::_c #1{\if ,#1\xint_dothis\XINT_pfloat::_e\fi
218     \if ^#1\xint_dothis\XINT::_end\fi
219     \xint_orthat\XINT_pfloat::_d #1}%
220 \def\XINT_pfloat::_d #1,#2%
221 {\expandafter\XINT_pfloat::_e\romannumeral0\XINT_pfloat_opt [\xint_relax #2]{#1},{#2}}%
222 \def\XINT_pfloat::_e #1,#2#3{\XINT_pfloat::_b {#2}{#3, #1}}%

```

## 10.17 \XINT\_expr\_getnext: fetching some number then an operator

Big change in 1.1, no attempt to detect braced stuff anymore as the [N] notation is implemented otherwise. Now, braces should not be used at all; one level removed, then \romannumeral-`0 expansion.

```

223 \def\XINT_expr_getnext #1%
224 {%
225     \expandafter\XINT_expr_getnext_a\romannumeral-`0#1%
226 }%
227 \def\XINT_expr_getnext_a #1%
228 {% screens out sub-expressions and \count or \dimen registers/variables
229     \xint_gob_til_! #1\XINT_expr_subexpr !% recall this ! has catcode 11
230     \ifcat\relax#1% \count or \numexpr etc... token or count, dimen, skip cs
231         \expandafter\XINT_expr_countetc
232     \else
233         \expandafter\expandafter\expandafter\XINT_expr_getnextfork\expandafter\string
234     \fi
235     #1%
236 }%
237 \def\XINT_expr_subexpr !#1\fi !{\expandafter\XINT_expr_getop\xint_gobble_iii }%

```

1.2 adds \ht, \dp, \wd and the eTeX font things.

```

238 \def\XINT_expr_countetc #1%
239 {%
240     \ifx\count#1\else\ifx\dimen#1\else\ifx\numexpr#1\else\ifx\dimexpr#1\else
241     \ifx\skip#1\else\ifx\glueexpr#1\else\ifx\fontdimen#1\else\ifx\ht#1\else
242     \ifx\dp#1\else\ifx\wd#1\else\ifx\fontcharht#1\else\ifx\fontcharwd#1\else
243     \ifx\fontcharhp#1\else\ifx\fontcharic#1\else
244         \XINT_expr_unpackvar
245     \fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi
246     \expandafter\XINT_expr_getnext\number #1%
247 }%
248 \def\XINT_expr_unpackvar\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi
249     \expandafter\XINT_expr_getnext\number #1%
250     {\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi\fi
251     \expandafter\XINT_expr_getop\csname .=\number#1\endcsname }%
252 \begingroup
253 \lccode`*=`#
254 \lowercase{\endgroup
255 \def\XINT_expr_getnextfork #1{%
256     \if#1*\xint_dothis {\XINT_expr_scan_macropar *} \fi
257     \if#1[\xint_dothis {\xint_c_xviii ({} )} \fi

```

```

258 \if#1+\xint_dothis \XINT_expr_getnext \fi
259 \if#1.\xint_dothis {\XINT_expr_startdec}\fi
260 \if#1-\xint_dothis -\fi
261 \if#1(\xint_dothis {\xint_c_xviii ({} }\fi
262 \xint_orthat {\XINT_expr_scan_nbr_or_func #1}%
263 }}%
264 \def\xintexpr_scan_macropar #1#2{\expandafter\xintexpr_getop\csname .=#1#2\endcsname }%

```

## 10.18 The integer or decimal number or hexa-decimal number or function name or variable name or special hacky things big parser

1.2 release has replaced chains of `\romannumeral-`0` by `\csname` governed expansion. Thus there is no more the limit at about 5000 digits for parsed numbers.

In order to avoid having to lock and unlock in succession to handle the scientific part and adjust the exponent according to the number of digits of the decimal part, the parsing of this decimal part counts on the fly the number of digits it encounters.

There is some slight annoyance with `\xintiexpr` which should never be given a `[n]` inside its `\csname`.=<digits>\endcsname storage of numbers (because its arithmetic uses the `ii` macros which know nothing about the `[N]` notation). Hence if the parser has only seen digits when hitting something else than the dot or `e` (or `E`), it will not insert a `[0]`. Thus we very slightly compromise the efficiency of `\xintexpr` and `\xintfloatexpr` in order to be able to share the same code with `\xintiexpr`.

Indeed, the parser at this location is completely common to all, it does not know if it is working inside `\xintexpr` or `\xintiexpr`. On the other hand if a dot or a `e` (or `E`) is met, then the (common) parser has no scruples ending this number with a `[n]`, this will provoke an error later if that was within an `\xintiexpr`, as soon as an arithmetic macro is used.

As the gathered numbers have no spaces, no pluses, no minuses, the only remaining issue is with leading zeroes, which are discarded on the fly. The hexadecimal numbers leading zeroes are stripped in a second stage by the `\xintHexToDec` macro.

With v1.2, `\xinttheexpr . \relax` does not work anymore (it did in earlier releases). There must be digits either before or after the decimal mark. Thus both `\xinttheexpr 1.\relax` and `\xinttheexpr .1\relax` are legal.

```

265 \catcode96 11 % `
266 \def\xintexpr_scan_nbr_or_func #1% this #1 has necessarily here catcode 12
267 {%
268 \if "#1\xint_dothis \XINT_expr_scanhex_I\fi
269 \if `#1\xint_dothis {\XINT_expr_onlitteral_`}\fi
270 \ifnum \xint_c_ix<1#1 \xint_dothis \XINT_expr_startint\fi
271 \xint_orthat \XINT_expr_scanfunc #1%
272 }%
273 \catcode96 12 % `
274 \def\xintexpr_startint #1%
275 {%
276 \if #10\expandafter\xintexpr_gobz_a\else\xintexpr_scanint_a\fi #1%
277 }%
278 \def\xintexpr_scanint_a #1#2%
279 {\expandafter\xintexpr_getop\csname .=#1%
280 \expandafter\xintexpr_scanint_b\romannumeral-`0#2}%
281 \def\xintexpr_gobz_a #1%
282 {\expandafter\xintexpr_getop\csname .=%
283 \expandafter\xintexpr_gobz_scanint_b\romannumeral-`0#1}%

```



```

284 \def\XINT_expr_startdec #1%
285   {\expandafter\XINT_expr_getop\csname.=%
286     \expandafter\XINT_expr_scandec_a\romannumeral-`0#1}%

```

### 10.18.1 Integral part (skipping zeroes)

Sub-expressions are recognized as starting with catcode 11 exclamation mark, which is treated together with variable names composed of letters below, hence induces a tacit multiplication if encountered while gathering a number.

1.2 has modified the code to give highest priority to digits, the impact is non-negligeable. I don't think the doubled `\string` is a serious penalty.

```

287 \def\XINT_expr_scanint_b #1%
288 {%
289   \ifcat \relax #1\expandafter\XINT_expr_scanint_endbycs\expandafter #1\fi
290   \ifnum\xint_c_ix<1\string#1 \else\expandafter\XINT_expr_scanint_c\fi
291   \string#1\XINT_expr_scanint_d
292 }%
293 \def\XINT_expr_scanint_d #1%
294 {%
295   \expandafter\XINT_expr_scanint_b\romannumeral-`0#1%
296 }%
297 \def\XINT_expr_scanint_endbycs#1#2\XINT_expr_scanint_d{\endcsname #1}%
298 \def\XINT_expr_scanint_c\string #1\XINT_expr_scanint_d
299 {%
300   \if e#1\xint_dothis{[\the\numexpr0\XINT_expr_scanexp_a +}\fi
301   \if E#1\xint_dothis{[\the\numexpr0\XINT_expr_scanexp_a +}\fi
302   \ifcat a#1\xint_dothis{\endcsname*#1}\fi
303   \if .#1\xint_dothis{\XINT_expr_startdec_a .}\fi
304   \xint_orthat {\expandafter\endcsname \string#1}%
305 }%
306 \def\XINT_expr_startdec_a .#1%
307 {%
308   \expandafter\XINT_expr_scandec_a\romannumeral-`0#1%
309 }%
310 \def\XINT_expr_scandec_a #1%
311 {%
312   \if .#1\xint_dothis{\endcsname.}\fi
313   \xint_orthat {\XINT_expr_scandec_b 0.#1}%
314 }%
315 \def\XINT_expr_gobz_scanint_b #1%
316 {%
317   \ifcat \relax #1\expandafter\XINT_expr_gobz_scanint_endbycs\expandafter #1\fi
318   \ifnum\xint_c_x<1\string#1 \else\expandafter\XINT_expr_gobz_scanint_c\fi
319   \string#1\XINT_expr_scanint_d
320 }%
321 \def\XINT_expr_gobz_scanint_endbycs#1#2\XINT_expr_scanint_d{0\endcsname #1}%
322 \def\XINT_expr_gobz_scanint_c\string #1\XINT_expr_scanint_d
323 {%
324   \if e#1\xint_dothis{0[\the\numexpr0\XINT_expr_scanexp_a +}\fi
325   \if E#1\xint_dothis{0[\the\numexpr0\XINT_expr_scanexp_a +}\fi
326   \ifcat a#1\xint_dothis{0\endcsname*#1}\fi
327   \if .#1\xint_dothis{\XINT_expr_gobz_startdec_a .}\fi

```

```

328 \if 0#1\xint_dothis\XINT_expr_gobz_scanint_d\fi
329 \xint_orthat {0\expandafter\endcsname \string#1}%
330 }%
331 \def\XINT_expr_gobz_scanint_d #1%
332 {%
333 \expandafter\XINT_expr_gobz_scanint_b\romannumeral-`0#1%
334 }%
335 \def\XINT_expr_gobz_startdec_a .#1%
336 {%
337 \expandafter\XINT_expr_gobz_scandec_a\romannumeral-`0#1%
338 }%
339 \def\XINT_expr_gobz_scandec_a #1%
340 {%
341 \if .#1\xint_dothis{0\endcsname.}\fi
342 \xint_orthat {\XINT_expr_gobz_scandec_b 0.#1}%
343 }%

```

### 10.18.2 Fractional part

Annoying duplication of code to allow 0. as input.

```

344 \def\XINT_expr_scandec_b #1.#2%
345 {%
346 \ifcat \relax #2\expandafter\XINT_expr_scandec_endbycs\expandafter#2\fi
347 \ifnum\xint_c_ix<1\string#2 \else\expandafter\XINT_expr_scandec_c\fi
348 \string#2\expandafter\XINT_expr_scandec_d\the\numexpr #1-\xint_c_i.%
349 }%
350 \def\XINT_expr_scandec_endbycs #1#2\XINT_expr_scandec_d
351 \the\numexpr#3-\xint_c_i.{[#3]\endcsname #1}%
352 \def\XINT_expr_scandec_d #1.#2%
353 {%
354 \expandafter\XINT_expr_scandec_b
355 \the\numexpr #1\expandafter.\romannumeral-`0#2%
356 }%
357 \def\XINT_expr_scandec_c\string #1#2\the\numexpr#3-\xint_c_i.%
358 {%
359 \if e#1\xint_dothis{[\the\numexpr#3\XINT_expr_scanexp_a +}\fi
360 \if E#1\xint_dothis{[\the\numexpr#3\XINT_expr_scanexp_a +}\fi
361 \ifcat a#1\xint_dothis{[#3]\endcsname *#1}\fi
362 \xint_orthat {[#3]\expandafter\endcsname \string#1}%
363 }%
364 \def\XINT_expr_gobz_scandec_b 0.#1%
365 {%
366 \ifcat \relax #1\expandafter\XINT_expr_gobz_scandec_endbycs\expandafter#1\fi
367 \ifnum\xint_c_ix<1\string#1 \else\expandafter\XINT_expr_gobz_scandec_c\fi
368 \string#1\expandafter\XINT_expr_scandec_d\the\numexpr\xint_c_mone.%
369 }%
370 \def\XINT_expr_gobz_scandec_endbycs #1#2\xint_c_mone.{0[0]\endcsname #1}%
371 \def\XINT_expr_gobz_scandec_c\string #1#2\xint_c_mone.%
372 {%
373 \if e#1\xint_dothis{0[\the\numexpr0\XINT_expr_scanexp_a +}\fi
374 \if E#1\xint_dothis{0[\the\numexpr0\XINT_expr_scanexp_a +}\fi
375 \ifcat a#1\xint_dothis{0[0]\endcsname *#1}\fi

```

```
376 \xint_orthat {0[0]\expandafter\endcsname \string#1}%
377 }%
```

### 10.18.3 Scientific notation

Some pluses and minuses are allowed at the start of the scientific part, however not later, and no parenthesis.

```
378 \def\xint_expr_scanexp_a #1#2%
379 {%
380   #1\expandafter\xint_expr_scanexp_b\romannumeral-`0#2%
381 }%
382 \def\xint_expr_scanexp_b #1%
383 {%
384   \ifcat \relax #1\expandafter\xint_expr_scanexp_endbycs\expandafter #1\fi
385   \ifnum\xint_c_ix<1\string#1 \else\expandafter\xint_expr_scanexp_c\fi
386   \string#1\xint_expr_scanexp_d
387 }%
388 \def\xint_expr_scanexpr_endbycs#1#2\xint_expr_scanexp_d []\endcsname #1}%
389 \def\xint_expr_scanexp_d #1%
390 {%
391   \expandafter\xint_expr_scanexp_bb\romannumeral-`0#1%
392 }%
393 \def\xint_expr_scanexp_c\string #1\xint_expr_scanexp_d
394 {%
395   \ifcat a#1\xint_dothis []\endcsname *#1}\fi
396   \if +#1\xint_dothis {\xint_expr_scanexp_a +}\fi
397   \if -#1\xint_dothis {\xint_expr_scanexp_a -}\fi
398   \xint_orthat []\expandafter\endcsname\string #1}%
399 }%
400 \def\xint_expr_scanexp_bb #1%
401 {%
402   \ifcat \relax #1\expandafter\xint_expr_scanexp_endbycs_b\expandafter #1\fi
403   \ifnum\xint_c_ix<1\string#1 \else\expandafter\xint_expr_scanexp_cb\fi
404   \string#1\xint_expr_scanexp_db
405 }%
406 \def\xint_expr_scanexp_endbycs_b#1#2\xint_expr_scanexp_db []\endcsname #1}%
407 \def\xint_expr_scanexp_db #1%
408 {%
409   \expandafter\xint_expr_scanexp_bb\romannumeral-`0#1%
410 }%
411 \def\xint_expr_scanexp_cb\string #1\xint_expr_scanexp_db
412 {%
413   \ifcat a#1\xint_dothis []\endcsname *#1}\fi
414   \xint_orthat []\expandafter\endcsname\string #1}%
415 }%
```

### 10.18.4 Hexadecimal numbers

```
416 \def\xint_expr_scanhex_I #1% #1="
417 {%
418   \expandafter\xint_expr_getop\csname.=\expandafter
419   \xint_expr_unlock_hex_in\csname.=\xint_expr_scanhexI_a
```

```

420 }%
421 \def\XINT_expr_scanhexI_a #1%
422 {%
423   \ifcat #1\relax\xint_dothis{.>\endcsname\endcsname #1}\fi
424   \ifx !#1\xint_dothis{.>\endcsname\endcsname*!}\fi % tacit multiplication
425   \xint_orthat {\expandafter\XINT_expr_scanhexI_aa\string #1}%
426 }%
427 \def\XINT_expr_scanhexI_aa #1%
428 {%
429   \if\ifnum`#1>`/
430     \ifnum`#1>`9
431       \ifnum`#1>`@
432         \ifnum`#1>`F
433           0\else1\fi\else0\fi\else1\fi\else0\fi 1%
434         \expandafter\XINT_expr_scanhexI_b
435       \else
436         \if .#1%
437           \expandafter\xint_firstoftwo
438         \else % gather what we got so far, leave catcode 12 #1 in stream
439           \expandafter\xint_secondoftwo
440         \fi
441         {\expandafter\XINT_expr_scanhex_transition}%
442         {\xint_afterfi {.>\endcsname\endcsname}}}%
443     \fi
444     #1%
445 }%
446 \def\XINT_expr_scanhexI_b #1#2%
447 {%
448   #1\expandafter\XINT_expr_scanhexI_a\romannumeral-`0#2%
449 }%
450 \def\XINT_expr_scanhex_transition .#1%
451 {%
452   \expandafter.\expandafter.\expandafter
453   \XINT_expr_scanhexII_a\romannumeral-`0#1%
454 }%
455 \def\XINT_expr_scanhexII_a #1%
456 {%
457   \ifcat #1\relax\xint_dothis{\endcsname\endcsname#1}\fi
458   \ifx !#1\xint_dothis{\endcsname\endcsname*!}\fi % tacit multiplication
459   \xint_orthat {\expandafter\XINT_expr_scanhexII_aa\string #1}%
460 }%
461 \def\XINT_expr_scanhexII_aa #1%
462 {%
463   \if\ifnum`#1>`/
464     \ifnum`#1>`9
465       \ifnum`#1>`@
466         \ifnum`#1>`F
467           0\else1\fi\else0\fi\else1\fi\else0\fi 1%
468         \expandafter\XINT_expr_scanhexII_b
469       \else
470         \xint_afterfi {\endcsname\endcsname}%
471     \fi

```

```

472    #1%
473 }%
474 \def\XINT_expr_scanhexII_b #1#2%
475 {%
476    #1\expandafter\XINT_expr_scanhexII_a\romannumeral-`0#2%
477 }%

```

### 10.18.5 Function and variable names

```

478 \def\XINT_expr_scanfunc
479 {%
480    \expandafter\XINT_expr_func\romannumeral-`0\XINT_expr_scanfunc_a
481 }%
482 \def\XINT_expr_scanfunc_a #1#2%
483 {%
484    \expandafter #1\romannumeral-`0\expandafter\XINT_expr_scanfunc_b\romannumeral-`0#2%
485 }%
486 \def\XINT_expr_scanfunc_b #1%
487 {%
488    \ifx !#1\xint_dothis{\xint_firstoftwo{(_*!)} }\fi
489    \ifcat \relax#1\xint_dothis{(_)\fi
490    \if (#1\xint_dothis{\xint_firstoftwo{(}\fi
491    \if _#1\xint_dothis \XINT_expr_scanfunc_a \fi
492    \if @#1\xint_dothis \XINT_expr_scanfunc_a \fi
493    \ifnum \xint_c_ix<1\string#1 \xint_dothis \XINT_expr_scanfunc_a \fi
494    \ifcat a#1\xint_dothis \XINT_expr_scanfunc_a \fi
495    \xint_orthat {(_}%
496    #1%
497 }%
498 \def\XINT_expr_func #1(#2%
499 {% #2=` pour une fonction, #2=_ pour une variable
500    \if #2`\ifcsname XINT_expr_var_#1\endcsname
501        \expandafter\expandafter\expandafter\xint_thirdofthree
502    \fi\fi
503    \xint_firstoftwo {\xint_c_xviii #2{#1}}{\xint_c_xviii _{#1}*}%
504 }%

```

## 10.19 *\XINT\_expr\_getop*: finding the next operator or closing parenthesis or end of expression

Release 1.1 implements multi-character operators.

```

505 \def\XINT_expr_getop #1#2% this #1 is the current locked computed value
506 {%
507    \expandafter\XINT_expr_getop_a\expandafter #1\romannumeral-`0#2%
508 }%
509 \catcode`* 11
510 \def\XINT_expr_getop_a #1#2%
511 {%
512    \ifx \relax #2\xint_dothis\xint_firstofthree\fi
513    \ifcat \relax #2\xint_dothis\xint_secondofthree\fi
514    \if _#2\xint_dothis \xint_secondofthree\fi
515    \if @#2\xint_dothis \xint_secondofthree\fi
516    \if (#2\xint_dothis \xint_secondofthree\fi

```

```

517 \ifx !#2\xint_dothis \xint_secon dofthree\fi
518 \xint_orthat \xint_thir dofthree
519 {\XINT_expr_foundend #1}%
520 {\XINT_expr_precedence_* *#1#2}% tacit multiplication
521 {\XINT_expr_getop_b #2#1}%
522 }%
523 \catcode`* 12
524 \def\XINT_expr_foundend {\xint_c_ \relax }% \relax is a place holder here.

```

? and : a special syntax in *\xintexpr* as they are followed by braced arguments, and thus we must intercept them here. I wanted to change this but now I don't have time to think about it. 1.1 removes : as logic operator. Replaced by ??.

