

The intcalc package

Heiko Oberdiek
<oberdiek@uni-freiburg.de>

2007/09/27 v1.1

Abstract

This package provides expandable arithmetic operations with integers.

Contents

1	Documentation	2
1.1	Introduction	2
1.2	Conditions	2
1.2.1	Preconditions	2
1.2.2	Postconditions	3
1.3	Error handling	3
1.4	Operations	3
1.4.1	Num	3
1.4.2	Inv, Abs, Sgn	4
1.4.3	Min, Max, Cmp	4
1.4.4	Inc, Dec, Add, Sub	5
1.4.5	Shl, Shr	5
1.4.6	Mul, Sqr, Fac, Pow	5
1.4.7	Div, Mod	6
1.5	Interface for programmer	6
2	Implementation	7
2.1	Reload check and package identification	7
2.2	Catcodes	8
2.3	Macros independent of ε -TeX	9
2.3.1	Abs, Sgn	9
2.3.2	Min, Max, Cmp	9
2.3.3	Fac	10
2.4	Implementation based on ε -TeX	10
2.4.1	Num	11
2.4.2	Inv, Abs, Sgn	11
2.4.3	Min, Max, Cmp	11
2.4.4	Inc, Dec	11
2.4.5	Add, Sub	12
2.4.6	Shl, Shr	12
2.4.7	Mul, Sqr, Fac	13
2.4.8	Pow	13
2.4.9	Div, Mod	14
2.5	Implementation without ε -TeX	17
2.5.1	Num	17
2.5.2	Inv, Abs, Sgn	17
2.5.3	Min, Max, Cmp	17
2.5.4	Inc, Dec	18
2.5.5	Add, Sub	20

2.5.6	Shl, Shr	27
2.5.7	\InCa@Tim	29
2.5.8	Mul	32
2.5.9	Sqr, Fac	34
2.5.10	Pow	34
2.5.11	Div	36
2.5.12	Mod	39
2.5.13	Help macros	41
3	Test	41
3.1	Catcode checks for loading	41
3.2	Macro tests	42
3.2.1	Preamble with test macro definitions	42
3.2.2	Time	46
3.2.3	Test 4: additional mod/div operations	46
3.2.4	Test sets	47
4	Installation	56
4.1	Download	56
4.2	Bundle installation	56
4.3	Package installation	56
4.4	Refresh file name databases	57
4.5	Some details for the interested	57
5	History	57
	[2007/09/09 v1.0]	57
	[2007/09/27 v1.1]	57
6	Index	58

1 Documentation

1.1 Introduction

Package `intcalc` defines arithmetic operations that deal with integers. Integers mean numbers in \TeX . The same restrictions apply, the range is limited to `[-2147483647, 2147483647]`.

The operations have the form of macros that take one or two integers as parameter and return the integer result. The macro name is a three letter operation name prefixed by the package name, e.g. `\intcalcAdd{10}{43}` returns 53.

The macros are fully expandable, exactly two expansion steps generate the result. Therefore the operations may be used nearly everywhere in \TeX , even inside `\number`, `\csname`, file names, or other expandable contexts.

The package contains two implementations of the operations. If $\varepsilon\text{-}\text{\TeX}$ is detected then the macros are implemented using its features (`\numexpr`). Otherwise the slower implementation without $\varepsilon\text{-}\text{\TeX}$'s help is choosen.

1.2 Conditions

1.2.1 Preconditions

- Arguments can be anything that \TeX interprets as “number”. Examples: plain numbers, count or length register, macros that expands to a number.
- The arguments are limited to the range -2147483647 until 2147483647. These numbers belong to the range. Note that some operations have additional restrictions to the range.

- The argument may be expressions that `\numexpr` understands if ε -TeX is available.
- The resulting number must fit in the allowed range.

1.2.2 Postconditions

Additional properties of the macros apart from calculating a correct result (of course ☺):

- The macros are fully expandable. Thus they can be used inside `\edef`, `\csname`, after `\number`, for example.
- Furthermore exactly two expansion steps calculate the result.
- The number consists of one optional minus sign and one to ten digits. The first digit is larger than zero for numbers that consists of more than one digit.

In short, the number format is exactly the same as `\number` generates. And the tokens (minus sign, digits) have catcode 12 (other).

- Call by value is simulated. First the arguments are converted to numbers. Then these numbers are used in the calculations.

Remember that arguments may contain expensive macros or ε -TeX expressions. This strategy avoids multiple evaluations of such arguments.

1.3 Error handling

There are two kinds of errors if a precondition is violated: Some errors are detected by the macros, example: division by zero. In this cases an undefined control sequence is called and causes a TeX error message, example: `\IntCalcError:DivisionByZero`. The name of the control sequence contains the reason for the error. The TeX error may be ignored. Then the operation returns zero as result. Because the macros are supposed to work in expandible contexts. An traditional error message, however, is not expandable and would break these contexts.

If a number exceeds the range of -2147483647 until 2147483647, then TeX throws an error “Number too big” and recovers by using biggest allowed value. Example for the negative number -3000000000 is replaced by -2147483647.

1.4 Operations

Some definition equations below use the function `Int` that converts a real number to an integer. The number is truncated that means rounding to zero:

$$\text{Int}(x) := \begin{cases} \lfloor x \rfloor & \text{if } x \geq 0 \\ \lceil x \rceil & \text{otherwise} \end{cases}$$

1.4.1 Num

`\intcalcNum {⟨x⟩}`

Macro `\intcalcNum` converts its argument to a normalized integer number without unnecessary leading zeros or signs. The result matches the regular expression:

`0|-?[1-9][0-9]*`

1.4.2 Inv, Abs, Sgn

`\intcalcInv {⟨x⟩}`

Macro `\intcalcInv` switches the sign.

$$\text{Inv}(x) := -x$$

`\intcalcAbs {⟨x⟩}`

Macro `\intcalcAbs` returns the absolute value of integer $\langle x \rangle$.

$$\text{Abs}(x) := |x|$$

`\intcalcSgn {⟨x⟩}`

Macro `\intcalcSgn` encodes the sign of $\langle x \rangle$ as number.

$$\text{Sgn}(x) := \begin{cases} -1 & \text{if } x < 0 \\ 0 & \text{if } x = 0 \\ 1 & \text{if } x > 0 \end{cases}$$

These return values can easily be distinguished by `\ifcase`:

```
\ifcase\intcalcSgn{<x>}
  $x=0$
\or
  $x>0$
\else
  $x<0$
\fi
```

1.4.3 Min, Max, Cmp

`\intcalcMin {⟨x⟩} {⟨y⟩}`

Macro `\intcalcMin` returns the smaller of the two integers.

$$\text{Min}(x, y) := \begin{cases} x & \text{if } x < y \\ y & \text{otherwise} \end{cases}$$

`\intcalcMax {⟨x⟩} {⟨y⟩}`

Macro `\intcalcMax` returns the larger of the two integers.

$$\text{Max}(x, y) := \begin{cases} x & \text{if } x > y \\ y & \text{otherwise} \end{cases}$$

`\intcalcCmp {⟨x⟩} {⟨y⟩}`

Macro `\intcalcCmp` encodes the comparison result as number:

$$\text{Cmp}(x, y) := \begin{cases} -1 & \text{if } x < y \\ 0 & \text{if } x = y \\ 1 & \text{if } x > y \end{cases}$$

These values can be distinguished by `\ifcase`:

```

\ifcase\intcalcCmp{<x>}{<y>}
  $x=y$
\or
  $x>y$
\else
  $x<y$
\fi

```

1.4.4 Inc, Dec, Add, Sub

`\intcalcInc {<x>}`

Macro `\intcalcInc` increments $\langle x \rangle$ by one.

$$\text{Inc}(x) := x + 1$$

`\intcalcDec {<x>}`

Macro `\intcalcDec` decrements $\langle x \rangle$ by one.

$$\text{Dec}(x) := x - 1$$

`\intcalcAdd {<x>} {<y>}`

Macro `\intcalcAdd` adds the two numbers.

$$\text{Add}(x, y) := x + y$$

`\intcalcSub {<x>} {<y>}`

Macro `\intcalcSub` calculates the difference.

$$\text{Sub}(x, y) := x - y$$

1.4.5 Shl, Shr

`\intcalcShl {<x>}`

Macro `\intcalcShl` implements shifting to the left that means the number is multiplied by two. Overflow is possible. The sign is preserved.

$$\text{Shl}(x) := x * 2$$

`\intcalcShr {<x>}`

Macro `\intcalcShr` implements shifting to the right. That is equivalent to an integer division by two. The sign is preserved.

$$\text{Shr}(x) := \text{Int}(x/2)$$

1.4.6 Mul, Sqr, Fac, Pow

`\intcalcMul {<x>} {<y>}`

Macro `\intcalcMul` calculates the product of $\langle x \rangle$ and $\langle y \rangle$.

$$\text{Mul}(x, y) := x * y$$

`\intcalcSqr {⟨x⟩}`

Macro `\intcalcSqr` returns the square product.

$$\text{Sqr}(x) := x^2$$

`\intcalcFac {⟨x⟩}`

Macro `\intcalcFac` returns the factorial of $\langle x \rangle$. Negative numbers are not permitted.

$$\text{Fac}(x) := x! \quad \text{for } x \geq 0$$

$$(0! = 1)$$

`\intcalcPow Mx My`

Macro `\intcalcPow` calculates the value of $\langle x \rangle$ to the power of $\langle y \rangle$. The error “division by zero” is thrown if $\langle x \rangle$ is zero and $\langle y \rangle$ is negative. permitted:

$$\text{Pow}(x, y) := \text{Int}(x^y) \quad \text{for } x \neq 0 \text{ or } y \geq 0$$

$$(0^0 = 1)$$

1.4.7 Div, Mul

`\intcalcDiv {⟨x⟩} {⟨y⟩}`

Macro `\intcalcDiv` performs an integer division. Argument $\langle y \rangle$ must not be zero.

$$\text{Div}(x, y) := \text{Int}(x/y) \quad \text{for } y \neq 0$$

`\intcalcMod {⟨x⟩} {⟨y⟩}`

Macro `\intcalcMod` gets the remainder of the integer division. The sign follows the divisor $\langle y \rangle$. Argument $\langle y \rangle$ must not be zero.

$$\text{Mod}(x, y) := x \% y \quad \text{for } y \neq 0$$

The result ranges:

$$\begin{aligned} -|y| < \text{Mod}(x, y) \leq 0 & \quad \text{for } y < 0 \\ 0 \leq \text{Mod}(x, y) < y & \quad \text{for } y \geq 0 \end{aligned}$$

1.5 Interface for programmer

If the programmer can ensure some more properties about the arguments of the operations, then the following macros are a little more efficient.

In general numbers must obey the following constraints:

- Plain number: digit tokens only, no command tokens.
- Non-negative. Signs are forbidden.
- Arguments and the result must fit in range `0..2147483647`.
- Delimited by exclamation mark. Curly braces around the number are not allowed and will break the code.

`\IntCalcInc $\langle number \rangle$!`

Incrementation, range: 0..2147483646.

`\IntCalcDec $\langle number \rangle$!`

Decrementation, range: 1..2147483647.

`\IntCalcAdd $\langle number A \rangle$! $\langle number B \rangle$!`

Addition, $A \geq B$.

`\IntCalcSub $\langle number A \rangle$! $\langle number B \rangle$!`

Subtraction, $A \geq B$.

`\IntCalcShl $\langle number \rangle$!`

Left shift (multiplication with two), range: 0..1073741823.

`\IntCalcShr $\langle number \rangle$!`

Right shift (integer division by two).

`\IntCalcMul $\langle number A \rangle$! $\langle number B \rangle$!`

Multiplication, $A \geq B$.

`\IntCalcDiv $\langle number A \rangle$! $\langle number B \rangle$!`

Division operation.

`\IntCalcMod $\langle number A \rangle$! $\langle number B \rangle$!`

Modulo operation.

2 Implementation

1 `*package`

2.1 Reload check and package identification

Reload check, especially if the package is not used with L^AT_EX.

```
2 \begingroup
3 \catcode44 12 % ,
4 \catcode45 12 % -
5 \catcode46 12 % .
6 \catcode58 12 % :
7 \catcode64 11 % @
8 \expandafter\let\expandafter\x\csname ver@intcalc.sty\endcsname
9 \ifcase 0%
10 \ifx\x\relax % plain
11 \else
12 \ifx\x\empty % LaTeX
13 \else
```

```

14      1%
15      \fi
16      \fi
17      \else
18      \catcode35 6 % #
19      \catcode123 1 % {
20      \catcode125 2 % }
21      \expandafter\ifx\csname PackageInfo\endcsname\relax
22      \def\x#1#2{%
23      \immediate\write-1{Package #1 Info: #2.}%
24      }%
25      \else
26      \def\x#1#2{\PackageInfo{#1}{#2, stopped}}%
27      \fi
28      \x{intcalc}{The package is already loaded}%
29      \endgroup
30      \expandafter\endinput
31      \fi
32 \endgroup

```

Package identification:

```

33 \begingroup
34 \catcode35 6 % #
35 \catcode40 12 % (
36 \catcode41 12 % )
37 \catcode44 12 % ,
38 \catcode45 12 % -
39 \catcode46 12 % .
40 \catcode47 12 % /
41 \catcode58 12 % :
42 \catcode64 11 % @
43 \catcode123 1 % {
44 \catcode125 2 % }
45 \expandafter\ifx\csname ProvidesPackage\endcsname\relax
46 \def\x#1#2#3[#4]{\endgroup
47 \immediate\write-1{Package: #3 #4}%
48 \xdef#1{#4}%
49 }%
50 \else
51 \def\x#1#2[#3]{\endgroup
52 #2[#{#3}]%
53 \ifx#1\relax
54 \xdef#1{#3}%
55 \fi
56 }%
57 \fi
58 \expandafter\x\csname ver@intcalc.sty\endcsname
59 \ProvidesPackage{intcalc}%
60 [2007/09/27 v1.1 Expandable integer calculations (H0)]

```

2.2 Catcodes

```

61 \begingroup
62 \catcode123 1 % {
63 \catcode125 2 % }
64 \def\x{\endgroup
65 \expandafter\edef\csname InCa@AtEnd\endcsname{%
66 \catcode35 \the\catcode35\relax
67 \catcode64 \the\catcode64\relax
68 \catcode123 \the\catcode123\relax
69 \catcode125 \the\catcode125\relax
70 }%
71 }%

```



```

72 \x
73 \catcode35 6 % #
74 \catcode64 11 % @
75 \catcode123 1 % {
76 \catcode125 2 % }
77 \def\TMP@EnsureCode#1#2{%
78   \edef\InCa@AtEnd{%
79     \InCa@AtEnd
80     \catcode#1 \the\catcode#1\relax
81   }%
82   \catcode#1 #2\relax
83 }
84 \TMP@EnsureCode{33}{12}% !
85 \TMP@EnsureCode{40}{12}% (
86 \TMP@EnsureCode{41}{12}% )
87 \TMP@EnsureCode{42}{12}% *
88 \TMP@EnsureCode{43}{12}% +
89 \TMP@EnsureCode{45}{12}% -
90 \TMP@EnsureCode{47}{12}% /
91 \TMP@EnsureCode{58}{11}% : (letter!)
92 \TMP@EnsureCode{60}{12}% <
93 \TMP@EnsureCode{61}{12}% =
94 \TMP@EnsureCode{62}{12}% >
95 \TMP@EnsureCode{63}{14}% ? (comment!)
96 \begingroup\expandafter\expandafter\expandafter\endgroup
97 \expandafter\ifx\csname InCa@TestMode\endcsname\relax
98 \else
99   \catcode63=9 % ? (ignore)
100 \fi
101 ? \let\InCa@@TestMode\InCa@TestMode

```

2.3 Macros independent of ε -TeX

2.3.1 Abs, Sgn

\InCa@Abs

```

102 \def\InCa@Abs#1#2!{%
103   \ifx#1-%
104     #2%
105   \else
106     #1#2%
107   \fi
108 }

```

\InCa@Sgn

```

109 \def\InCa@Sgn#1#2!{%
110   \ifx#1-%
111     -1%
112   \else
113     \ifx#10%
114       0%
115     \else
116       1%
117     \fi
118   \fi
119 }

```

2.3.2 Min, Max, Cmp

\InCa@Min

```

120 \def\InCa@Min#1#2!{%
121   \ifnum#1<#2 %
122     #1%

```

```

123   \else
124     #2%
125   \fi
126 }

\InCa@Max

127 \def\InCa@Max#1!#2!{%
128   \ifnum#1>#2 %
129     #1%
130   \else
131     #2%
132   \fi
133 }

\InCa@Cmp

134 \def\InCa@Cmp#1!#2!{%
135   \ifnum#1=#2 %
136     0%
137   \else
138     \ifnum#1<#2 %
139       -%
140     \fi
141     1%
142   \fi
143 }

