

The intcalc package

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Abstract

This package provides expandable arithmetic operations with integers.

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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\@undefined
54          \xdef#1{#3}%
55        \fi
56        \ifx#1\relax
57          \xdef#1{#3}%
58        \fi
59      }%
60    \fi
61    \expandafter\x\csname ver@intcalc.sty\endcsname
62    \ProvidesPackage{intcalc}%
63    [2007/09/27 v1.1 Expandable integer calculations (H0)]

```

2.2 Catcodes

```

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

```



```

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

```

2.3 Macros independent of ε -TeX

2.3.1 Abs, Sgn

\InCa@Abs

```

105 \def\InCa@Abs#1#2!{%
106   \ifx#1-%
107     #2%
108   \else
109     #1#2%
110   \fi
111 }

```

\InCa@Sgn

```

112 \def\InCa@Sgn#1#2!{%
113   \ifx#1-%
114     -1%
115   \else
116     \ifx#10%
117       0%
118     \else
119       1%
120     \fi
121   \fi
122 }

```

2.3.2 Min, Max, Cmp

\InCa@Min

```

123 \def\InCa@Min#1!#2!{%
124   \ifnum#1<#2 %
125     #1%
126   \else
127     #2%
128   \fi
129 }

\InCa@Max

130 \def\InCa@Max#1!#2!{%
131   \ifnum#1>#2 %
132     #1%
133   \else
134     #2%
135   \fi
136 }

\InCa@Cmp

137 \def\InCa@Cmp#1!#2!{%
138   \ifnum#1=#2 %
139     0%
140   \else
141     \ifnum#1<#2 %
142       -%
143     \fi
144     1%
145   \fi
146 }

```

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.

```

147 \def\InCa@Fac#1!{%
148   \ifcase#1 1% 0!
149   \or 1% 1!
150   \or 2% 2!
151   \or 6% 3!
152   \or 24% 4!
153   \or 120% 5!
154   \or 720% 6!
155   \or 5040% 7!
156   \or 40320% 8!
157   \or 362880% 9!
158   \or 3628800% 10!
159   \or 39916800% 11!
160   \or 479001600% 12!
161   \else
162     \ifnum#1<\z@
163       0\IntCalcError:FacNegative%
164     \else
165       0\IntCalcError:FacOverflow%
166     \fi
167   \fi
168 }

```

2.4 Implementation based on ε -TeX

Only `\numexpr` is used from ε -TeX.

```

169 \begingroup\expandafter\expandafter\expandafter\endgroup
170 \expandafter\ifx\csname numexpr\endcsname\relax
171 \else

```

2.4.1 Num

\intcalcNum

```
172 \def\intcalcNum#1{%
173   \the\numexpr#1\relax
174 }%
```

2.4.2 Inv, Abs, Sgn

\intcalcInv

```
175 \def\intcalcInv#1{%
176   \number-\intcalcNum{#1} %
177 }%
```

\intcalcAbs

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

\intcalcSgn

```
181 \def\intcalcSgn#1{%
182   \number\expandafter\InCa@Sgn\the\numexpr#1! %
183 }%
```

2.4.3 Min, Max, Cmp

\intcalcMin

```
184 \def\intcalcMin#1#2{%
185   \number\expandafter\InCa@Min
186   \the\numexpr#1\expandafter!%
187   \the\numexpr#2! %
188 }%
```

\intcalcMax

```
189 \def\intcalcMax#1#2{%
190   \number\expandafter\InCa@Max
191   \the\numexpr#1\expandafter!%
192   \the\numexpr#2! %
193 }%
```

\intcalcCmp

```
194 \def\intcalcCmp#1#2{%
195   \number\expandafter\InCa@Cmp
196   \the\numexpr#1\expandafter!\the\numexpr#2! %
197 }%
```

2.4.4 Inc, Dec

\intcalcInc

```
198 \def\intcalcInc#1{%
199   \the\numexpr#1+1\relax
200 }%
```

\intcalcDec

```
201 \def\intcalcDec#1{%
202   \the\numexpr#1-1\relax
203 }%
```

\IntCalcInc

```
204 \def\IntCalcInc#1!{%
205   \the\numexpr#1+1\relax
206 }%
```

\IntCalcDec

```
207 \def\IntCalcDec#1!{%
208   \the\numexpr#1-1\relax
209 }%
```

2.4.5 Add, Sub

\intcalcAdd

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

\intcalcSub