```

525 \def\XINT_expr_getop_b #1%
526 {%
527 \if '#1\xint_dothis{\XINT_expr_binopwr d }\fi
528 \if ?#1\xint_dothis{\XINT_expr_precedence_? ?}\fi
529 \xint_orthat {\XINT_expr_scanop_a #1}%
530 }%
531 \def\XINT_expr_binopwr d #1#2'\{\expandafter\XINT_expr_foundop_a
532 \csname XINT_expr_itself_\xint_zapspaces #2 \xint_gobble_i\endcsname #1}%
533 \def\XINT_expr_scanop_a #1#2#3%
534 {\expandafter\XINT_expr_scanop_b\expandafter #1\expandafter #2\romannumeral-`0#3}%
535 \def\XINT_expr_scanop_b #1#2#3%
536 {%
537 \ifcat#3\relax\xint_dothis{\XINT_expr_foundop_a #1#2#3}\fi
538 \ifcsname XINT_expr_itself_#1#3\endcsname
539 \xint_dothis
540 {\expandafter\XINT_expr_scanop_c\csname XINT_expr_itself_#1#3\endcsname #2}\fi
541 \xint_orthat {\XINT_expr_foundop_a #1#2#3}%
542 }%
543 \def\XINT_expr_scanop_c #1#2#3%
544 {%
545 \expandafter\XINT_expr_scanop_d\expandafter #1\expandafter #2\romannumeral-`0#3%
546 }%
547 \def\XINT_expr_scanop_d #1#2#3%
548 {%
549 \ifcat#3\relax \xint_dothis{\XINT_expr_foundop #1#2#3}\fi
550 \ifcsname XINT_expr_itself_#1#3\endcsname
551 \xint_dothis
552 {\expandafter\XINT_expr_scanop_c\csname XINT_expr_itself_#1#3\endcsname #2}\fi
553 \xint_orthat {\csname XINT_expr_precedence_#1\endcsname #1#2#3}%
554 }%
555 \def\XINT_expr_foundop_a #1%
556 {%
557 \ifcsname XINT_expr_precedence_#1\endcsname
558 \csname XINT_expr_precedence_#1\expandafter\endcsname
559 \expandafter #1%
560 \else
561 \xint_afterfi{\XINT_expr_unknown_operator {#1}\XINT_expr_getop}%
562 \fi
563 }%
564 \def\XINT_expr_unknown_operator #1{\xintError:removed \xint_gobble_i {#1}}%

```

```
565 \def\XINT_expr_foundop #1{\csname XINT_expr_precedence_#1\endcsname #1}%
```

## 10.20 Opening and closing parentheses, square brackets for lists, the ^C for omit and abort within seq or rseq

```
566 \catcode`) 11
567 \def\XINT_tmpa #1#2#3#4% (avant #4#5)
568 {%
569   \def#1##1%
570   {%
571     \xint_UDsignfork
572       ##1{\expandafter#1\romannumeral-`0#3}%
573       -{#2##1}%
574     \krof
575   }%
576 \def#2##1##2%
577 {%
578   \ifcase ##1\xint_afterfi
579   {\ifx\XINT_expr_itself_`^C ##2\xint_dothis
580   {\expandafter#1\romannumeral-`0\expandafter\XINT_expr_getnext\xint_gobble_i}\fi
581   \xint_orthat \XINT_expr_done }%
582   \or\xint_afterfi{\XINT_expr_extra_)
583       \expandafter #1\romannumeral-`0\XINT_expr_getop }%
584   \else
585   \xint_afterfi{\expandafter#1\romannumeral-`0\csname XINT_#4_op_##2\endcsname }%
586   \fi
587 }%
588 }%
589 \def\XINT_expr_extra_) {\xintError:removed }%
590 \xintFor #1 in {expr,flexpr,iiexpr} \do {%
591   \expandafter\XINT_tmpa
592   \csname XINT_#1_until_end_a\expandafter\endcsname
593   \csname XINT_#1_until_end_b\expandafter\endcsname
594   \csname XINT_#1_op_-vi\endcsname
595   {#1}%
596 }%
597 \def\XINT_tmpa #1#2#3#4#5#6%
598 {%
599   \def #1##1{\expandafter #3\romannumeral-`0\XINT_expr_getnext }%
600   \def #2{\expandafter #3\romannumeral-`0\XINT_expr_getnext }%
601   \def #3##1{\xint_UDsignfork
602       ##1{\expandafter #3\romannumeral-`0#5}%
603       -{#4##1}%
604     \krof }%
605   \def #4##1##2{\ifcase ##1%
606   \xint_afterfi{\ifx\XINT_expr_itself_`^C ##2\xint_dothis{\xint_c_ ##2}\fi
607   \xint_orthat\XINT_expr_missing_) }%
608   \or \csname XINT_#6_op_##2\expandafter\endcsname
609   \else
610   \xint_afterfi{\expandafter #3\romannumeral-`0\csname XINT_#6_op_##2\endcsname }%
611   \fi
612 }%
```

```

613 }%
614 \def\XINT_expr_missing_ {\xintError:inserted \xint_c_ \XINT_expr_done }%
615 \catcode` ) 12
616 \xintFor #1 in {expr,flexpr,iiexpr} \do {%
617   \expandafter\XINT_tmpa
618   \csname XINT_#1_op_(\expandafter\endcsname
619   \csname XINT_#1_oparen\expandafter\endcsname
620   \csname XINT_#1_until_)_a\expandafter\endcsname
621   \csname XINT_#1_until_)_b\expandafter\endcsname
622   \csname XINT_#1_op_-vi\endcsname
623   {#1}%
624 }%
625 \expandafter\let\csname XINT_expr_precedence_)\endcsname\xint_c_i
626 \expandafter\let\csname XINT_expr_precedence_]\endcsname\xint_c_i
627 \expandafter\let\csname XINT_expr_precedence_;\endcsname\xint_c_i
628 \let\XINT_expr_precedence_a \xint_c_xviii
629 \expandafter\let\csname XINT_expr_precedence_^C\endcsname \xint_c_
630 \expandafter\let\csname XINT_expr_precedence_++)\endcsname \xint_c_i
631 \catcode`. 11 \catcode`= 11 \catcode`+ 11
632 \xintFor #1 in {expr,flexpr,iiexpr} \do {%
633   \expandafter\let\csname XINT_#1_op_)\endcsname \XINT_expr_getop
634   \expandafter\let\csname XINT_#1_op_;\endcsname \space
635   \expandafter\def\csname XINT_#1_op_]\endcsname ##1{\XINT_expr_getop ##1a}%
636   \expandafter\let\csname XINT_#1_op_a\endcsname \XINT_expr_getop
637   \expandafter\def\csname XINT_#1_op_++)\endcsname ##1##2\relax
638   {\expandafter\XINT_expr_foundend \expandafter
639     {\expandafter\.=\xintiCeil{\XINT_expr_unlock ##1}}}%
640 }%
641 \catcode`. 12 \catcode`= 12 \catcode`+ 12

```

## 10.21 |, ||, &, &&, <, >, =, ==, <=, >=, !=, +, -, \*, /, ^, \*\*, //, /:, .., ..[, ].., ][, ][:, :], ^C, and ++ operators

```

642 \xintFor* #1 in {{==}{<=}{>=}{!=}{&&}{||}{**}{//}{/}{:}{..}{.}{.}{.}{.}%
643   {+}{-}{*}{/}{^}{a+}{a-}{a*}{a/}{a*}{a^}%
644   {[]}{[]}{:}{:}{^C}{++}{++}}
645 \do {\expandafter\def\csname XINT_expr_itself_#1\endcsname {#1}}%

```

### 10.21.1 The |, &, xor, <, >, =, <=, >=, !=, //, /:, .., ..[, and ].. operators

```

646 \def\XINT_tmpc #1#2#3#4#5#6#7#8%
647 {%
648   \def #1##1% \XINT_expr_op_<op> ou flexpr ou iiexpr
649   {% keep value, get next number and operator, then do until
650     \expandafter #2\expandafter ##1%
651     \romannumeral-`0\expandafter\XINT_expr_getnext }%
652   \def #2##1##2% \XINT_expr_until_<op>_a ou flexpr ou iiexpr
653   {\xint_UDsignfork ##2{\expandafter #2\expandafter ##1\romannumeral-`0#4}%
654     -{#3##1##2}%
655     \krof }%
656   \def #3##1##2##3##4% \XINT_expr_until_<op>_b ou flexpr ou iiexpr
657   {% either execute next operation now, or first do next (possibly unary)
658     \ifnum ##2>#5%
659     \xint_afterfi {\expandafter #2\expandafter ##1\romannumeral-`0%
660       \csname XINT_#8_op_##3\endcsname {##4}}%

```



```

661 \else \xint_afterfi {\expandafter ##2\expandafter ##3%
662 \csname .#6{\XINT_expr_unlock ##1}{\XINT_expr_unlock ##4}\endcsname }%
663 \fi }%
664 \let #7#5%
665 }%
666 \def\XINT_tmpb #1#2#3#4#5#6%
667 {%
668 \expandafter\XINT_tmpc
669 \csname XINT_#1_op_#3\expandafter\endcsname
670 \csname XINT_#1_until_#3_a\expandafter\endcsname
671 \csname XINT_#1_until_#3_b\expandafter\endcsname
672 \csname XINT_#1_op_#5\expandafter\endcsname
673 \csname xint_c_#4\expandafter\endcsname
674 \csname #2#6\expandafter\endcsname
675 \csname XINT_expr_precedence_#3\endcsname {#1}%
676 }%
677 \xintFor #1 in {expr, flexpr} \do {%
678 \def\XINT_tmpa ##1{\XINT_tmpb {#1}{xint}##1}%
679 \xintApplyInline {\XINT_tmpa }{%
680   {\{iii\}{vi}{OR}}%
681   {\&\{iv\}{vi}{AND}}%
682   {\{xor\}{iii\}{vi}{XOR}}%
683   {\<\{v\}{vi}{Lt}}%
684   {\>\{v\}{vi}{Gt}}%
685   {\={v\}{vi}{Eq}}%
686   {\{<=\}{v\}{vi}{LtorEq}}%
687   {\{>=\}{v\}{vi}{GtorEq}}%
688   {\{!=\}{v\}{vi}{Neq}}%
689   {\{.\. \}{iii\}{vi}{Seq::csv}}%
690   {\{/\/\}{vii\}{vii}{DivTrunc}}%
691   {\{/:\}{vii\}{vii}{Mod}}%
692 }%
693 }%
694 \def\XINT_tmpa #1{\XINT_tmpb {expr}{xint}#1}%
695 \xintApplyInline {\XINT_tmpa }{%
696   {\+{vi}{vi}{Add}}%
697   {\-{vi}{vi}{Sub}}%
698   {\*{vii}{vii}{Mul}}%
699   {\/{vii}{vii}{Div}}%
700   {\^{viii}{viii}{Pow}}%
701   {\{.\. []\}{iii\}{vi}{SeqA::csv}}%
702   {\{[].\. \}{iii\}{vi}{SeqB::csv}}%
703 }%
704 \def\XINT_tmpa #1{\XINT_tmpb {flexpr}{XINTinFloat}#1}%
705 \xintApplyInline {\XINT_tmpa }{%
706   {\+{vi}{vi}{Add}}%
707   {\-{vi}{vi}{Sub}}%
708   {\*{vii}{vii}{Mul}}%
709   {\/{vii}{vii}{Div}}%
710   {\^{viii}{viii}{Power}}%
711   {\{.\. []\}{iii\}{vi}{SeqA::csv}}%
712   {\{[].\. \}{iii\}{vi}{SeqB::csv}}%

```

```

713 }%
714 \def\XINT_tmpa #1{\XINT_tmpb {iiexpr}{xint}#1}%
715 \xintApplyInline {\XINT_tmpa }{%
716   {\{iii}{vi}{OR}}}%
717   {\&{iv}{vi}{AND}}}%
718   {\{xor}{iii}{vi}{XOR}}}%
719   {\<{v}{vi}{iiLt}}}%
720   {\>{v}{vi}{iiGt}}}%
721   {\={v}{vi}{iiEq}}}%
722   {\{<={v}{vi}{iiLtorEq}}}%
723   {\{>={v}{vi}{iiGtorEq}}}%
724   {\{!=}{v}{vi}{iiNeq}}}%
725   {\+{vi}{vi}{iiAdd}}}%
726   {\-{vi}{vi}{iiSub}}}%
727   {\*{vii}{vii}{iiMul}}}%
728   {\/{vii}{vii}{iiDivRound}}}% CHANGED IN 1.1! PREVIOUSLY DID EUCLIDEAN QUOTIENT
729   {\^{viii}{viii}{iiPow}}}%
730   {\{..[\{iii}{vi}{iiSeqA::csv}}}%
731   {\{[.]\{iii}{vi}{iiSeqB::csv}}}%
732   {\{..}\{iii}{vi}{iiSeq::csv}}}%
733   {\{/\}{vii}{vii}{iiDivTrunc}}}%
734   {\{/:\{vii}{vii}{iiMod}}}%
735 }%

```

### 10.21.2 The $+$ , $-$ , $*$ , $/$ , $^$ , $+$ , $-$ , $*$ , $/$ , and $^$ list operators

#### $\backslash$ XINT\_expr\_binop\_inline\_b

```

736 \def\XINT_expr_binop_inline_a
737   {\expandafter\xint_gobble_i\romannumeral-`0\XINT_expr_binop_inline_b }%
738 \def\XINT_expr_binop_inline_b #1#2,{\XINT_expr_binop_inline_c #2,{#1}}%
739 \def\XINT_expr_binop_inline_c #1{%
740   \if ,#1\xint_dothis\XINT_expr_binop_inline_e\fi
741   \if ^#1\xint_dothis\XINT_expr_binop_inline_end\fi
742   \xint_orthat\XINT_expr_binop_inline_d #1}%
743 \def\XINT_expr_binop_inline_d #1,#2{,#2{#1}\XINT_expr_binop_inline_b {#2}}%
744 \def\XINT_expr_binop_inline_e #1,#2{,\XINT_expr_binop_inline_b {#2}}%
745 \def\XINT_expr_binop_inline_end #1,#2{%
746 \def\XINT_tmpc #1#2#3#4#5#6#7#8%
747 {%
748   \def #1#1% \XINT_expr_op_<op> ou flexpr ou iiexpr
749   {% keep value, get next number and operator, then do until
750     \expandafter #2\expandafter ##1%
751     \romannumeral-`0\expandafter\XINT_expr_getnext }%
752   \def #2##1##2% \XINT_expr_until_<op>_a ou flexpr ou iiexpr
753   {\xint_UDsignfork ##2{\expandafter #2\expandafter ##1\romannumeral-`0#4}%
754     -{#3##1##2}%
755     \krof }%
756   \def #3##1##2##3##4% \XINT_expr_until_<op>_b ou flexpr ou iiexpr
757   {% either execute next operation now, or first do next (possibly unary)
758     \ifnum ##2>#5%
759     \xint_afterfi {\expandafter #2\expandafter ##1\romannumeral-`0%
760       \csname XINT_#8_op_##3\endcsname {##4}}%
761     \else \xint_afterfi {\expandafter ##2\expandafter ##3%
762       \csname .=\expandafter\XINT_expr_binop_inline_a\expandafter

```

```

763     {\expandafter\expandafter\expandafter#6\expandafter
764       \xint_exchangetwo_keepbraces\expandafter
765       {\expandafter\XINT_expr_unlock\expandafter ##4\expandafter}\expandafter}%
766       \romannumeral-`0\XINT_expr_unlock ##1,^,\endcsname }%
767   \fi }%
768   \let #7#5%
769 }%
770 \def\XINT_tmpb #1#2#3#4%
771 {%
772   \expandafter\XINT_tmpc
773   \csname XINT_#1_op_#2\expandafter\endcsname
774   \csname XINT_#1_until_#2_a\expandafter\endcsname
775   \csname XINT_#1_until_#2_b\expandafter\endcsname
776   \csname XINT_#1_op_#3\expandafter\endcsname
777   \csname xint_c_#3\expandafter\endcsname
778   \csname #4\expandafter\endcsname
779   \csname XINT_expr_precedence_#2\endcsname {#1}%
780 }%
781 \xintApplyInline {\expandafter\XINT_tmpb \xint_firstofone}{%
782   {{expr}{a+}{vi}{xintAdd}}}%
783   {{expr}{a-}{vi}{xintSub}}}%
784   {{expr}{a*}{vii}{xintMul}}}%
785   {{expr}{a/}{vii}{xintDiv}}}%
786   {{expr}{a^}{viii}{xintPow}}}%
787   {{iiexpr}{a+}{vi}{xintiiAdd}}}%
788   {{iiexpr}{a-}{vi}{xintiiSub}}}%
789   {{iiexpr}{a*}{vii}{xintiiMul}}}%
790   {{iiexpr}{a/}{vii}{xintiiDivRound}}}%
791   {{iiexpr}{a^}{viii}{xintiiPow}}}%
792   {{flexpr}{a+}{vi}{XINTinFloatAdd}}}%
793   {{flexpr}{a-}{vi}{XINTinFloatSub}}}%
794   {{flexpr}{a*}{vii}{XINTinFloatMul}}}%
795   {{flexpr}{a/}{vii}{XINTinFloatDiv}}}%
796   {{flexpr}{a^}{viii}{XINTinFloatPower}}}%
797 }%
798 \def\XINT_tmpc #1#2#3#4#5#6#7%
799 {%
800   \def #1#1{\expandafter#2\expandafter##1\romannumeral-`0%
801     \expandafter #3\romannumeral-`0\XINT_expr_getnext }%
802   \def #2##1##2##3##4%
803   {% either execute next operation now, or first do next (possibly unary)
804     \ifnum ##2>#4%
805       \xint_afterfi {\expandafter #2\expandafter ##1\romannumeral-`0%
806         \csname XINT_#7_op_##3\endcsname {##4}}}%
807     \else \xint_afterfi {\expandafter ##2\expandafter ##3%
808       \csname .=\expandafter\XINT_expr_binop_inline_a\expandafter
809         {\expandafter#5\expandafter
810           {\expandafter\XINT_expr_unlock\expandafter ##1\expandafter}\expandafter}%
811         \romannumeral-`0\XINT_expr_unlock ##4,^,\endcsname }%
812       \fi }%
813   \let #6#4%
814 }%

```

```

815 \def\XINT_tmpb #1#2#3#4%
816 {%
817   \expandafter\XINT_tmpc
818   \csname XINT_#1_op_#2\expandafter\endcsname
819   \csname XINT_#1_until_#2\expandafter\endcsname
820   \csname XINT_#1_until_)_a\expandafter\endcsname
821   \csname xint_c_#3\expandafter\endcsname
822   \csname #4\expandafter\endcsname
823   \csname XINT_expr_precedence_#2\endcsname {#1}%
824 }%
825 \xintApplyInline {\expandafter\XINT_tmpb\xint_firstofone }{%
826   {{expr}}{+}{{vi}}{xintAdd}}%
827   {{expr}}{-}{{vi}}{xintSub}}%
828   {{expr}}{*}{{vii}}{xintMul}}%
829   {{expr}}{/}{{vii}}{xintDiv}}%
830   {{expr}}{^}{{viii}}{xintPow}}%
831   {{iiexpr}}{+}{{vi}}{xintiiAdd}}%
832   {{iiexpr}}{-}{{vi}}{xintiiSub}}%
833   {{iiexpr}}{*}{{vii}}{xintiiMul}}%
834   {{iiexpr}}{/}{{vii}}{xintiiDivRound}}%
835   {{iiexpr}}{^}{{viii}}{xintiiPow}}%
836   {{flexpr}}{+}{{vi}}{XINTinFloatAdd}}%
837   {{flexpr}}{-}{{vi}}{XINTinFloatSub}}%
838   {{flexpr}}{*}{{vii}}{XINTinFloatMul}}%
839   {{flexpr}}{/}{{vii}}{XINTinFloatDiv}}%
840   {{flexpr}}{^}{{viii}}{XINTinFloatPower}}%
841 }%

```

### 10.21.3 The 'and', 'or', 'xor', and 'mod' as infix operator words

```

842 \xintFor #1 in {and,or,xor,mod} \do {%
843   \expandafter\def\csname XINT_expr_itself_#1\endcsname {#1}%
844   \expandafter\let\csname XINT_expr_precedence_and\expandafter\endcsname
845     \csname XINT_expr_precedence_&\endcsname
846   \expandafter\let\csname XINT_expr_precedence_or\expandafter\endcsname
847     \csname XINT_expr_precedence_|\endcsname
848   \expandafter\let\csname XINT_expr_precedence_mod\expandafter\endcsname
849     \csname XINT_expr_precedence_/\endcsname
850 \xintFor #1 in {expr, flexpr, iiexpr} \do {%
851   \expandafter\let\csname XINT_#1_op_and\expandafter\endcsname
852     \csname XINT_#1_op_&\endcsname
853   \expandafter\let\csname XINT_#1_op_or\expandafter\endcsname
854     \csname XINT_#1_op_|\endcsname
855   \expandafter\let\csname XINT_#1_op_mod\expandafter\endcsname
856     \csname XINT_#1_op_/\endcsname
857 }%

```

### 10.21.4 The ||, &&, \*\*, \*\*[, ]\*\* operators as synonyms

```

858 \expandafter\let\csname XINT_expr_precedence_==\expandafter\endcsname
859   \csname XINT_expr_precedence_=\endcsname
860 \expandafter\let\csname XINT_expr_precedence_&&\expandafter\endcsname
861   \csname XINT_expr_precedence_&\endcsname
862 \expandafter\let\csname XINT_expr_precedence_||\expandafter\endcsname

```

```

863         \csname XINT_expr_precedence_|\endcsname
864 \expandafter\let\csname XINT_expr_precedence_**\expandafter\endcsname
865         \csname XINT_expr_precedence_^\endcsname
866 \expandafter\let\csname XINT_expr_precedence_a**\expandafter\endcsname
867         \csname XINT_expr_precedence_a^\endcsname
868 \expandafter\let\csname XINT_expr_precedence_**[\expandafter\endcsname
869         \csname XINT_expr_precedence_^\endcsname
870 \xintFor #1 in {expr, flexpr, iexpr} \do {%
871   \expandafter\let\csname XINT_#1_op_==\expandafter\endcsname
872         \csname XINT_#1_op_=\endcsname
873   \expandafter\let\csname XINT_#1_op_&\expandafter\endcsname
874         \csname XINT_#1_op_&\endcsname
875   \expandafter\let\csname XINT_#1_op_||\expandafter\endcsname
876         \csname XINT_#1_op_||\endcsname
877   \expandafter\let\csname XINT_#1_op_**\expandafter\endcsname
878         \csname XINT_#1_op_^\endcsname
879   \expandafter\let\csname XINT_#1_op_a**\expandafter\endcsname
880         \csname XINT_#1_op_a^\endcsname
881   \expandafter\let\csname XINT_#1_op_**[\expandafter\endcsname
882         \csname XINT_#1_op_^\endcsname
883 }%

```

#### 10.21.5 List selectors: [list][N], [list][:b], [list][a:], [list][a:b]

1.1 (27 octobre 2014) I implement Python syntax, see <http://stackoverflow.com/a/13005464/4184837>. Do not implement third argument giving the step. Also, I gather that [5:2] selector returns empty and not, as I could have been tempted to do, (list[5], list[4], list[3]). Anyway, it is simpler not to go that way. For reversing I could implement [::-1] but this would get confusing, better to do function "reversed".

This gets the job done, but I would definitely need \xintTrim::csv, \xintKeep::csv, \xintNthElt::csv for better efficiency. Not for 1.1.