```

2.3.3 Fac

\InCa@Fac It does not make much sense to calculate the faculty by an general algorithm. The allowed range of arguments is too low because of the limited integer domain.

```

144 \def\InCa@Fac#1!{%
145   \ifcase#1 1% 0!
146   \or 1% 1!
147   \or 2% 2!
148   \or 6% 3!
149   \or 24% 4!
150   \or 120% 5!
151   \or 720% 6!
152   \or 5040% 7!
153   \or 40320% 8!
154   \or 362880% 9!
155   \or 3628800% 10!
156   \or 39916800% 11!
157   \or 479001600% 12!
158   \else
159     \ifnum#1<\z@
160       0\IntCalcError:FacNegative%
161     \else
162       0\IntCalcError:FacOverflow%
163     \fi
164   \fi
165 }

```

2.4 Implementation based on ε -TeX

Only \numexpr is used from ε -TeX.

```

166 \begingroup\expandafter\expandafter\expandafter\endgroup
167 \expandafter\ifx\csname numexpr\endcsname\relax
168 \else

```

2.4.1 Num

\intcalcNum

```
169 \def\intcalcNum#1{%
170   \the\numexpr#1\relax
171 }%
```

2.4.2 Inv, Abs, Sgn

\intcalcInv

```
172 \def\intcalcInv#1{%
173   \number-\intcalcNum{#1} %
174 }%
```

\intcalcAbs

```
175 \def\intcalcAbs#1{%
176   \number\expandafter\InCa@Abs\the\numexpr#1! %
177 }%
```

\intcalcSgn

```
178 \def\intcalcSgn#1{%
179   \number\expandafter\InCa@Sgn\the\numexpr#1! %
180 }%
```

2.4.3 Min, Max, Cmp

\intcalcMin

```
181 \def\intcalcMin#1#2{%
182   \number\expandafter\InCa@Min
183   \the\numexpr#1\expandafter!%
184   \the\numexpr#2! %
185 }%
```

\intcalcMax

```
186 \def\intcalcMax#1#2{%
187   \number\expandafter\InCa@Max
188   \the\numexpr#1\expandafter!%
189   \the\numexpr#2! %
190 }%
```

\intcalcCmp

```
191 \def\intcalcCmp#1#2{%
192   \number\expandafter\InCa@Cmp
193   \the\numexpr#1\expandafter!\the\numexpr#2! %
194 }%
```

2.4.4 Inc, Dec

\intcalcInc

```
195 \def\intcalcInc#1{%
196   \the\numexpr#1+1\relax
197 }%
```

\intcalcDec

```
198 \def\intcalcDec#1{%
199   \the\numexpr#1-1\relax
200 }%
```

\IntCalcInc

```
201 \def\IntCalcInc#1!{%
202   \the\numexpr#1+1\relax
203 }%
```

\IntCalcDec

```
204 \def\IntCalcDec#1!{%
205   \the\numexpr#1-1\relax
206 }%
```

2.4.5 Add, Sub

\intcalcAdd

```
207 \def\intcalcAdd#1#2{%
208   \the\numexpr#1+(#2)\relax
209 }%
```

\intcalcSub

```
210 \def\intcalcSub#1#2{%
211   \the\numexpr#1-(#2)\relax
212 }%
```

\IntCalcAdd

```
213 \def\IntCalcAdd#1!#2!{%
214   \the\numexpr#1+#2\relax
215 }%
```

\IntCalcSub

```
216 \def\IntCalcSub#1!#2!{%
217   \the\numexpr#1-#2\relax
218 }%
```

2.4.6 Shl, Shr

\intcalcShl

```
219 \def\intcalcShl#1{%
220   \the\numexpr(#1)*2\relax
221 }%
```

\intcalcShr

```
222 \def\intcalcShr#1{%
223   \number\expandafter\InCa@Shr\the\numexpr#1! %
224 }%
```

\IntCalcShl

```
225 \def\IntCalcShl#1!{%
226   \the\numexpr#1*2\relax
227 }%
```

\IntCalcShr

```
228 \def\IntCalcShr#1!{%
229   \the\numexpr\ifodd#1 (#1-1)\else#1\fi/2\relax
230 }%
```

\InCa@Shr

```
231 \def\InCa@Shr#1#2!{%
232   \ifx#1-%
233     -\InCa@Shr#2!%
234   \else
```

```

235     \ifodd#1#2 %
236     \the\numexpr(#1#2-1)/2\relax
237     \else
238     \the\numexpr#1#2/2\relax
239     \fi
240     \fi
241 }%

```

2.4.7 Mul, Sqr, Fac

\intcalcMul

```

242 \def\intcalcMul#1#2{%
243     \the\numexpr(#1)*(#2)\relax
244 }%

```

\IntCalcMul

```

245 \def\IntCalcMul#1!#2!{%
246     \the\numexpr#1*#2\relax
247 }%

```

\intcalcSqr

```

248 \def\intcalcSqr#1{%
249     \number\expandafter\InCa@Sqr\the\numexpr#1! %
250 }%

```

\InCa@Sqr

```

251 \def\InCa@Sqr#1!{%
252     \the\numexpr#1*#1\relax
253 }%

```

\intcalcFac

```

254 \def\intcalcFac#1{%
255     \number\expandafter\InCa@Fac\the\numexpr#1! %
256 }%

```

2.4.8 Pow

\intcalcPow

```

257 \def\intcalcPow#1#2{%
258     \number\expandafter\InCa@Pow
259     \the\numexpr#1\expandafter!%
260     \the\numexpr#2! %
261 }%

```

\InCa@Pow

```

262 \def\InCa@Pow#1#2!#3#4!{%
263     \ifcase#3#4 % power = 0
264     1%
265     \or % power = 1
266     #1#2%
267     \or % power = 2
268     \the\numexpr#1#2*#1#2\relax
269     \else
270     \ifcase#1#2 % basis = 0, power <> 0
271     0%
272     \ifx#3-% power < 0
273     0\IntCalcError:DivisionByZero%
274     \fi
275     \or
276     1% basis = 1

```

```

277     \else
278     \ifnum#1#2=\m@ne % basis = -1
279     \ifodd#3#4 %
280     -%
281     \fi
282     1%
283     \else % |basis| > 1
284     \ifx#3-% power < 0
285     0%
286     \else % power > 2
287     \InCa@PowRec#1#2!#3#4!1!%
288     \fi
289     \fi
290     \fi
291     \fi
292 }%

\InCa@PowRec Pow(b, p) {
    PowRec(b, p, 1)
}
PowRec(b, p, r) {
    if p == 1 then
        return r*b
    else
        ifodd p then
            return PowRec(b*b, (p-1)/2, r*b) % p div 2 = (p-1)/2
        else
            return PowRec(b*b, (p-1)/2, r)
        fi
    fi
}

293 \def\InCa@PowRec#1!#2!#3!{%
294     \ifnum#2=\@ne
295     \the\numexpr#1*#3\relax
296     \else
297     \ifodd#2 %
298     \expandafter\InCa@PowRec
299     \the\numexpr#1*#1\expandafter!%
300     \the\numexpr(#2-1)/2\expandafter!%
301     \the\numexpr#1*#3\expandafter\expandafter\expandafter!%
302     \else
303     \expandafter\InCa@PowRec
304     \the\numexpr#1*#1\expandafter!%
305     \the\numexpr(#2-1)/2\expandafter!%
306     \number#3\expandafter\expandafter\expandafter!%
307     \fi
308     \fi
309 }%

```

2.4.9 Div, Mod

$\mathrm{T}_{\mathrm{E}}\mathrm{X}$'s `\divide` truncates, $\varepsilon\text{-}\mathrm{T}_{\mathrm{E}}\mathrm{X}$'s `\numexpr` rounds the result of a division. The rounding method is called “Symmetric Arithmetic Rounding” or “Round-Half-Up” (“Kaufmännisches Runden” in German):

$$\begin{aligned}
 1 &= 3 \text{ divide } 2 = 1.5 = \text{numexpr } 3/2 = 2 \\
 -1 &= -3 \text{ divide } 2 = -1.5 = \text{numexpr } -3/2 = -2
 \end{aligned}$$

Macro `\intcalcDiv` follows $\mathrm{T}_{\mathrm{E}}\mathrm{X}$ and truncates. The calculation is done by the following formula:

$$\text{Div}(X, Y) = (X - (Y - 1)/2)/Y \quad \text{for } X, Y > 0 \quad (1)$$

The operator ‘/’ is `\numexpr`'s division.

```

\intcalcDiv
310 \def\intcalcDiv#1#2{%
311 \number\expandafter\InCa@Div
312 \the\numexpr#1\expandafter!%
313 \the\numexpr#2! %
314 }%

\InCa@Div
315 \def\InCa@Div#1!#2!{%
316 \ifcase#2 %
317 0\IntCalcError:DivisionByZero%
318 \else
319 \ifcase#1 %
320 0%
321 \else
322 \expandafter\InCa@@Div
323 \romannumeral 0%
324 \ifnum#1<\z@
325 \expandafter-\number-#1%
326 \else
327 \expandafter+\number#1%
328 \fi
329 \expandafter!%
330 \romannumeral 0%
331 \ifnum#2<\z@
332 \expandafter-\number-#2%
333 \else
334 \expandafter+\number#2%
335 \fi
336 !%
337 \fi
338 \fi
339 }%

\IntCalcDiv
340 \def\InCa@Temp#1{%
341 \def\IntCalcDiv##1!##2!{%
342 \number
343 \ifcase##2 %
344 0\IntCalcError:DivisionByZero%
345 \else
346 \ifcase##1 %
347 0%
348 \else
349 \the\numexpr(##1-(##2-1)/2)/##2\relax
350 \fi
351 \fi
352 #1%
353 }%
354 }%
355 \InCa@Temp{ }%

\InCa@@Div
356 \def\InCa@@Div#1#2!#3#4!{%
357 #1#3%
358 \the\numexpr(#2-(#4-1)/2)/#4\relax
359 }%

\intcalcMod
360 \def\intcalcMod#1#2{%
361 \number\expandafter\InCa@Mod

```

```

362     \the\numexpr#1\expandafter!%
363     \the\numexpr#2! %
364 }%

\InCa@Mod

365 \def\InCa@Mod#1!#2!{%
366     \ifcase#2 %
367         0\IntCalcError:DivisionByZero%
368     \else
369         \ifcase#1 %
370             0%
371         \else
372             \expandafter\InCa@@Mod
373             \romannumeral 0%
374             \ifnum#1<\z@
375                 \expandafter-\number-#1%
376             \else
377                 \expandafter+\number#1%
378             \fi
379             \expandafter!%
380             \romannumeral 0%
381             \ifnum#2<\z@
382                 \expandafter-\number-#2%
383             \else
384                 \expandafter+\number#2%
385             \fi
386             !%
387         \fi
388     \fi
389 }%

\IntCalcMod

390 \def\InCa@Temp#1{%
391     \def\IntCalcMod##1!##2!{%
392         \number
393         \ifcase##2 %
394             0\IntCalcError:DivisionByZero%
395         \else
396             \ifcase##1 %
397                 0%
398             \else
399                 \the\numexpr##1-(##1-(##2-1)/2)/##2*##2\relax
400             \fi
401         \fi
402         #1%
403     }%
404 }%
405 \InCa@Temp{ }%

\InCa@@Mod

406 \def\InCa@@Mod#1#2!#3#4!{%
407     \if#3+{%
408         \if#1+{%
409             \the\numexpr#2-\InCa@@Div+#2!+#4!*#4!\relax
410         \else
411             \expandafter\InCa@ModX
412             \the\numexpr-#2+\InCa@@Div+#2!+#4!*#4!*#4!%
413         \fi
414     \else
415         -%
416         \if#1+{%
417             \expandafter\InCa@ModX

```



```

418         \the\numexpr-#2+\InCa@@Div+#2!+#4!*\#4!\#4!%
419     \else
420         \the\numexpr#2-\InCa@@Div+#2!+#4!*\#4\relax
421     \fi
422 \fi
423 }%

```

\InCa@ModX

```

424 \def\InCa@ModX#1!#2!{%
425     \ifcase#1 %
426         0%
427     \else
428         \the\numexpr#1+#2\relax
429     \fi
430 }%

431 \InCa@AtEnd
432 \expandafter\endinput
433 \fi

```

2.5 Implementation without ε -TeX

2.5.1 Num

\intcalcNum

```

434 \def\intcalcNum#1{%
435     \number\expandafter\InCa@FirstOfOne\number#1! %
436 }

```

2.5.2 Inv, Abs, Sgn

\intcalcInv

```

437 \def\intcalcInv#1{%
438     \number\expandafter\InCa@FirstOfOne\number-#1! %
439 }

```

\InCa@FirstOfOne

```

440 \def\InCa@FirstOfOne#1!{#1}

```

\intcalcAbs

```

441 \def\intcalcAbs#1{%
442     \number\expandafter\InCa@Abs\number#1! %
443 }

```

\intcalcSgn

```

444 \def\intcalcSgn#1{%
445     \number\expandafter\InCa@Sgn\number#1! %
446 }

```

2.5.3 Min, Max, Cmp

\intcalcMin

```

447 \def\intcalcMin#1#2{%
448     \number\expandafter\InCa@Min
449     \number\number#1\expandafter!\number#2! %
450 }

```

\intcalcMax

```

451 \def\intcalcMax#1#2{%
452     \number\expandafter\InCa@Max
453     \number\number#1\expandafter!\number#2! %
454 }

```

\intcalcCmp

```
455 \def\intcalcCmp#1#2{%
456   \number\expandafter\InCa@Cmp
457   \number\number#1\expandafter!\number#2! %
458 }%
```

2.5.4 Inc, Dec

\intcalcInc

```
459 \def\intcalcInc#1{%
460   \number\expandafter\InCa@IncSwitch\number#1! %
461 }
```

\InCa@IncSwitch

```
462 \def\InCa@IncSwitch#1#2!{%
463   \ifx#1-%
464     -%
465     \csname InCa@Empty%
466     \InCa@Dec#2!%
467   \else
468     \csname InCa@Empty%
469     \InCa@Inc#1#2!%
470   \fi
471 }
```

\intcalcDec

```
472 \def\intcalcDec#1{%
473   \number\expandafter\InCa@DecSwitch\number#1! %
474 }
```

\InCa@DecSwitch

```
475 \def\InCa@DecSwitch#1#2!{%
476   \ifx#1-%
477     -%
478     \csname InCa@Empty%
479     \expandafter\InCa@Inc#2!%
480   \else
481     \ifx#10%
482       -1%
483     \else
484       \csname InCa@Empty%
485       \InCa@Dec#1#2!%
486     \fi
487   \fi
488 }
```

\IntCalcInc

```
489 \def\IntCalcInc#1!{%
490   \number\csname InCa@Empty\InCa@Inc#1! %
491 }
```

\IntCalcDec

```
492 \def\IntCalcDec#1!{%
493   \number\csname InCa@Empty\InCa@Dec#1! %
494 }
```

\InCa@Inc

```
495 \def\InCa@Inc#1#2{%
496   \ifx#2!%
497     \csname InCa@IncDigit#1\endcsname1%
```

```

498 \else
499 \csname InCa@IncDigit#1%
500 \expandafter\InCa@Inc\expandafter#2%
501 \fi
502 }

```

\InCa@IncDigit[0-8]

```

503 \def\InCa@Temp#1#2{%
504 \expandafter\def\csname InCa@IncDigit#1\endcsname##1{%
505 \endcsname
506 0%
507 \ifcase##1 %
508 #1%
509 \else
510 #2%
511 \fi
512 }%
513 }
514 \InCa@Temp 01
515 \InCa@Temp 12
516 \InCa@Temp 23
517 \InCa@Temp 34
518 \InCa@Temp 45
519 \InCa@Temp 56
520 \InCa@Temp 67
521 \InCa@Temp 78
522 \InCa@Temp 89

```

\InCa@IncDigit9

```

523 \expandafter\def\csname InCa@IncDigit9\endcsname#1{%
524 \expandafter\endcsname
525 \ifcase#1 %
526 09%
527 \else
528 10%
529 \fi
530 }

```

\InCa@Dec

```

531 \def\InCa@Dec#1#2{%
532 \ifx#2!%
533 \csname InCa@DecDigit#1\endcsname1%
534 \else
535 \csname InCa@DecDigit#1%
536 \expandafter\InCa@Dec\expandafter#2%
537 \fi
538 }

```

\InCa@DecDigit[1-9]

```

539 \def\InCa@Temp#1#2{%
540 \expandafter\def\csname InCa@DecDigit#1\endcsname##1{%
541 \endcsname
542 0%
543 \ifcase##1 %
544 #1%
545 \else
546 #2%
547 \fi
548 }%
549 }
550 \InCa@Temp 98
551 \InCa@Temp 87

```

```

552 \InCa@Temp 76
553 \InCa@Temp 65
554 \InCa@Temp 54
555 \InCa@Temp 43
556 \InCa@Temp 32
557 \InCa@Temp 21
558 \InCa@Temp 10

```

\InCa@DecDigit0

```

559 \expandafter\def\csname InCa@DecDigit0\endcsname#1{%
560   \expandafter\endcsname
561   \ifcase#1 %
562     00%
563   \else
564     19%
565   \fi
566 }

```

2.5.5 Add, Sub

\intcalcAdd

```

567 \def\intcalcAdd#1#2{%
568   \number
569   \expandafter\InCa@AddSwitch
570   \number\number#1\expandafter!%
571   \number#2! %
572 }

```

\intcalcSub

```

573 \def\intcalcSub#1#2{%
574   \number
575   \expandafter\InCa@AddSwitch
576   \number\number#1\expandafter!%
577   \number-\number#2! %
578 }

```

\InCa@AddSwitch Decision table for \InCa@AddSwitch. The sign of negative numbers can be removed by a simple \@gobble instead of the more expensive \number-.