```
213 \def\intcalcSub#1#2{%
214   \the\numexpr#1-(#2)\relax
215 }%
```

\IntCalcAdd

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

\IntCalcSub

```
219 \def\IntCalcSub#1!#2!{%
220   \the\numexpr#1-#2\relax
221 }%
```

2.4.6 Shl, Shr

\intcalcShl

```
222 \def\intcalcShl#1{%
223   \the\numexpr(#1)*2\relax
224 }%
```

\intcalcShr

```
225 \def\intcalcShr#1{%
226   \number\expandafter\InCa@Shr\the\numexpr#1! %
227 }%
```

\IntCalcShl

```
228 \def\IntCalcShl#1!{%
229   \the\numexpr#1*2\relax
230 }%
```

\IntCalcShr

```
231 \def\IntCalcShr#1!{%
232   \the\numexpr\ifodd#1 (#1-1)\else#1\fi/2\relax
233 }%
```

\InCa@Shr

```
234 \def\InCa@Shr#1#2!{%
235   \ifx#1-%
236     -\InCa@Shr#2!%
237   \else
```

```

238     \ifodd#1#2 %
239     \the\numexpr(#1#2-1)/2\relax
240     \else
241     \the\numexpr#1#2/2\relax
242     \fi
243     \fi
244 }%

```

2.4.7 Mul, Sqr, Fac

\intcalcMul

```

245 \def\intcalcMul#1#2{%
246 \the\numexpr(#1)*(#2)\relax
247 }%

```

\IntCalcMul

```

248 \def\IntCalcMul#1!#2!{%
249 \the\numexpr#1*#2\relax
250 }%

```

\intcalcSqr

```

251 \def\intcalcSqr#1{%
252 \number\expandafter\InCa@Sqr\the\numexpr#1! %
253 }%

```

\InCa@Sqr

```

254 \def\InCa@Sqr#1!{%
255 \the\numexpr#1*#1\relax
256 }%

```

\intcalcFac

```

257 \def\intcalcFac#1{%
258 \number\expandafter\InCa@Fac\the\numexpr#1! %
259 }%

```

2.4.8 Pow

\intcalcPow

```

260 \def\intcalcPow#1#2{%
261 \number\expandafter\InCa@Pow
262 \the\numexpr#1\expandafter!%
263 \the\numexpr#2! %
264 }%

```

\InCa@Pow

```

265 \def\InCa@Pow#1#2!#3#4!{%
266 \ifcase#3#4 % power = 0
267 1%
268 \or % power = 1
269 #1#2%
270 \or % power = 2
271 \the\numexpr#1#2*#1#2\relax
272 \else
273 \ifcase#1#2 % basis = 0, power <> 0
274 0%
275 \ifx#3-% power < 0
276 0\IntCalcError:DivisionByZero%
277 \fi
278 \or
279 1% basis = 1

```

```

280     \else
281     \ifnum#1#2=\m@ne % basis = -1
282     \ifodd#3#4 %
283     -%
284     \fi
285     1%
286     \else % |basis| > 1
287     \ifx#3-% power < 0
288     0%
289     \else % power > 2
290     \InCa@PowRec#1#2!#3#4!1!%
291     \fi
292     \fi
293     \fi
294     \fi
295     }%