```

884 \def\XINT_tmpa #1#2#3#4#5#6%
885 {%
886   \def #1##1% \XINT_expr_op_][
887   {%
888     \expandafter #2\expandafter ##1\romannumeral-`0\XINT_expr_getnext
889   }%
890   \def #2##1##2% \XINT_expr_until_][_a
891   {\xint_UDsignfork
892     ##2{\expandafter #2\expandafter ##1\romannumeral-`0#4}%
893     -{#3##1##2}%
894   \krof }%
895   \def #3##1##2##3##4% \XINT_expr_until_][_b
896   {%
897     \ifnum ##2>\xint_c_ii
898       \xint_afterfi {\expandafter #2\expandafter ##1\romannumeral-`0%
899         \csname XINT_#6_op_##3\endcsname {##4}}%
900     \else
901       \xint_afterfi
902       {\expandafter ##2\expandafter ##3\csname
903         .=\expandafter\xintListSel:csv \romannumeral-`0\XINT_expr_unlock ##4;%
904         \XINT_expr_unlock ##1;\endcsname % unlock for \xintNewExpr
905       }%

```

```

906     \fi
907   }%
908   \let #5\xint_c_ii
909 }%
910 \xintFor #1 in {expr,flexpr,iiexpr} \do {%
911 \expandafter\XINT_tmpa
912   \csname XINT_#1_op_][\expandafter\endcsname
913   \csname XINT_#1_until_][_a\expandafter\endcsname
914   \csname XINT_#1_until_][_b\expandafter\endcsname
915   \csname XINT_#1_op_-vi\expandafter\endcsname
916   \csname XINT_expr_precedence_][\endcsname {#1}%
917 }%
918 \def\XINT_tmpa #1#2#3#4#5#6%
919 {%
920   \def #1##1% \XINT_expr_op_:
921   {%
922     \expandafter #2\expandafter ##1\romannumeral-`0\XINT_expr_getnext
923   }%
924   \def #2##1##2% \XINT_expr_until_:_a
925   {\xint_UDsignfork
926     ##2{\expandafter #2\expandafter ##1\romannumeral-`0#4}%
927     -{#3##1##2}%
928   \krof }%
929   \def #3##1##2##3##4% \XINT_expr_until_:_b
930   {%
931     \ifnum ##2>\xint_c_iii
932       \xint_afterfi {\expandafter #2\expandafter ##1\romannumeral-`0%
933         \csname XINT_#6_op_##3\endcsname {##4}}%
934     \else
935       \xint_afterfi
936       {\expandafter ##2\expandafter ##3\csname
937         .:=\xintiiifSgn{\XINT_expr_unlock ##1}NPP.%
938         \xintiiifSgn{\XINT_expr_unlock ##4}NPP.%
939         \xintNum{\XINT_expr_unlock ##1};\xintNum{\XINT_expr_unlock ##4}\endcsname
940       }%
941     \fi
942   }%
943   \let #5\xint_c_iii
944 }%
945 \xintFor #1 in {expr,flexpr,iiexpr} \do {%
946 \expandafter\XINT_tmpa
947   \csname XINT_#1_op_:\expandafter\endcsname
948   \csname XINT_#1_until_:_a\expandafter\endcsname
949   \csname XINT_#1_until_:_b\expandafter\endcsname
950   \csname XINT_#1_op_-vi\expandafter\endcsname
951   \csname XINT_expr_precedence_:\endcsname {#1}%
952 }%
953 \catcode`[ 11 \catcode`] 11
954 \let\XINT_expr_precedence_:\ \xint_c_iii
955 \def\XINT_expr_op_:] #1{\expandafter\xint_c_i\expandafter }%
956   \csname .:=\xintiiifSgn{\XINT_expr_unlock #1}npp\XINT_expr_unlock #1\endcsname }%
957 \let\XINT_flexpr_op_:] \XINT_expr_op_:]

```

```

958 \let\XINT_iiexpr_op_[: \XINT_expr_op_:]
959 \let\XINT_expr_precedence_[: \xint_c_iii
960 \edef\XINT_expr_op_[: #1{\xint_c_ii \expandafter\noexpand
961 \csname XINT_expr_itself_][\endcsname #10\string :}%

: must be catcode 12, else will be mistaken for start of variable by expression parser. In
\xintListSel:csv some complications are due to \xintNewExpr matters.

962 \let\XINT_flexpr_op_[: \XINT_expr_op_[:
963 \let\XINT_iiexpr_op_[: \XINT_expr_op_[:
964 \catcode`[ 12 \catcode`] 12
965 \def\xintListSel:csv #1{%
966   \if ]\noexpand#1\xint_dothis{\expandafter\XINT_listsel:_s\romannumeral-`0}\fi
967   \if :\noexpand#1\xint_dothis{\XINT_listsel:_:}\fi
968   \xint_orthat {\XINT_listsel:_nth #1}%
969 }%
970 \def\XINT_listsel:_s #1{\if p#1\expandafter\XINT_listsel:_trim\else
971   \expandafter\XINT_listsel:_keep\fi }%
972 \def\XINT_listsel:_: #1.#2.{\csname XINT_listsel:_#1#2\endcsname }%
973 \def\XINT_listsel:_trim #1;#2;%
974   {\xintListWithSep,{\xintTrim {\xintNum{#1}}{\xintCSVtoListNonStripped{#2}}}}%
975 \def\XINT_listsel:_keep #1;#2;%
976   {\xintListWithSep,{\xintKeep {\xintNum{#1}}{\xintCSVtoListNonStripped{#2}}}}%
977 \def\XINT_listsel:_nth#1;#2;%
978   {\xintNthElt {\xintNum{#1}}{\xintCSVtoListNonStripped{#2}}}%
979 \def\XINT_listsel:_PP #1;#2;#3;%
980   {\xintListWithSep,%
981     {\xintTrim {\xintNum{#1}}%
982       {\xintKeep {\xintNum{#2}}%
983         {\xintCSVtoListNonStripped{#3}}}%
984     }%
985   }%
986 }%
987 \def\XINT_listsel:_NN #1;#2;#3;%
988   {\xintListWithSep,%
989     {\xintTrim {\xintNum{#2}}%
990       {\xintKeep {\xintNum{#1}}%
991         {\xintCSVtoListNonStripped{#3}}}%
992     }%
993   }%
994 }%
995 \def\XINT_listsel:_NP #1;#2;#3;%
996   {\expandafter\XINT_listsel:_NP_a \the\numexpr #1+%
997     \xintNthElt{0}{\xintCSVtoListNonStripped{#3}};#2;#3;%
998 \def\XINT_listsel:_NP_a #1#2;{\if -#1\expandafter\XINT_listsel:_OP\fi
999   \XINT_listsel:_PP #1#2;%
1000 \def\XINT_listsel:_OP\XINT_listsel:_PP #1;{\XINT_listsel:_PP 0;%
1001 \def\XINT_listsel:_PN #1;#2;#3;%
1002   {\expandafter\XINT_listsel:_PN_a \the\numexpr #2+%
1003     \xintNthElt{0}{\xintCSVtoListNonStripped{#3}};#1;#3;%
1004 \def\XINT_listsel:_PN_a #1#2;#3;{\if -#1\expandafter\XINT_listsel:_PO\fi
1005   \XINT_listsel:_PP #3;#1#2;%
1006 \def\XINT_listsel:_PO\XINT_listsel:_PP #1;#2;{\XINT_listsel:_PP #1;0;%

```

## 10.22 Macros for a..b list generation

Attention, ne produit que des listes de petits entiers!

### 10.22.1 `\xintSeq::csv`

Commence par remplacer a par `ceil(a)` et b par `floor(b)` et renvoie ensuite les entiers entre les deux, possiblement en décroissant, et extrémités comprises. Si `a=b` est non entier en obtient donc `ceil(a)` et `floor(a)`. Ne renvoie jamais une liste vide.

```

1007 \def\xintSeq::csv {\romannumeral0\xintseq::csv}%
1008 \def\xintseq::csv #1#2%
1009 {%
1010   \expandafter\XINT_seq::csv\expandafter
1011     {\the\numexpr \xintiCeil{#1}\expandafter}\expandafter
1012     {\the\numexpr \xintiFloor{#2}}%
1013}%
1014 \def\XINT_seq::csv #1#2%
1015 {%
1016   \ifcase\ifnum #1=#2 0\else\ifnum #2>#1 1\else -1\fi\fi\space
1017   \expandafter\XINT_seq::csv_z
1018   \or
1019   \expandafter\XINT_seq::csv_p
1020   \else
1021   \expandafter\XINT_seq::csv_n
1022   \fi
1023   {#2}{#1}%
1024}%
1025 \def\XINT_seq::csv_z #1#2{ #1/1[0]}%
1026 \def\XINT_seq::csv_p #1#2%
1027 {%
1028   \ifnum #1>#2
1029     \expandafter\expandafter\expandafter\XINT_seq::csv_p
1030   \else
1031     \expandafter\XINT_seq::csv_e
1032   \fi
1033   \expandafter{\the\numexpr #1-\xint_c_i}{#2},#1/1[0]%
1034}%
1035 \def\XINT_seq::csv_n #1#2%
1036 {%
1037   \ifnum #1<#2
1038     \expandafter\expandafter\expandafter\XINT_seq::csv_n
1039   \else
1040     \expandafter\XINT_seq::csv_e
1041   \fi
1042   \expandafter{\the\numexpr #1+\xint_c_i}{#2},#1/1[0]%
1043}%
1044 \def\XINT_seq::csv_e #1,{ }%

```

### 10.22.2 `\xintiSeq::csv`

```

1045 \def\xintiSeq::csv {\romannumeral0\xintiiseq::csv}%
1046 \def\xintiiseq::csv #1#2%

```



```

1047 {%
1048   \expandafter\XINT_iiseq::csv\expandafter
1049     {\the\numexpr #1\expandafter}\expandafter{\the\numexpr #2}%
1050 }%
1051 \def\XINT_iiseq::csv #1#2%
1052 {%
1053   \ifcase\ifnum #1=#2 0\else\ifnum #2>#1 1\else -1\fi\fi\space
1054     \expandafter\XINT_iiseq::csv_z
1055   \or
1056     \expandafter\XINT_iiseq::csv_p
1057   \else
1058     \expandafter\XINT_iiseq::csv_n
1059   \fi
1060   {#2}{#1}%
1061 }%
1062 \def\XINT_iiseq::csv_z #1#2{ #1}%
1063 \def\XINT_iiseq::csv_p #1#2%
1064 {%
1065   \ifnum #1>#2
1066     \expandafter\expandafter\expandafter\XINT_iiseq::csv_p
1067   \else
1068     \expandafter\XINT_seq::csv_e
1069   \fi
1070   \expandafter{\the\numexpr #1-\xint_c_i}{#2},#1%
1071 }%
1072 \def\XINT_iiseq::csv_n #1#2%
1073 {%
1074   \ifnum #1<#2
1075     \expandafter\expandafter\expandafter\XINT_iiseq::csv_n
1076   \else
1077     \expandafter\XINT_seq::csv_e
1078   \fi
1079   \expandafter{\the\numexpr #1+\xint_c_i}{#2},#1%
1080 }%
1081 \def\XINT_seq::csv_e #1,{ }%

```

## 10.23 Macros for a..*[d]*..*b* list generation

Contrarily to a..*b* which is limited to small integers, this works with *a*, *b*, and *d* (big) fractions. It will produce a «nil» list, if *a*>*b* and *d*<0 or *a*<*b* and *d*>0.

### 10.23.1 \xintSeqA::csv, \xintiiSeqA::csv, \XINTinFloatSeqA::csv

```

1082 \def\xintSeqA::csv #1%
1083   {\expandafter\XINT_seqA::csv\expandafter{\romannumeral0\xintraw {#1}}}%
1084 \def\XINT_seqA::csv #1#2{\expandafter\XINT_seqA::csv_a \romannumeral0\xintraw {#2};#1;}%
1085 \def\xintiiSeqA::csv #1#2{\XINT_iiseqA::csv #1#2}%
1086 \def\XINT_iiseqA::csv #1#2#3#4{\expandafter\XINT_seqA::csv_a
1087   \romannumeral-`0\expandafter \XINT_expr_unlock\expandafter#4%
1088   \expandafter;\romannumeral-`0\XINT_expr_unlock #2;}%
1089 \def\XINTinFloatSeqA::csv #1{\expandafter\XINT_flseqA::csv\expandafter
1090   {\romannumeral0\XINTinfloat [\XINTdigits]{#1}}}%
1091 \def\XINT_flseqA::csv #1#2%

```

```

1092   {\expandafter\XINT_seqa::csv_a\romannumeral0\XINTinfloat [\XINTdigits]{#2};#1}%
1093 \def\XINT_seqa::csv_a #1{\xint_UDzerominusfork
1094     #1-{z}%
1095     0#1{n}%
1096     0-{p}%
1097     \krof #1}%

```

### 10.23.2 \xintSeqB::csv

```

1098 \def\xintSeqB::csv #1#2%
1099   {\expandafter\XINT_seqb::csv \expandafter{\romannumeral0\xintraw{#2}}{#1}}%
1100 \def\XINT_seqb::csv #1#2{\expandafter\XINT_seqb::csv_a\romannumeral-`0#2#1!}%
1101 \def\XINT_seqb::csv_a #1#2;#3;#4!\{\expandafter\XINT_expr_seq_empty?
1102   \romannumeral0\csname XINT_seqb::csv_#1\endcsname {#3}{#4}{#2}}%
1103 \def\XINT_seqb::csv_p #1#2#3%
1104 {%
1105   \xintifCmp {#1}{#2}{, #1\expandafter\XINT_seqb::csv_p\expandafter}%
1106   {, #1\xint_gobble_iii}{\xint_gobble_iii}%

```

\romannumeral0 stopped by \endcsname, XINT\_expr\_seq\_empty? constructs "nil".

```

1107   {\romannumeral0\xintadd {#3}{#1}}{#2}{#3}%
1108 }%
1109 \def\XINT_seqb::csv_n #1#2#3%
1110 {%
1111   \xintifCmp {#1}{#2}{\xint_gobble_iii}{, #1\xint_gobble_iii}%
1112   {, #1\expandafter\XINT_seqb::csv_n\expandafter}%
1113   {\romannumeral0\xintadd {#3}{#1}}{#2}{#3}%
1114 }%
1115 \def\XINT_seqb::csv_z #1#2#3{, #1}%

```

### 10.23.3 \xintiiSeqB::csv

```

1116 \def\xintiiSeqB::csv #1#2{\XINT_iiseqb::csv #1#2}%
1117 \def\XINT_iiseqb::csv #1#2#3#4%
1118   {\expandafter\XINT_iiseqb::csv_a
1119     \romannumeral-`0\expandafter \XINT_expr_unlock\expandafter#2%
1120     \romannumeral-`0\XINT_expr_unlock #4!}%
1121 \def\XINT_iiseqb::csv_a #1#2;#3;#4!\{\expandafter\XINT_expr_seq_empty?
1122   \romannumeral-`0\csname XINT_iiseqb::csv_#1\endcsname {#3}{#4}{#2}}%
1123 \def\XINT_iiseqb::csv_p #1#2#3%
1124 {%
1125   \xintSgnFork{\XINT_Cmp {#1}{#2}}{, #1\expandafter\XINT_iiseqb::csv_p\expandafter}%
1126   {, #1\xint_gobble_iii}{\xint_gobble_iii}%
1127   {\romannumeral0\xintiiadd {#3}{#1}}{#2}{#3}%
1128 }%
1129 \def\XINT_iiseqb::csv_n #1#2#3%
1130 {%
1131   \xintSgnFork{\XINT_Cmp {#1}{#2}}{\xint_gobble_iii}{, #1\xint_gobble_iii}%
1132   {, #1\expandafter\XINT_iiseqb::csv_n\expandafter}%
1133   {\romannumeral0\xintiiadd {#3}{#1}}{#2}{#3}%
1134 }%
1135 \def\XINT_iiseqb::csv_z #1#2#3{, #1}%

```

### 10.23.4 \XINTinFloatSeqB::csv

```

1136 \def\XINTinFloatSeqB::csv #1#2{\expandafter\XINT_flseqb::csv \expandafter

```

```

1137   {\romannumeral0\XINTinfloat [\XINTdigits]{#2}}{#1}}%
1138 \def\XINT_flseqb::csv #1#2{\expandafter\XINT_flseqb::csv_a\romannumeral-`0#2#1!}%
1139 \def\XINT_flseqb::csv_a #1#2;#3;#4!{\expandafter\XINT_expr_seq_empty?
1140   \romannumeral-`0\csname XINT_flseqb::csv_#1\endcsname {#3}{#4}{#2}}%
1141 \def\XINT_flseqb::csv_p #1#2#3%
1142 {%
1143   \xintifCmp {#1}{#2}{#1\expandafter\XINT_flseqb::csv_p\expandafter}%
1144   {#1\xint_gobble_iii}{\xint_gobble_iii}%
1145   {\romannumeral0\XINTinfloatadd {#3}{#1}}{#2}{#3}%
1146 }%
1147 \def\XINT_flseqb::csv_n #1#2#3%
1148 {%
1149   \xintifCmp {#1}{#2}{\xint_gobble_iii}{#1\xint_gobble_iii}%
1150   {#1\expandafter\XINT_flseqb::csv_n\expandafter}%
1151   {\romannumeral0\XINTinfloatadd {#3}{#1}}{#2}{#3}%
1152 }%
1153 \def\XINT_flseqb::csv_z #1#2#3{, #1}%

```

## 10.24 The comma as binary operator

New with 1.09a.