$x < 0$	$y < 0$	$x < y$	-	$\text{Add}(-x, -y)$
		else		$\text{Add}(-y, -x)$
	else	$-x > y$	-	$\text{Sub}(-x, y)$
		else	+	$\text{Sub}(y, -x)$
else	$y < 0$	$x > -y$	+	$\text{Sub}(x, -y)$
		else	-	$\text{Sub}(-y, x)$
	else	$x > y$	+	$\text{Add}(x, y)$
		else		$\text{Add}(y, x)$

```

579 \def\InCa@AddSwitch#1#2!{%
580   \ifnum#1<\z@
581     \ifnum#2<\z@
582       -%
583     \ifnum#1<#2 %
584       \expandafter\InCa@Add\number-#1\expandafter!%
585       \@gobble#2!%
586     \else
587       \expandafter\InCa@Add\number-#2\expandafter!%
588       \@gobble#1!%
589     \fi
590   \else
591     \ifnum-#1>#2 %

```

```

592      -%
593      \expandafter\InCa@Sub\@gobble#1!#2!%
594    \else
595      \expandafter\InCa@Sub\number#2\expandafter!%
596      \@gobble#1!%
597    \fi
598  \fi
599 \else
600   \ifnum#2<\z@
601     \ifnum#1>#2 %
602       \expandafter\InCa@Sub\number#1\expandafter!%
603       \@gobble#2!%
604     \else
605       -%
606       \expandafter\InCa@Sub\@gobble#2!#1!%
607     \fi
608   \else
609     \ifnum#1>#2 %
610       \InCa@Add#1!#2!%
611     \else
612       \InCa@Add#2!#1!%
613     \fi
614   \fi
615 \fi
616 }

\IntCalcAdd

617 \def\IntCalcAdd#1!#2!{%
618   \number\InCa@Add#1!#2! %
619 }

\IntCalcSub

620 \def\IntCalcSub#1!#2!{%
621   \number\InCa@Sub#1!#2! %
622 }

\InCa@Space

623 \begingroup
624   \def\x#1{\endgroup
625     \let\InCa@Space= #1%
626   }%
627 \x{ }

\InCa@Add

628 \def\InCa@Add#1!#2!{%
629   \ifcase#2 %
630     #1%
631   \else
632     \InCa@@Add#1!#2!00000000\InCa@Space
633   \fi
634 }

\InCa@Sub

635 \def\InCa@Sub#1!#2!{%
636   \ifnum#1=#2 %
637     0%
638   \else
639     \InCa@@Sub#1!#2!00000000\InCa@Space
640   \fi
641 }

```

\InCa@@@Add

```
642 \def\InCa@@Add#1!#2#3!{%
643   \ifx\InCa@Empty#3\InCa@Empty
644     \@ReturnAfterElseFi{%
645       \InCa@@@Add!!#1!#2%
646     }%
647   \else
648     \@ReturnAfterFi{%
649       \InCa@@Add#1!#3!#2%
650     }%
651   \fi
652 }
```

\InCa@@@Sub

```
653 \def\InCa@@Sub#1!#2#3!{%
654   \ifx\InCa@Empty#3\InCa@Empty
655     \@ReturnAfterElseFi{%
656       \InCa@@@Sub!!#1!#2%
657     }%
658   \else
659     \@ReturnAfterFi{%
660       \InCa@@Sub#1!#3!#2%
661     }%
662   \fi
663 }
```

\InCa@@@Add

```
664 \def\InCa@@@Add#1!#2!#3#4!#5{%
665   \ifx\InCa@Empty#4\InCa@Empty
666     \csname InCa@Empty%
667       \@ReturnAfterElseFi{%
668         \InCa@ProcessAdd#1#3!#5#2%
669       }%
670   \else
671     \@ReturnAfterFi{%
672       \InCa@@@Add#1#3!#5#2!#4!%
673     }%
674   \fi
675 }
```

\InCa@@@Sub

```
676 \def\InCa@@@Sub#1!#2!#3#4!#5{%
677   \ifx\InCa@Empty#4\InCa@Empty
678     \csname @gobble%
679       \@ReturnAfterElseFi{%
680         \InCa@ProcessSub#1#3!#5#2%
681       }%
682   \else
683     \@ReturnAfterFi{%
684       \InCa@@@Sub#1#3!#5#2!#4!%
685     }%
686   \fi
687 }
```

\InCa@ProcessAdd

```
688 \def\InCa@ProcessAdd#1#2!#3#4{%
689   \ifx\InCa@Empty#2\InCa@Empty
690     \csname InCa@AddDigit#1\endcsname#3%
691     \romannumeral0#4%
692   \else
693     \csname InCa@AddDigit#1\csname InCa@DigitCarry#3%
```

```

694 \ReturnAfterFi{%
695 \InCa@ProcessAdd#2!#4%
696 }%
697 \fi
698 }

```

\InCa@ProcessSub

```

699 \def\InCa@ProcessSub#1#2!#3#4{%
700 \ifx\InCa@Empty#2\InCa@Empty
701 \csname InCa@SubDigit#1\endcsname#3%
702 \romannumeral0#4%
703 \else
704 \csname InCa@SubDigit#1\csname InCa@DigitCarry#3%
705 \ReturnAfterFi{%
706 \InCa@ProcessSub#2!#4%
707 }%
708 \fi
709 }

```

\InCa@DigitCarry[0-9]

```

710 \def\InCa@Temp#1#2{%
711 \expandafter\def\csname InCa@DigitCarry#1\endcsname##1{%
712 \ifcase##1 %
713 \endcsname#1%
714 \else
715 \endcsname#2%
716 \fi
717 }%
718 }
719 \InCa@Temp 01
720 \InCa@Temp 12
721 \InCa@Temp 23
722 \InCa@Temp 34
723 \InCa@Temp 45
724 \InCa@Temp 56
725 \InCa@Temp 67
726 \InCa@Temp 78
727 \InCa@Temp 89
728 \InCa@Temp 9{{10}}

```

\InCa@AddDigit0

```

729 \expandafter\def\csname InCa@AddDigit0\endcsname#1{%
730 \ifnum#1>9 %
731 \endcsname10%
732 \else
733 \endcsname0#1%
734 \fi
735 }

```

\InCa@AddDigit[1-9]

```

736 \def\InCa@Temp#1#2#3{%
737 \expandafter\def\csname InCa@AddDigit#1\endcsname##1{%
738 \ifnum##1>#2 %
739 \endcsname 1%
740 \else
741 \endcsname 0%
742 \fi
743 \ifcase##1 #1% 0
744 #3%
745 \else #1% 10
746 \fi
747 }%

```

```

748 }
749 \InCa@Temp 18{
750 \or 2% 1
751 \or 3% 2
752 \or 4% 3
753 \or 5% 4
754 \or 6% 5
755 \or 7% 6
756 \or 8% 7
757 \or 9% 8
758 \or 0% 9
759 }%
760 \InCa@Temp 27{
761 \or 3% 1
762 \or 4% 2
763 \or 5% 3
764 \or 6% 4
765 \or 7% 5
766 \or 8% 6
767 \or 9% 7
768 \or 0% 8
769 \or 1% 9
770 }%
771 \InCa@Temp 36{
772 \or 4% 1
773 \or 5% 2
774 \or 6% 3
775 \or 7% 4
776 \or 8% 5
777 \or 9% 6
778 \or 0% 7
779 \or 1% 8
780 \or 2% 9
781 }%
782 \InCa@Temp 45{
783 \or 5% 1
784 \or 6% 2
785 \or 7% 3
786 \or 8% 4
787 \or 9% 5
788 \or 0% 6
789 \or 1% 7
790 \or 2% 8
791 \or 3% 9
792 }%
793 \InCa@Temp 54{
794 \or 6% 1
795 \or 7% 2
796 \or 8% 3
797 \or 9% 4
798 \or 0% 5
799 \or 1% 6
800 \or 2% 7
801 \or 3% 8
802 \or 4% 9
803 }%
804 \InCa@Temp 63{
805 \or 7% 1
806 \or 8% 2
807 \or 9% 3
808 \or 0% 4
809 \or 1% 5

```



```

810 \or 2% 6
811 \or 3% 7
812 \or 4% 8
813 \or 5% 9
814 }%
815 \InCa@Temp 72{%
816 \or 8% 1
817 \or 9% 2
818 \or 0% 3
819 \or 1% 4
820 \or 2% 5
821 \or 3% 6
822 \or 4% 7
823 \or 5% 8
824 \or 6% 9
825 }%
826 \InCa@Temp 81{%
827 \or 9% 1
828 \or 0% 2
829 \or 1% 3
830 \or 2% 4
831 \or 3% 5
832 \or 4% 6
833 \or 5% 7
834 \or 6% 8
835 \or 7% 9
836 }%
837 \InCa@Temp 90{%
838 \or 0% 1
839 \or 1% 2
840 \or 2% 3
841 \or 3% 4
842 \or 4% 5
843 \or 5% 6
844 \or 6% 7
845 \or 7% 8
846 \or 8% 9
847 }%

```

\InCa@SubDigit[0-9]

```

848 \def\InCa@Temp#1#2{%
849 \expandafter\def\csname InCa@SubDigit#1\endcsname##1{%
850 \ifnum##1>#1 %
851 \endcsname 1%
852 \else
853 \endcsname 0%
854 \fi
855 \ifcase##1 #1% 0
856 #2%
857 \else #1% 10
858 \fi
859 }%
860 }
861 \InCa@Temp 0{%
862 \or 9% 1
863 \or 8% 2
864 \or 7% 3
865 \or 6% 4
866 \or 5% 5
867 \or 4% 6
868 \or 3% 7
869 \or 2% 8
870 \or 1% 9

```

```

871 }
872 \InCa@Temp 1{%
873 \or 0% 1
874 \or 9% 2
875 \or 8% 3
876 \or 7% 4
877 \or 6% 5
878 \or 5% 6
879 \or 4% 7
880 \or 3% 8
881 \or 2% 9
882 }
883 \InCa@Temp 2{%
884 \or 1% 1
885 \or 0% 2
886 \or 9% 3
887 \or 8% 4
888 \or 7% 5
889 \or 6% 6
890 \or 5% 7
891 \or 4% 8
892 \or 3% 9
893 }
894 \InCa@Temp 3{%
895 \or 2% 1
896 \or 1% 2
897 \or 0% 3
898 \or 9% 4
899 \or 8% 5
900 \or 7% 6
901 \or 6% 7
902 \or 5% 8
903 \or 4% 9
904 }
905 \InCa@Temp 4{%
906 \or 3% 1
907 \or 2% 2
908 \or 1% 3
909 \or 0% 4
910 \or 9% 5
911 \or 8% 6
912 \or 7% 7
913 \or 6% 8
914 \or 5% 9
915 }
916 \InCa@Temp 5{%
917 \or 4% 1
918 \or 3% 2
919 \or 2% 3
920 \or 1% 4
921 \or 0% 5
922 \or 9% 6
923 \or 8% 7
924 \or 7% 8
925 \or 6% 9
926 }
927 \InCa@Temp 6{%
928 \or 5% 1
929 \or 4% 2
930 \or 3% 3
931 \or 2% 4
932 \or 1% 5

```

```

933 \or 0% 6
934 \or 9% 7
935 \or 8% 8
936 \or 7% 9
937 }
938 \InCa@Temp 7{%
939 \or 6% 1
940 \or 5% 2
941 \or 4% 3
942 \or 3% 4
943 \or 2% 5
944 \or 1% 6
945 \or 0% 7
946 \or 9% 8
947 \or 8% 9
948 }
949 \InCa@Temp 8{%
950 \or 7% 1
951 \or 6% 2
952 \or 5% 3
953 \or 4% 4
954 \or 3% 5
955 \or 2% 6
956 \or 1% 7
957 \or 0% 8
958 \or 9% 9
959 }
960 \InCa@Temp 9{%
961 \or 8% 1
962 \or 7% 2
963 \or 6% 3
964 \or 5% 4
965 \or 4% 5
966 \or 3% 6
967 \or 2% 7
968 \or 1% 8
969 \or 0% 9
970 }

```

2.5.6 Shl, Shr

\intcalcShl

```

971 \def\intcalcShl#1{%
972 \number\expandafter\InCa@ShlSwitch\number#1! %
973 }

```

\InCa@ShlSwitch

```

974 \def\InCa@ShlSwitch#1#2!{%
975 \ifx#1-%
976 -\csname InCa@Empty%
977 \InCa@Shl#2!%
978 \else
979 \csname InCa@Empty%
980 \InCa@Shl#1#2!%
981 \fi
982 }

```

\IntCalcShl

```

983 \def\IntCalcShl#1!{%
984 \number
985 \csname InCa@Empty%
986 \InCa@Shl#1! %

```

```

987 }

\IntCal@ShlDigit

988 \def\InCa@Shl#1#2{%
989   \ifx#2!%
990     \csname InCa@ShlDigit#1\endcsname0%
991   \else
992     \csname InCa@ShlDigit#1%
993     \@ReturnAfterFi{%
994       \InCa@Shl#2%
995     }%
996   \fi
997 }

\InCa@ShlDigit0

998 \expandafter\def\csname InCa@ShlDigit0\endcsname{%
999   \endcsname0%
1000 }

\InCa@ShlDigit[1-9]

1001 \def\InCa@Temp#1#2#3#4#5{%
1002   \expandafter\def\csname InCa@ShlDigit#1\endcsname##1{%
1003     \expandafter\endcsname
1004     \ifcase##1 %
1005       #2#3%
1006     \else
1007       #4#5%
1008     \fi
1009   }%
1010 }
1011 \InCa@Temp 10203
1012 \InCa@Temp 20405
1013 \InCa@Temp 30607
1014 \InCa@Temp 40809
1015 \InCa@Temp 51011
1016 \InCa@Temp 61213
1017 \InCa@Temp 71415
1018 \InCa@Temp 81617
1019 \InCa@Temp 91819

\intcalcShr

1020 \def\intcalcShr#1{%
1021   \number\expandafter\InCa@ShrSwitch\number#1! %
1022 }

\InCa@ShrSwitch

1023 \def\InCa@ShrSwitch#1#2!{%
1024   \ifx#1-%
1025     -\InCa@Shr#2!%
1026   \else
1027     \InCa@Shr#1#2!%
1028   \fi
1029 }

\IntCalcShr

1030 \def\IntCalcShr#1!{%
1031   \number\InCa@Shr#1! %
1032 }

\InCa@Shr

1033 \def\InCa@Shr#1#2{%

```

```

1034 \InCa@ShrDigit#1!%
1035 \ifx#2!%
1036 \else
1037 \ReturnAfterFi{%
1038 \ifodd#1 %
1039 \ReturnAfterElseFi{%
1040 \InCa@Shr{1#2}%
1041 }%
1042 \else
1043 \expandafter\InCa@Shr\expandafter#2%
1044 \fi
1045 }%
1046 \fi
1047 }

1048 \def\InCa@ShrDigit#1!{%
1049 \ifcase#1 0% 0
1050 \or 0% 1
1051 \or 1% 2
1052 \or 1% 3
1053 \or 2% 4
1054 \or 2% 5
1055 \or 3% 6
1056 \or 3% 7
1057 \or 4% 8
1058 \or 4% 9
1059 \or 5% 10
1060 \or 5% 11
1061 \or 6% 12
1062 \or 6% 13
1063 \or 7% 14
1064 \or 7% 15
1065 \or 8% 16
1066 \or 8% 17
1067 \or 9% 18
1068 \or 9% 19
1069 \fi
1070 }

```

2.5.7 \InCa@Tim

\InCa@Tim Macro \InCa@Tim implements “Number *times* digit”.

```

1071 \def\InCa@Temp#1{%
1072 \def\InCa@Tim##1##2{%
1073 \number
1074 \ifcase##2 % 0
1075 0%
1076 \or % 1
1077 ##1%
1078 \else % 2-9
1079 \csname InCa@Empty%
1080 \InCa@ProcessTim##2##1!%
1081 \fi
1082 #1%
1083 }%
1084 }
1085 \InCa@Temp{ }

```

\InCa@ProcessTim

```

1086 \def\InCa@ProcessTim#1#2#3{%
1087 \ifx#3!%
1088 \csname InCa@TimDigit#2\endcsname#10%