\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
}

296 \def\InCa@PowRec#1!#2!#3!{%
297     \ifnum#2=\@ne
298     \the\numexpr#1*#3\relax
299     \else
300     \ifodd#2 %
301     \expandafter\InCa@PowRec
302     \the\numexpr#1*#1\expandafter!%
303     \the\numexpr(#2-1)/2\expandafter!%
304     \the\numexpr#1*#3\expandafter\expandafter\expandafter!%
305     \else
306     \expandafter\InCa@PowRec
307     \the\numexpr#1*#1\expandafter!%
308     \the\numexpr(#2-1)/2\expandafter!%
309     \number#3\expandafter\expandafter\expandafter!%
310     \fi
311     \fi
312     }%

```

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 `\intcalcdDiv` 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
313 \def\intcalcDiv#1#2{%
314 \number\expandafter\InCa@Div
315 \the\numexpr#1\expandafter!%
316 \the\numexpr#2! %
317 }%

\InCa@Div
318 \def\InCa@Div#1!#2!{%
319 \ifcase#2 %
320 0\IntCalcError:DivisionByZero%
321 \else
322 \ifcase#1 %
323 0%
324 \else
325 \expandafter\InCa@@Div
326 \romannumeral 0%
327 \ifnum#1<\z@
328 \expandafter-\number-#1%
329 \else
330 \expandafter+\number#1%
331 \fi
332 \expandafter!%
333 \romannumeral 0%
334 \ifnum#2<\z@
335 \expandafter-\number-#2%
336 \else
337 \expandafter+\number#2%
338 \fi
339 !%
340 \fi
341 \fi
342 }%

\IntCalcDiv
343 \def\InCa@Temp#1{%
344 \def\IntCalcDiv##1!##2!{%
345 \number
346 \ifcase##2 %
347 0\IntCalcError:DivisionByZero%
348 \else
349 \ifcase##1 %
350 0%
351 \else
352 \the\numexpr(##1-(##2-1)/2)/##2\relax
353 \fi
354 \fi
355 #1%
356 }%
357 }%
358 \InCa@Temp{ }%

\InCa@@Div
359 \def\InCa@@Div#1#2!#3#4!{%
360 #1#3%
361 \the\numexpr(#2-(#4-1)/2)/#4\relax
362 }%

\intcalcMod
363 \def\intcalcMod#1#2{%
364 \number\expandafter\InCa@Mod

```

```

365     \the\numexpr#1\expandafter!%
366     \the\numexpr#2! %
367 }%

\InCa@Mod

368 \def\InCa@Mod#1!#2!{%
369     \ifcase#2 %
370         0\IntCalcError:DivisionByZero%
371     \else
372         \ifcase#1 %
373             0%
374         \else
375             \expandafter\InCa@@Mod
376             \romannumeral 0%
377             \ifnum#1<\z@
378                 \expandafter-\number-#1%
379             \else
380                 \expandafter+\number#1%
381             \fi
382             \expandafter!%
383             \romannumeral 0%
384             \ifnum#2<\z@
385                 \expandafter-\number-#2%
386             \else
387                 \expandafter+\number#2%
388             \fi
389             !%
390         \fi
391     \fi
392 }%

\IntCalcMod

393 \def\InCa@Temp#1{%
394     \def\IntCalcMod##1!##2!{%
395         \number
396         \ifcase##2 %
397             0\IntCalcError:DivisionByZero%
398         \else
399             \ifcase##1 %
400                 0%
401             \else
402                 \the\numexpr##1-(##1-(##2-1)/2)/##2*##2\relax
403             \fi
404         \fi
405         #1%
406     }%
407 }%
408 \InCa@Temp{ }%

\InCa@@Mod

409 \def\InCa@@Mod#1#2!#3#4!{%
410     \if#3+%
411         \if#1+%
412             \the\numexpr#2-\InCa@@Div+#2!+#4!*#4!\relax
413         \else
414             \expandafter\InCa@ModX
415             \the\numexpr-#2+\InCa@@Div+#2!+#4!*#4!*#4!%
416         \fi
417     \else
418         -%
419         \if#1+%
420             \expandafter\InCa@ModX

```



```

421         \the\numexpr-#2+\InCa@Div+#2!+#4!*\#4!\#4!%
422     \else
423         \the\numexpr#2-\InCa@Div+#2!+#4!*\#4\relax
424     \fi
425 \fi
426 }%

\InCa@ModX

427 \def\InCa@ModX#1!#2!{%
428     \ifcase#1 %
429         0%
430     \else
431         \the\numexpr#1+#2\relax
432     \fi
433 }%

434 \InCa@AtEnd
435 \expandafter\endinput
436 \fi

```

2.5 Implementation without ε -TeX

2.5.1 Num

```

\intcalcNum

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

```

2.5.2 Inv, Abs, Sgn

```

\intcalcInv

440 \def\intcalcInv#1{%
441     \number\expandafter\InCa@FirstOfOne\number-#1! %
442 }

\InCa@FirstOfOne

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

\intcalcAbs

444 \def\intcalcAbs#1{%
445     \number\expandafter\InCa@Abs\number#1! %
446 }

\intcalcSgn

447 \def\intcalcSgn#1{%
448     \number\expandafter\InCa@Sgn\number#1! %
449 }