```

1154 \def\XINT_tmpa #1#2#3#4#5#6%
1155 {%
1156   \def #1##1% \XINT_expr_op_,
1157   {%
1158     \expandafter #2\expandafter ##1\romannumeral-`0\XINT_expr_getnext
1159   }%
1160   \def #2##1##2% \XINT_expr_until_,_a
1161   {\xint_UDsignfork
1162     ##2{\expandafter #2\expandafter ##1\romannumeral-`0#4}%
1163     -{#3##1##2}%
1164   \krof }%
1165   \def #3##1##2##3##4% \XINT_expr_until_,_b
1166   {%
1167     \ifnum ##2>\xint_c_ii
1168     \xint_afterfi {\expandafter #2\expandafter ##1\romannumeral-`0%
1169       \csname XINT_#6_op_##3\endcsname {##4}}%
1170   \else
1171     \xint_afterfi
1172     {\expandafter ##2\expandafter ##3%
1173     \csname .=\XINT_expr_unlock ##1,\XINT_expr_unlock ##4\endcsname }%
1174   \fi
1175   }%
1176   \let #5\xint_c_ii
1177 }%
1178 \xintFor #1 in {expr,flexpr,iiexpr} \do {%
1179 \expandafter\XINT_tmpa
1180   \csname XINT_#1_op_,\expandafter\endcsname
1181   \csname XINT_#1_until_,_a\expandafter\endcsname
1182   \csname XINT_#1_until_,_b\expandafter\endcsname
1183   \csname XINT_#1_op_-vi\expandafter\endcsname
1184   \csname XINT_expr_precedence_,\endcsname {#1}%
1185 }%

```

## 10.25 The minus as prefix operator of variable precedence level

```

1186 \def\XINT_tmpa #1#2#3%
1187 {%
1188   \expandafter\XINT_tmpb
1189   \csname XINT_#1_op_-#3\expandafter\endcsname
1190   \csname XINT_#1_until_-#3_a\expandafter\endcsname
1191   \csname XINT_#1_until_-#3_b\expandafter\endcsname
1192   \csname xint_c_#3\endcsname {#1}#2%
1193 }%
1194 \def\XINT_tmpb #1#2#3#4#5#6%
1195 {%
1196   \def #1% \XINT_expr_op_-<level>
1197   {% get next number+operator then switch to _until macro
1198     \expandafter #2\romannumeral-`0\XINT_expr_getnext
1199   }%
1200   \def #2##1% \XINT_expr_until_-<l>_a
1201   {\xint_UDsignfork
1202     ##1{\expandafter #2\romannumeral-`0#1}%
1203     -{#3##1}%
1204   \krof }%
1205   \def #3##1##2##3% \XINT_expr_until_-<l>_b
1206   {% _until tests precedence level with next op, executes now or postpones
1207     \ifnum ##1>#4%
1208       \xint_afterfi {\expandafter #2\romannumeral-`0%
1209         \csname XINT_#5_op_##2\endcsname {##3}}%
1210     \else
1211       \xint_afterfi {\expandafter ##1\expandafter ##2%
1212         \csname .=#6{\XINT_expr_unlock ##3}\endcsname }%
1213     \fi
1214   }%
1215 }%
1216 \xintApplyInline{\XINT_tmpa {expr}\xintOpp}{{vi}{vii}{viii}{ix}}%
1217 \xintApplyInline{\XINT_tmpa {fexpr}\xintOpp}{{vi}{vii}{viii}{ix}}%
1218 \xintApplyInline{\XINT_tmpa {iiexpr}\xintiiOpp}{{vi}{vii}{viii}{ix}}%

```

## 10.26 ? as two-way and ?? as three-way conditionals with braced branches

In 1.1, I overload ? with ??, as : will be used for list extraction, problem with (stuff)??(1){0} for example, one should put a space (stuff)?{?(1)}{0} will work. Small idiosyncrasy. ?{yes}{no} and ??{<0}{=0}{>0}

```

1219 \let\XINT_expr_precedence_? \xint_c_x
1220 \def\XINT_expr_op_? #1#2{\if ?#2\expandafter \XINT_expr_op_??\fi
1221   \XINT_expr_op_?a #1{#2}}%
1222 \def\XINT_expr_op_?a #1#2#3%
1223 {%
1224   \xintiiifNotZero{\XINT_expr_unlock #1}{\XINT_expr_getnext #2}{\XINT_expr_getnext #3}%
1225 }%
1226 \let\XINT_flexpr_op_?\XINT_expr_op_?
1227 \let\XINT_iiexpr_op_?\XINT_expr_op_?
1228 \def\XINT_expr_op_?? #1#2#3#4#5#6%
1229 {%
1230   \xintiiifSgn {\XINT_expr_unlock #2}{\XINT_expr_getnext #4}{\XINT_expr_getnext #5}%

```

```
1231          {\XINT_expr_getnext #6}%
1232 }%
```

## 10.27 ! as postfix factorial operator

Float version was at last done 2015/10/06. As xint does not have yet exp/log, Stirling is no go.

```
1233 \let\XINT_expr_precedence_! \xint_c_x
1234 \def\XINT_expr_op_! #1{\expandafter\XINT_expr_getop
1235          \csname .=\xintFac{\XINT_expr_unlock #1}\endcsname }%
1236 \def\XINT_flexpr_op_! #1{\expandafter\XINT_expr_getop
1237          \csname .=\XINTinFloatFac{\XINT_expr_unlock #1}\endcsname }%
1238 \def\XINT_iiexpr_op_! #1{\expandafter\XINT_expr_getop
1239          \csname .=\xintiiFac{\XINT_expr_unlock #1}\endcsname }%
```

## 10.28 The A/B[N] mechanism

Releases earlier than 1.1 required the use of braces around A/B[N] input. The [N] is now implemented directly. \*BUT\* this uses a delimited macro! thus N is not allowed to be itself an expression (I could add it...). \xintE, \xintiiE, and \XINTinFloatE all put #2 in a \numexpr. But attention to the fact that \numexpr stops at spaces separating digits: \the\numexpr 3 + 7 9\relax gives 109\relax !! Hence we have to be careful.

```
1240 \catcode`[ 11
1241 \catcode`* 11
1242 \let\XINT_expr_precedence_[ \xint_c_vii
1243 \def\XINT_expr_op_[ #1#2]{\expandafter\XINT_expr_getop
1244          \csname .=\xintE{\XINT_expr_unlock #1}%
1245          {\xint_zapspace #2 \xint_gobble_i}\endcsname}%
1246 \def\XINT_iiexpr_op_[ #1#2]{\expandafter\XINT_expr_getop
1247          \csname .=\xintiiE{\XINT_expr_unlock #1}%
1248          {\xint_zapspace #2 \xint_gobble_i}\endcsname}%
1249 \def\XINT_flexpr_op_[ #1#2]{\expandafter\XINT_expr_getop
1250          \csname .=\XINTinFloatE{\XINT_expr_unlock #1}%
1251          {\xint_zapspace #2 \xint_gobble_i}\endcsname}%
1252 \catcode`[ 12
1253 \catcode`* 12
```

## 10.29 For variables

```
1254 \def\XINT_expr_op__ #1% op__ with two _'s
1255     {%
1256     \ifcsname XINT_expr_var_#1\endcsname
1257     \expandafter\xint_firstoftwo
1258     \else
1259     \expandafter\xint_secondoftwo
1260     \fi
1261     {\expandafter\expandafter\expandafter\expandafter
1262     \expandafter\expandafter\expandafter
1263     \XINT_expr_getop\csname XINT_expr_var_#1\endcsname}%
1264     {\XINT_expr_unknown_variable {#1}%
1265     \expandafter\XINT_expr_getop\csname .:=0\endcsname}%
1266     }%
```

```
1267 \def\XINT_expr_unknown_variable #1{\xintError:removed \xint_gobble_i {#1}}%
1268 \let\XINT_flexpr_op__ \XINT_expr_op__
1269 \let\XINT_iiexpr_op__ \XINT_expr_op__
```

### 10.29.1 Defining variables

1.1 An active : character will be a pain and I almost decided not to use := but rather = as affectation operator, but this is the same problem inside expressions with the modulo operator /:, or with babel+frenchb with all high punctuation ?, !, :, ;.

It is not recommended to overwrite single Latin letters which are pre-defined to serve as dummy variables. Variable names may contain letters, digits, underscores, and must not start with a digit.

```
1270 \catcode`: 12
1271 \def\xintdefvar #1:=#2;\expandafter\odef
1272   \csname XINT_expr_var_\xint_zapspaces #1 \xint_gobble_i\endcsname
1273   {\expandafter\empty\romannumeral0\xintbareeval #2\relax }%
1274 \def\xintdefiivar #1:=#2;\expandafter\odef
1275   \csname XINT_expr_var_\xint_zapspaces #1 \xint_gobble_i\endcsname
1276   {\expandafter\empty\romannumeral0\xintbareiieval #2\relax }%
1277 }%
1278 \def\xintdeffloatvar #1:=#2;\expandafter\odef
1279   \csname XINT_expr_var_\xint_zapspaces #1 \xint_gobble_i\endcsname
1280   {\expandafter\empty\romannumeral0\xintbarefloateval #2\relax }%
1281 }%
1282 \catcode`: 11
```

### 10.29.2 Letters as dummy variables; the nil list

```
1283 \def\XINT_tmpa #1%
1284 {%
1285   \expandafter\def\csname XINT_expr_var_#1\endcsname ##1\relax !#1##2%
1286   {\romannumeral0\XINT_expr_lockscan ##2!##1\relax !#1{##2}}%
1287 }%
1288 \xintApplyUnbraced \XINT_tmpa {abcdefghijklmnopqrstuvwxyz}%
1289 \xintApplyUnbraced \XINT_tmpa {ABCDEFGHIJKLMNOPQRSTUVWXYZ}%
1290 \expandafter\def\expandafter\XINT_expr_var_nil\expandafter
1291   {\expandafter\empty\csname . = \endcsname}%
```

### 10.29.3 The omit and abort constructs

```
1292 \catcode`. 11 \catcode`= 11
1293 \def\XINT_expr_var_omit #1\relax !{1^C!{}{}{}.\!=\relax !}% 24 juin
1294 \def\XINT_expr_var_abort #1\relax !{1^C!{}{}{}.\!=^ \relax !}% 25 juin
1295 \catcode`. 12 \catcode`= 12
```

### 10.29.4 The @, @1, @2, @3, @4, @@, @@(1), ..., @@@, @@@(1), ... for recursion

I had completely forgotten what the @@@ etc... stuff were supposed to do: this is for nesting recursions! (I was mad back in June 2014). @@(N) gives the Nth back, @@@(N) gives the Nth back of the higher recursion!

```
1296 \catcode`? 3
1297 \def\XINT_expr_var_@ #1~#2{ #2#1~#2}%
1298 \expandafter\let\csname XINT_expr_var_@1\endcsname \XINT_expr_var_@
1299 \expandafter\def\csname XINT_expr_var_@2\endcsname #1~#2#3{ #3#1~#2#3}%
```

```

1300 \expandafter\def\csname XINT_expr_var_@3\endcsname #1~#2#3#4{ #4#1~#2#3#4}%
1301 \expandafter\def\csname XINT_expr_var_@4\endcsname #1~#2#3#4#5{ #5#1~#2#3#4#5}%
1302 \def\XINT_expr_func_@@ #1#2#3#4~#5?%
1303 {%
1304   \expandafter#1\expandafter#2\romannumeral0\xintntheltnoexpand
1305     {\xintNum{\XINT_expr_unlock#3}}{#5}#4~#5?%
1306 }%
1307 \def\XINT_expr_func_@@@ #1#2#3#4~#5~#6?%
1308 {%
1309   \expandafter#1\expandafter#2\romannumeral0\xintntheltnoexpand
1310     {\xintNum{\XINT_expr_unlock#3}}{#6}#4~#5~#6?%
1311 }%
1312 \def\XINT_expr_func_@@@@ #1#2#3#4~#5~#6~#7?%
1313 {%
1314   \expandafter#1\expandafter#2\romannumeral0\xintntheltnoexpand
1315     {\xintNum{\XINT_expr_unlock#3}}{#7}#4~#5~#6~#7?%
1316 }%
1317 \let\XINT_flexpr_func_@@\XINT_expr_func_@@
1318 \let\XINT_flexpr_func_@@@\XINT_expr_func_@@@
1319 \let\XINT_flexpr_func_@@@@\XINT_expr_func_@@@@
1320 \def\XINT_iexpr_func_@@ #1#2#3#4~#5?%
1321 {%
1322   \expandafter#1\expandafter#2\romannumeral0\xintntheltnoexpand
1323     {\XINT_expr_unlock#3}{#5}#4~#5?%
1324 }%
1325 \def\XINT_iexpr_func_@@@ #1#2#3#4~#5~#6?%
1326 {%
1327   \expandafter#1\expandafter#2\romannumeral0\xintntheltnoexpand
1328     {\XINT_expr_unlock#3}{#6}#4~#5~#6?%
1329 }%
1330 \def\XINT_iexpr_func_@@@@ #1#2#3#4~#5~#6~#7?%
1331 {%
1332   \expandafter#1\expandafter#2\romannumeral0\xintntheltnoexpand
1333     {\XINT_expr_unlock#3}{#7}#4~#5~#6~#7?%
1334 }%
1335 \catcode`? 11

```

### 10.30 For functions

```

1336 \def\XINT_tmpa #1#2#3{%
1337   \def #1##1% \XINT_expr_op_`, #2=\XINT_expr_oparen
1338   {%
1339     \ifcsname XINT_expr_onlitteral_##1\endcsname
1340       \xint_dothis{\csname XINT_expr_onlitteral_##1\endcsname}\fi
1341     \ifcsname XINT_#3_func_##1\endcsname
1342       \xint_dothis{\expandafter\expandafter
1343         \csname XINT_#3_func_##1\endcsname\romannumeral-`0#2}\fi
1344     \xint_orthat{\XINT_expr_unknown_function {##1}}%
1345     \expandafter\XINT_expr_func_unknown\romannumeral-`0#2}%
1346   }%
1347 }%
1348 \def\XINT_expr_unknown_function #1{\xintError:removed \xint_gobble_i {#1}}%
1349 \xintFor #1 in {expr,flexpr,iexpr} \do {%

```

```

1350 \expandafter\XINT_tmpa
1351 \csname XINT_#1_op_`\expandafter\endcsname
1352 \csname XINT_#1_oparen\endcsname
1353 {#1}%
1354 }%
1355 \expandafter\def\csname XINT_expr_onlitteral_`\endcsname #1#2#3({\xint_c_xviii `#{2}}%

```

### 10.31 The bool, togl, protect, unknown, and break “functions”

*bool*, *togl* and *protect* use delimited macros. Only *unknown* and *break* are true functions with a more flexible parsing of the opening and closing parentheses, which may possibly arise from expansion itself.

```

1356 \def\XINT_expr_onlitteral_bool #1)%
1357 {\expandafter\XINT_expr_getop\csname .=\xintBool{#1}\endcsname }%
1358 \def\XINT_expr_onlitteral_togl #1)%
1359 {\expandafter\XINT_expr_getop\csname .=\xintToggle{#1}\endcsname }%
1360 \def\XINT_expr_onlitteral_protect #1)%
1361 {\expandafter\XINT_expr_getop\csname .=\detokenize{#1}\endcsname }%
1362 \def\XINT_expr_func_unknown #1#2#3%
1363 {\expandafter #1\expandafter #2\csname .=#0\endcsname }%
1364 \def\XINT_expr_func_break #1#2#3%
1365 {\expandafter #1\expandafter #2\csname .=?\romannumeral-`0\XINT_expr_unlock #3\endcsname }%
1366 \let\XINT_flexpr_func_break \XINT_expr_func_break
1367 \let\XINT_iexpr_func_break \XINT_expr_func_break

```

### 10.32 The qint, qfrac, qfloat “functions”

New with 1.2. Allows the user to hand over quickly a big number to the parser, spaces not immediately removed but should be harmless in general.

```

1368 \def\XINT_expr_onlitteral_qint #1)%
1369 {\expandafter\XINT_expr_getop\csname .=\xintiNum{#1}\endcsname }%
1370 \def\XINT_expr_onlitteral_qfrac #1)%
1371 {\expandafter\XINT_expr_getop\csname .=\xintRaw{#1}\endcsname }%
1372 \def\XINT_expr_onlitteral_qfloat #1)%
1373 {\expandafter\XINT_expr_getop\csname .=\XINTinFloatdigits{#1}\endcsname }%

```

### 10.33 seq and the implementation of dummy variables

All of *seq*, *add*, *mul*, *rseq*, etc... (actually all of the extensive changes from *xintexpr* 1.09n to 1.1) was done around June 15-25th 2014, but the problem is that I did not document the code enough, and I had a hard time understanding in October what I had done in June. Despite the lesson, again being short on time, I do not document enough my current understanding of the innards of the beast...

I added *subs*, and *iter* in October (also the *[:n]*, *[n:]* list extractors), proving I did at least understand a bit (or rather could imitate) my earlier code (but don't ask me to explain *\xintNewExpr* !)

The *\XINT\_expr\_onlitteral\_seq\_a* parses: "expression, variable=list)" (when it is called the opening ( has been swallowed, and it looks for the ending one.) Both expression and list may themselves contain parentheses and commas, we allow nesting. For example "x^2,x=1..10)", at the end of *seq\_a* we have {variable{expression}}{list}, in this example {x{x^2}}{1..10}, or more complicated "seq(add(y,y=1..x),x=1..10)" will work too. The variable is a single lowercase Latin letter.



The complications with `\xint_c_xviii` in `seq_f` is for the recurrent thing that we don't know in what type of expressions we are, hence we must move back up, with some loss of efficiency (superfluous check for minus sign, etc...). But the code manages simultaneously `expr`, `flexpr` and `iiexpr`.

### 10.33.1 `\XINT_expr_onlitteral_seq`

```
1374 \def\xint_expr_onlitteral_seq
1375 {\expandafter\xint_expr_onlitteral_seq_f\romannumeral-`0\xint_expr_onlitteral_seq_a {}}%
1376 \def\xint_expr_onlitteral_seq_f #1#2{\xint_c_xviii `{seqx}#2)\relax #1}%
```

### 10.33.2 `\XINT_expr_onlitteral_seq_a`

```
1377 \def\xint_expr_onlitteral_seq_a #1#2,%
1378 {% checks balancing of parentheses
1379   \ifcase\xint_isbalanced_a \relax #1#2(\xint_bye)\xint_bye
1380     \expandafter\xint_expr_onlitteral_seq_c
1381     \or\expandafter\xint_expr_onlitteral_seq_b
1382     \else\expandafter\xintError:we_are_doomed
1383   \fi {#1#2},%
1384 }%
1385 \def\xint_expr_onlitteral_seq_b #1,{\xint_expr_onlitteral_seq_a {#1,}}%
1386 \def\xint_expr_onlitteral_seq_c #1,#2#3# #3 pour absorber le =
1387 {%
1388   \xint_expr_onlitteral_seq_d {#2{#1}}}%
1389 }%
1390 \def\xint_expr_onlitteral_seq_d #1#2#3)%
1391 {%
1392   \ifcase\xint_isbalanced_a \relax #2#3(\xint_bye)\xint_bye
1393     \or\expandafter\xint_expr_onlitteral_seq_e
1394     \else\expandafter\xintError:we_are_doomed
1395   \fi
1396   {#1}{#2#3}%
1397 }%
1398 \def\xint_expr_onlitteral_seq_e #1#2{\xint_expr_onlitteral_seq_d {#1}{#2}}%
```

### 10.33.3 `\XINT_isbalanced_a` for `\XINT_expr_onlitteral_seq_a`

Expands to `\xint_c_mone` in case a closing `)` had no opening ( matching it, to `\@ne` if opening `)` had no closing ) matching it, to `\z@` if expression was balanced.

```
1399 % use as \XINT_isbalanced_a \relax #1(\xint_bye)\xint_bye
1400 \def\xint_isbalanced_a #1({\XINT_isbalanced_b #1)\xint_bye }%
1401 \def\xint_isbalanced_b #1)#2%
1402   {\xint_bye #2\xint_isbalanced_c\xint_bye\xint_isbalanced_error }%

   if #2 is not \xint_bye, a ) was found, but there was no (. Hence error -> -1

1403 \def\xint_isbalanced_error #1)\xint_bye {\xint_c_mone}%

   #2 was \xint_bye, was there a ) in original #1?

1404 \def\xint_isbalanced_c\xint_bye\xint_isbalanced_error #1%
1405   {\xint_bye #1\xint_isbalanced_yes\xint_bye\xint_isbalanced_d #1}%

   #1 is \xint_bye, there was never ( nor ) in original #1, hence OK.

1406 \def\xint_isbalanced_yes\xint_bye\xint_isbalanced_d\xint_bye )\xint_bye {\xint_c_ }%
```

#1 is not \xint\_bye, there was indeed a ( in original #1. We check if we see a ). If we do, we then loop until no ( nor ) is to be found.

```
1407 \def\xint_isbalanced_d #1)#2%
1408   {\xint_bye #2\xint_isbalanced_no\xint_bye\xint_isbalanced_a #1#2}%
```

#2 was \xint\_bye, we did not find a closing ) in original #1. Error.

```
1409 \def\xint_isbalanced_no\xint_bye #1\xint_bye\xint_bye {\xint_c_i }%
```

### 10.33.4 \XINT\_allexpr\_func\_seqx, \XINT\_allexpr\_func\_subx

```
1410 \def\xint_expr_func_seqx #1#2{\XINT_allexpr_seqx \xintbareeval }%
1411 \def\xint_expr_func_fseqx #1#2{\XINT_allexpr_seqx \xintbarefloateval}%
1412 \def\xint_expr_func_iifseqx #1#2{\XINT_allexpr_seqx \xintbareiieval }%
1413 \def\xint_allexpr_seqx #1#2#3#4% #2 is the index list, fully evaluated and encapsulated
1414 {% #3 is the Latin letter serving as dummy variable, #4 is the expression to evaluate
1415   \expandafter \XINT_expr_getop
1416   \csname .=\expandafter\xint_expr_seq:_aa
1417     \romannumeral-\`0\xint_expr_unlock #2!{#1#4\relax !#3},^,\endcsname
1418 }%
1419 \def\xint_expr_seq:_aa #1{\if +#1\expandafter\xint_expr_seq:_A\else
1420   \expandafter\xint_expr_seq:_a\fi #1}%
```

### 10.33.5 break, abort, omit within seq

when evaluation is done in seq:\_d, after the ! we find: the Latin letter, the braced evaluated value to which it will be assigned, a saved copy of the the \xintexpr stuff, the braced accumulated comma separated list of previous computations, and the rest of the list of comma separated values to assign to the dummy letter and at the very end there is ^ and the final comma.