```

```

1089 \else
1090 \csname InCa@TimDigit#2\csname InCa@Param#1%
1091 \@ReturnAfterFi{%
1092 \InCa@ProcessTim#1#3%
1093 }%
1094 \fi
1095 }

\InCa@Param[0-9]

1096 \def\InCa@Temp#1{%
1097 \expandafter\def\csname InCa@Param#1\endcsname{%
1098 \endcsname#1%
1099 }%
1100 }
1101 \InCa@Temp 0%
1102 \InCa@Temp 1%
1103 \InCa@Temp 2%
1104 \InCa@Temp 3%
1105 \InCa@Temp 4%
1106 \InCa@Temp 5%
1107 \InCa@Temp 6%
1108 \InCa@Temp 7%
1109 \InCa@Temp 8%
1110 \InCa@Temp 9%

\InCa@TimDigit0

1111 \expandafter\def\csname InCa@TimDigit0\endcsname#1#2{%
1112 \endcsname
1113 0#2%
1114 }

\InCa@TimDigit1

1115 \expandafter\def\csname InCa@TimDigit1\endcsname#1#2{%
1116 \ifcase#2 %
1117 \endcsname 0#1%
1118 \else
1119 \csname InCa@AddDigit#1\endcsname #2%
1120 \fi
1121 }

\InCa@TimDigit[2-9]

1122 \def\InCa@Temp#1#2{%
1123 \expandafter\def\csname InCa@TimDigit#1\endcsname##1{%
1124 \expandafter\InCa@TimDigitCarry
1125 \number
1126 \ifcase##1 0% 0
1127 #2%
1128 \fi
1129 !%
1130 }%
1131 }
1132 \InCa@Temp 2{%
1133 \or 2% 1
1134 \or 4% 2
1135 \or 6% 3
1136 \or 8% 4
1137 \or 10% 5
1138 \or 12% 6
1139 \or 14% 7
1140 \or 16% 8
1141 \or 18% 9
1142 }

```

```

1143 \InCa@Temp 3{%
1144 \or 3% 1
1145 \or 6% 2
1146 \or 9% 3
1147 \or 12% 4
1148 \or 15% 5
1149 \or 18% 6
1150 \or 21% 7
1151 \or 24% 8
1152 \or 27% 9
1153 }
1154 \InCa@Temp 4{%
1155 \or 4% 1
1156 \or 8% 2
1157 \or 12% 3
1158 \or 16% 4
1159 \or 20% 5
1160 \or 24% 6
1161 \or 28% 7
1162 \or 32% 8
1163 \or 36% 9
1164 }
1165 \InCa@Temp 5{%
1166 \or 5% 1
1167 \or 10% 2
1168 \or 15% 3
1169 \or 20% 4
1170 \or 25% 5
1171 \or 30% 6
1172 \or 35% 7
1173 \or 40% 8
1174 \or 45% 9
1175 }
1176 \InCa@Temp 6{%
1177 \or 6% 1
1178 \or 12% 2
1179 \or 18% 3
1180 \or 24% 4
1181 \or 30% 5
1182 \or 36% 6
1183 \or 42% 7
1184 \or 48% 8
1185 \or 54% 9
1186 }
1187 \InCa@Temp 7{%
1188 \or 7% 1
1189 \or 14% 2
1190 \or 21% 3
1191 \or 28% 4
1192 \or 35% 5
1193 \or 42% 6
1194 \or 49% 7
1195 \or 56% 8
1196 \or 63% 9
1197 }
1198 \InCa@Temp 8{%
1199 \or 8% 1
1200 \or 16% 2
1201 \or 24% 3
1202 \or 32% 4
1203 \or 40% 5
1204 \or 48% 6

```

```

1205 \or 56% 7
1206 \or 64% 8
1207 \or 72% 9
1208 }
1209 \InCa@Temp 9{%
1210 \or 9% 1
1211 \or 18% 2
1212 \or 27% 3
1213 \or 36% 4
1214 \or 45% 5
1215 \or 54% 6
1216 \or 63% 7
1217 \or 72% 8
1218 \or 81% 9
1219 }

```

\InCa@TimDigitCarry

```

1220 \def\InCa@TimDigitCarry#1!{%
1221 \ifnum#1<10 %
1222 \csname InCa@AddDigit#1\expandafter\endcsname
1223 \else
1224 \@ReturnAfterFi{%
1225 \InCa@@TimDigitCarry#1!%
1226 }%
1227 \fi
1228 }

```

\InCa@@TimDigitCarry

```

1229 \def\InCa@@TimDigitCarry#1#2!#3{%
1230 \csname InCa@DigitCarry#1%
1231 \csname InCa@AddDigit#2\endcsname #3%
1232 }

```

2.5.8 Mul

\intcalcMul

```

1233 \def\intcalcMul#1#2{%
1234 \number
1235 \expandafter\InCa@MulSwitch
1236 \number\number#1\expandafter!%
1237 \number#2! %
1238 }

```

\InCa@MulSwitch Decision table for \InCa@MulSwitch.

$x < 0$	$y < 0$	$x < y$	+	$\text{Mul}(-x, -y)$
		else		$\text{Mul}(-y, -x)$
	else	$-x > y$	-	$\text{Mul}(-x, y)$
		else		$\text{Mul}(y, -x)$
else	$y < 0$	$x > -y$	-	$\text{Mul}(x, -y)$
		else		$\text{Mul}(-y, x)$
	else	$x > y$	+	$\text{Mul}(x, y)$
		else		$\text{Mul}(y, x)$

```

1239 \def\InCa@MulSwitch#1!#2!{%
1240 \ifnum#1<\z@
1241 \ifnum#2<\z@
1242 \ifnum#1<#2 %
1243 \expandafter\InCa@Mul\number-#1\expandafter!%
1244 \@gobble#2!%
1245 \else

```



```

1246         \expandafter\InCa@Mul\number-#2\expandafter!%
1247         \@gobble#1!%
1248     \fi
1249 \else
1250     -%
1251     \ifnum-#1>#2 %
1252         \expandafter\InCa@Mul\@gobble#1!#2!%
1253     \else
1254         \expandafter\InCa@Mul\number#2\expandafter!%
1255         \@gobble#1!%
1256     \fi
1257 \fi
1258 \else
1259     \ifnum#2<\z@
1260         -%
1261         \ifnum#1>-#2 %
1262             \expandafter\InCa@Mul\number#1\expandafter!%
1263             \@gobble#2!%
1264         \else
1265             \expandafter\InCa@Mul\@gobble#2!#1!%
1266         \fi
1267     \else
1268         \ifnum#1>#2 %
1269             \InCa@Mul#1!#2!%
1270         \else
1271             \InCa@Mul#2!#1!%
1272         \fi
1273     \fi
1274 \fi
1275 }

```

\IntCalcMul

```

1276 \def\IntCalcMul#1!#2!{%
1277     \number\InCa@Mul#1!#2! %
1278 }

```

\InCa@Mul

```

1279 \def\InCa@Mul#1!#2!{%
1280     \ifcase#2 %
1281         0%
1282     \or
1283         #1%
1284     \or
1285         \csname InCa@Empty%
1286         \expandafter\InCa@Shl#1!%
1287     \else
1288         \ifnum#2<10 %
1289             \InCa@Tim{#1}#2%
1290         \else
1291             \InCa@ProcessMul!#2!#1!%
1292         \fi
1293     \fi
1294 }

```

\InCa@Mul

```

1295 \def\InCa@ProcessMul#1!#2#3!#4!{%
1296     \ifx\InCa@Empty#3\InCa@Empty
1297         \expandafter\InCa@Add\number
1298         #10\expandafter\expandafter\expandafter!%
1299         \InCa@Tim{#4}#2!%
1300     \else
1301         \ifx\InCa@Empty#1\InCa@Empty

```

```

1302     \expandafter\expandafter\expandafter\InCa@ProcessMul
1303     \InCa@Tim{#4}#2!%
1304     #3!#4!%
1305     \else
1306     \expandafter\InCa@ProcessMul\number
1307     \expandafter\InCa@Add\number%
1308     #10\expandafter\expandafter\expandafter!%
1309     \InCa@Tim{#4}#2!!%
1310     #3!#4!%
1311     \fi
1312 \fi
1313 }

```

2.5.9 Sqr, Fac

\intcalcSqr

```

1314 \def\intcalcSqr#1{%
1315   \number\expandafter\InCa@Sqr\number#1! %
1316 }

```

\InCa@Sqr

```

1317 \def\InCa@Sqr#1#2!{%
1318   \ifx#1-%
1319     \InCa@Mul#2!#2!%
1320   \else
1321     \InCa@Mul#1#2!#1#2!%
1322   \fi
1323 }

```

\intcalcFac

```

1324 \def\intcalcFac#1{%
1325   \number\expandafter\InCa@Fac\number#1! %
1326 }

```

2.5.10 Pow

\intcalcPow

```

1327 \def\intcalcPow#1#2{%
1328   \number\expandafter\InCa@Pow
1329   \number\number#1\expandafter!%
1330   \number#2! %
1331 }

```

\InCa@Pow

```

1332 \def\InCa@Pow#1#2!#3#4!{%
1333   \ifcase#3#4 % power = 0
1334     1%
1335   \or % power = 1
1336     #1#2%
1337   \or % power = 2
1338     \ifx#1-%
1339       \InCa@Mul#2!#2!%
1340     \else
1341       \InCa@Mul#1#2!#1#2!%
1342     \fi
1343   \else
1344     \ifcase#1#2 % basis = 0, power <> 0
1345       0%
1346     \ifx#3-% power < 0
1347       0\IntCalcError:DivisionByZero%
1348     \fi

```

```

1349 \or
1350 1% basis = 1
1351 \else
1352 \ifnum#1#2=\m@ne % basis = -1
1353 \ifodd#3#4 %
1354 -%
1355 \fi
1356 1%
1357 \else % |basis| > 1
1358 \ifx#3-% power < 0
1359 0%
1360 \else % power > 2
1361 \ifx#1-% basis < 0
1362 \ifodd#3#4 %
1363 -%
1364 \fi
1365 \InCa@PowRec#2!#3#4!1!%
1366 \else
1367 \InCa@PowRec#1#2!#3#4!1!%
1368 \fi
1369 \fi
1370 \fi
1371 \fi
1372 \fi
1373 }

\InCa@PowRec Pow(b, p) {
PowRec(b, p, 1)
}
PowRec(b, p, r) {
if p == 1 then
return r
else
ifodd p then
return PowRec(b*b, p div 2, r*b) % p div 2 = (p-1)/2
else
return PowRec(b*b, p div 2, r)
fi
fi
}

1374 \def\InCa@PowRec#1!#2!#3!{%
1375 \ifnum#2=\@ne
1376 \ifnum#1>#3 %
1377 \InCa@Mul#1!#3!%
1378 \else
1379 \InCa@Mul#3!#1!%
1380 \fi
1381 \else
1382 \expandafter\InCa@PowRec
1383 \number\InCa@Mul#1!#1!\expandafter!%
1384 \number\intcalcShr{#2}\expandafter!%
1385 \number
1386 \ifodd#2 %
1387 \ifnum#1>#3 %
1388 \InCa@Mul#1!#3!%
1389 \else
1390 \InCa@Mul#3!#1!%
1391 \fi
1392 \else
1393 #3%
1394 \fi
1395 \expandafter!%
1396 \fi

```

1397 }

2.5.11 Div

\intcalcDiv

```
1398 \def\intcalcDiv#1#2{%
1399   \number\expandafter\InCa@Div
1400   \number\number#1\expandafter!%
1401   \number#2! %
1402 }
```

\InCa@Div

```
1403 \def\InCa@Div#1!#2!{%
1404   \ifcase#2 %
1405     0\IntCalcError:DivisionByZero%
1406   \else
1407     \ifcase#1 %
1408       0%
1409     \else
1410       \expandafter\InCa@DivSwitch
1411       \number#1\expandafter!%
1412       \number#2!%
1413     \fi
1414   \fi
1415 }
```

\IntCalcDiv

```
1416 \def\InCa@Temp#1{%
1417   \def\IntCalcDiv##1!##2!{%
1418     \number
1419     \ifcase##2 %
1420       0\IntCalcError:DivisionByZero%
1421     \else
1422       \ifcase##1 %
1423         0%
1424       \else
1425         \InCa@@Div##1!##2!%
1426       \fi
1427     \fi
1428     #1%
1429   }%
1430 }
1431 \InCa@Temp{ }%
```

\InCa@DivSwitch Decision table for \InCa@DivSwitch.

$x < 0$	$y < 0$	+	$\text{Div}(-x, -y)$
	else	-	$\text{Div}(-x, y)$
else	$y < 0$	-	$\text{Div}(x, -y)$
	else	+	$\text{Div}(x, y)$

```
1432 \def\InCa@DivSwitch#1!#2!{%
1433   \ifnum#1<\z@
1434     \ifnum#2<\z@
1435       \expandafter\InCa@@Div\number-#1\expandafter!%
1436       \@gobble#2!%
1437     \else
1438       -%
1439     \expandafter\InCa@@Div\@gobble#1!#2!%
1440   \fi
1441   \else
```

```

1442     \ifnum#2<\z@
1443     -%
1444     \expandafter\InCa@@Div\number#1\expandafter!%
1445     \@gobble#2!%
1446     \else
1447     \InCa@@Div#1!#2!%
1448     \fi
1449 \fi
1450 }

\InCa@@Div
1451 \def\InCa@@Div#1!#2!{%
1452     \ifnum#1>#2 %
1453     \ifcase#2 % 0 already caught
1454 ?     \IntCalcError:ThisCannotHappen%
1455     \or % 1
1456     #1%
1457     \or % 2
1458     \InCa@Shr#1!%
1459     \else
1460     \InCa@DivStart!#1!#2!#2!%
1461     \fi
1462 \else
1463     \ifnum#1=#2 %
1464     1%
1465     \else
1466     0%
1467     \fi
1468 \fi
1469 }

\InCa@DivStart
1470 \def\InCa@DivStart#1!#2#3!#4#5{%
1471     \ifx#5!%
1472     \@ReturnAfterElseFi{%
1473     \InCa@DivStartI{#1#2}#3=!%
1474     }%
1475     \else
1476     \@ReturnAfterFi{%
1477     \InCa@DivStart{#1#2}!#3!#5%
1478     }%
1479     \fi
1480 }

\InCa@StartI
1481 \def\InCa@DivStartI#1!#2!{%
1482     \expandafter\InCa@DivStartII
1483     \number#2\expandafter\expandafter\expandafter!%
1484     \intcalcShl{#2}!%
1485     #1!%
1486 }

\InCa@StartII
1487 \def\InCa@DivStartII#1!#2!{%
1488     \expandafter\InCa@DivStartIII
1489     \number#1\expandafter!%
1490     \number#2\expandafter\expandafter\expandafter!%
1491     \intcalcShl{#2}!%
1492 }

\InCa@StartIII

```

```

1493 \def\InCa@DivStartIII#1!#2!#3!{%
1494   \expandafter\InCa@DivStartIV
1495   \number#1\expandafter!%
1496   \number#2\expandafter!%
1497   \number#3\expandafter!%
1498   \number\InCa@Add#3!#2!\expandafter\expandafter\expandafter!%
1499   \intcalcShl{#3}!%
1500 }

```

\InCa@StartIV

```

1501 \def\InCa@DivStartIV#1!#2!#3!#4!#5!#6!{%
1502   \InCa@ProcessDiv#6!#1!#2!#3!#4!#5!/ %
1503 }

```

\InCa@ProcessDiv

```

1504 \def\InCa@ProcessDiv#1#2#3!#4!#5!#6!#7!#8!#9/{%
1505   #9%
1506   \ifnum#1<#4 % 0
1507     0%
1508     \ifx#2=%
1509     \else
1510       \InCa@ProcessDiv{#1#2}#3!#4!#5!#6!#7!#8!%
1511     \fi
1512   \else % 1-9
1513     \ifnum#1<#5 % 1
1514       1%
1515       \ifx#2=%
1516       \else
1517         \expandafter\InCa@ProcessDiv\expandafter{%
1518           \number\InCa@Sub#1!#4!%
1519           #2%
1520         }#3!#4!#5!#6!#7!#8!%
1521       \fi
1522     \else % 2-9
1523       \ifnum#1<#7 % 2 3 4 5
1524       \ifnum#1<#6 % 2 3
1525         \@ReturnAfterElseFi{%
1526           \expandafter\InCa@@ProcessDiv
1527           \number\InCa@Sub#1!#5!%
1528           23%
1529         }%
1530       \else % 4 5
1531         \@ReturnAfterFi{%
1532           \expandafter\InCa@@ProcessDiv
1533           \number\InCa@Sub#1!#6!%
1534           45%
1535         }%
1536       \fi
1537       #2#3!#4!#5!#6!#7!#8!%
1538     \else % 6 7 8 9
1539       \ifnum#1<#8 % 6 7
1540         \@ReturnAfterElseFi{%
1541           \expandafter\InCa@@ProcessDiv
1542           \number\InCa@Sub#1!#7!%
1543           67%
1544         }%
1545       \else % 8 9
1546         \@ReturnAfterFi{%
1547           \expandafter\InCa@@ProcessDiv
1548           \number\InCa@Sub#1!#8!%
1549           89%
1550         }%

```

```

1551     \fi
1552     #2#3!#4!#5!#6!#7!#8!%
1553     \fi
1554     \fi
1555     \fi
1556     \ifx#2=%
1557         \expandafter\@gobble
1558     \fi
1559     /%
1560 }