```

2.5.3 Min, Max, Cmp

```

\intcalcMin

450 \def\intcalcMin#1#2{%
451     \number\expandafter\InCa@Min
452     \number\number#1\expandafter!\number#2! %
453 }

\intcalcMax

454 \def\intcalcMax#1#2{%
455     \number\expandafter\InCa@Max
456     \number\number#1\expandafter!\number#2! %
457 }

```

\intcalcCmp

```
458 \def\intcalcCmp#1#2{%
459   \number\expandafter\InCa@Cmp
460   \number\number#1\expandafter!\number#2! %
461 }%
```

2.5.4 Inc, Dec

\intcalcInc

```
462 \def\intcalcInc#1{%
463   \number\expandafter\InCa@IncSwitch\number#1! %
464 }
```

\InCa@IncSwitch

```
465 \def\InCa@IncSwitch#1#2!{%
466   \ifx#1-%
467     -%
468     \csname InCa@Empty%
469     \InCa@Dec#2!%
470   \else
471     \csname InCa@Empty%
472     \InCa@Inc#1#2!%
473   \fi
474 }
```

\intcalcDec

```
475 \def\intcalcDec#1{%
476   \number\expandafter\InCa@DecSwitch\number#1! %
477 }
```

\InCa@DecSwitch

```
478 \def\InCa@DecSwitch#1#2!{%
479   \ifx#1-%
480     -%
481     \csname InCa@Empty%
482     \expandafter\InCa@Inc#2!%
483   \else
484     \ifx#10%
485       -1%
486     \else
487       \csname InCa@Empty%
488       \InCa@Dec#1#2!%
489     \fi
490   \fi
491 }
```

\IntCalcInc

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

\IntCalcDec

```
495 \def\IntCalcDec#1!{%
496   \number\csname InCa@Empty\InCa@Dec#1! %
497 }
```

\InCa@Inc

```
498 \def\InCa@Inc#1#2{%
499   \ifx#2!%
500     \csname InCa@IncDigit#1\endcsname1%
```

```

501 \else
502 \csname InCa@IncDigit#1%
503 \expandafter\InCa@Inc\expandafter#2%
504 \fi
505 }

```

\InCa@IncDigit[0-8]

```

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

```

\InCa@IncDigit9

```

526 \expandafter\def\csname InCa@IncDigit9\endcsname#1{%
527 \expandafter\endcsname
528 \ifcase#1 %
529 09%
530 \else
531 10%
532 \fi
533 }

```

\InCa@Dec

```

534 \def\InCa@Dec#1#2{%
535 \ifx#2!%
536 \csname InCa@DecDigit#1\endcsname1%
537 \else
538 \csname InCa@DecDigit#1%
539 \expandafter\InCa@Dec\expandafter#2%
540 \fi
541 }

```

\InCa@DecDigit[1-9]

```

542 \def\InCa@Temp#1#2{%
543 \expandafter\def\csname InCa@DecDigit#1\endcsname##1{%
544 \endcsname
545 0%
546 \ifcase##1 %
547 #1%
548 \else
549 #2%
550 \fi
551 }%
552 }
553 \InCa@Temp 98
554 \InCa@Temp 87

```

```

555 \InCa@Temp 76
556 \InCa@Temp 65
557 \InCa@Temp 54
558 \InCa@Temp 43
559 \InCa@Temp 32
560 \InCa@Temp 21
561 \InCa@Temp 10

```

\InCa@DecDigit0

```

562 \expandafter\def\csname InCa@DecDigit0\endcsname#1{%
563   \expandafter\endcsname
564   \ifcase#1 %
565     00%
566   \else
567     19%
568   \fi
569 }

```

2.5.5 Add, Sub

\intcalcAdd

```

570 \def\intcalcAdd#1#2{%
571   \number
572   \expandafter\InCa@AddSwitch
573   \number\number#1\expandafter!%
574   \number#2! %
575 }

```

\intcalcSub

```

576 \def\intcalcSub#1#2{%
577   \number
578   \expandafter\InCa@AddSwitch
579   \number\number#1\expandafter!%
580   \number-\number#2! %
581 }

```

\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		$\text{Add}(y, x)$

```

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