```
1421 \def\xint_expr_seq:_a #1!#2{\expandafter\xint_expr_seq:_empty?
1422   \romannumeral0\xint_expr_seq:_b {#2}#1}%
1423 \def\xint_expr_seq:_b #1#2,{\XINT_expr_seq:_c #2,{#1}}%
1424 \def\xint_expr_seq:_c #1{\if ,#1\xint_dothis\xint_expr_seq:_noop\fi
1425   \if ^#1\xint_dothis\xint_expr_seq:_end\fi
1426   \xint_orthat\xint_expr_seq:_d #1}%
1427 \def\xint_expr_seq:_d #1,#2{\expandafter\xint_expr_seq:_e
1428   \romannumeral-\`0\expandafter\xint_expr_unlock\romannumeral0#2{#1}{#2}}%
1429 \def\xint_expr_seq:_e #1{\if #1^\xint_dothis\xint_expr_seq:_abort\fi
1430   \if #1?\xint_dothis\xint_expr_seq:_break\fi
1431   \if #1!\xint_dothis\xint_expr_seq:_omit\fi
1432   \xint_orthat{\XINT_expr_seq:_goon #1}}%
1433 \def\xint_expr_seq:_goon #1!#2#3#4{,#1\xint_expr_seq:_b {#4}}%
1434 \def\xint_expr_seq:_omit #1!#2#3#4{\XINT_expr_seq:_b {#4}}%
1435 \def\xint_expr_seq:_abort #1!#2#3#4#5^,{}%
1436 \def\xint_expr_seq:_break #1!#2#3#4#5^,{,#1}%
1437 \def\xint_expr_seq:_noop ,#1{\XINT_expr_seq:_b {#1}}%
1438 \def\xint_expr_seq:_end ^,#1{% if all is omit, _empty? constructs "nil"
1439 \def\xint_expr_seq:_empty? #1{%
1440 \def\xint_expr_seq:_empty? ##1{\if ,##1\expandafter\xint_gobble_i\fi #1\endcsname }}%
1441 \XINT_expr_seq:_empty? { }%
```

**10.33.6 \XINT\_expr\_seq:\_A**

This is for index lists generated by ++. The starting point will have been replaced by its ceil. For efficiency I use \numexpr rather than \xintInc, hence the indexing is limited to small integers.

```

1442 \def\XINT_expr_seq:_A #1!#2,^,%
1443   {\expandafter\XINT_expr_seq_empty?\romannumeral0\XINT_expr_seq:_D {#1}{#2}}%
1444 \def\XINT_expr_seq:_D #1#2{\expandafter\XINT_expr_seq:_E
1445   \romannumeral-`0\expandafter\XINT_expr_unlock\romannumeral0#2{#1}{#2}}%
1446 \def\XINT_expr_seq:_E #1{\if #1^\xint_dothis\XINT_expr_seq:_Abort\fi
1447   \if #1?\xint_dothis\XINT_expr_seq:_Break\fi
1448   \if #1!\xint_dothis\XINT_expr_seq:_Omit\fi
1449   \xint_orthat{\XINT_expr_seq:_Goon #1}}%
1450 \def\XINT_expr_seq:_Goon #1!#2#3#4%
1451   {,#1\expandafter\XINT_expr_seq:_D\expandafter{\the\numexpr #3+\xint_c_i}{#4}}%
1452 \def\XINT_expr_seq:_Omit #1!#2#3#4%
1453   {\expandafter\XINT_expr_seq:_D\expandafter{\the\numexpr #3+\xint_c_i}{#4}}%
1454 \def\XINT_expr_seq:_Abort #1!#2#3#4}%
1455 \def\XINT_expr_seq:_Break #1!#2#3#4{,#1}%

```

**10.33.7 add and mul, \XINT\_expr\_onlitteral\_add, \XINT\_expr\_onlitteral\_mul**

```

1456 \def\XINT_expr_onlitteral_add
1457   {\expandafter\XINT_expr_onlitteral_add_f\romannumeral-`0\XINT_expr_onlitteral_seq_a {}}%
1458 \def\XINT_expr_onlitteral_add_f #1#2{\xint_c_xviii `{opx}#2)\relax #1+}%
1459 \def\XINT_expr_onlitteral_mul
1460   {\expandafter\XINT_expr_onlitteral_mul_f\romannumeral-`0\XINT_expr_onlitteral_seq_a {}}%
1461 \def\XINT_expr_onlitteral_mul_f #1#2{\xint_c_xviii `{opx}#2)\relax #1*}%

```

**10.33.8 \XINT\_expr\_func\_opx, \XINT\_flexpr\_func\_opx, \XINT\_iexpr\_func\_opx**

```

1462 \expandafter\edef\csname XINT_expr_op:_+\endcsname
1463   {\noexpand\xint_gobble_v {}}{\expandafter\noexpand\csname .:=0\endcsname}%
1464 \expandafter\edef\csname XINT_expr_op:_*\endcsname
1465   {\noexpand\xint_gobble_v {}}{\expandafter\noexpand\csname .:=1\endcsname}%
1466 \def\XINT_expr_func_opx #1#2{\XINT_allexpr_opx \xintexpr}%
1467 \def\XINT_flexpr_func_opx #1#2{\XINT_allexpr_opx \xintfloatexpr}%
1468 \def\XINT_iexpr_func_opx #1#2{\XINT_allexpr_opx \xintiexpr}%
1469 \def\XINT_allexpr_opx #1#2#3#4#5%

```

au d\'e part on avait op(#4,#3=#2 (\'evalu\'e ici)) #3=la variable, #4=expression, #5=+ ou\*.

```

1470 {%
1471   \expandafter\XINT_expr_getop\romannumeral0\expandafter\XINT_expr_op:_a
1472   \csname XINT_expr_op:_#5\endcsname
1473   \romannumeral-`0\XINT_expr_unlock #2!#5#1#3{#4}%
1474 }%

```

**10.33.9 \XINT\_expr\_op:\_a, ...**

```

1475 \def\XINT_expr_op:_a #1#2!#3#4#5#6{\XINT_expr_op:_b {#1#4#3{#6\relax\relax !#5}}#2,^,%
1476   #1=op_+ ou op_*, #2=liste, #3=+ou*, #4=\xintexpr, etc, #5=la var,#6=expression
1477 \def\XINT_expr_op:_b #1#2,{\XINT_expr_op:_c #2,#1}%
1478 \def\XINT_expr_op:_c #1{\if ,#1\xint_dothis\XINT_expr_op:_noop\fi
1479   \if ^#1\xint_dothis\XINT_expr_op:_end\fi

```

```

1479 \xint_orthat\XINT_expr_op:_d #1}%
1480 \def\XINT_expr_op:_noop #1,#2#3#4#5{\XINT_expr_op:_b {{#2}#3#4{#5}}}%
1481 \def\XINT_expr_op:_d #1,#2#3#4#5%

#1=valeur, #2=partiel, #3=\xintexpr #4=+ ou *, #5 = expression

1482 {\expandafter\expandafter\expandafter\XINT_expr_op:_e #3#2#4#3#5{#1}{#3#4{#5}}}%

#2=nom de la variable, #3=ancienne valeur variable

1483 \def\XINT_expr_op:_e !#1!#2#3#4{\XINT_expr_op:_b {{!#1}#4}}%
1484 \def\XINT_expr_op:_end ^,#1#2#3#4{\expandafter\expandafter\expandafter\space
1485 \expandafter\xint_gobble_iv #1}%

```

### 10.33.10 subs, \XINT\_expr\_onlitteral\_subs

```

1486 \def\XINT_expr_onlitteral_subs
1487 {\expandafter\XINT_expr_onlitteral_subs_f\romannumeral-`0\XINT_expr_onlitteral_seq_a {}}%
1488 \def\XINT_expr_onlitteral_subs_f #1#2{\xint_c_xviii `{subx}#2)\relax #1}%
1489 \def\XINT_expr_func_subx #1#2{\XINT_allexpr_subx \xintbareeval}%
1490 \def\XINT_flexpr_func_subx #1#2{\XINT_allexpr_subx \xintbarefloateval}%
1491 \def\XINT_iiexpr_func_subx #1#2{\XINT_allexpr_subx \xintbareiieval}%
1492 \def\XINT_allexpr_subx #1#2#3#4% #2 is the value to assign to the dummy variable
1493 {% #3 is the dummy variable, #4 is the expression to evaluate
1494 \expandafter \XINT_expr_getop
1495 \csname .=\expandafter\XINT_expr_subx:_a
1496 \romannumeral-`0\XINT_expr_unlock #2!{#1#4\relax !#3}\endcsname
1497}%
1498 \def\XINT_expr_subx:_a #1!#2%
1499 {\expandafter\XINT_expr_subx:_end \romannumeral0#2{#1}}%

attention, if one day I add a space in unlock, will need \romannumeral-`0

1500 \def\XINT_expr_subx:_end #1!#2#3{\XINT_expr_unlock #1}%

```

### 10.34 rseq

When func\_rseq has its turn, initial segment has been scanned by oparen, the ; mimicking the rôle of a closing parenthesis, and stopping further expansion.

```

1501 \def\XINT_expr_func_rseq {\XINT_allexpr_rseq \xintbareeval}%
1502 \def\XINT_flexpr_func_rseq {\XINT_allexpr_rseq \xintbarefloateval}%
1503 \def\XINT_iiexpr_func_rseq {\XINT_allexpr_rseq \xintbareiieval}%
1504 \def\XINT_allexpr_rseq #1#2%
1505 {%
1506 \expandafter\XINT_expr_rseqx\expandafter #1\expandafter
1507 #2\romannumeral-`0\XINT_expr_onlitteral_seq_a {}}%
1508}%

```

#### 10.34.1 \XINT\_expr\_rseqx

The (#4) is for ++ mechanism which must have its closing parenthesis.

```

1509 \def\XINT_expr_rseqx #1#2#3#4%
1510 {%
1511 \expandafter\XINT_expr_rseqy\romannumeral0#1(#4)\relax
1512 #2#3#1%
1513}%

```

**10.34.2 \XINT\_expr\_rseq**

#1=valeurs pour variable (locked), #2=toutes les valeurs initiales (csv,locked), #3=variable, #4=expr, #5=\xintbareeval ou \xintbarefloateval ou \xintbareieval

```

1514 \def\XINT_expr_rseq #1#2#3#4#5%
1515 {%
1516     \expandafter \XINT_expr_getop
1517     \csname .=\XINT_expr_unlock #2%
1518     \expandafter\XINT_expr_rseq:_aa
1519         \romannumeral-\0\XINT_expr_unlock #1!{#5#4\relax !#3}#2,^,\endcsname
1520 }%
1521 \def\XINT_expr_rseq:_aa #1{\if +#1\expandafter\XINT_expr_rseq:_A\else
1522     \expandafter\XINT_expr_rseq:_a\fi #1}%

```

**10.34.3 \XINT\_expr\_rseq:\_a etc...**

```

1523 \def\XINT_expr_rseq:_a #1!#2#3{\XINT_expr_rseq:_b #3{#2}#1}%
1524 \def\XINT_expr_rseq:_b #1#2#3,{\XINT_expr_rseq:_c #3,~#1{#2}}%
1525 \def\XINT_expr_rseq:_c #1{\if ,#1\xint_dothis\XINT_expr_rseq:_noop\fi
1526     \if ^#1\xint_dothis\XINT_expr_rseq:_end\fi
1527     \xint_orthat\XINT_expr_rseq:_d #1}%
1528 \def\XINT_expr_rseq:_d #1,~#2#3{\expandafter\XINT_expr_rseq:_e
1529     \romannumeral-\0\expandafter\XINT_expr_unlock\romannumeral0#3{#1}~#2{#3}}%
1530 \def\XINT_expr_rseq:_e #1{%
1531     \if ^#1\xint_dothis\XINT_expr_rseq:_abort\fi
1532     \if ?#1\xint_dothis\XINT_expr_rseq:_break\fi
1533     \if !#1\xint_dothis\XINT_expr_rseq:_omit\fi
1534     \xint_orthat{\XINT_expr_rseq:_goon #1}}%
1535 \def\XINT_expr_rseq:_goon #1!#2#3~#4#5{,#1\expandafter\XINT_expr_rseq:_b
1536     \romannumeral0\XINT_expr_lockit {#1}{#5}}%
1537 \def\XINT_expr_rseq:_omit #1!#2#3~{\XINT_expr_rseq:_b }%
1538 \def\XINT_expr_rseq:_abort #1!#2#3~#4#5#6^,{ }%
1539 \def\XINT_expr_rseq:_break #1!#2#3~#4#5#6^,{ ,#1}%
1540 \def\XINT_expr_rseq:_noop ,~#1#2{\XINT_expr_rseq:_b #1{#2}}%
1541 \def\XINT_expr_rseq:_end ^,~#1#2{}% no nil for rseq

```

**10.34.4 \XINT\_expr\_rseq:\_A etc...**

*n++ for rseq*

```

1542 \def\XINT_expr_rseq:_A +#1!#2#3,^,{\XINT_expr_rseq:_D {#1}#3{#2}}%
1543 \def\XINT_expr_rseq:_D #1#2#3{\expandafter\XINT_expr_rseq:_E
1544     \romannumeral-\0\expandafter\XINT_expr_unlock\romannumeral0#3{#1}~#2{#3}}%
1545 \def\XINT_expr_rseq:_E #1{\if #1^\xint_dothis\XINT_expr_rseq:_Abort\fi
1546     \if #1?\xint_dothis\XINT_expr_rseq:_Break\fi
1547     \if #1!\xint_dothis\XINT_expr_rseq:_Omit\fi
1548     \xint_orthat{\XINT_expr_rseq:_Goon #1}}%
1549 \def\XINT_expr_rseq:_Goon #1!#2#3~#4#5%
1550     {,#1\expandafter\XINT_expr_rseq:_D\expandafter{\the\numexpr #3+\xint_c_i\expandafter}%
1551     \romannumeral0\XINT_expr_lockit{#1}{#5}}%
1552 \def\XINT_expr_rseq:_Omit #1!#2#3~#4#5%
1553     {\expandafter\XINT_expr_rseq:_D\expandafter{\the\numexpr #3+\xint_c_i}}%
1554 \def\XINT_expr_rseq:_Abort #1!#2#3~#4#5{}%
1555 \def\XINT_expr_rseq:_Break #1!#2#3~#4#5{,#1}%

```

### 10.35 rrseq

When `func_rrseq` has its turn, initial segment has been scanned by `oparen`, the ; mimicking the rôle of a closing parenthesis, and stopping further expansion.

```

1556 \def\XINT_expr_func_rrseq    {\XINT_allexpr_rrseq \xintbareeval    }%
1557 \def\XINT_flexpr_func_rrseq {\XINT_allexpr_rrseq \xintbarefloateval }%
1558 \def\XINT_iexpr_func_rrseq  {\XINT_allexpr_rrseq \xintbareiieval    }%
1559 \def\XINT_allexpr_rrseq #1#2%
1560 {%
1561     \expandafter\XINT_expr_rrseq\expandafter #1\expandafter
1562     #2\romannumeral-\0\XINT_expr_onlitteral_seq_a {}%
1563 }%
```

#### 10.35.1 \XINT\_expr\_rrseqx

The (#4) is for ++ mechanism which must have its closing parenthesis.

```

1564 \def\XINT_expr_rrseqx #1#2#3#4%
1565 {%
1566     \expandafter\XINT_expr_rrseq\romannumeral0#1(#4)\expandafter\relax
1567     \expandafter{\romannumeral0\xintapply \XINT_expr_lockit
1568         {\xintRevWithBraces{\xintCSVtoListNonStripped{\XINT_expr_unlock #2}}}}%
1569     #2#3#1%
1570 }%
```

#### 10.35.2 \XINT\_expr\_rrseqy

#1=valeurs pour variable (locked), #2=initial values (reversed, one (braced) token each) #3=toutes les valeurs initiales (csv,locked), #4=variable, #5=expr, #6=\xintbareeval ou \xintbarefloateval ou \xintbareiieval

```

1571 \def\XINT_expr_rrseqy #1#2#3#4#5#6%
1572 {%
1573     \expandafter \XINT_expr_getop
1574     \csname .=\XINT_expr_unlock #3%
1575     \expandafter\XINT_expr_rrseq:_aa
1576         \romannumeral-\0\XINT_expr_unlock #1!{#6#5\relax !#4}{#2},^,\endcsname
1577 }%
1578 \def\XINT_expr_rrseq:_aa #1{\if +#1\expandafter\XINT_expr_rrseq:_A\else
1579     \expandafter\XINT_expr_rrseq:_a\fi #1}%

```

#### 10.35.3 \XINT\_expr\_rrseq:\_a etc...

```

1580 \catcode`? 3
1581 \def\XINT_expr_rrseq:_a #1!#2#3{\XINT_expr_rrseq:_b {#3}{#2}#1}%
1582 \def\XINT_expr_rrseq:_b #1#2#3,{\XINT_expr_rrseq:_c #3,~#1?{#2}}%
1583 \def\XINT_expr_rrseq:_c #1{\if ,#1\xint_dothis\XINT_expr_rrseq:_noop\fi
1584     \if ^#1\xint_dothis\XINT_expr_rrseq:_end\fi
1585     \xint_orthat\XINT_expr_rrseq:_d #1}%
1586 \def\XINT_expr_rrseq:_d #1,~#2?#3{\expandafter\XINT_expr_rrseq:_e
1587     \romannumeral-\0\expandafter\XINT_expr_unlock\romannumeral0#3{#1}~#2?{#3}}%
1588 \def\XINT_expr_rrseq:_goon #1!#2#3~#4?#5{,#1\expandafter\XINT_expr_rrseq:_b\expandafter
1589     {\romannumeral0\xinttrim{-1}{\XINT_expr_lockit{#1}{#4}}{#5}}%

```

```

1590 \def\XINT_expr_rrseq:_omit #1!#2#3~{\XINT_expr_rrseq:_b }%
1591 \def\XINT_expr_rrseq:_abort #1!#2#3~#4?#5#6^,{ }%
1592 \def\XINT_expr_rrseq:_break #1!#2#3~#4?#5#6^,{,#1}%
1593 \def\XINT_expr_rrseq:_noop ,~#1?#2{\XINT_expr_rrseq:_b {#1}{#2}}%
1594 \def\XINT_expr_rrseq:_end ^,~#1?#2{}% No nil for rrseq.
1595 \catcode`? 11
1596 \def\XINT_expr_rrseq:_e #1{%
1597   \if ^#1\xint_dothis\XINT_expr_rrseq:_abort\fi
1598   \if ?#1\xint_dothis\XINT_expr_rrseq:_break\fi
1599   \if !#1\xint_dothis\XINT_expr_rrseq:_omit\fi
1600   \xint_orthat{\XINT_expr_rrseq:_goon #1}%
1601 }%

```

#### 10.35.4 \XINT\_expr\_rrseq:\_A etc...

*n++ for rrseq*

```

1602 \catcode`? 3
1603 \def\XINT_expr_rrseq:_A +#1!#2#3,^,{\XINT_expr_rrseq:_D {#1}{#3}{#2}}%
1604 \def\XINT_expr_rrseq:_D #1!#2#3{\expandafter\XINT_expr_rrseq:_E
1605   \romannumeral-`0\expandafter\XINT_expr_unlock\romannumeral0#3{#1}~#2?{#3}}%
1606 \def\XINT_expr_rrseq:_Goon #1!#2#3~#4?#5%
1607   {,#1\expandafter\XINT_expr_rrseq:_D\expandafter{\the\numexpr #3+\xint_c_i\expandafter}%
1608   \expandafter{\romannumeral0\xinttrim{-1}{\XINT_expr_lockit{#1}{#4}}{#5}}}%
1609 \def\XINT_expr_rrseq:_Omit #1!#2#3~#4?#5%
1610   {\expandafter\XINT_expr_rrseq:_D\expandafter{\the\numexpr #3+\xint_c_i}}%
1611 \def\XINT_expr_rrseq:_Abort #1!#2#3~#4?#5{}%
1612 \def\XINT_expr_rrseq:_Break #1!#2#3~#4?#5{,#1}%
1613 \catcode`? 11
1614 \def\XINT_expr_rrseq:_E #1{\if #1^ \xint_dothis\XINT_expr_rrseq:_Abort\fi
1615   \if #1? \xint_dothis\XINT_expr_rrseq:_Break\fi
1616   \if #1! \xint_dothis\XINT_expr_rrseq:_Omit\fi
1617   \xint_orthat{\XINT_expr_rrseq:_Goon #1}}%

```

#### 10.36 iter