```

\InCa@@ProcessDiv

```

1561 \def\InCa@@ProcessDiv#1!#2#3#4#5!#6!{%
1562     \ifnum#1<#6 %
1563         #2%
1564         \@ReturnAfterElseFi{%
1565             \ifx#4=%
1566                 \expandafter\InCa@CleanupIV
1567             \else
1568                 \@ReturnAfterFi{%
1569                     \InCa@ProcessDiv{#1#4}#5!#6!%
1570                 }%
1571             \fi
1572         }%
1573     \else
1574         #3%
1575         \@ReturnAfterFi{%
1576             \ifx#4=%
1577                 \expandafter\InCa@CleanupIV
1578             \else
1579                 \@ReturnAfterFi{%
1580                     \expandafter\InCa@ProcessDiv\expandafter{%
1581                         \number\InCa@Sub#1!#6! %
1582                         #4%
1583                     }#5!#6!%
1584                 }%
1585             \fi
1586         }%
1587     \fi
1588 }

```

\InCa@CleanupIV

```

1589 \def\InCa@CleanupIV#1!#2!#3!#4!{}

```

2.5.12 Mod

\intcalcMod

```

1590 \def\intcalcMod#1#2{%
1591     \number\expandafter\InCa@Mod
1592     \number\number#1\expandafter!%
1593     \number#2! %
1594 }

```

\intcalc@Mod Pseudocode/decision table for \intcalc@Mod.

if	$y = 0$	DivisionByZero
elsif	$y < 0$	$-\text{Mod}(-x, -y)$
elsif	$x = 0$	0
elsif	$y = 1$	0
elsif	$y = 2$	$\text{ifodd}(x) ? 1 : 0$
elsif	$x < 0$	$z \leftarrow x - (x/y) * y; \quad (z < 0) ? z + y : z$
else		$x - (x/y) * y$

```

1595 \def\InCa@Mod#1!#2!{%
1596   \ifcase#2 %
1597     0\IntCalcError:DivisionByZero%
1598   \else
1599     \ifnum#2<\z@
1600       -%
1601       \expandafter\InCa@Mod
1602       \number-#1\expandafter!%
1603       \number-#2!%
1604     \else
1605       \ifcase#1 %
1606         0%
1607       \else
1608         \ifcase#2 % 0 already caught
1609 ?       \IntCalcError:ThisCannotHappen%
1610         \or % 1
1611         0%
1612         \or % 2
1613         \ifodd#1 1\else 0\fi
1614       \else
1615         \ifnum#1<\z@
1616         \expandafter\InCa@ModShift
1617         \number-%
1618         \expandafter\InCa@Sub
1619         \number\@gobble#1\expandafter!%
1620         \number\intcalcMul{#2}{%
1621         \expandafter\InCa@Div\@gobble#1!#2!%
1622         }!%
1623         !#2!%
1624       \else
1625         \expandafter\InCa@Sub\number#1\expandafter!%
1626         \number\intcalcMul{#2}{\InCa@Div#1!#2!}%
1627       \fi
1628     \fi
1629   \fi
1630 \fi
1631 \fi
1632 }

```

\IntCalcMod

```

1633 \def\InCa@Temp#1{%
1634   \def\IntCalcMod##1!##2!{%
1635     \number
1636     \ifcase##2 %
1637       0\IntCalcError:DivisionByZero%
1638     \else
1639       \ifcase##1 %
1640         0%
1641       \else
1642         \ifcase##2 % 0 already caught
1643 ?       \IntCalcError:ThisCannotHappen
1644         \or % 1
1645         0%
1646         \or % 2
1647         \ifodd ##1 1\else 0\fi
1648       \else
1649         \expandafter\InCa@Sub\number##1\expandafter!%
1650         \number\intcalcMul{##2}{\InCa@Div##1!##2!}%
1651       \fi
1652     \fi
1653   \fi
1654   #1%
1655 }%

```



```

1656 }
1657 \InCa@Temp{ }%

```

\InCa@ModShift

```

1658 \def\InCa@ModShift#1!#2!{%
1659   \ifnum#1<\z@
1660     \expandafter\InCa@Sub\number#2\expandafter!%
1661     \@gobble#1!%
1662   \else
1663     #1%
1664   \fi
1665 }

```

2.5.13 Help macros

\InCa@Empty

```

1666 \def\InCa@Empty{}

```

\@gobble

```

1667 \expandafter\ifx\csname \@gobble\endcsname\relax
1668   \long\def\@gobble#1{}%
1669 \fi

```

\@ReturnAfterFi

```

1670 \long\def\@ReturnAfterFi#1\fi{\fi#1}%

```

\@ReturnAfterElseFi

```

1671 \long\def\@ReturnAfterElseFi#1\else#2\fi{\fi#1}%

```

```

1672 \InCa@AtEnd

```

```

1673 \</package>

```

3 Test

3.1 Catcode checks for loading

```

1674 \<test1>
1675 \catcode'\{=1 %
1676 \catcode'\}=2 %
1677 \catcode'\#=6 %
1678 \catcode'\@=11 %
1679 \expandafter\ifx\csname count@\endcsname\relax
1680   \countdef\count@=255 %
1681 \fi
1682 \expandafter\ifx\csname \@gobble\endcsname\relax
1683   \long\def\@gobble#1{}%
1684 \fi
1685 \expandafter\ifx\csname @firstofone\endcsname\relax
1686   \long\def\@firstofone#1{#1}%
1687 \fi
1688 \expandafter\ifx\csname loop\endcsname\relax
1689   \expandafter\@firstofone
1690 \else
1691   \expandafter\@gobble
1692 \fi
1693 {%
1694   \def\loop#1\repeat{%
1695     \def\body{#1}%
1696     \iterate
1697   }%

```

```

1698 \def\iterate{%
1699   \body
1700   \let\next\iterate
1701   \else
1702   \let\next\relax
1703   \fi
1704   \next
1705 }%
1706 \let\repeat=\fi
1707 }%
1708 \def\RestoreCatcodes{}
1709 \count@=0 %
1710 \loop
1711   \edef\RestoreCatcodes{%
1712     \RestoreCatcodes
1713     \catcode\the\count@=\the\catcode\count@\relax
1714   }%
1715 \ifnum\count@<255 %
1716   \advance\count@ 1 %
1717 \repeat
1718
1719 \def\RangeCatcodeInvalid#1#2{%
1720   \count@=#1\relax
1721   \loop
1722     \catcode\count@=15 %
1723   \ifnum\count@<#2\relax
1724     \advance\count@ 1 %
1725   \repeat
1726 }
1727 \def\Test{%
1728   \RangeCatcodeInvalid{0}{47}%
1729   \RangeCatcodeInvalid{58}{64}%
1730   \RangeCatcodeInvalid{91}{96}%
1731   \RangeCatcodeInvalid{123}{255}%
1732   \catcode'\@=12 %
1733   \catcode'\=0 %
1734   \catcode'\{=1 %
1735   \catcode'\}=2 %
1736   \catcode'\#=6 %
1737   \catcode'\[=12 %
1738   \catcode'\]=12 %
1739   \catcode'\%=14 %
1740   \catcode'\ =10 %
1741   \catcode13=5 %
1742   \input intcalc.sty\relax
1743   \RestoreCatcodes
1744 }
1745 \Test
1746 \csname @@end\endcsname
1747 \end
1748 </test1>

```

3.2 Macro tests

3.2.1 Preamble with test macro definitions

```

1749 <*test2 | test4>
1750 \NeedsTeXFormat{LaTeX2e}
1751 \nofiles
1752 \documentclass{article}
1753 <noetex> \let\SavedNumexpr\numexpr
1754 <noetex> \let\numexpr\UNDEFINED
1755 \makeatletter

```

```

1756 \chardef\InCa@TestMode=1 %
1757 \makeatother
1758 \usepackage{intcalc}[2007/09/27]
1759 <noetex> \let\numexpr\SavedNumexpr
1760 \usepackage{qstest}
1761 \IncludeTests{*}
1762 \LogTests{log}{*}{*}
1763 </test2 | test4>
1764 <*test2>
1765 \newcommand*\TestSpaceAtEnd}[1]{%
1766 <noetex> \let\SavedNumexpr\numexpr
1767 <noetex> \let\numexpr\UNDEFINED
1768 \edef\resultA{#1}%
1769 \edef\resultB{#1 }%
1770 <noetex> \let\numexpr\SavedNumexpr
1771 \Expect*\resultA\space*{\resultB}%
1772 }
1773 \newcommand*\TestResult}[2]{%
1774 <noetex> \let\SavedNumexpr\numexpr
1775 <noetex> \let\numexpr\UNDEFINED
1776 \edef\result{#1}%
1777 <noetex> \let\numexpr\SavedNumexpr
1778 \Expect*\result{#2}%
1779 }
1780 \newcommand*\TestResultTwoExpansions}[2]{%
1781 <*noetex>
1782 \begingroup
1783 \let\numexpr\UNDEFINED
1784 \expandafter\expandafter\expandafter
1785 \endgroup
1786 </noetex>
1787 \expandafter\expandafter\expandafter\Expect
1788 \expandafter\expandafter\expandafter{#1}{#2}%
1789 }
1790 \newcount\TestCount
1791 <etex> \newcommand*\TestArg}[1]{\numexpr#1\relax}
1792 <noetex> \newcommand*\TestArg}[1]{#1}
1793 \newcommand*\TestTeXDivide}[2]{%
1794 \TestCount=\TestArg{#1}\relax
1795 \divide\TestCount by \TestArg{#2}\relax
1796 \Expect*\intcalcDiv{#1}{#2}*{\the\TestCount}%
1797 }
1798 \newcommand*\Test}[2]{%
1799 \TestResult{#1}{#2}%
1800 \TestResultTwoExpansions{#1}{#2}%
1801 \TestSpaceAtEnd{#1}%
1802 }
1803 \newcommand*\TestExch}[2]{\Test{#2}{#1}}
1804 \newcommand*\TestInv}[2]{%
1805 \Test{\intcalcInv{#1}}{#2}%
1806 }
1807 \newcommand*\TestNum}[2]{%
1808 \Test{\intcalcNum{#1}}{#2}%
1809 }
1810 \newcommand*\TestAbs}[2]{%
1811 \Test{\intcalcAbs{#1}}{#2}%
1812 }
1813 \newcommand*\TestSgn}[2]{%
1814 \Test{\intcalcSgn{#1}}{#2}%
1815 }
1816 \newcommand*\TestMin}[3]{%
1817 \Test{\intcalcMin{#1}{#2}}{#3}%

```

```

1818 }
1819 \newcommand*{\TestMax}[3]{%
1820   \Test{\intcalcMax{#1}{#2}}{#3}%
1821 }
1822 \newcommand*{\TestCmp}[3]{%
1823   \Test{\intcalcCmp{#1}{#2}}{#3}%
1824 }
1825 \newcommand*{\TestInc}[2]{%
1826   \Test{\intcalcInc{#1}{#2}}%
1827   \ifnum\intcalcNum{#1}>-1 %
1828     \edef\x{%
1829       \noexpand\Test{%
1830         \noexpand\IntCalcInc\intcalcNum{#1}!%
1831       }{#2}%
1832     }%
1833     \x
1834   \fi
1835 }
1836 \newcommand*{\TestDec}[2]{%
1837   \Test{\intcalcDec{#1}{#2}}%
1838   \ifnum\intcalcNum{#1}>0 %
1839     \edef\x{%
1840       \noexpand\Test{%
1841         \noexpand\IntCalcDec\intcalcNum{#1}!%
1842       }{#2}%
1843     }%
1844     \x
1845   \fi
1846 }
1847 \newcommand*{\TestAdd}[3]{%
1848   \Test{\intcalcAdd{#1}{#2}}{#3}%
1849   \ifnum\intcalcNum{#1}>0 %
1850     \ifnum\intcalcNum{#2}> 0 %
1851       \ifnum\intcalcCmp{#1}{#2}>0 %
1852         \edef\x{%
1853           \noexpand\Test{%
1854             \noexpand\IntCalcAdd
1855             \intcalcNum{#1}!\intcalcNum{#2}!%
1856           }{#3}%
1857         }%
1858         \x
1859       \else
1860         \edef\x{%
1861           \noexpand\Test{%
1862             \noexpand\IntCalcAdd
1863             \intcalcNum{#2}!\intcalcNum{#1}!%
1864           }{#3}%
1865         }%
1866         \x
1867       \fi
1868     \fi
1869   \fi
1870 }
1871 \newcommand*{\TestSub}[3]{%
1872   \Test{\intcalcSub{#1}{#2}}{#3}%
1873   \ifnum\intcalcNum{#1}>0 %
1874     \ifnum\intcalcNum{#2}> 0 %
1875       \ifnum\intcalcCmp{#1}{#2}>0 %
1876         \edef\x{%
1877           \noexpand\Test{%
1878             \noexpand\IntCalcSub
1879             \intcalcNum{#1}!\intcalcNum{#2}!%

```

```

1880         }{#3}%
1881     }%
1882     \x
1883     \fi
1884     \fi
1885     \fi
1886 }
1887 \newcommand*{\TestShl}[2]{%
1888   \Test{\intcalcShl{#1}{#2}%
1889     \edef\x{%
1890       \noexpand\Test{%
1891         \noexpand\IntCalcShl\intcalcAbs{#1}!%
1892       }{\intcalcAbs{#2}}}%
1893   }%
1894   \x
1895 }
1896 \newcommand*{\TestShr}[2]{%
1897   \Test{\intcalcShr{#1}{#2}%
1898     \edef\x{%
1899       \noexpand\Test{%
1900         \noexpand\IntCalcShr\intcalcAbs{#1}!%
1901       }{\intcalcAbs{#2}}}%
1902   }%
1903   \x
1904 }
1905 \newcommand*{\TestMul}[3]{%
1906   \Test{\intcalcMul{#1}{#2}{#3}%
1907     \edef\x{%
1908       \noexpand\Test{%
1909         \noexpand\IntCalcMul\intcalcAbs{#1}!\intcalcAbs{#2}!%
1910       }{\intcalcAbs{#3}}}%
1911   }%
1912   \x
1913 }
1914 \newcommand*{\TestSqr}[2]{%
1915   \Test{\intcalcSqr{#1}{#2}%
1916 }
1917 \newcommand*{\TestFac}[2]{%
1918   \expandafter\TestExch\expandafter{\the\numexpr#2}{\intcalcFac{#1}}%
1919 }
1920 \newcommand*{\TestPow}[3]{%
1921   \Test{\intcalcPow{#1}{#2}{#3}%
1922 }
1923 \newcommand*{\TestDiv}[3]{%
1924   \Test{\intcalcDiv{#1}{#2}{#3}%
1925     \TestTeXDivide{#1}{#2}%
1926     \edef\x{%
1927       \noexpand\Test{%
1928         \noexpand\IntCalcDiv\intcalcAbs{#1}!\intcalcAbs{#2}!%
1929       }{\intcalcAbs{#3}}}%
1930   }%
1931 }
1932 \newcommand*{\TestMod}[3]{%
1933   \Test{\intcalcMod{#1}{#2}{#3}%
1934     \ifcase\ifcase\intcalcSgn{#1} 0%
1935       \or
1936       \ifcase\intcalcSgn{#2} 1%
1937       \or 0%
1938       \else 1%
1939     \fi
1940     \else
1941       \ifcase\intcalcSgn{#2} 1%

```

```

1942         \or 1%
1943         \else 0%
1944         \fi
1945     \fi\relax
1946 \edef\x{%
1947     \noexpand\Test{%
1948         \noexpand\IntCalcMod
1949         \intcalcAbs{#1}!\intcalcAbs{#2}!%
1950     }\intcalcAbs{#3}}%
1951 }%
1952 \x
1953 \fi
1954 }
1955 </test2>

```

3.2.2 Time

```

1956 <*test2>
1957 \begingroup\expandafter\expandafter\expandafter\endgroup
1958 \expandafter\ifx\cename pdfresettimer\endcename\relax
1959 \else
1960     \makeatletter
1961     \newcount\SummaryTime
1962     \newcount\TestTime
1963     \SummaryTime=\z@
1964     \newcommand*\PrintTime}[2]{%
1965         \typeout{%
1966             [Time #1: \strip@pt\dimexpr\number#2sp\relax\space s]%
1967         }%
1968     }%
1969     \newcommand*\StartTime#[1]{%
1970         \renewcommand*\TimeDescription}{#1}%
1971         \pdfresettimer
1972     }%
1973     \newcommand*\TimeDescription}{}%
1974     \newcommand*\StopTime{%
1975         \TestTime=\pdfelapseddtime
1976         \global\advance\SummaryTime\TestTime
1977         \PrintTime\TimeDescription\TestTime
1978     }%
1979     \let\saved@qstest\qstest
1980     \let\saved@endqstest\endqstest
1981     \def\qstest#1#2{%
1982         \saved@qstest{#1}{#2}%
1983         \StartTime{#1}%
1984     }%
1985     \def\endqstest{%
1986         \StopTime
1987         \saved@endqstest
1988     }%
1989     \AtEndDocument{%
1990         \PrintTime{summary}\SummaryTime
1991     }%
1992     \makeatother
1993 \fi
1994 </test2>