```

```

595         -%
596         \expandafter\InCa@Sub\@gobble#1!#2!%
597     \else
598         \expandafter\InCa@Sub\number#2\expandafter!%
599         \@gobble#1!%
600     \fi
601 \fi
602 \else
603     \ifnum#2<\z@
604         \ifnum#1>=#2 %
605             \expandafter\InCa@Sub\number#1\expandafter!%
606             \@gobble#2!%
607         \else
608             -%
609             \expandafter\InCa@Sub\@gobble#2!#1!%
610         \fi
611     \else
612         \ifnum#1>#2 %
613             \InCa@Add#1!#2!%
614         \else
615             \InCa@Add#2!#1!%
616         \fi
617     \fi
618 \fi
619 }

\IntCalcAdd

620 \def\IntCalcAdd#1!#2!{%
621     \number\InCa@Add#1!#2! %
622 }

\IntCalcSub

623 \def\IntCalcSub#1!#2!{%
624     \number\InCa@Sub#1!#2! %
625 }

\InCa@Space

626 \begingroup
627 \def\x#1{\endgroup
628     \let\InCa@Space= #1%
629 }%
630 \x{ }

\InCa@Add

631 \def\InCa@Add#1!#2!{%
632     \ifcase#2 %
633         #1%
634     \else
635         \InCa@@Add#1!#2!00000000\InCa@Space
636     \fi
637 }

\InCa@Sub

638 \def\InCa@Sub#1!#2!{%
639     \ifnum#1=#2 %
640         0%
641     \else
642         \InCa@@Sub#1!#2!00000000\InCa@Space
643     \fi
644 }

```

\InCa@@@Add

```
645 \def\InCa@@Add#1!#2#3!{%
646   \ifx\InCa@Empty#3\InCa@Empty
647     \@ReturnAfterElseFi{%
648       \InCa@@@Add!!#1!#2%
649     }%
650   \else
651     \@ReturnAfterFi{%
652       \InCa@@Add#1!#3!#2%
653     }%
654   \fi
655 }
```

\InCa@@@Sub

```
656 \def\InCa@@Sub#1!#2#3!{%
657   \ifx\InCa@Empty#3\InCa@Empty
658     \@ReturnAfterElseFi{%
659       \InCa@@@Sub!!#1!#2%
660     }%
661   \else
662     \@ReturnAfterFi{%
663       \InCa@@Sub#1!#3!#2%
664     }%
665   \fi
666 }
```

\InCa@@@Add

```
667 \def\InCa@@@Add#1!#2!#3#4!#5{%
668   \ifx\InCa@Empty#4\InCa@Empty
669     \csname InCa@Empty%
670       \@ReturnAfterElseFi{%
671         \InCa@ProcessAdd#1#3!#5#2%
672       }%
673   \else
674     \@ReturnAfterFi{%
675       \InCa@@@Add#1#3!#5#2!#4!%
676     }%
677   \fi
678 }
```

\InCa@@@Sub

```
679 \def\InCa@@@Sub#1!#2!#3#4!#5{%
680   \ifx\InCa@Empty#4\InCa@Empty
681     \csname @gobble%
682       \@ReturnAfterElseFi{%
683         \InCa@ProcessSub#1#3!#5#2%
684       }%
685   \else
686     \@ReturnAfterFi{%
687       \InCa@@@Sub#1#3!#5#2!#4!%
688     }%
689   \fi
690 }
```

\InCa@ProcessAdd

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

```

697 \ReturnAfterFi{%
698 \InCa@ProcessAdd#2!#4%
699 }%
700 \fi
701 }

```

\InCa@ProcessSub

```

702 \def\InCa@ProcessSub#1#2!#3#4{%
703 \ifx\InCa@Empty#2\InCa@Empty
704 \csname InCa@SubDigit#1\endcsname#3%
705 \romannumeral0#4%
706 \else
707 \csname InCa@SubDigit#1\csname InCa@DigitCarry#3%
708 \ReturnAfterFi{%
709 \InCa@ProcessSub#2!#4%
710 }%
711 \fi
712 }

```

\InCa@DigitCarry[0-9]

```

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

```

\InCa@AddDigit0

```

732 \expandafter\def\csname InCa@AddDigit0\endcsname#1{%
733 \ifnum#1>9 %
734 \endcsname10%
735 \else
736 \endcsname0#1%
737 \fi
738 }

```

\InCa@AddDigit[1-9]

```

739 \def\InCa@Temp#1#2#3{%
740 \expandafter\def\csname InCa@AddDigit#1\endcsname##1{%
741 \ifnum##1>#2 %
742 \endcsname 1%
743 \else
744 \endcsname 0%
745 \fi
746 \ifcase##1 #1% 0
747 #3%
748 \else #1% 10
749 \fi
750 }%