```

1618 \def\XINT_expr_func_iter {\XINT_allexpr_iter \xintbareeval }%
1619 \def\XINT_flexpr_func_iter {\XINT_allexpr_iter \xintbarefloateval }%
1620 \def\XINT_iexpr_func_iter {\XINT_allexpr_iter \xintbareiieval }%
1621 \def\XINT_allexpr_iter #1#2%
1622 {%
1623   \expandafter\XINT_expr_iterx\expandafter #1\expandafter
1624   #2\romannumeral-`0\XINT_expr_onlitteral_seq_a {}%
1625 }%

```

##### 10.36.1 \XINT\_expr\_iterx

*The (#4) is for ++ mechanism which must have its closing parenthesis.*

```

1626 \def\XINT_expr_iterx #1#2#3#4%
1627 {%
1628   \expandafter\XINT_expr_itery\romannumeral0#1(#4)\expandafter\relax
1629   \expandafter{\romannumeral0\xintapply \XINT_expr_lockit
1630     {\xintRevWithBraces{\xintCSVtoListNonStripped{\XINT_expr_unlock #2}}}}%
1631   #2#3#1%
1632 }%

```



**10.36.2 \XINT\_expr\_itery**

#1=valeurs pour variable (locked), #2=initial values (reversed, one (braced) token each) #3=toutes les valeurs initiales (csv,locked), #4=variable, #5=expr, #6=\xintbareeval ou \xintbarefloateval ou \xintbareieval

```

1633 \def\XINT_expr_itery #1#2#3#4#5#6%
1634 {%
1635   \expandafter \XINT_expr_getop
1636   \csname .=%
1637   \expandafter\XINT_expr_iter:_aa
1638   \romannumeral-`0\XINT_expr_unlock #1!{#6#5\relax !#4}{#2},^,\endcsname
1639 }%
1640 \def\XINT_expr_iter:_aa #1{\if +#1\expandafter\XINT_expr_iter:_A\else
1641   \expandafter\XINT_expr_iter:_a\fi #1}%

```

**10.36.3 \XINT\_expr\_iter:\_a etc...**

```

1642 \catcode`? 3
1643 \def\XINT_expr_iter:_a #1!#2#3{\XINT_expr_iter:_b {#3}{#2}#1}%
1644 \def\XINT_expr_iter:_b #1#2#3,{\XINT_expr_iter:_c #3,~#1?{#2}}%
1645 \def\XINT_expr_iter:_c #1{\if ,#1\xint_dothis\XINT_expr_iter:_noop\fi
1646   \if ^#1\xint_dothis\XINT_expr_iter:_end\fi
1647   \xint_orthat\XINT_expr_iter:_d #1}%
1648 \def\XINT_expr_iter:_d #1,~#2?#3{\expandafter\XINT_expr_iter:_e
1649   \romannumeral-`0\expandafter\XINT_expr_unlock\romannumeral0#3{#1}~#2?{#3}}%
1650 \def\XINT_expr_iter:_goon #1!#2#3~#4?#5{\expandafter\XINT_expr_iter:_b\expandafter
1651   {\romannumeral0\xinttrim{-1}{\XINT_expr_lockit{#1}#4}}{#5}}%
1652 \def\XINT_expr_iter:_omit #1!#2#3~{\XINT_expr_iter:_b }%
1653 \def\XINT_expr_iter:_abort #1!#2#3~#4?#5#6^,%
1654   {\expandafter\xint_gobble_i\romannumeral0\xintapplyunbraced
1655     {\XINT_expr:_unlock}{\xintReverseOrder{#4\space}}}%
1656 \def\XINT_expr_iter:_break #1!#2#3~#4?#5#6^,%
1657   {\expandafter\xint_gobble_iv\romannumeral0\xintapplyunbraced
1658     {\XINT_expr:_unlock}{\xintReverseOrder{#4\space}},#1}%
1659 \def\XINT_expr_iter:_noop ,~#1?#2{\XINT_expr_iter:_b {#1}{#2}}%
1660 \def\XINT_expr_iter:_end ^,~#1?#2%
1661   {\expandafter\xint_gobble_i\romannumeral0\xintapplyunbraced
1662     {\XINT_expr:_unlock}{\xintReverseOrder{#1\space}}}%
1663 \catcode`? 11
1664 \def\XINT_expr_iter:_e #1{%
1665   \if ^#1\xint_dothis\XINT_expr_iter:_abort\fi
1666   \if ?#1\xint_dothis\XINT_expr_iter:_break\fi
1667   \if !#1\xint_dothis\XINT_expr_iter:_omit\fi
1668   \xint_orthat{\XINT_expr_iter:_goon #1}%
1669 }%
1670 \def\XINT_expr:_unlock #1{\XINT_expr_unlock #1}%

```

**10.36.4 \XINT\_expr\_iter:\_A etc...**

*n++ for iter*

```

1671 \catcode`? 3
1672 \def\XINT_expr_iter:_A +#1!#2#3,^,{\XINT_expr_iter:_D {#1}{#3}{#2}}%

```



```

1673 \def\XINT_expr_iter:_D #1#2#3{\expandafter\XINT_expr_iter:_E
1674   \romannumeral-`0\expandafter\XINT_expr_unlock\romannumeral0#3{#1}~#2?{#3}}%
1675 \def\XINT_expr_iter:_Goon #1!#2#3~#4?#5%
1676   {\expandafter\XINT_expr_iter:_D\expandafter{\the\numexpr #3+\xint_c_i\expandafter}%
1677   \expandafter{\romannumeral0\xinttrim{-1}{\XINT_expr_lockit{#1}#4}}{#5}}%
1678 \def\XINT_expr_iter:_Omit #1!#2#3~#4?#5%
1679   {\expandafter\XINT_expr_iter:_D\expandafter{\the\numexpr #3+\xint_c_i}}%
1680 \def\XINT_expr_iter:_Abort #1!#2#3~#4?#5%
1681   {\expandafter\xint_gobble_i\romannumeral0\xintapplyunbraced
1682    {,\XINT_expr:_unlock}{\xintReverseOrder{#4\space}}}%
1683 \def\XINT_expr_iter:_Break #1!#2#3~#4?#5%
1684   {\expandafter\xint_gobble_iv\romannumeral0\xintapplyunbraced
1685    {,\XINT_expr:_unlock}{\xintReverseOrder{#4\space}},#1}%
1686 \catcode`? 11
1687 \def\XINT_expr_iter:_E #1{\if #1^\xint_dothis\XINT_expr_iter:_Abort\fi
1688   \if #1?\xint_dothis\XINT_expr_iter:_Break\fi
1689   \if #1!\xint_dothis\XINT_expr_iter:_Omit\fi
1690   \xint_orthat{\XINT_expr_iter:_Goon #1}}%

```

## 10.37 Macros handling csv lists for functions with multiple comma separated arguments in expressions

These 17 macros are used inside `\csname...\endcsname`. These things are not initiated by a `\romannumeral` in general, but in some cases they are, especially when involved in an `\xintNewExpr`. They will then be protected against expansion and expand only later in contexts governed by an initial `\romannumeral-`0`. There each new item may need to be expanded, which would not be the case in the use for the `_func_` things.

### 10.37.1 `\xintANDof:csv`

1.09a. For use by `\xintexpr` inside `\csname`. 1.1, je remplace `ifTrueAelseB` par `iiNotZero` pour des raisons d'optimisations.

```

1691 \def\xintANDof:csv #1{\expandafter\XINT_andof:_a\romannumeral-`0#1,,^}%
1692 \def\XINT_andof:_a #1{\if ,#1\expandafter\XINT_andof:_e
1693   \else\expandafter\XINT_andof:_c\fi #1}%
1694 \def\XINT_andof:_c #1,{\xintiiifNotZero {#1}{\XINT_andof:_a}{\XINT_andof:_no}}%
1695 \def\XINT_andof:_no #1^{0}%
1696 \def\XINT_andof:_e #1^{1}% works with empty list

```

### 10.37.2 `\xintORof:csv`

1.09a. For use by `\xintexpr`.

```

1697 \def\xintORof:csv #1{\expandafter\XINT_orof:_a\romannumeral-`0#1,,^}%
1698 \def\XINT_orof:_a #1{\if ,#1\expandafter\XINT_orof:_e
1699   \else\expandafter\XINT_orof:_c\fi #1}%
1700 \def\XINT_orof:_c #1,{\xintiiiifNotZero{#1}{\XINT_orof:_yes}{\XINT_orof:_a}}%
1701 \def\XINT_orof:_yes #1^{1}%
1702 \def\XINT_orof:_e #1^{0}% works with empty list

```

### 10.37.3 `\xintXORof:csv`

1.09a. For use by `\xintexpr` (inside a `\csname..\endcsname`).

```

1703 \def\xintXORof:csv #1{\expandafter\XINT_xorof:_a\expandafter 0\romannumeral-`0#1,,^}%
1704 \def\XINT_xorof:_a #1#2,{\XINT_xorof:_b #2,#1}%
1705 \def\XINT_xorof:_b #1{\if ,#1\expandafter\XINT_xorof:_e
1706         \else\expandafter\XINT_xorof:_c\fi #1}%
1707 \def\XINT_xorof:_c #1,#2%
1708         {\xintiiifNotZero {#1}{\if #20\xint_afterfi{\XINT_xorof:_a 1}%
1709         \else\xint_afterfi{\XINT_xorof:_a 0}\fi}%
1710         {\XINT_xorof:_a #2}%
1711         }%
1712 \def\XINT_xorof:_e ,#1#2^{#1}% allows empty list (then returns 0)

```

### 10.37.4 Generic csv routine

1.1. generic routine. up to the loss of some efficiency, especially for `Sum:csv` and `Prod:csv`, where `\XINTinFloat` will be done twice for each argument.

```

1713 \def\XINT_oncsv:_empty #1,^,#2{#2}%
1714 \def\XINT_oncsv:_end ^,#1#2#3#4{#1}%
1715 \def\XINT_oncsv:_a #1#2#3%
1716     {\if ,#3\expandafter\XINT_oncsv:_empty\else\expandafter\XINT_oncsv:_b\fi #1#2#3}%
1717 \def\XINT_oncsv:_b #1#2#3,%
1718     {\expandafter\XINT_oncsv:_c \expandafter{\romannumeral-`0#2{#3}}#1#2}%
1719 \def\XINT_oncsv:_c #1#2#3#4,{\expandafter\XINT_oncsv:_d \romannumeral-`0#4,{#1}{#2#3}%
1720 \def\XINT_oncsv:_d #1%
1721     {\if ^#1\expandafter\XINT_oncsv:_end\else\expandafter\XINT_oncsv:_e\fi #1}%
1722 \def\XINT_oncsv:_e #1,#2#3#4%
1723     {\expandafter\XINT_oncsv:_c\expandafter {\romannumeral-`0#3{#4{#1}}{#2}}#3#4}%

```

### 10.37.5 `\xintMaxof:csv`, `\xintiiMaxof:csv`

1.09i. Rewritten for 1.1. Compatible avec liste vide donnant valeur par défaut. Pas compatible avec items manquants. ah je m'aperçois au dernier moment que je n'ai pas en effet de `\xintiiMax`. Je devrais le rajouter. En tout cas ici c'est uniquement pour `xintiexpr`, dans il faut bien sûr ne pas faire de `xintNum`, donc il faut un `iimax`.

```

1724 \def\xintMaxof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintmax
1725         \expandafter\xint_firstofone\romannumeral-`0#1,{0/1[0]}}%
1726 \def\xintiiMaxof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintiiimax
1727         \expandafter\xint_firstofone\romannumeral-`0#1,{0}%

```

### 10.37.6 `\xintMinof:csv`, `\xintiiMinof:csv`

1.09i. Rewritten for 1.1. For use by `\xintiexpr`.

```

1728 \def\xintMinof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintmin
1729         \expandafter\xint_firstofone\romannumeral-`0#1,{0/1[0]}}%
1730 \def\xintiiMinof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintiiimin
1731         \expandafter\xint_firstofone\romannumeral-`0#1,{0}%

```

### 10.37.7 `\xintSum:csv`, `\xintiiSum:csv`

1.09a. Rewritten for 1.1. For use by `\xintexpr`.

```
1732 \def\xintSum:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintadd
1733         \expandafter\xint_firstofone\romannumeral-`0#1,^{0/1[0]}}%
1734 \def\xintiiSum:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintiiadd
1735         \expandafter\xint_firstofone\romannumeral-`0#1,^{0}%
```

### 10.37.8 `\xintPrd:csv`, `\xintiiPrd:csv`

1.09a. Rewritten for 1.1. For use by `\xintexpr`.

```
1736 \def\xintPrd:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintmul
1737         \expandafter\xint_firstofone\romannumeral-`0#1,^{1/1[0]}}%
1738 \def\xintiiPrd:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintiiimul
1739         \expandafter\xint_firstofone\romannumeral-`0#1,^{1}%
```

### 10.37.9 `\xintGCDof:csv`, `\xintLCMof:csv`

1.09a. Rewritten for 1.1. For use by `\xintexpr`. Expansion réinstaurée pour besoins de `xintNewExpr` de version 1.1

```
1740 \def\xintGCDof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintgcd
1741         \expandafter\xint_firstofone\romannumeral-`0#1,^{1}%
1742 \def\xintLCMof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintlcm
1743         \expandafter\xint_firstofone\romannumeral-`0#1,^{0}%
```

### 10.37.10 `\xintiiGCDof:csv`, `\xintiiLCMof:csv`

1.1a pour `\xintiiexpr`. Ces histoires de ii sont pénibles à la fin.

```
1744 \def\xintiiGCDof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintiigcd
1745         \expandafter\xint_firstofone\romannumeral-`0#1,^{1}%
1746 \def\xintiiLCMof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintii lcm
1747         \expandafter\xint_firstofone\romannumeral-`0#1,^{0}%
```

### 10.37.11 `\XINTinFloatdigits`, `\XINTinFloatSqrtdigits`

for `\xintNewExpr` matters, mainly.

```
1748 \def\XINTinFloatdigits {\XINTinFloat [\XINTdigits]}%
1749 \def\XINTinFloatSqrtdigits {\XINTinFloatSqrt [\XINTdigits]}%
```

### 10.37.12 `\XINTinFloatMaxof:csv`, `\XINTinFloatMinof:csv`

1.09a. Rewritten for 1.1. For use by `\xintfloatexpr`. Name changed in 1.09h

```
1750 \def\XINTinFloatMaxof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintmax
1751         \expandafter\XINTinFloatdigits\romannumeral-`0#1,^{0[0]}}%
1752 \def\XINTinFloatMinof:csv #1{\expandafter\XINT_oncsv:_a\expandafter\xintmin
1753         \expandafter\XINTinFloatdigits\romannumeral-`0#1,^{0[0]}}%
```

### 10.37.13 `\XINTinFloatSum:csv`, `\XINTinFloatPrd:csv`

1.09a. Rewritten for 1.1. For use by `\xintfloatexpr`.

```

1754 \def\XINTinFloatSum:csv #1{\expandafter\XINT_oncsv:_a\expandafter\XINTinfloatadd
1755         \expandafter\XINTinFloatdigits\romannumeral-`0#1,^,{0[0]}}}%
1756 \def\XINTinFloatPrd:csv #1{\expandafter\XINT_oncsv:_a\expandafter\XINTinfloatmul
1757         \expandafter\XINTinFloatdigits\romannumeral-`0#1,^,{1[0]}}}%

```

### 10.38 The `num`, `reduce`, `abs`, `sgn`, `frac`, `floor`, `ceil`, `sqr`, `sqrt`, `sqrtr`, `float`, `round`, `trunc`, `mod`, `quo`, `rem`, `gcd`, `lcm`, `max`, `min`, ``+``, ``*``, `?`, `!`, `not`, `all`, `any`, `xor`, `if`, `ifsgn`, `first`, `last`, `even`, `odd`, and `reversed` functions

```

1758 \def\XINT_expr_twoargs #1,#2,{#{#1}{#2}}}%
1759 \def\XINT_expr_argadopt #1,#2,#3.#4#5%
1760 {%
1761     \if\relax#3\relax\expandafter\xint_firstoftwo\else
1762         \expandafter\xint_secondoftwo\fi
1763     {#4}{#5[\xintNum {#2}]}{#1}%
1764 }%
1765 \def\XINT_expr_oneortwo #1#2#3,#4,#5.%
1766 {%
1767     \if\relax#5\relax\expandafter\xint_firstoftwo\else
1768         \expandafter\xint_secondoftwo\fi
1769     {#1{0}}{#2{\xintNum {#4}}}{#3}%
1770 }%
1771 \def\XINT_iiexpr_oneortwo #1#2,#3,#4.%
1772 {%
1773     \if\relax#4\relax\expandafter\xint_firstoftwo\else
1774         \expandafter\xint_secondoftwo\fi
1775     {#1{0}}{#1{#3}}{#2}%
1776 }%
1777 \def\XINT_expr_func_num #1#2#3%
1778     {\expandafter #1\expandafter #2\csname=\xintNum {\XINT_expr_unlock #3}\endcsname }%
1779 \let\XINT_flexpr_func_num\XINT_expr_func_num
1780 \let\XINT_iiexpr_func_num\XINT_expr_func_num
1781 % [0] added Oct 25. For interaction with SPRaw::csv
1782 \def\XINT_expr_func_reduce #1#2#3%
1783     {\expandafter #1\expandafter #2\csname=\xintIrr {\XINT_expr_unlock #3}[0]\endcsname }%
1784 \let\XINT_flexpr_func_reduce\XINT_expr_func_reduce
1785 % no \XINT_iiexpr_func_reduce
1786 \def\XINT_expr_func_abs #1#2#3%
1787     {\expandafter #1\expandafter #2\csname=\xintAbs {\XINT_expr_unlock #3}\endcsname }%
1788 \let\XINT_flexpr_func_abs\XINT_expr_func_abs
1789 \def\XINT_iiexpr_func_abs #1#2#3%
1790     {\expandafter #1\expandafter #2\csname=\xintiiAbs {\XINT_expr_unlock #3}\endcsname }%
1791 \def\XINT_expr_func_sgn #1#2#3%
1792     {\expandafter #1\expandafter #2\csname=\xintSgn {\XINT_expr_unlock #3}\endcsname }%
1793 \let\XINT_flexpr_func_sgn\XINT_expr_func_sgn
1794 \def\XINT_iiexpr_func_sgn #1#2#3%
1795     {\expandafter #1\expandafter #2\csname=\xintiiSgn {\XINT_expr_unlock #3}\endcsname }%
1796 \def\XINT_expr_func_frac #1#2#3%
1797     {\expandafter #1\expandafter #2\csname=\xintTFrac {\XINT_expr_unlock #3}\endcsname }%

```

```

1798 \def\XINT_flexpr_func_frac #1#2#3{\expandafter #1\expandafter #2\csname
1799   .=\XINTinFloatFracdigits {\XINT_expr_unlock #3}\endcsname }%
1800 % no \XINT_iiexpr_func_frac
1801 \def\XINT_expr_func_floor #1#2#3%
1802   {\expandafter #1\expandafter #2\csname .=\xintFloor {\XINT_expr_unlock #3}\endcsname }%
1803 \let\XINT_flexpr_func_floor\XINT_expr_func_floor
1804 \def\XINT_iiexpr_func_floor #1#2#3%
1805 {% mais absurde si on ne peut pas avoir quotient comme input
1806   \expandafter #1\expandafter #2\csname .=\xintiFloor {\XINT_expr_unlock #3}\endcsname }%
1807 \def\XINT_expr_func_ceil #1#2#3%
1808   {\expandafter #1\expandafter #2\csname .=\xintCeil {\XINT_expr_unlock #3}\endcsname }%
1809 \let\XINT_flexpr_func_ceil\XINT_expr_func_ceil
1810 \def\XINT_iiexpr_func_ceil #1#2#3%
1811 {% mais absurde si on ne peut pas avoir quotient comme input
1812   \expandafter #1\expandafter #2\csname .=\xintiCeil {\XINT_expr_unlock #3}\endcsname }%
1813 \def\XINT_expr_func_sqr #1#2#3%
1814   {\expandafter #1\expandafter #2\csname .=\xintSqr {\XINT_expr_unlock #3}\endcsname }%
1815 \def\XINT_flexpr_func_sqr #1#2#3%
1816 {%
1817   \expandafter #1\expandafter #2\csname
1818     .=\XINTinFloatMul{\XINT_expr_unlock #3}{\XINT_expr_unlock #3}\endcsname
1819 }%
1820 \def\XINT_iiexpr_func_sqr #1#2#3%
1821   {\expandafter #1\expandafter #2\csname .=\xintiiSqr {\XINT_expr_unlock #3}\endcsname }%
1822 \def\XINT_expr_func_sqrt #1#2#3%
1823 {%
1824   \expandafter #1\expandafter #2\csname .=%
1825   \expandafter\XINT_expr_argandopt
1826   \romannumeral-`0\XINT_expr_unlock#3,,.\XINTinFloatSqrtdigits\XINTinFloatSqrt
1827   \endcsname
1828 }%
1829 \let\XINT_flexpr_func_sqrt\XINT_expr_func_sqrt
1830 \def\XINT_iiexpr_func_sqrt #1#2#3%
1831   {\expandafter #1\expandafter #2\csname .=\xintiiSqrt {\XINT_expr_unlock #3}\endcsname }%
1832 \def\XINT_iiexpr_func_sqrtr #1#2#3%
1833   {\expandafter #1\expandafter #2\csname .=\xintiiSqrR {\XINT_expr_unlock #3}\endcsname }%
1834 \def\XINT_expr_func_round #1#2#3%
1835 {%
1836   \expandafter #1\expandafter #2\csname .=%
1837   \expandafter\XINT_expr_oneortwo
1838   \expandafter\xintiRound\expandafter\xintRound
1839   \romannumeral-`0\XINT_expr_unlock #3,,.\endcsname
1840 }%
1841 \let\XINT_flexpr_func_round\XINT_expr_func_round
1842 \def\XINT_iiexpr_func_round #1#2#3%
1843 {%
1844   \expandafter #1\expandafter #2\csname .=%
1845   \expandafter\XINT_iiexpr_oneortwo\expandafter\xintiRound
1846   \romannumeral-`0\XINT_expr_unlock #3,,.\endcsname
1847 }%
1848 \def\XINT_expr_func_trunc #1#2#3%
1849 {%

```