```

3.2.3 Test 4: additional mod/div operations

```

1995 <*test4>
1996 \newcommand*\TestDo}[2]{%
1997     \ifcase\numexpr#2\relax
1998     \else
1999         \edef\temp{\intcalcMod{#1}{#2}}%
2000         \Expect*{%

```

```

2001      \the\numexpr
2002      \intcalcMul{%
2003          \intcalcDiv{\intcalcAbs{#1}}{\intcalcAbs{#2}}}%
2004      }\intcalcAbs{#2}}%
2005      +\intcalcMod{\intcalcAbs{#1}}{\intcalcAbs{#2}}\relax
2006      }*{\the\numexpr\intcalcAbs{#1}\relax}%
2007  \fi
2008 }
2009 \newcommand*{\TestOne}[2]{%
2010   \TestDo{#1}{#1}%
2011 }
2012 \newcommand*{\TestTwo}[3]{%
2013   \TestDo{#1}{#2}%
2014   \TestDo{#2}{#1}%
2015 }
2016 \let\TestNum\TestOne
2017 \let\TestInv\TestOne
2018 \let\TestAbs\TestOne
2019 \let\TestSgn\TestOne
2020 \let\TestMin\TestTwo
2021 \let\TestMax\TestTwo
2022 \let\TestCmp\TestTwo
2023 \let\TestInc\TestOne
2024 \let\TestDec\TestOne
2025 \let\TestAdd\TestTwo
2026 \let\TestSub\TestTwo
2027 \let\TestShl\TestOne
2028 \let\TestShr\TestOne
2029 \let\TestMul\TestTwo
2030 \let\TestSqr\TestOne
2031 \def\TestFac#1#2{}
2032 \let\TestPow\TestTwo
2033 \let\TestDiv\TestTwo
2034 \let\TestMod\TestTwo
2035 </test4>

```

3.2.4 Test sets

```

2036 <*test2 | test4>
2037 \makeatletter
2038
2039 \begin{qstest}{num}{num}%
2040   \TestNum{0}{0}%
2041   \TestNum{1}{1}%
2042   \TestNum{-1}{-1}%
2043   \TestNum{10}{10}%
2044   \TestNum{-10}{-10}%
2045   \TestNum{2147483647}{2147483647}%
2046   \TestNum{-2147483647}{-2147483647}%
2047   \TestNum{ 0 }{0}%
2048   \TestNum{ 1 }{1}%
2049   \TestNum{--1}{1}%
2050   \TestNum{ - + - + 4 }{4}%
2051   \TestNum{\z@}{0}%
2052   \TestNum{\@ne}{1}%
2053   \TestNum{\m@ne}{-1}%
2054 <*etex>
2055   \TestNum{-10+30}{20}%
2056   \TestNum{10-30}{-20}%
2057 </etex>
2058 \end{qstest}
2059
2060 \begin{qstest}{inv}{inv}%
2061   \TestInv{0}{0}%

```

```

2062 \TestInv{1}{-1}%
2063 \TestInv{-1}{1}%
2064 \TestInv{10}{-10}%
2065 \TestInv{-10}{10}%
2066 \TestInv{2147483647}{-2147483647}%
2067 \TestInv{-2147483647}{2147483647}%
2068 \TestInv{ 0 }{0}%
2069 \TestInv{ 1 }{-1}%
2070 \TestInv{--1}{-1}%
2071 \TestInv{\z0}{0}%
2072 \TestInv{\@ne}{-1}%
2073 \TestInv{\m@ne}{1}%
2074 <*etex>
2075 \TestInv{-10+30}{-20}%
2076 \TestInv{10-30}{20}%
2077 </etex>
2078 \end{qstest}
2079
2080 \begin{qstest}{abs}{abs}%
2081 \TestAbs{0}{0}%
2082 \TestAbs{1}{1}%
2083 \TestAbs{-1}{1}%
2084 \TestAbs{10}{10}%
2085 \TestAbs{-10}{10}%
2086 \TestAbs{2147483647}{2147483647}%
2087 \TestAbs{-2147483647}{2147483647}%
2088 \TestAbs{ 0 }{0}%
2089 \TestAbs{ 1 }{1}%
2090 \TestAbs{--1}{1}%
2091 \TestAbs{\z0}{0}%
2092 \TestAbs{\@ne}{1}%
2093 \TestAbs{\m@ne}{1}%
2094 <*etex>
2095 \TestAbs{-10+30}{20}%
2096 \TestAbs{10-30}{20}%
2097 </etex>
2098 \end{qstest}
2099
2100 \begin{qstest}{sign}{sign}%
2101 \TestSgn{0}{0}%
2102 \TestSgn{1}{1}%
2103 \TestSgn{-1}{-1}%
2104 \TestSgn{10}{1}%
2105 \TestSgn{-10}{-1}%
2106 \TestSgn{2147483647}{1}%
2107 \TestSgn{-2147483647}{-1}%
2108 \TestSgn{ 0 }{0}%
2109 \TestSgn{ 2 }{1}%
2110 \TestSgn{ -2 }{-1}%
2111 \TestSgn{--2}{1}%
2112 \TestSgn{\z0}{0}%
2113 \TestSgn{\@ne}{1}%
2114 \TestSgn{\m@ne}{-1}%
2115 <*etex>
2116 \TestSgn{-10+30}{1}%
2117 \TestSgn{10-30}{-1}%
2118 </etex>
2119 \end{qstest}
2120
2121 \begin{qstest}{min}{min}%
2122 \TestMin{0}{1}{0}%
2123 \TestMin{1}{0}{0}%

```



```

2124 \TestMin{-10}{-20}{-20}%
2125 \TestMin{ 1 }{ 2 }{1}%
2126 \TestMin{ 2 }{ 1 }{1}%
2127 \TestMin{1}{1}{1}%
2128 \TestMin{\z@}{\@ne}{0}%
2129 \TestMin{\@ne}{\m@ne}{-1}%
2130 <*etex>
2131 \TestMin{1+2}{3+4}{3}%
2132 </etex>
2133 \end{qstest}
2134
2135 \begin{qstest}{max}{max}%
2136 \TestMax{0}{1}{1}%
2137 \TestMax{1}{0}{1}%
2138 \TestMax{-10}{-20}{-10}%
2139 \TestMax{ 1 }{ 2 }{2}%
2140 \TestMax{ 2 }{ 1 }{2}%
2141 \TestMax{1}{1}{1}%
2142 \TestMax{\z@}{\@ne}{1}%
2143 \TestMax{\@ne}{\m@ne}{1}%
2144 <*etex>
2145 \TestMax{1+2}{3+4}{7}%
2146 </etex>
2147 \end{qstest}
2148
2149 \begin{qstest}{cmp}{cmp}%
2150 \TestCmp{0}{0}{0}%
2151 \TestCmp{-21}{17}{-1}%
2152 \TestCmp{3}{4}{-1}%
2153 \TestCmp{-10}{-10}{0}%
2154 \TestCmp{-10}{-11}{1}%
2155 \TestCmp{100}{5}{1}%
2156 \TestCmp{2147483647}{-2147483647}{1}%
2157 \TestCmp{-2147483647}{2147483647}{-1}%
2158 \TestCmp{2147483647}{2147483647}{0}%
2159 \TestCmp{\z@}{\@ne}{-1}%
2160 \TestCmp{\@ne}{\m@ne}{1}%
2161 \TestCmp{ 4 }{ 5 }{-1}%
2162 \TestCmp{ -3 }{ -7 }{1}%
2163 <*etex>
2164 \TestCmp{1+2}{3+4}{-1}%
2165 </etex>
2166 \end{qstest}
2167
2168 \begin{qstest}{fac}{fac}
2169 \TestFac{0}{1}%
2170 \TestFac{1}{1}%
2171 \TestFac{2}{2}%
2172 \TestFac{3}{2*3}%
2173 \TestFac{4}{2*3*4}%
2174 \TestFac{5}{2*3*4*5}%
2175 \TestFac{6}{2*3*4*5*6}%
2176 \TestFac{7}{2*3*4*5*6*7}%
2177 \TestFac{8}{2*3*4*5*6*7*8}%
2178 \TestFac{9}{2*3*4*5*6*7*8*9}%
2179 \TestFac{10}{2*3*4*5*6*7*8*9*10}%
2180 \TestFac{11}{2*3*4*5*6*7*8*9*10*11}%
2181 \TestFac{12}{2*3*4*5*6*7*8*9*10*11*12}%
2182 \end{qstest}
2183
2184 \begin{qstest}{inc}{inc}%
2185 \TestInc{0}{1}%

```

```

2186 \TestInc{1}{2}%
2187 \TestInc{-1}{0}%
2188 \TestInc{10}{11}%
2189 \TestInc{-10}{-9}%
2190 \TestInc{999}{1000}%
2191 \TestInc{-1000}{-999}%
2192 \TestInc{129}{130}%
2193 \TestInc{2147483646}{2147483647}%
2194 \TestInc{-2147483647}{-2147483646}%
2195 \end{qstest}
2196
2197 \begin{qstest}{dec}{dec}%
2198 \TestDec{0}{-1}%
2199 \TestDec{1}{0}%
2200 \TestDec{-1}{-2}%
2201 \TestDec{10}{9}%
2202 \TestDec{-10}{-11}%
2203 \TestDec{1000}{999}%
2204 \TestDec{-999}{-1000}%
2205 \TestDec{130}{129}%
2206 \TestDec{2147483647}{2147483646}%
2207 \TestDec{-2147483646}{-2147483647}%
2208 \end{qstest}
2209
2210 \begin{qstest}{add}{add}%
2211 \TestAdd{0}{0}{0}%
2212 \TestAdd{1}{0}{1}%
2213 \TestAdd{0}{1}{1}%
2214 \TestAdd{1}{2}{3}%
2215 \TestAdd{-1}{-1}{-2}%
2216 \TestAdd{2147483646}{1}{2147483647}%
2217 \TestAdd{-2147483647}{2147483647}{0}%
2218 \TestAdd{20}{-5}{15}%
2219 \TestAdd{-4}{-1}{-5}%
2220 \TestAdd{-1}{-4}{-5}%
2221 \TestAdd{-4}{1}{-3}%
2222 \TestAdd{-1}{4}{3}%
2223 \TestAdd{4}{-1}{3}%
2224 \TestAdd{1}{-4}{-3}%
2225 \TestAdd{-4}{-1}{-5}%
2226 \TestAdd{-1}{-4}{-5}%
2227 \TestAdd{ -4 }{ -1 }{-5}%
2228 \TestAdd{ -1 }{ -4 }{-5}%
2229 \TestAdd{ -4 }{ 1 }{-3}%
2230 \TestAdd{ -1 }{ 4 }{3}%
2231 \TestAdd{ 4 }{ -1 }{3}%
2232 \TestAdd{ 1 }{ -4 }{-3}%
2233 \TestAdd{ -4 }{ -1 }{-5}%
2234 \TestAdd{ -1 }{ -4 }{-5}%
2235 \TestAdd{876543210}{111111111}{987654321}%
2236 \TestAdd{999999999}{2}{1000000001}%
2237 <etex>
2238 \TestAdd{100}{50+150}{300}%
2239 \TestAdd{2147483647}{10-2147483647}{10}%
2240 </etex>
2241 \end{qstest}
2242
2243 \begin{qstest}{sub}{sub}
2244 \TestSub{0}{0}{0}%
2245 \TestSub{1}{0}{1}%
2246 \TestSub{1}{2}{-1}%
2247 \TestSub{-1}{-1}{0}%

```

```

2248 \TestSub{2147483646}{-1}{2147483647}%
2249 \TestSub{-2147483647}{-2147483647}{0}%
2250 \TestSub{-4}{-1}{-3}%
2251 \TestSub{-1}{-4}{3}%
2252 \TestSub{-4}{1}{-5}%
2253 \TestSub{-1}{4}{-5}%
2254 \TestSub{4}{-1}{5}%
2255 \TestSub{1}{-4}{5}%
2256 \TestSub{-4}{-1}{-3}%
2257 \TestSub{-1}{-4}{3}%
2258 \TestSub{ -4 }{ -1 }{-3}%
2259 \TestSub{ -1 }{ -4 }{3}%
2260 \TestSub{ -4 }{ 1 }{-5}%
2261 \TestSub{ -1 }{ 4 }{-5}%
2262 \TestSub{ 4 }{ -1 }{5}%
2263 \TestSub{ 1 }{ -4 }{5}%
2264 \TestSub{ -4 }{ -1 }{-3}%
2265 \TestSub{ -1 }{ -4 }{3}%
2266 \TestSub{1000000000}{2}{999999998}%
2267 \TestSub{987654321}{111111111}{876543210}%
2268 <*etex>
2269 \TestSub{100}{50+150}{-100}%
2270 \TestSub{2147483647}{-10+2147483647}{10}%
2271 </etex>
2272 \end{qstest}
2273
2274 \begin{qstest}{shl}{shl}
2275 \TestShl{0}{0}%
2276 \TestShl{1}{2}%
2277 \TestShl{5621}{11242}%
2278 \TestShl{1073741823}{2147483646}%
2279 \TestShl{-1}{-2}%
2280 \TestShl{-5621}{-11242}%
2281 \end{qstest}
2282
2283 \begin{qstest}{shr}{shr}
2284 \TestShr{0}{0}%
2285 \TestShr{1}{0}%
2286 \TestShr{2}{1}%
2287 \TestShr{3}{1}%
2288 \TestShr{4}{2}%
2289 \TestShr{5}{2}%
2290 \TestShr{6}{3}%
2291 \TestShr{7}{3}%
2292 \TestShr{8}{4}%
2293 \TestShr{9}{4}%
2294 \TestShr{10}{5}%
2295 \TestShr{11}{5}%
2296 \TestShr{12}{6}%
2297 \TestShr{13}{6}%
2298 \TestShr{14}{7}%
2299 \TestShr{15}{7}%
2300 \TestShr{16}{8}%
2301 \TestShr{17}{8}%
2302 \TestShr{18}{9}%
2303 \TestShr{19}{9}%
2304 \TestShr{20}{10}%
2305 \TestShr{21}{10}%
2306 \TestShr{22}{11}%
2307 \TestShr{11241}{5620}%
2308 \TestShr{73054202}{36527101}%
2309 \TestShr{2147483646}{1073741823}%

```

```

2310 \TestShr{-1}{0}%
2311 \TestShr{-2}{-1}%
2312 \TestShr{-3}{-1}%
2313 \TestShr{-11241}{-5620}%
2314 \end{qstest}
2315
2316 \begin{qstest}{mul}{mul}
2317 \TestMul{0}{0}{0}%
2318 \TestMul{1}{0}{0}%
2319 \TestMul{0}{1}{0}%
2320 \TestMul{1}{1}{1}%
2321 \TestMul{3}{1}{3}%
2322 \TestMul{1}{-3}{-3}%
2323 \TestMul{-4}{-5}{20}%
2324 \TestMul{3}{7}{21}%
2325 \TestMul{7}{3}{21}%
2326 \TestMul{3}{-7}{-21}%
2327 \TestMul{7}{-3}{-21}%
2328 \TestMul{-3}{7}{-21}%
2329 \TestMul{-7}{3}{-21}%
2330 \TestMul{-3}{-7}{21}%
2331 \TestMul{-7}{-3}{21}%
2332 \TestMul{12}{11}{132}%
2333 \TestMul{999}{333}{332667}%
2334 \TestMul{1000}{4321}{4321000}%
2335 \TestMul{12345}{173955}{2147474475}%
2336 \TestMul{1073741823}{2}{2147483646}%
2337 \TestMul{2}{1073741823}{2147483646}%
2338 \TestMul{-1073741823}{2}{-2147483646}%
2339 \TestMul{2}{-1073741823}{-2147483646}%
2340 \etex
2341 \TestMul{2+3}{5+7}{60}%
2342 \TestMul{2147483647}{2147483647/2147483647}{2147483647}%
2343 \etex
2344 \end{qstest}
2345
2346 \begin{qstest}{sqr}{sqr}
2347 \TestSqr{0}{0}%
2348 \TestSqr{1}{1}%
2349 \TestSqr{2}{4}%
2350 \TestSqr{3}{9}%
2351 \TestSqr{4}{16}%
2352 \TestSqr{9}{81}%
2353 \TestSqr{10}{100}%
2354 \TestSqr{46340}{2147395600}%
2355 \TestSqr{-1}{1}%
2356 \TestSqr{-2}{4}%
2357 \TestSqr{-46340}{2147395600}%
2358 \end{qstest}
2359
2360 \begin{qstest}{pow}{pow}
2361 \TestPow{-2}{0}{1}%
2362 \TestPow{-1}{0}{1}%
2363 \TestPow{0}{0}{1}%
2364 \TestPow{1}{0}{1}%
2365 \TestPow{2}{0}{1}%
2366 \TestPow{3}{0}{1}%
2367 \TestPow{-2}{1}{-2}%
2368 \TestPow{-1}{1}{-1}%
2369 \TestPow{1}{1}{1}%
2370 \TestPow{2}{1}{2}%
2371 \TestPow{3}{1}{3}%