```

```

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

```



```

813 \or 2% 6
814 \or 3% 7
815 \or 4% 8
816 \or 5% 9
817 }%
818 \InCa@Temp 72{%
819 \or 8% 1
820 \or 9% 2
821 \or 0% 3
822 \or 1% 4
823 \or 2% 5
824 \or 3% 6
825 \or 4% 7
826 \or 5% 8
827 \or 6% 9
828 }%
829 \InCa@Temp 81{%
830 \or 9% 1
831 \or 0% 2
832 \or 1% 3
833 \or 2% 4
834 \or 3% 5
835 \or 4% 6
836 \or 5% 7
837 \or 6% 8
838 \or 7% 9
839 }%
840 \InCa@Temp 90{%
841 \or 0% 1
842 \or 1% 2
843 \or 2% 3
844 \or 3% 4
845 \or 4% 5
846 \or 5% 6
847 \or 6% 7
848 \or 7% 8
849 \or 8% 9
850 }%

```

\InCa@SubDigit[0-9]

```

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

```

```

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

```

```

936 \or 0% 6
937 \or 9% 7
938 \or 8% 8
939 \or 7% 9
940 }
941 \InCa@Temp 7{%
942 \or 6% 1
943 \or 5% 2
944 \or 4% 3
945 \or 3% 4
946 \or 2% 5
947 \or 1% 6
948 \or 0% 7
949 \or 9% 8
950 \or 8% 9
951 }
952 \InCa@Temp 8{%
953 \or 7% 1
954 \or 6% 2
955 \or 5% 3
956 \or 4% 4
957 \or 3% 5
958 \or 2% 6
959 \or 1% 7
960 \or 0% 8
961 \or 9% 9
962 }
963 \InCa@Temp 9{%
964 \or 8% 1
965 \or 7% 2
966 \or 6% 3
967 \or 5% 4
968 \or 4% 5
969 \or 3% 6
970 \or 2% 7
971 \or 1% 8
972 \or 0% 9
973 }

```

2.5.6 Shl, Shr

\intcalcShl

```

974 \def\intcalcShl#1{%
975 \number\expandafter\InCa@ShlSwitch\number#1! %
976 }

```

\InCa@ShlSwitch

```

977 \def\InCa@ShlSwitch#1#2!{%
978 \ifx#1-%
979 -\csname InCa@Empty%
980 \InCa@Shl#2!%
981 \else
982 \csname InCa@Empty%
983 \InCa@Shl#1#2!%
984 \fi
985 }

```

\IntCalcShl

```

986 \def\IntCalcShl#1!{%
987 \number
988 \csname InCa@Empty%
989 \InCa@Shl#1! %

```

```

990 }

\IntCal@ShlDigit

991 \def\InCa@Shl#1#2{%
992   \ifx#2!%
993     \csname InCa@ShlDigit#1\endcsname0%
994   \else
995     \csname InCa@ShlDigit#1%
996     \@ReturnAfterFi{%
997       \InCa@Shl#2%
998     }%
999   \fi
1000 }

\InCa@ShlDigit0

1001 \expandafter\def\csname InCa@ShlDigit0\endcsname{%
1002   \endcsname0%
1003 }

\InCa@ShlDigit[1-9]

1004 \def\InCa@Temp#1#2#3#4#5{%
1005   \expandafter\def\csname InCa@ShlDigit#1\endcsname##1{%
1006     \expandafter\endcsname
1007     \ifcase##1 %
1008       #2#3%
1009     \else
1010       #4#5%
1011     \fi
1012   }%
1013 }
1014 \InCa@Temp 10203
1015 \InCa@Temp 20405
1016 \InCa@Temp 30607
1017 \InCa@Temp 40809
1018 \InCa@Temp 51011
1019 \InCa@Temp 61213
1020 \InCa@Temp 71415
1021 \InCa@Temp 81617
1022 \InCa@Temp 91819

\intcalcShr

1023 \def\intcalcShr#1{%
1024   \number\expandafter\InCa@ShrSwitch\number#1! %
1025 }

\InCa@ShrSwitch

1026 \def\InCa@ShrSwitch#1#2!{%
1027   \ifx#1-%
1028     -\InCa@Shr#2!%
1029   \else
1030     \InCa@Shr#1#2!%
1031   \fi
1032 }

\IntCalcShr

1033 \def\IntCalcShr#1!{%
1034   \number\InCa@Shr#1! %
1035 }

\InCa@Shr

1036 \def\InCa@Shr#1#2{%