```

1850 \expandafter #1\expandafter #2\csname .=%
1851 \expandafter\XINT_expr_oneortwo
1852 \expandafter\xintiTrunc\expandafter\xintTrunc
1853 \romannumeral-`0\XINT_expr_unlock #3,,.\endcsname
1854 }%
1855 \let\XINT_flexpr_func_trunc\XINT_expr_func_trunc
1856 \def\XINT_iiexpr_func_trunc #1#2#3%
1857 {%
1858 \expandafter #1\expandafter #2\csname .=%
1859 \expandafter\XINT_iiexpr_oneortwo\expandafter\xintiTrunc
1860 \romannumeral-`0\XINT_expr_unlock #3,,.\endcsname
1861 }%
1862 \def\XINT_expr_func_float #1#2#3%
1863 {%
1864 \expandafter #1\expandafter #2\csname .=%
1865 \expandafter\XINT_expr_argandopt
1866 \romannumeral-`0\XINT_expr_unlock #3,,.\XINTinFloatdigits\XINTinFloat
1867 \endcsname
1868 }%
1869 \let\XINT_flexpr_func_float\XINT_expr_func_float
1870 % \XINT_iiexpr_func_float not defined
1871 \def\XINT_expr_func_mod #1#2#3%
1872 {%
1873 \expandafter #1\expandafter #2\csname .=%
1874 \expandafter\expandafter\expandafter\xintMod
1875 \expandafter\XINT_expr_twoargs
1876 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1877 }%
1878 \def\XINT_flexpr_func_mod #1#2#3%
1879 {%
1880 \expandafter #1\expandafter #2\csname .=%
1881 \expandafter\XINTinFloatMod
1882 \romannumeral-`0\expandafter\XINT_expr_twoargs
1883 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1884 }%
1885 \def\XINT_iiexpr_func_mod #1#2#3%
1886 {%
1887 \expandafter #1\expandafter #2\csname .=%
1888 \expandafter\expandafter\expandafter\xintiiMod
1889 \expandafter\XINT_expr_twoargs
1890 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1891 }%
1892 \def\XINT_expr_func_quo #1#2#3%
1893 {%
1894 \expandafter #1\expandafter #2\csname .=%
1895 \expandafter\expandafter\expandafter\xintiQuo
1896 \expandafter\XINT_expr_twoargs
1897 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1898 }%
1899 \let\XINT_flexpr_func_quo\XINT_expr_func_quo
1900 \def\XINT_iiexpr_func_quo #1#2#3%
1901 {%

```

```

1902 \expandafter #1\expandafter #2\csname .=%
1903 \expandafter\expandafter\expandafter\xintiiQuo
1904 \expandafter\XINT_expr_twoargs
1905 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1906 }%
1907 \def\XINT_expr_func_rem #1#2#3%
1908 {%
1909 \expandafter #1\expandafter #2\csname .=%
1910 \expandafter\expandafter\expandafter\xintiRem
1911 \expandafter\XINT_expr_twoargs
1912 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1913 }%
1914 \let\XINT_flexpr_func_rem\XINT_expr_func_rem
1915 \def\XINT_iiexpr_func_rem #1#2#3%
1916 {%
1917 \expandafter #1\expandafter #2\csname .=%
1918 \expandafter\expandafter\expandafter\xintiRem
1919 \expandafter\XINT_expr_twoargs
1920 \romannumeral-`0\XINT_expr_unlock #3,\endcsname
1921 }%
1922 \def\XINT_expr_func_gcd #1#2#3%
1923 {\expandafter #1\expandafter #2\csname
1924 .=\xintGCDof:csv{\XINT_expr_unlock #3}\endcsname }%
1925 \let\XINT_flexpr_func_gcd\XINT_expr_func_gcd
1926 \def\XINT_iiexpr_func_gcd #1#2#3%
1927 {\expandafter #1\expandafter #2\csname
1928 .=\xintiigCDof:csv{\XINT_expr_unlock #3}\endcsname }%
1929 \def\XINT_expr_func_lcm #1#2#3%
1930 {\expandafter #1\expandafter #2\csname
1931 .=\xintLCMof:csv{\XINT_expr_unlock #3}\endcsname }%
1932 \let\XINT_flexpr_func_lcm\XINT_expr_func_lcm
1933 \def\XINT_iiexpr_func_lcm #1#2#3%
1934 {\expandafter #1\expandafter #2\csname
1935 .=\xintiilCMof:csv{\XINT_expr_unlock #3}\endcsname }%
1936 \def\XINT_expr_func_max #1#2#3%
1937 {\expandafter #1\expandafter #2\csname
1938 .=\xintMaxof:csv{\XINT_expr_unlock #3}\endcsname }%
1939 \def\XINT_iiexpr_func_max #1#2#3%
1940 {\expandafter #1\expandafter #2\csname
1941 .=\xintiMaxof:csv{\XINT_expr_unlock #3}\endcsname }%
1942 \def\XINT_flexpr_func_max #1#2#3%
1943 {\expandafter #1\expandafter #2\csname
1944 .=\XINTinFloatMaxof:csv{\XINT_expr_unlock #3}\endcsname }%
1945 \def\XINT_expr_func_min #1#2#3%
1946 {\expandafter #1\expandafter #2\csname
1947 .=\xintMinof:csv{\XINT_expr_unlock #3}\endcsname }%
1948 \def\XINT_iiexpr_func_min #1#2#3%
1949 {\expandafter #1\expandafter #2\csname
1950 .=\xintiMinof:csv{\XINT_expr_unlock #3}\endcsname }%
1951 \def\XINT_flexpr_func_min #1#2#3%
1952 {\expandafter #1\expandafter #2\csname
1953 .=\XINTinFloatMinof:csv{\XINT_expr_unlock #3}\endcsname }%

```



```

1954 \expandafter\def\csname XINT_expr_func_+\endcsname #1#2#3%
1955     {\expandafter #1\expandafter #2\csname
1956         .=\xintSum:csv{\XINT_expr_unlock #3}\endcsname }%
1957 \expandafter\def\csname XINT_flexpr_func_+\endcsname #1#2#3%
1958     {\expandafter #1\expandafter #2\csname
1959         .=\XINTinFloatSum:csv{\XINT_expr_unlock #3}\endcsname }%
1960 \expandafter\def\csname XINT_iiexpr_func_+\endcsname #1#2#3%
1961     {\expandafter #1\expandafter #2\csname
1962         .=\xintiiSum:csv{\XINT_expr_unlock #3}\endcsname }%
1963 \expandafter\def\csname XINT_expr_func_*\endcsname #1#2#3%
1964     {\expandafter #1\expandafter #2\csname
1965         .=\xintPrd:csv{\XINT_expr_unlock #3}\endcsname }%
1966 \expandafter\def\csname XINT_flexpr_func_*\endcsname #1#2#3%
1967     {\expandafter #1\expandafter #2\csname
1968         .=\XINTinFloatPrd:csv{\XINT_expr_unlock #3}\endcsname }%
1969 \expandafter\def\csname XINT_iiexpr_func_*\endcsname #1#2#3%
1970     {\expandafter #1\expandafter #2\csname
1971         .=\xintiiPrd:csv{\XINT_expr_unlock #3}\endcsname }%
1972 \def\XINT_expr_func_? #1#2#3%
1973     {\expandafter #1\expandafter #2\csname
1974         .=\xintiiIsNotZero {\XINT_expr_unlock #3}\endcsname }%
1975 \let\XINT_flexpr_func_? \XINT_expr_func_?
1976 \let\XINT_iiexpr_func_? \XINT_expr_func_?
1977 \def\XINT_expr_func_! #1#2#3%
1978     {\expandafter #1\expandafter #2\csname .=\xintiiIsZero {\XINT_expr_unlock #3}\endcsname }%
1979 \let\XINT_flexpr_func_! \XINT_expr_func_!
1980 \let\XINT_iiexpr_func_! \XINT_expr_func_!
1981 \def\XINT_expr_func_not #1#2#3%
1982     {\expandafter #1\expandafter #2\csname .=\xintiiIsZero {\XINT_expr_unlock #3}\endcsname }%
1983 \let\XINT_flexpr_func_not \XINT_expr_func_not
1984 \let\XINT_iiexpr_func_not \XINT_expr_func_not
1985 \def\XINT_expr_func_all #1#2#3%
1986     {\expandafter #1\expandafter #2\csname
1987         .=\xintANDof:csv{\XINT_expr_unlock #3}\endcsname }%
1988 \let\XINT_flexpr_func_all\XINT_expr_func_all
1989 \let\XINT_iiexpr_func_all\XINT_expr_func_all
1990 \def\XINT_expr_func_any #1#2#3%
1991     {\expandafter #1\expandafter #2\csname
1992         .=\xintORof:csv{\XINT_expr_unlock #3}\endcsname }%
1993 \let\XINT_flexpr_func_any\XINT_expr_func_any
1994 \let\XINT_iiexpr_func_any\XINT_expr_func_any
1995 \def\XINT_expr_func_xor #1#2#3%
1996     {\expandafter #1\expandafter #2\csname
1997         .=\xintXORof:csv{\XINT_expr_unlock #3}\endcsname }%
1998 \let\XINT_flexpr_func_xor\XINT_expr_func_xor
1999 \let\XINT_iiexpr_func_xor\XINT_expr_func_xor
2000 \def\xintifNotZero: #1,#2,#3,{\xintiiifNotZero{#1}{#2}{#3}}%
2001 \def\XINT_expr_func_if #1#2#3%
2002     {\expandafter #1\expandafter #2\csname
2003         .=\expandafter\xintifNotZero:\romannumeral-`0\XINT_expr_unlock #3,\endcsname }%
2004 \let\XINT_flexpr_func_if\XINT_expr_func_if
2005 \let\XINT_iiexpr_func_if\XINT_expr_func_if

```



```

2006 \def\xintifSgn: #1,#2,#3,#4,{\xintiifSgn{#1}{#2}{#3}{#4}}%
2007 \def\XINT_expr_func_ifsgn #1#2#3%
2008 {%
2009     \expandafter #1\expandafter #2\csname
2010         .=\expandafter\xintifSgn:\romannumeral-`0\XINT_expr_unlock #3,\endcsname
2011 }%
2012 \let\XINT_flexpr_func_ifsgn\XINT_expr_func_ifsgn
2013 \let\XINT_iiexpr_func_ifsgn\XINT_expr_func_ifsgn
2014 \def\XINT_expr_func_first #1#2#3%
2015     {\expandafter #1\expandafter #2\csname.=\expandafter\XINT_expr_func_firsta
2016         \romannumeral-`0\XINT_expr_unlock #3,\endcsname }%
2017 \def\XINT_expr_func_firsta #1,#2^{#1}%
2018 \let\XINT_flexpr_func_first\XINT_expr_func_first
2019 \let\XINT_iiexpr_func_first\XINT_expr_func_first
2020 \def\XINT_expr_func_last #1#2#3% will not work in \xintNewExpr if macro param involved
2021     {\expandafter #1\expandafter #2\csname.=\expandafter\XINT_expr_func_lasta
2022         \romannumeral-`0\XINT_expr_unlock #3,\endcsname }%
2023 \def\XINT_expr_func_lasta #1,#2%
2024     {\if ^#2 #1\expandafter\xint_gobble_ii\fi \XINT_expr_func_lasta #2}%
2025 \let\XINT_flexpr_func_last\XINT_expr_func_last
2026 \let\XINT_iiexpr_func_last\XINT_expr_func_last
2027 \def\XINT_expr_func_odd #1#2#3%
2028     {\expandafter #1\expandafter #2\csname.=\xintOdd{\XINT_expr_unlock #3}\endcsname}%
2029 \let\XINT_flexpr_func_odd\XINT_expr_func_odd
2030 \def\XINT_iiexpr_func_odd #1#2#3%
2031     {\expandafter #1\expandafter #2\csname.=\xintiiOdd{\XINT_expr_unlock #3}\endcsname}%
2032 \def\XINT_expr_func_even #1#2#3%
2033     {\expandafter #1\expandafter #2\csname.=\xintEven{\XINT_expr_unlock #3}\endcsname}%
2034 \let\XINT_flexpr_func_even\XINT_expr_func_even
2035 \def\XINT_iiexpr_func_even #1#2#3%
2036     {\expandafter #1\expandafter #2\csname.=\xintiiEven{\XINT_expr_unlock #3}\endcsname}%
2037 \def\XINT_expr_func_nuple #1#2#3%
2038     {\expandafter #1\expandafter #2\csname .=\XINT_expr_unlock #3\endcsname }%
2039 \let\XINT_flexpr_func_nuple\XINT_expr_func_nuple
2040 \let\XINT_iiexpr_func_nuple\XINT_expr_func_nuple
2041 \def\XINT_expr_func_reversed #1#2#3%
2042     {\expandafter #1\expandafter #2\csname .=\xintReversed::csv
2043         {\XINT_expr_unlock #3}\endcsname }%
2044 \let\XINT_flexpr_func_reversed\XINT_expr_func_reversed
2045 \let\XINT_iiexpr_func_reversed\XINT_expr_func_reversed
2046 \def\xintReversed::csv #1% should be done directly, of course
2047     {\xintListWithSep,{\xintRevWithBraces {\xintCSVtoListNonStripped{#1}}}}%

```

## 10.39 f-expandable versions of the SeqB::csv routines, for *\xintNewExpr*

### 10.39.1 *\xintSeqB:f:csv*

Produces in f-expandable way. If the step is zero, gives empty result except if start and end coincide.

```

2048 \def\xintSeqB:f:csv #1#2%
2049     {\expandafter\XINT_seqb:f:csv \expandafter{\romannumeral0\xintra{#2}}{#1}}%
2050 \def\XINT_seqb:f:csv #1#2{\expandafter\XINT_seqb:f:csv_a\romannumeral-`0#2#1!}%
2051 \def\XINT_seqb:f:csv_a #1#2;#3;#4!{%

```

```

2052 \expandafter\xint_gobble_i\romannumeral-\`0%
2053 \xintifCmp {#3}{#4}\XINT_seqb:f:csv_bl\XINT_seqb:f:csv_be\XINT_seqb:f:csv_bg
2054 #1{#3}{#4}{#2}}%
2055 \def\XINT_seqb:f:csv_be #1#2#3#4#5{,#2}%
2056 \def\XINT_seqb:f:csv_bl #1{\if #1p\expandafter\XINT_seqb:f:csv_pa\else
2057 \xint_afterfi{\expandafter,\xint_gobble_iv}\fi }%
2058 \def\XINT_seqb:f:csv_pa #1#2#3#4{\expandafter\XINT_seqb:f:csv_p\expandafter
2059 {\romannumeral0\xintadd{#4}{#1}}{#2}{#3,#1}{#4}}%
2060 \def\XINT_seqb:f:csv_p #1#2%
2061 {%
2062 \xintifCmp {#1}{#2}\XINT_seqb:f:csv_pa\XINT_seqb:f:csv_pb\XINT_seqb:f:csv_pc
2063 {#1}{#2}%
2064 }%
2065 \def\XINT_seqb:f:csv_pb #1#2#3#4{#3,#1}%
2066 \def\XINT_seqb:f:csv_pc #1#2#3#4{#3}%
2067 \def\XINT_seqb:f:csv_bg #1{\if #1n\expandafter\XINT_seqb:f:csv_na\else
2068 \xint_afterfi{\expandafter,\xint_gobble_iv}\fi }%
2069 \def\XINT_seqb:f:csv_na #1#2#3#4{\expandafter\XINT_seqb:f:csv_n\expandafter
2070 {\romannumeral0\xintadd{#4}{#1}}{#2}{#3,#1}{#4}}%
2071 \def\XINT_seqb:f:csv_n #1#2%
2072 {%
2073 \xintifCmp {#1}{#2}\XINT_seqb:f:csv_nc\XINT_seqb:f:csv_nb\XINT_seqb:f:csv_na
2074 {#1}{#2}%
2075 }%
2076 \def\XINT_seqb:f:csv_nb #1#2#3#4{#3,#1}%
2077 \def\XINT_seqb:f:csv_nc #1#2#3#4{#3}%

```

### 10.39.2 \xintiiSeqB:f:csv

Produces in f-expandable way. If the step is zero, gives empty result except if start and end coincide.

```

2078 \def\xintiiSeqb:f:csv #1#2%
2079 {\expandafter\XINT_iiseqb:f:csv \expandafter{\romannumeral-\`0#2}{#1}}%
2080 \def\XINT_iiseqb:f:csv #1#2{\expandafter\XINT_iiseqb:f:csv_a\romannumeral-\`0#2#1!}%
2081 \def\XINT_iiseqb:f:csv_a #1#2;#3;#4!{%
2082 \expandafter\xint_gobble_i\romannumeral-\`0%
2083 \xintSgnFork{\XINT_Cmp {#3}{#4}}%
2084 \XINT_iiseqb:f:csv_bl\XINT_seqb:f:csv_be\XINT_iiseqb:f:csv_bg
2085 #1{#3}{#4}{#2}}%
2086 \def\XINT_iiseqb:f:csv_bl #1{\if #1p\expandafter\XINT_iiseqb:f:csv_pa\else
2087 \xint_afterfi{\expandafter,\xint_gobble_iv}\fi }%
2088 \def\XINT_iiseqb:f:csv_pa #1#2#3#4{\expandafter\XINT_iiseqb:f:csv_p\expandafter
2089 {\romannumeral0\xintiiadd{#4}{#1}}{#2}{#3,#1}{#4}}%
2090 \def\XINT_iiseqb:f:csv_p #1#2%
2091 {%
2092 \xintSgnFork{\XINT_Cmp {#1}{#2}}%
2093 \XINT_iiseqb:f:csv_pa\XINT_iiseqb:f:csv_pb\XINT_iiseqb:f:csv_pc {#1}{#2}%
2094 }%
2095 \def\XINT_iiseqb:f:csv_pb #1#2#3#4{#3,#1}%
2096 \def\XINT_iiseqb:f:csv_pc #1#2#3#4{#3}%
2097 \def\XINT_iiseqb:f:csv_bg #1{\if #1n\expandafter\XINT_iiseqb:f:csv_na\else
2098 \xint_afterfi{\expandafter,\xint_gobble_iv}\fi }%

```

```

2099 \def\XINT_iiseqb:f:csv_na #1#2#3#4{\expandafter\XINT_iiseqb:f:csv_n\expandafter
2100      {\romannumeral0\xintiiadd{#4}{#1}}{#2}{#3,#1}{#4}}%
2101 \def\XINT_iiseqb:f:csv_n #1#2%
2102 {%
2103     \xintSgnFork{\XINT_Cmp {#1}{#2}}%
2104     \XINT_seqb:f:csv_nc\XINT_seqb:f:csv_nb\XINT_iiseqb:f:csv_na {#1}{#2}%
2105 }%

```

### 10.39.3 \XINTinFloatSeqB:f:csv

Produces in f-expandable way. If the step is zero, gives empty result except if start and end coincide. This is all for \xintNewExpr.