```

```

2372 \TestPow{-2}{2}{4}%
2373 \TestPow{-1}{2}{1}%
2374 \TestPow{0}{2}{0}%
2375 \TestPow{1}{2}{1}%
2376 \TestPow{2}{2}{4}%
2377 \TestPow{3}{2}{9}%
2378 \TestPow{0}{1}{0}%
2379 \TestPow{1}{-2}{1}%
2380 \TestPow{1}{-1}{1}%
2381 \TestPow{-1}{-2}{1}%
2382 \TestPow{-1}{-1}{-1}%
2383 \TestPow{-1}{3}{-1}%
2384 \TestPow{-1}{4}{1}%
2385 \TestPow{-2}{-1}{0}%
2386 \TestPow{-2}{-2}{0}%
2387 \TestPow{2}{3}{8}%
2388 \TestPow{2}{4}{16}%
2389 \TestPow{2}{5}{32}%
2390 \TestPow{2}{6}{64}%
2391 \TestPow{2}{7}{128}%
2392 \TestPow{2}{8}{256}%
2393 \TestPow{2}{9}{512}%
2394 \TestPow{2}{10}{1024}%
2395 \TestPow{-2}{3}{-8}%
2396 \TestPow{-2}{4}{16}%
2397 \TestPow{-2}{5}{-32}%
2398 \TestPow{-2}{6}{64}%
2399 \TestPow{-2}{7}{-128}%
2400 \TestPow{-2}{8}{256}%
2401 \TestPow{-2}{9}{-512}%
2402 \TestPow{-2}{10}{1024}%
2403 \TestPow{3}{3}{27}%
2404 \TestPow{3}{4}{81}%
2405 \TestPow{3}{5}{243}%
2406 \TestPow{-3}{3}{-27}%
2407 \TestPow{-3}{4}{81}%
2408 \TestPow{-3}{5}{-243}%
2409 \TestPow{2}{30}{1073741824}%
2410 \TestPow{-3}{19}{-1162261467}%
2411 \TestPow{5}{13}{1220703125}%
2412 \TestPow{-7}{11}{-1977326743}%
2413 \end{qstest}
2414
2415 \begin{qstest}{div}{div}
2416 \TestDiv{1}{1}{1}%
2417 \TestDiv{2}{1}{2}%
2418 \TestDiv{-2}{1}{-2}%
2419 \TestDiv{2}{-1}{-2}%
2420 \TestDiv{-2}{-1}{2}%
2421 \TestDiv{15}{2}{7}%
2422 \TestDiv{-16}{2}{-8}%
2423 \TestDiv{1}{2}{0}%
2424 \TestDiv{1}{3}{0}%
2425 \TestDiv{2}{3}{0}%
2426 \TestDiv{-2}{3}{0}%
2427 \TestDiv{2}{-3}{0}%
2428 \TestDiv{-2}{-3}{0}%
2429 \TestDiv{13}{3}{4}%
2430 \TestDiv{-13}{-3}{4}%
2431 \TestDiv{-13}{3}{-4}%
2432 \TestDiv{-6}{5}{-1}%
2433 \TestDiv{-5}{5}{-1}%

```

```

2434 \TestDiv{-4}{5}{0}%
2435 \TestDiv{-3}{5}{0}%
2436 \TestDiv{-2}{5}{0}%
2437 \TestDiv{-1}{5}{0}%
2438 \TestDiv{0}{5}{0}%
2439 \TestDiv{1}{5}{0}%
2440 \TestDiv{2}{5}{0}%
2441 \TestDiv{3}{5}{0}%
2442 \TestDiv{4}{5}{0}%
2443 \TestDiv{5}{5}{1}%
2444 \TestDiv{6}{5}{1}%
2445 \TestDiv{-5}{4}{-1}%
2446 \TestDiv{-4}{4}{-1}%
2447 \TestDiv{-3}{4}{0}%
2448 \TestDiv{-2}{4}{0}%
2449 \TestDiv{-1}{4}{0}%
2450 \TestDiv{0}{4}{0}%
2451 \TestDiv{1}{4}{0}%
2452 \TestDiv{2}{4}{0}%
2453 \TestDiv{3}{4}{0}%
2454 \TestDiv{4}{4}{1}%
2455 \TestDiv{5}{4}{1}%
2456 \TestDiv{12345}{678}{18}%
2457 \TestDiv{32372}{5952}{5}%
2458 \TestDiv{284271294}{18162}{15651}%
2459 \TestDiv{217652429}{12561}{17327}%
2460 \TestDiv{462028434}{5439}{84947}%
2461 \TestDiv{2147483647}{1000}{2147483}%
2462 \TestDiv{2147483647}{-1000}{-2147483}%
2463 \TestDiv{-2147483647}{1000}{-2147483}%
2464 \TestDiv{-2147483647}{-1000}{2147483}%
2465 \end{qstest}
2466
2467 \begin{qstest}{mod}{mod}
2468 \TestMod{-6}{5}{4}%
2469 \TestMod{-5}{5}{0}%
2470 \TestMod{-4}{5}{1}%
2471 \TestMod{-3}{5}{2}%
2472 \TestMod{-2}{5}{3}%
2473 \TestMod{-1}{5}{4}%
2474 \TestMod{0}{5}{0}%
2475 \TestMod{1}{5}{1}%
2476 \TestMod{2}{5}{2}%
2477 \TestMod{3}{5}{3}%
2478 \TestMod{4}{5}{4}%
2479 \TestMod{5}{5}{0}%
2480 \TestMod{6}{5}{1}%
2481 \TestMod{-5}{4}{3}%
2482 \TestMod{-4}{4}{0}%
2483 \TestMod{-3}{4}{1}%
2484 \TestMod{-2}{4}{2}%
2485 \TestMod{-1}{4}{3}%
2486 \TestMod{0}{4}{0}%
2487 \TestMod{1}{4}{1}%
2488 \TestMod{2}{4}{2}%
2489 \TestMod{3}{4}{3}%
2490 \TestMod{4}{4}{0}%
2491 \TestMod{5}{4}{1}%
2492 \TestMod{-6}{-5}{-1}%
2493 \TestMod{-5}{-5}{0}%
2494 \TestMod{-4}{-5}{-4}%
2495 \TestMod{-3}{-5}{-3}%

```

```

2496 \TestMod{-2}{-5}{-2}%
2497 \TestMod{-1}{-5}{-1}%
2498 \TestMod{0}{-5}{0}%
2499 \TestMod{1}{-5}{-4}%
2500 \TestMod{2}{-5}{-3}%
2501 \TestMod{3}{-5}{-2}%
2502 \TestMod{4}{-5}{-1}%
2503 \TestMod{5}{-5}{0}%
2504 \TestMod{6}{-5}{-4}%
2505 \TestMod{-5}{-4}{-1}%
2506 \TestMod{-4}{-4}{0}%
2507 \TestMod{-3}{-4}{-3}%
2508 \TestMod{-2}{-4}{-2}%
2509 \TestMod{-1}{-4}{-1}%
2510 \TestMod{0}{-4}{0}%
2511 \TestMod{1}{-4}{-3}%
2512 \TestMod{2}{-4}{-2}%
2513 \TestMod{3}{-4}{-1}%
2514 \TestMod{4}{-4}{0}%
2515 \TestMod{5}{-4}{-3}%
2516 \TestMod{2147483647}{1000}{647}%
2517 \TestMod{2147483647}{-1000}{-353}%
2518 \TestMod{-2147483647}{1000}{353}%
2519 \TestMod{-2147483647}{-1000}{-647}%
2520 \TestMod{ 0 }{ 4 }{0}%
2521 \TestMod{ 1 }{ 4 }{1}%
2522 \TestMod{ -1 }{ 4 }{3}%
2523 \TestMod{ 0 }{ -4 }{0}%
2524 \TestMod{ 1 }{ -4 }{-3}%
2525 \TestMod{ -1 }{ -4 }{-1}%
2526 <etex>
2527 \TestMod{1+2}{1+3}{3}%
2528 \TestMod{1-2}{1+3}{3}%
2529 \TestMod{1-2}{1-4}{-1}%
2530 \TestMod{1+2}{1-4}{0}%
2531 \TestMod{1+2}{1-5}{-1}%
2532 </etex>
2533 \end{qstest}
2534 </test2 | test4>
2535
2536 <*test2>
2537 \newcommand*{\TestError}[2]{%
2538   \begingroup
2539     \expandafter\def\csname IntCalcError:#1\endcsname{%
2540       \Expect*{#2}{0}%
2541       \expandafter\def\csname IntCalcError:#1\endcsname{ERROR}%
2542       \Expect*{#2}{0ERROR }%
2543     \endgroup
2544   }
2545 \begin{qstest}{error}{error}
2546 \TestError{FacNegative}{\intcalcFac{-1}}%
2547 \TestError{FacNegative}{\intcalcFac{-2147483647}}%
2548 \TestError{FacOverflow}{\intcalcFac{13}}%
2549 \TestError{FacOverflow}{\intcalcFac{2147483647}}%
2550 \TestError{DivisionByZero}{\intcalcPow{0}{-1}}%
2551 \TestError{DivisionByZero}{\intcalcDiv{1}{0}}%
2552 \TestError{DivisionByZero}{\intcalcMod{1}{0}}%
2553 \TestError{DivisionByZero}{\IntCalcDiv1!0!}%
2554 \TestError{DivisionByZero}{\IntCalcMod1!0!}%
2555 \end{qstest}
2556 </test2>
2557

```

```

2558 <*test2 | test4>
2559 \begin{document}
2560 \end{document}
2561 </test2 | test4>

```

4 Installation

4.1 Download

Package. This package is available on CTAN¹:

[CTAN:macros/latex/contrib/oberdiek/intcalc.dtx](#) The source file.

[CTAN:macros/latex/contrib/oberdiek/intcalc.pdf](#) Documentation.

Bundle. All the packages of the bundle ‘oberdiek’ are also available in a TDS compliant ZIP archive. There the packages are already unpacked and the documentation files are generated. The files and directories obey the TDS standard.

[CTAN:macros/latex/contrib/oberdiek/oberdiek-tds.zip](#)

TDS refers to the standard “A Directory Structure for T_EX Files” ([CTAN:tds/tds.pdf](#)). Directories with `texmf` in their name are usually organized this way.

4.2 Bundle installation

Unpacking. Unpack the `oberdiek-tds.zip` in the TDS tree (also known as `texmf` tree) of your choice. Example (linux):

```
unzip oberdiek-tds.zip -d ~/texmf
```

Script installation. Check the directory `TDS:scripts/oberdiek/` for scripts that need further installation steps. Package `attachfile2` comes with the Perl script `pdfatfi.pl` that should be installed in such a way that it can be called as `pdfatfi`. Example (linux):

```

chmod +x scripts/oberdiek/pdfatfi.pl
cp scripts/oberdiek/pdfatfi.pl /usr/local/bin/

```

4.3 Package installation

Unpacking. The `.dtx` file is a self-extracting `docstrip` archive. The files are extracted by running the `.dtx` through plain-T_EX:

```
tex intcalc.dtx
```

TDS. Now the different files must be moved into the different directories in your installation TDS tree (also known as `texmf` tree):

```

intcalc.sty           → tex/generic/oberdiek/intcalc.sty
intcalc.pdf           → doc/latex/oberdiek/intcalc.pdf
test/intcalc-test1.tex → doc/latex/oberdiek/test/intcalc-test1.tex
test/intcalc-test2.tex → doc/latex/oberdiek/test/intcalc-test2.tex
test/intcalc-test3.tex → doc/latex/oberdiek/test/intcalc-test3.tex
test/intcalc-test4.tex → doc/latex/oberdiek/test/intcalc-test4.tex
intcalc.dtx           → source/latex/oberdiek/intcalc.dtx

```

If you have a `docstrip.cfg` that configures and enables `docstrip`’s TDS installing feature, then some files can already be in the right place, see the documentation of `docstrip`.

¹<http://ftp.ctan.org/tex-archive/>

4.4 Refresh file name databases

If your \TeX distribution ($\text{\texttt{teTeX}}$, $\text{\texttt{mikTeX}}$, ...) relies on file name databases, you must refresh these. For example, $\text{\texttt{teTeX}}$ users run $\text{\texttt{texhash}}$ or $\text{\texttt{mktexlsr}}$.

4.5 Some details for the interested

Attached source. The PDF documentation on CTAN also includes the $\text{\texttt{.dtx}}$ source file. It can be extracted by AcrobatReader 6 or higher. Another option is $\text{\texttt{pdftk}}$, e.g. unpack the file into the current directory:

```
pdftk intcalc.pdf unpack_files output .
```

Unpacking with \LaTeX . The $\text{\texttt{.dtx}}$ chooses its action depending on the format:

plain- \TeX : Run $\text{\texttt{docstrip}}$ and extract the files.

\LaTeX : Generate the documentation.

If you insist on using \LaTeX for $\text{\texttt{docstrip}}$ (really, $\text{\texttt{docstrip}}$ does not need \LaTeX), then inform the autodetect routine about your intention:

```
latex \let\install=y\input{intcalc.dtx}
```

Do not forget to quote the argument according to the demands of your shell.

Generating the documentation. You can use both the $\text{\texttt{.dtx}}$ or the $\text{\texttt{.drv}}$ to generate the documentation. The process can be configured by the configuration file $\text{\texttt{ltxdoc.cfg}}$. For instance, put this line into this file, if you want to have A4 as paper format:

```
\PassOptionsToClass{a4paper}{article}
```

An example follows how to generate the documentation with \pdfLaTeX :

```
pdflatex intcalc.dtx
makeindex -s gind.ist intcalc.idx
pdflatex intcalc.dtx
makeindex -s gind.ist intcalc.idx
pdflatex intcalc.dtx
```

5 History

[2007/09/09 v1.0]

- First version.

[2007/09/27 v1.1]

- $\text{\texttt{\intcalcNum}}$ added.
- $\text{\texttt{\intcalcShl}}$ and $\text{\texttt{\intcalcShr}}$ allow negative numbers. The sign is preserved.
- Reuse $\text{\texttt{@gobble}}$ instead of own macro $\text{\texttt{\IntCalc@Gobble}}$.
- Small fixes.
- Shorter internal prefix.
- Some programmer's interface.

6 Index

Numbers written in *italic* refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

Symbols		1115, 1119, 1123, 1222, 1230, 1231, 1285, 1667, 1679, 1682, 1685, 1688, 1746, 1958, 2539, 2541
<code>\#</code>	1677, 1736	
<code>\%</code>	1739	
<code>\@</code>	1678, 1732	
<code>\@ReturnAfterElseFi</code>		
	644, 655, 667, 679, 1039, 1472, 1525, 1540, 1564, <u>1671</u>	
<code>\@ReturnAfterFi</code>		
	648, 659, 671, 683, 694, 705, 993, 1037, 1091, 1224, 1476, 1531, 1546, 1568, 1575, 1579, <u>1670</u>	
<code>\@firstofone</code>	1686, 1689	
<code>\@gobble</code> 585, 588, 593, 596, 603, 606, 1244, 1247, 1252, 1255, 1263, 1265, 1436, 1439, 1445, 1557, 1619, 1621, 1661, <u>1667</u> , 1683, 1691		
<code>\@ne</code> 294, 1375, 2052, 2072, 2092, 2113, 2128, 2129, 2142, 2143, 2159, 2160		
<code>\[</code>	1737	
<code>\]</code>	1733	
<code>\{</code>	1675, 1734	
<code>\}</code>	1676, 1735	
<code>\]</code>	1738	
<code>_</code>	1740	
A		
<code>\advance</code>	1716, 1724, 1976	
<code>\AtEndDocument</code>	1989	
B		
<code>\begin</code> 2039, 2060, 2080, 2100, 2121, 2135, 2149, 2168, 2184, 2197, 2210, 2243, 2274, 2283, 2316, 2346, 2360, 2415, 2467, 2545, 2559		
<code>\body</code>	1695, 1699	
C		
<code>\catcode</code>	3, 4, 5, 6, 7, 18, 19, 20, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 62, 63, 66, 67, 68, 69, 73, 74, 75, 76, 80, 82, 99, 1675, 1676, 1677, 1678, 1713, 1722, 1732, 1733, 1734, 1735, 1736, 1737, 1738, 1739, 1740, 1741	
<code>\chardef</code>	1756	
<code>\count@</code>	1680, 1709, 1713, 1715, 1716, 1720, 1722, 1723, 1724	
<code>\countdef</code>	1680	
<code>\csname</code> 8, 21, 45, 58, 65, 97, 167, 465, 468, 478, 484, 490, 493, 497, 499, 504, 523, 533, 535, 540, 559, 666, 678, 690, 693, 701, 704, 711, 729, 737, 849, 976, 979, 985, 990, 992, 998, 1002, 1079, 1088, 1090, 1097, 1111,		
D		
<code>\dimexpr</code>	1966	
<code>\divide</code>	1795	
<code>\documentclass</code>	1752	
E		
<code>\empty</code>	12	
<code>\end</code>	1747, 2058, 2078, 2098, 2119, 2133, 2147, 2166, 2182, 2195, 2208, 2241, 2272, 2281, 2314, 2344, 2358, 2413, 2465, 2533, 2555, 2560	
<code>\endcsname</code>	8, 21, 45, 58, 65, 97, 167, 497, 504, 505, 523, 524, 533, 540, 541, 559, 560, 690, 701, 711, 713, 715, 729, 731, 733, 737, 739, 741, 849, 851, 853, 990, 998, 999, 1002, 1003, 1088, 1097, 1098, 1111, 1112, 1115, 1117, 1119, 1123, 1222, 1231, 1667, 1679, 1682, 1685, 1688, 1746, 1958, 2539, 2541	
<code>\endinput</code>	30, 432	
<code>\endqstest</code>	1980, 1985	
<code>\Expect</code>	1771, 1778, 1787, 1796, 2000, 2540, 2542	
I		
<code>\if</code>	407, 408, 416	
<code>\ifcase</code>	9, 145, 263, 270, 316, 319, 343, 346, 366, 369, 393, 396, 425, 507, 525, 543, 561, 629, 712, 743, 855, 1004, 1049, 1074, 1116, 1126, 1280, 1333, 1344, 1404, 1407, 1419, 1422, 1453, 1596, 1605, 1608, 1636, 1639, 1642, 1934, 1936, 1941, 1997	
<code>\ifnum</code>	121, 128, 135, 138, 159, 278, 294, 324, 331, 374, 381, 580, 581, 583, 591, 600, 601, 609, 636, 730, 738, 850, 1221, 1240, 1241, 1242, 1251, 1259, 1261, 1268, 1288, 1352, 1375, 1376, 1387, 1433, 1434, 1442, 1452, 1463, 1506, 1513, 1523, 1524, 1539, 1562, 1599, 1615, 1659, 1715, 1723, 1827, 1838, 1849, 1850, 1851, 1873, 1874, 1875	
<code>\ifodd</code>	229, 235, 279, 297, 1038, 1353, 1362, 1386, 1613, 1647	
<code>\ifx</code>	10, 12, 21, 45, 53, 97, 103, 110, 113, 167, 232, 272, 284, 463, 476,	