```

```

1037 \InCa@ShrDigit#1!%
1038 \ifx#2!%
1039 \else
1040 \ReturnAfterFi{%
1041 \ifodd#1 %
1042 \ReturnAfterElseFi{%
1043 \InCa@Shr{1#2}%
1044 }%
1045 \else
1046 \expandafter\InCa@Shr\expandafter#2%
1047 \fi
1048 }%
1049 \fi
1050 }

1051 \def\InCa@ShrDigit#1!{%
1052 \ifcase#1 0% 0
1053 \or 0% 1
1054 \or 1% 2
1055 \or 1% 3
1056 \or 2% 4
1057 \or 2% 5
1058 \or 3% 6
1059 \or 3% 7
1060 \or 4% 8
1061 \or 4% 9
1062 \or 5% 10
1063 \or 5% 11
1064 \or 6% 12
1065 \or 6% 13
1066 \or 7% 14
1067 \or 7% 15
1068 \or 8% 16
1069 \or 8% 17
1070 \or 9% 18
1071 \or 9% 19
1072 \fi
1073 }

```

2.5.7 \InCa@Tim

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

```

1074 \def\InCa@Temp#1{%
1075 \def\InCa@Tim##1##2{%
1076 \number
1077 \ifcase##2 % 0
1078 0%
1079 \or % 1
1080 ##1%
1081 \else % 2-9
1082 \csname InCa@Empty%
1083 \InCa@ProcessTim##2##1!%
1084 \fi
1085 #1%
1086 }%
1087 }
1088 \InCa@Temp{ }

```

\InCa@ProcessTim

```

1089 \def\InCa@ProcessTim#1#2#3{%
1090 \ifx#3!%
1091 \csname InCa@TimDigit#2\endcsname#10%

```

```

1092 \else
1093 \csname InCa@TimDigit#2\csname InCa@Param#1%
1094 \@ReturnAfterFi{%
1095 \InCa@ProcessTim#1#3%
1096 }%
1097 \fi
1098 }

\InCa@Param[0-9]

1099 \def\InCa@Temp#1{%
1100 \expandafter\def\csname InCa@Param#1\endcsname{%
1101 \endcsname#1%
1102 }%
1103 }
1104 \InCa@Temp 0%
1105 \InCa@Temp 1%
1106 \InCa@Temp 2%
1107 \InCa@Temp 3%
1108 \InCa@Temp 4%
1109 \InCa@Temp 5%
1110 \InCa@Temp 6%
1111 \InCa@Temp 7%
1112 \InCa@Temp 8%
1113 \InCa@Temp 9%

\InCa@TimDigit0

1114 \expandafter\def\csname InCa@TimDigit0\endcsname#1#2{%
1115 \endcsname
1116 0#2%
1117 }

\InCa@TimDigit1

1118 \expandafter\def\csname InCa@TimDigit1\endcsname#1#2{%
1119 \ifcase#2 %
1120 \endcsname 0#1%
1121 \else
1122 \csname InCa@AddDigit#1\endcsname #2%
1123 \fi
1124 }

\InCa@TimDigit[2-9]

1125 \def\InCa@Temp#1#2{%
1126 \expandafter\def\csname InCa@TimDigit#1\endcsname##1{%
1127 \expandafter\InCa@TimDigitCarry
1128 \number
1129 \ifcase##1 0% 0
1130 #2%
1131 \fi
1132 !%
1133 }%
1134 }
1135 \InCa@Temp 2{%
1136 \or 2% 1
1137 \or 4% 2
1138 \or 6% 3
1139 \or 8% 4
1140 \or 10% 5
1141 \or 12% 6
1142 \or 14% 7
1143 \or 16% 8
1144 \or 18% 9
1145 }