```

2106 \def\XINTinFloatSeqB:f:csv #1#2{\expandafter\XINT_flseqb:f:csv \expandafter
2107     {\romannumeral0\XINTinfloat [\XINTdigits]{#2}}{#1}}%
2108 \def\XINT_flseqb:f:csv #1#2{\expandafter\XINT_flseqb:f:csv_a\romannumeral-`0#2#1!}%
2109 \def\XINT_flseqb:f:csv_a #1#2;#3;#4!{%
2110     \expandafter\xint_gobble_i\romannumeral-`0%
2111     \xintifCmp {#3}{#4}\XINT_flseqb:f:csv_bl\XINT_seqb:f:csv_be\XINT_flseqb:f:csv_bg
2112     #1{#3}{#4}}{#2}}%
2113 \def\XINT_flseqb:f:csv_bl #1{\if #1p\expandafter\XINT_flseqb:f:csv_pa\else
2114     \xint_afterfi{\expandafter,\xint_gobble_iv}\fi }%
2115 \def\XINT_flseqb:f:csv_pa #1#2#3#4{\expandafter\XINT_flseqb:f:csv_p\expandafter
2116     {\romannumeral0\XINTinfloatadd{#4}{#1}}{#2}{#3,#1}{#4}}%
2117 \def\XINT_flseqb:f:csv_p #1#2%
2118 {%
2119     \xintifCmp {#1}{#2}%
2120     \XINT_flseqb:f:csv_pa\XINT_flseqb:f:csv_pb\XINT_flseqb:f:csv_pc {#1}{#2}%
2121 }%
2122 \def\XINT_flseqb:f:csv_pb #1#2#3#4{#3,#1}%
2123 \def\XINT_flseqb:f:csv_pc #1#2#3#4{#3}%
2124 \def\XINT_flseqb:f:csv_bg #1{\if #1n\expandafter\XINT_flseqb:f:csv_na\else
2125     \xint_afterfi{\expandafter,\xint_gobble_iv}\fi }%
2126 \def\XINT_flseqb:f:csv_na #1#2#3#4{\expandafter\XINT_flseqb:f:csv_n\expandafter
2127     {\romannumeral0\XINTinfloatadd{#4}{#1}}{#2}{#3,#1}{#4}}%
2128 \def\XINT_flseqb:f:csv_n #1#2%
2129 {%
2130     \xintifCmp {#1}{#2}%
2131     \XINT_seqb:f:csv_nc\XINT_seqb:f:csv_nb\XINT_flseqb:f:csv_na {#1}{#2}%
2132 }%

```

## 10.40 \xintNewExpr, \xintNewIExpr, \xintNewFloatExpr, \xintNewIIExpr

### 10.40.1 \xintApply::csv

Don't ask me what this is for. I wrote it in June, and we are now late October.

```

2133 \def\xintApply::csv #1#2%
2134     {\expandafter\XINT_applyon::_a\expandafter {\romannumeral-`0#2}{#1}}%
2135 \def\XINT_applyon::_a #1#2{\XINT_applyon::_b {#2}}{#1,,}%
2136 \def\XINT_applyon::_b #1#2#3,{\expandafter\XINT_applyon::_c \romannumeral-`0#3,{#1}{#2}}%
2137 \def\XINT_applyon::_c #1{\if #1,\expandafter\XINT_applyon::_end
2138     \else\expandafter\XINT_applyon::_d\fi #1}%

```

```

2139 \def\XINT_applyon::_d #1,#2{\expandafter\XINT_applyon::_e\romannumeral-`0#2{#1},{#2}}%
2140 \def\XINT_applyon::_e #1,#2#3{\XINT_applyon::_b {#2}{#3}, #1}%
2141 \def\XINT_applyon::_end #1,#2#3{\xint_seconddoftwo #3}%

```

#### 10.40.2 \xintApply:::csv

```

2142 \def\xintApply:::csv #1#2#3%
2143   {\expandafter\XINT_applyon::_a\expandafter{\romannumeral-`0#2}{#1}{#3}}%
2144 \def\XINT_applyon::_a #1#2#3{\XINT_applyon::_b {#2}{#3}{#1},,%}
2145 \def\XINT_applyon::_b #1#2#3#4,%
2146   {\expandafter\XINT_applyon::_c \romannumeral-`0#4,{#1}{#2}{#3}}%
2147 \def\XINT_applyon::_c #1{\if #1,\expandafter\XINT_applyon::_end
2148   \else\expandafter\XINT_applyon::_d\fi #1}%
2149 \def\XINT_applyon::_d #1,#2#3%
2150   {\expandafter\XINT_applyon::_e\expandafter
2151    {\romannumeral-`0\xintApply:::csv {#2{#1}}{#3}},{#2}{#3}}%
2152 \def\XINT_applyon::_e #1,#2#3#4{\XINT_applyon::_b {#2}{#3}{#4}, #1}%
2153 \def\XINT_applyon::_end #1,#2#3#4{\xint_seconddoftwo #4}%

```

#### 10.40.3 \XINT\_expr\_RApply:::csv, \XINT\_expr\_LApply:::csv, \XINT\_expr\_RLApply:::csv

The #1 in `_RApply` will start with a `~`. No risk of glueing to previous `~expandafter` during the `\scantokens`.

```

2154 \def\XINT_expr_RApply:::csv #1#2#3#4%
2155   {\xintApply:::csv{~expandafter#1~xint_exchangetwo_keepbraces{#4}}{#3}}%
2156 \def\XINT_expr_LApply:::csv #1#2#3#4{\xintApply:::csv{#1{#3}}{#4}}%
2157 \def\XINT_expr_RLApply:::csv #1#2{\xintApply:::csv{#1}}%

```

#### 10.40.4 Mysterious stuff

actually I dimly remember that the whole point is to allow maximal evaluation as long as macro parameters not encountered. Else it would be easier. `\xintNewIExpr \f [2]{[12] #1+#2+3*6*1}` will correctly compute the 18.

1.1a re-establishes the trick with `\toks0\expandafter{\the\toks0\expandafter etc...}` with `*no*` space after 0. I don't know why it was removed at some point before releasing 1.1, but `\XINT_expr_redefinemacros` is even bigger without the trick.

```

2158 \catcode`~ 12 % by the way, catcode is set to 3 in \XINTsetupcatcodes
2159 \catcode`$ 12 % $
2160 \def\XINT_xptwo_getab_b #1#2!#3%
2161   {\expandafter\XINT_xptwo_getab_c\romannumeral-`0#3!#1{#1#2}}%
2162 \def\XINT_xptwo_getab_c #1#2!#3#4#5#6{#1#3{#5}{#6}{#1#2}{#4}}%
2163 \def\xint_ddfork #1$#2#3\krof {#2}% $$
2164 \def\XINT_NEfork #1#2{\xint_ddfork
2165   #1#2\XINT_expr_RLApply:::csv
2166   #1$\XINT_expr_RApply:::csv% $
2167   $#2\XINT_expr_LApply:::csv% $
2168   $${\XINT_NEfork_nn #1#2}% $$
2169   \krof }%
2170 \def\XINT_NEfork_nn #1#2#3#4{%
2171   \if #1##\xint_dothis{#3}\fi
2172   \if #1~\xint_dothis{#3}\fi
2173   \if #2##\xint_dothis{#3}\fi

```

```

2174     \if #2~\xint_dothis{#3}\fi
2175     \xint_orthat {\csname #4NE\endcsname }%
2176     }%
2177 \def\XINT_NEfork_one #1#2!#3#4#5#6{%
2178     \if ###1\xint_dothis {#3}\fi
2179     \if ~#1\xint_dothis {#3}\fi
2180     \if $#1\xint_dothis {\xintApply::csv{#3#5}}\fi %$
2181     \xint_orthat {\csname #4NE\endcsname #6}{#1#2}%
2182 }%
2183 \toks0 {}%
2184 \xintFor #1 in {DivTrunc,iiDivTrunc,iiDivRound,Mod,iiMod,iRound,Round,iTrunc,Trunc,%
2185     Lt,Gt,Eq,LtorEq,GtorEq,Neq,AND,OR,XOR,iQuo,iRem,Add,Sub,Mul,Div,Pow,E,%
2186     iiAdd,iiSub,iiMul,iiPow,iiQuo,iiRem,iiE,SeqA::csv,iiSeqA::csv}\do
2187 {\toks0
2188     \expandafter{\the\toks0% no space! (makes shorter macro in the end)
2189     \expandafter\let\csname xint#1NE\expandafter\endcsname\csname xint#1\expandafter
2190     \endcsname\expandafter\def\csname xint#1\endcsname #####1####2{%
2191         \expandafter\XINT_NEfork
2192         \romannumeral-`0\expandafter\XINT_xptwo_getab_b
2193         \romannumeral-`0####2!{#####1}{~xint#1}{xint#1}}%
2194     }%
2195 }% cela aurait-il un sens d'ajouter Raw et iNum (à cause de qint, qfrac,
2196 % qfloat?). Pas le temps d'y réfléchir. Je ne fais rien.
2197 \xintFor #1 in {Num,Irr,Abs,iiAbs,Sgn,iiSgn,TFrac,Floor,iFloor,Ceil,iCeil,%
2198     Sqr,iiSqr,iiSqrt,iiSqrtR,iiIsZero,iiIsNotZero,iiifNotZero,iiifSgn,%
2199     Odd,Even,iiOdd,iiEven,Opp,iiOpp,iiifZero,Fac,iiFac,Bool,Toggle}\do
2200 {\toks0
2201     \expandafter{\the\toks0%
2202     \expandafter\let\csname xint#1NE\expandafter\endcsname\csname xint#1\expandafter
2203     \endcsname\expandafter\def\csname xint#1\endcsname #####1{%
2204         \expandafter\XINT_NEfork_one\romannumeral-`0####1!{~xint#1}{xint#1}{}}}%
2205     }%
2206 }%
2207 \toks0
2208     \expandafter{\the\toks0
2209     \let\XINTinFloatFacNE\XINTinFloatFac
2210     \def\XINTinFloatFac ##1{%
2211         \expandafter\XINT_NEfork_one
2212         \romannumeral-`0##1!{~XINTinFloatFac}{XINTinFloatFac}{}}}%
2213     }%
2214 \xintFor #1 in {Add,Sub,Mul,Div,Power,E,Mod,SeqA::csv}\do
2215 {\toks0
2216     \expandafter{\the\toks0%
2217     \expandafter\let\csname XINTinFloat#1NE\expandafter\endcsname
2218         \csname XINTinFloat#1\expandafter\endcsname
2219     \expandafter\def\csname XINTinFloat#1\endcsname #####1####2{%
2220         \expandafter\XINT_NEfork
2221         \romannumeral-`0\expandafter\XINT_xptwo_getab_b
2222         \romannumeral-`0####2!{#####1}{~XINTinFloat#1}{XINTinFloat#1}}%
2223     }%
2224 }%
2225 \xintFor #1 in {XINTinFloatdigits,XINTinFloatFracdigits,XINTinFloatSqrtdigits}\do

```

```

2226 {\toks0
2227   \expandafter{\the\toks0%
2228   \expandafter\let\csname #1NE\expandafter\endcsname\csname #1\expandafter
2229   \endcsname\expandafter\def\csname #1\endcsname ####1{\expandafter
2230     \XINT_NEfork_one\romannumeral-`0####1!{~#1}{#1}{}}}%
2231   }%
2232 }%
2233 \xintFor #1 in {xintSeq::csv,xintiiSeq::csv,XINTinFloatSeq::csv}\do
2234 {\toks0
2235   \expandafter{\the\toks0% no space
2236   \expandafter\let\csname #1NE\expandafter\endcsname\csname #1\expandafter
2237   \endcsname\expandafter\def\csname #1\endcsname ####1####2{%
2238     \expandafter\XINT_NEfork
2239     \romannumeral-`0\expandafter\XINT_xptwo_getab_b
2240     \romannumeral-`0####2!{####1}{$noexpand$#1}{#1}}}%
2241   }%
2242 }%
2243 \xintFor #1 in {xintSeqB,xintiiSeqB,XINTinFloatSeqB}\do
2244 {\toks0
2245   \expandafter{\the\toks0% no space
2246   \expandafter\let\csname #1::csvNE\expandafter\endcsname\csname #1::csv\expandafter
2247   \endcsname\expandafter\def\csname #1::csv\endcsname ####1####2{%
2248     \expandafter\XINT_NEfork
2249     \romannumeral-`0\expandafter\XINT_xptwo_getab_b
2250     \romannumeral-`0####2!{####1}{$noexpand$#1:f:csv}{#1::csv}}}%
2251   }%
2252 }%
2253 \toks0
2254   \expandafter{\the\toks0
2255   \let\XINTinFloatNE\XINTinFloat
2256   \def\XINTinFloat [##1]##2{% not ultimately general, but got tired
2257     \expandafter\XINT_NEfork_one
2258     \romannumeral-`0##2!{~XINTinFloat[##1]}{XINTinFloat}{}[##1]}}%
2259   \let\XINTinFloatSqrtNE\XINTinFloatSqrt
2260   \def\XINTinFloatSqrt [##1]##2{%
2261     \expandafter\XINT_NEfork_one
2262     \romannumeral-`0##2!{~XINTinFloatSqrt[##1]}{XINTinFloatSqrt}{}[##1]}}%
2263 }%
2264 \xintFor #1 in {ANDof,ORof,XORof,iiMaxof,iiMinof,iiSum,iiPrd,
2265               GCDof,LCMof,Sum,Prd,Maxof,Minof}\do
2266 {\toks0
2267   \expandafter{\the\toks0\expandafter\def\csname xint#1:csv\endcsname {~xint#1:csv}}%
2268 }%
2269 \xintFor #1 in {XINTinFloatMaxof,XINTinFloatMinof,XINTinFloatSum,XINTinFloatPrd}\do
2270 {\toks0
2271   \expandafter{\the\toks0\expandafter\def\csname #1:csv\endcsname {~#1:csv}}%
2272 }%
2273 \expandafter\def\expandafter\XINT_expr_redefinmacros\expandafter
2274 {\the\toks0
2275   \def\XINT_flexpr_noopt {\expandafter\XINT_flexpr_withopt_b\expandafter-%
2276     \romannumeral0\xintbarefloateval }%
2277   \def\XINT_flexpr_withopt_b ##1##2%

```

```

2278     {\expandafter\XINT_flexpr_wrap\csname .;##1.=\XINT_expr_unlock ##2\endcsname }%
2279 \def\XINT_expr_unlock_sp ##1.;##2##3.=##4!{\if -##2\expandafter\xint_firstoftwo
2280     \else\expandafter\xint_secondoftwo\fi \XINTdigits{{##2##3}}{{##4}}}%
2281 \def\XINT_expr_print ##1{\expandafter\xintSPRaw::csv\expandafter
2282     {\romannumeral-`0\XINT_expr_unlock ##1}}%
2283 \def\XINT_iexpr_print ##1{\expandafter\xintCSV::csv\expandafter
2284     {\romannumeral-`0\XINT_expr_unlock ##1}}%
2285 \def\XINT_boolexpr_print ##1{\expandafter\xintIsTrue::csv\expandafter
2286     {\romannumeral-`0\XINT_expr_unlock ##1}}%
2287 \def\xintCSV::csv {\xintCSV::csv }% spaces to separate from possible catcode 11
2288 \def\xintSPRaw::csv {\xintSPRaw::csv }% stuff after
2289 \def\xintPFloat::csv {\xintPFloat::csv }%
2290 \def\xintIsTrue::csv {\xintIsTrue::csv }%
2291 \def\xintRound::csv {\xintRound::csv }%

\def\XINTinFloat::csv {\xintinFloat::csv } should not be needed.

2292 \def\xintReversed::csv {\xintReversed::csv }%
2293 \def\xintListSel::csv {\xintListSel::csv }%
2294 }%
2295 \toks0 {}%
2296 \def\xintNewExpr {\xint_NewExpr\xinttheexpr }%
2297 \def\xintNewFloatExpr {\xint_NewExpr\xintthefloatexpr }%
2298 \def\xintNewIExpr {\xint_NewExpr\xinttheiexpr }%
2299 \def\xintNewIIExpr {\xint_NewExpr\xinttheiiexpr }%
2300 \def\xintNewBoolExpr {\xint_NewExpr\xinttheboolexpr }%

2301 \def\XINT_newexpr_finish #1>{\noexpand\romannumeral-`0}%
2302 \def\xint_NewExpr #1#2[#3]%
2303 {%
2304 \begingroup
2305     \ifcase #3\relax
2306         \toks0 {\xdef #2}%
2307     \or \toks0 {\xdef #2##1}%
2308     \or \toks0 {\xdef #2##1##2}%
2309     \or \toks0 {\xdef #2##1##2##3}%
2310     \or \toks0 {\xdef #2##1##2##3##4}%
2311     \or \toks0 {\xdef #2##1##2##3##4##5}%
2312     \or \toks0 {\xdef #2##1##2##3##4##5##6}%
2313     \or \toks0 {\xdef #2##1##2##3##4##5##6##7}%
2314     \or \toks0 {\xdef #2##1##2##3##4##5##6##7##8}%
2315     \or \toks0 {\xdef #2##1##2##3##4##5##6##7##8##9}%
2316     \fi
2317     \xintexprSafeCatcodes
2318     \XINT_NewExpr #1%
2319 }%
2320 \catcode`~ 13 \catcode`@ 14 \catcode`\% 6 \catcode`# 12 \catcode`$ 11 @ $
2321 \def\XINT_NewExpr %1%2@
2322 {@
2323     \def\XINT_tmpa %1%1%2%3%4%5%6%7%8%9%2}@
2324     \XINT_expr_redefinmacros
2325     \def~{$noexpand$}@
2326     \catcode`_ 11 \catcode`_ 11
2327     \catcode`# 12 \catcode`~ 13 \escapechar 126

```



```

2328 \endlinechar -1 \everyeof {\noexpand }@
2329 \edef\XINT_tmpb
2330 {\scantokens\expandafter
2331 {\romannumeral-`0\expandafter%1\XINT_tmpa {#1}{#2}{#3}{#4}{#5}{#6}{#7}{#8}{#9}\relax}@
2332 }@
2333 \escapechar 92 \catcode`# 6 \catcode`$ 0 @ $
2334 \the\toks0
2335 {\scantokens\expandafter{\expandafter\XINT_newexpr_finish\meaning\XINT_tmpb}}@
2336 \endgroup
2337 }@
2338 \catcode`% 14
2339 \let\xintexprRestoreCatcodes\empty
2340 \def\xintexprSafeCatcodes
2341 {%
2342 \edef\xintexprRestoreCatcodes {%
2343 \catcode59=\the\catcode59 % ;
2344 \catcode34=\the\catcode34 % "
2345 \catcode63=\the\catcode63 % ?
2346 \catcode124=\the\catcode124 % |
2347 \catcode38=\the\catcode38 % &
2348 \catcode33=\the\catcode33 % !
2349 \catcode93=\the\catcode93 % ]
2350 \catcode91=\the\catcode91 % [
2351 \catcode94=\the\catcode94 % ^
2352 \catcode95=\the\catcode95 % _
2353 \catcode47=\the\catcode47 % /
2354 \catcode41=\the\catcode41 % )
2355 \catcode40=\the\catcode40 % (
2356 \catcode42=\the\catcode42 % *
2357 \catcode43=\the\catcode43 % +
2358 \catcode62=\the\catcode62 % >
2359 \catcode60=\the\catcode60 % <
2360 \catcode58=\the\catcode58 % :
2361 \catcode46=\the\catcode46 % .
2362 \catcode45=\the\catcode45 % -
2363 \catcode44=\the\catcode44 % ,
2364 \catcode61=\the\catcode61 % =
2365 \catcode32=\the\catcode32\relax % space
2366 }%
2367 \catcode59=12 % ;
2368 \catcode34=12 % "
2369 \catcode63=12 % ?
2370 \catcode124=12 % |
2371 \catcode38=4 % &
2372 \catcode33=12 % !
2373 \catcode93=12 % ]
2374 \catcode91=12 % [
2375 \catcode94=7 % ^
2376 \catcode95=8 % _
2377 \catcode47=12 % /
2378 \catcode41=12 % )
2379 \catcode40=12 % (

```



```

2380      \catcode42=12 % *
2381      \catcode43=12 % +
2382      \catcode62=12 % >
2383      \catcode60=12 % <
2384      \catcode58=12 % :
2385      \catcode46=12 % .
2386      \catcode45=12 % -
2387      \catcode44=12 % ,
2388      \catcode61=12 % =
2389      \catcode32=10 % space
2390 }%
2391 \let\XINT_tmpa\relax \let\XINT_tmpb\relax \let\XINT_tmppc\relax
2392 \XINT_restorecatcodes_endinput%

xintkernel: 277. Total number of code lines: 12579. Among those, release 1.2
xinttools:1044. has about 3000 lines starting with either {% or }%.
xintcore:2121. Each package starts with circa 50 lines dealing with cat-
xint:1407. codes, package identification and reloading management,
xintbinhex: 631. also for Plain TeX. Version 1.2 of 2015/10/10.
xintgcd: 455.
xintfrac:2845.
xintseries: 386.
xintcfraction:1021.
xintexpr:2392.

```