481, 496, 532, 643, 654, 665,
 677, 689, 700, 975, 989, 1024,
 1035, 1087, 1296, 1301, 1318,
 1338, 1346, 1358, 1361, 1471,
 1508, 1515, 1556, 1565, 1576,
 1667, 1679, 1682, 1685, 1688, 1958
 \immediate 23, 47
 \InCa@@@Add 645, 664
 \InCa@@@Sub 656, 676
 \InCa@@@Add 632, 642
 \InCa@@Div
 322, 356, 409, 412, 418, 420,
 1425, 1435, 1439, 1444, 1447, 1451
 \InCa@@Mod 372, 406
 \InCa@@ProcessDiv
 1526, 1532, 1541, 1547, 1561
 \InCa@@Sub 639, 653
 \InCa@@TestMode 101
 \InCa@@TimDigitCarry 1225, 1229
 \InCa@Abs 102, 176, 442
 \InCa@Add 584, 587,
 610, 612, 618, 628, 1297, 1307, 1498
 \InCa@AddDigit0 729
 \InCa@AddDigit[1-9] 736
 \InCa@AddSwitch 569, 575, 579
 \InCa@AtEnd 78, 79, 431, 1672
 \InCa@CleanupIV 1566, 1577, 1589
 \InCa@Cmp 134, 192, 456
 \InCa@Dec 466, 485, 493, 531
 \InCa@DecDigit0 559
 \InCa@DecDigit[1-9] 539
 \InCa@DecSwitch 473, 475
 \InCa@DigitCarry[0-9] 710
 \InCa@Div 311,
 315, 1399, 1403, 1621, 1626, 1650
 \InCa@DivStart 1460, 1470
 \InCa@DivStartI 1473, 1481
 \InCa@DivStartII 1482, 1487
 \InCa@DivStartIII 1488, 1493
 \InCa@DivStartIV 1494, 1501
 \InCa@DivSwitch 1410, 1432
 \InCa@Empty 643, 654,
 665, 677, 689, 700, 1296, 1301, 1666
 \InCa@Fac 144, 255, 1325
 \InCa@FirstOfOne 435, 438, 440
 \InCa@Inc 469, 479, 490, 495
 \InCa@IncDigit9 523
 \InCa@IncDigit[0-8] 503
 \InCa@IncSwitch 460, 462
 \InCa@Max 127, 187, 452
 \InCa@Min 120, 182, 448
 \InCa@Mod .. 361, 365, 1591, 1595, 1601
 \InCa@ModShift 1616, 1658
 \InCa@ModX 411, 417, 424
 \InCa@Mul . 1243, 1246, 1252, 1254,
 1262, 1265, 1269, 1271, 1277,
 1279, 1295, 1319, 1321, 1339,
 1341, 1377, 1379, 1383, 1388, 1390
 \InCa@MulSwitch 1235, 1239
 \InCa@Param[0-9] 1096
 \InCa@Pow 258, 262, 1328, 1332
 \InCa@PowRec 287, 293, 1365, 1367, 1374
 \InCa@ProcessAdd 668, 688
 \InCa@ProcessDiv 1502, 1504, 1569, 1580
 \InCa@ProcessMul 1291, 1295, 1302, 1306
 \InCa@ProcessSub 680, 699
 \InCa@ProcessTim 1080, 1086
 \InCa@Sgn 109, 179, 445
 \InCa@Shl 977, 980, 986, 988, 994, 1286
 \InCa@ShlDigit0 998
 \InCa@ShlDigit[1-9] 1001
 \InCa@ShlSwitch 972, 974
 \InCa@Shr 223,
 231, 1025, 1027, 1031, 1033, 1458
 \InCa@ShrDigit 1034, 1048
 \InCa@ShrSwitch 1021, 1023
 \InCa@Space 623, 632, 639
 \InCa@Sqr 249, 251, 1315, 1317
 \InCa@StartI 1481
 \InCa@StartII 1487
 \InCa@StartIII 1493
 \InCa@StartIV 1501
 \InCa@Sub . 593, 595, 602, 606, 621,
 635, 1518, 1527, 1533, 1542,
 1548, 1581, 1618, 1625, 1649, 1660
 \InCa@SubDigit[0-9] 848
 \InCa@Temp 340, 355,
 390, 405, 503, 514, 515, 516,
 517, 518, 519, 520, 521, 522,
 539, 550, 551, 552, 553, 554,
 555, 556, 557, 558, 710, 719,
 720, 721, 722, 723, 724, 725,
 726, 727, 728, 736, 749, 760,
 771, 782, 793, 804, 815, 826,
 837, 848, 861, 872, 883, 894,
 905, 916, 927, 938, 949, 960,
 1001, 1011, 1012, 1013, 1014,
 1015, 1016, 1017, 1018, 1019,
 1071, 1085, 1096, 1101, 1102,
 1103, 1104, 1105, 1106, 1107,
 1108, 1109, 1110, 1122, 1132,
 1143, 1154, 1165, 1176, 1187,
 1198, 1209, 1416, 1431, 1633, 1657
 \InCa@TestMode 101, 1756
 \InCa@Tim 1071, 1289, 1299, 1303, 1309
 \InCa@TimDigit0 1111
 \InCa@TimDigit1 1115
 \InCa@TimDigit[2-9] 1122
 \InCa@TimDigitCarry 1124, 1220
 \IncludeTests 1761
 \input 1742
 \IntCal@ShlDigit 988
 \intcalc@Mod 1595
 \intcalcAbs 4, 175,
 441, 1811, 1891, 1892, 1900,
 1901, 1909, 1910, 1928, 1929,
 1949, 1950, 2003, 2004, 2005, 2006
 \IntCalcAdd ... 7, 213, 617, 1854, 1862
 \intcalcAdd 5, 207, 567, 1848
 \intcalcCmp 4, 191, 455, 1823, 1851, 1875
 \IntCalcDec 7, 204, 492, 1841
 \intcalcDec 5, 198, 472, 1837
 \IntCalcDiv ... 7, 340, 1416, 1928, 2553

<code>\intcalcDiv</code>	6, 310, 1398, 1796, 1924, 2003, 2551	577, 584, 587, 595, 602, 618, 621, 972, 984, 1021, 1031, 1073, 1125, 1234, 1236, 1237, 1243, 1246, 1254, 1262, 1277, 1297, 1306, 1307, 1315, 1325, 1328, 1329, 1330, 1383, 1384, 1385, 1399, 1400, 1401, 1411, 1412, 1418, 1435, 1444, 1483, 1489, 1490, 1495, 1496, 1497, 1498, 1518, 1527, 1533, 1542, 1548, 1581, 1591, 1592, 1593, 1602, 1603, 1617, 1619, 1620, 1625, 1626, 1635, 1649, 1650, 1660, 1966
<code>\IntCalcError</code>	160, 162, 273, 317, 344, 367, 394, 1347, 1405, 1420, 1454, 1597, 1609, 1637, 1643	
<code>\intcalcFac</code>	6, 254, 1324, 1918, 2546, 2547, 2548, 2549	
<code>\IntCalcInc</code>	7, 201, 489, 1830	
<code>\intcalcInc</code>	5, 195, 459, 1826	
<code>\intcalcInv</code>	4, 172, 437, 1805	
<code>\intcalcMax</code>	4, 186, 451, 1820	
<code>\intcalcMin</code>	4, 181, 447, 1817	
<code>\IntCalcMod</code> ...	7, 390, 1633, 1948, 2554	
<code>\intcalcMod</code>	6, 360, 1590, 1933, 1999, 2005, 2552	
<code>\IntCalcMul</code>	7, 245, 1276, 1909	
<code>\intcalcMul</code>	5, 242, 1233, 1620, 1626, 1650, 1906, 2002	
<code>\intcalcNum</code> .	3, 169, 173, 434, 1808, 1827, 1830, 1838, 1841, 1849, 1850, 1855, 1863, 1873, 1874, 1879	
<code>\intcalcPow</code> ...	6, 257, 1327, 1921, 2550	
<code>\intcalcSgn</code>	4, 178, 444, 1814, 1934, 1936, 1941	
<code>\IntCalcShl</code>	7, 225, 983, 1891	
<code>\intcalcShl</code>	5, 219, 971, 1484, 1491, 1499, 1888	
<code>\IntCalcShr</code>	7, 228, 1030, 1900	
<code>\intcalcShr</code> ...	5, 222, 1020, 1384, 1897	
<code>\intcalcSqr</code>	6, 248, 1314, 1915	
<code>\IntCalcSub</code>	7, 216, 620, 1878	
<code>\intcalcSub</code>	5, 210, 573, 1872	
<code>\iterate</code>	1696, 1698, 1700	
L		
<code>\LogTests</code>	1762	
<code>\loop</code>	1694, 1710, 1721	
M		
<code>\m@ne</code>	278, 1352, 2053, 2073, 2093, 2114, 2129, 2143, 2160	
<code>\makeatletter</code>	1755, 1960, 2037	
<code>\makeatother</code>	1757, 1992	
N		
<code>\NeedsTeXFormat</code>	1750	
<code>\newcommand</code>	1765, 1773, 1780, 1791, 1792, 1793, 1798, 1803, 1804, 1807, 1810, 1813, 1816, 1819, 1822, 1825, 1836, 1847, 1871, 1887, 1896, 1905, 1914, 1917, 1920, 1923, 1932, 1964, 1969, 1973, 1974, 1996, 2009, 2012, 2537	
<code>\newcount</code>	1790, 1961, 1962	
<code>\next</code>	1700, 1702, 1704	
<code>\nofiles</code>	1751	
<code>\number</code>	173, 176, 179, 182, 187, 192, 223, 249, 255, 258, 306, 311, 325, 327, 332, 334, 342, 361, 375, 377, 382, 384, 392, 435, 438, 442, 445, 448, 449, 452, 453, 456, 457, 460, 473, 490, 493, 568, 570, 571, 574, 576,	
<code>\numexpr</code> ..	170, 176, 179, 183, 184, 188, 189, 193, 196, 199, 202, 205, 208, 211, 214, 217, 220, 223, 226, 229, 236, 238, 243, 246, 249, 252, 255, 259, 260, 268, 295, 299, 300, 301, 304, 305, 312, 313, 349, 358, 362, 363, 399, 409, 412, 418, 420, 428, 1753, 1754, 1759, 1766, 1767, 1770, 1774, 1775, 1777, 1783, 1791, 1918, 1997, 2001, 2006	
P		
<code>\PackageInfo</code>	26	
<code>\pdfelapsedtime</code>	1975	
<code>\pdfresettimer</code>	1971	
<code>\PrintTime</code>	1964, 1977, 1990	
<code>\ProvidesPackage</code>	59	
Q		
<code>\qstest</code>	1979, 1981	
R		
<code>\RangeCatcodeInvalid</code>	1719, 1728, 1729, 1730, 1731	
<code>\renewcommand</code>	1970	
<code>\repeat</code>	1694, 1706, 1717, 1725	
<code>\RestoreCatcodes</code>	1708, 1711, 1712, 1743	
<code>\result</code>	1776, 1778	
<code>\resultA</code>	1768, 1771	
<code>\resultB</code>	1769, 1771	
<code>\romannumeral</code>	323, 330, 373, 380, 691, 702	
S		
<code>\saved@endqstest</code>	1980, 1987	
<code>\saved@qstest</code>	1979, 1982	
<code>\SavedNumexpr</code>	1753, 1759, 1766, 1770, 1774, 1777	
<code>\space</code>	1771, 1966	
<code>\StartTime</code>	1969, 1983	
<code>\StopTime</code>	1974, 1986	
<code>\strip@pt</code>	1966	
<code>\SummaryTime</code> ...	1961, 1963, 1976, 1990	
T		
<code>\temp</code>	1999	
<code>\Test</code>	1727, 1745, 1798, 1803, 1805, 1808, 1811, 1814, 1817, 1820, 1823,	

1826, 1829, 1837, 1840, 1848, 1853, 1861, 1872, 1877, 1888, 1890, 1897, 1899, 1906, 1908, 1915, 1921, 1924, 1927, 1933, 1947	2525, 2527, 2528, 2529, 2530, 2531
\TestAbs 1810, 2018, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2095, 2096	\TestMul 1905, 2029, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2341, 2342
\TestAdd . . 1847, 2025, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2238, 2239	\TestNum 1807, 2016, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2055, 2056
\TestArg 1791, 1792, 1794, 1795	\TestOne . . 2009, 2016, 2017, 2018, 2019, 2023, 2024, 2027, 2028, 2030
\TestCmp 1822, 2022, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2164	\TestPow 1920, 2032, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412
\TestCount 1790, 1794, 1795, 1796	\TestResult 1773, 1799
\TestDec 1836, 2024, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207	\TestResultTwoExpansions . 1780, 1800
\TestDiv 1923, 2033, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464	\TestSgn 1813, 2019, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2116, 2117
\TestDo 1996, 2010, 2013, 2014	\TestShl 1887, 2027, 2275, 2276, 2277, 2278, 2279, 2280
\TestError 2537, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554	\TestShr 1896, 2028, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313
\TestExch 1803, 1918	\TestSpaceAtEnd 1765, 1801
\TestFac . . 1917, 2031, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181	\TestSqr 1914, 2030, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357
\TestInc 1825, 2023, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194	\TestSub 1871, 2026, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2269, 2270
\TestInv 1804, 2017, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2075, 2076	\TestTeXDivide 1793, 1925
\TestMax 1819, 2021, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2145	\TestTime 1962, 1975, 1976, 1977
\TestMin 1816, 2020, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2131	\TestTwo . . 2012, 2020, 2021, 2022, 2025, 2026, 2029, 2032, 2033, 2034
\TestMod . . 1932, 2034, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524,	\the 66, 67, 68, 69, 80, 170, 176, 179, 183, 184, 188, 189, 193, 196, 199, 202, 205, 208, 211, 214, 217, 220, 223, 226, 229, 236, 238, 243, 246, 249, 252, 255, 259, 260, 268, 295, 299, 300, 301, 304, 305, 312, 313, 349, 358, 362, 363, 399, 409, 412, 418, 420,

	428, 1713, 1796, 1918, 2001, 2006		X
\TimeDescription	... 1970, 1973, 1977	\x	8, 10, 12, 22, 26, 28, 46, 51, 58, 64,
\TMP@EnsureCode	..... 77, 84, 85,		72, 624, 627, 1828, 1833, 1839,
	86, 87, 88, 89, 90, 91, 92, 93, 94, 95		1844, 1852, 1858, 1860, 1866,
\typeout	..... 1965		1876, 1882, 1889, 1894, 1898,
			1903, 1907, 1912, 1926, 1946, 1952
	U		Z
\UNDEFINED	.... 1754, 1767, 1775, 1783	\z@	..... 159, 324, 331,
\usepackage	..... 1758, 1760		374, 381, 580, 581, 600, 1240,
			1241, 1259, 1433, 1434, 1442,
	W		1599, 1615, 1659, 1963, 2051,
\write	..... 23, 47		2071, 2091, 2112, 2128, 2142, 2159