```

```

1146 \InCa@Temp 3{%
1147 \or 3% 1
1148 \or 6% 2
1149 \or 9% 3
1150 \or 12% 4
1151 \or 15% 5
1152 \or 18% 6
1153 \or 21% 7
1154 \or 24% 8
1155 \or 27% 9
1156 }
1157 \InCa@Temp 4{%
1158 \or 4% 1
1159 \or 8% 2
1160 \or 12% 3
1161 \or 16% 4
1162 \or 20% 5
1163 \or 24% 6
1164 \or 28% 7
1165 \or 32% 8
1166 \or 36% 9
1167 }
1168 \InCa@Temp 5{%
1169 \or 5% 1
1170 \or 10% 2
1171 \or 15% 3
1172 \or 20% 4
1173 \or 25% 5
1174 \or 30% 6
1175 \or 35% 7
1176 \or 40% 8
1177 \or 45% 9
1178 }
1179 \InCa@Temp 6{%
1180 \or 6% 1
1181 \or 12% 2
1182 \or 18% 3
1183 \or 24% 4
1184 \or 30% 5
1185 \or 36% 6
1186 \or 42% 7
1187 \or 48% 8
1188 \or 54% 9
1189 }
1190 \InCa@Temp 7{%
1191 \or 7% 1
1192 \or 14% 2
1193 \or 21% 3
1194 \or 28% 4
1195 \or 35% 5
1196 \or 42% 6
1197 \or 49% 7
1198 \or 56% 8
1199 \or 63% 9
1200 }
1201 \InCa@Temp 8{%
1202 \or 8% 1
1203 \or 16% 2
1204 \or 24% 3
1205 \or 32% 4
1206 \or 40% 5
1207 \or 48% 6

```

```

1208 \or 56% 7
1209 \or 64% 8
1210 \or 72% 9
1211 }
1212 \InCa@Temp 9{%
1213 \or 9% 1
1214 \or 18% 2
1215 \or 27% 3
1216 \or 36% 4
1217 \or 45% 5
1218 \or 54% 6
1219 \or 63% 7
1220 \or 72% 8
1221 \or 81% 9
1222 }

```

\InCa@TimDigitCarry

```

1223 \def\InCa@TimDigitCarry#1!{%
1224 \ifnum#1<10 %
1225 \csname InCa@AddDigit#1\expandafter\endcsname
1226 \else
1227 \@ReturnAfterFi{%
1228 \InCa@@TimDigitCarry#1!%
1229 }%
1230 \fi
1231 }

```

\InCa@@TimDigitCarry

```

1232 \def\InCa@@TimDigitCarry#1#2!#3{%
1233 \csname InCa@DigitCarry#1%
1234 \csname InCa@AddDigit#2\endcsname #3%
1235 }

```

2.5.8 Mul

\intcalcMul

```

1236 \def\intcalcMul#1#2{%
1237 \number
1238 \expandafter\InCa@MulSwitch
1239 \number\number#1\expandafter!%
1240 \number#2! %
1241 }

```

\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		$\text{Mul}(y, x)$

```

1242 \def\InCa@MulSwitch#1!#2!{%
1243 \ifnum#1<\z@
1244 \ifnum#2<\z@
1245 \ifnum#1<#2 %
1246 \expandafter\InCa@Mul\number-#1\expandafter!%
1247 \@gobble#2!%
1248 \else

```



```

1249         \expandafter\InCa@Mul\number-#2\expandafter!%
1250         \@gobble#1!%
1251     \fi
1252 \else
1253     -%
1254     \ifnum-#1>#2 %
1255         \expandafter\InCa@Mul\@gobble#1!#2!%
1256     \else
1257         \expandafter\InCa@Mul\number#2\expandafter!%
1258         \@gobble#1!%
1259     \fi
1260 \fi
1261 \else
1262     \ifnum#2<\z@
1263         -%
1264         \ifnum#1>-#2 %
1265             \expandafter\InCa@Mul\number#1\expandafter!%
1266             \@gobble#2!%
1267         \else
1268             \expandafter\InCa@Mul\@gobble#2!#1!%
1269         \fi
1270     \else
1271         \ifnum#1>#2 %
1272             \InCa@Mul#1!#2!%
1273         \else
1274             \InCa@Mul#2!#1!%
1275         \fi
1276     \fi
1277 \fi
1278 }

```

\IntCalcMul

```

1279 \def\IntCalcMul#1!#2!{%
1280     \number\InCa@Mul#1!#2! %
1281 }

```

\InCa@Mul

```

1282 \def\InCa@Mul#1!#2!{%
1283     \ifcase#2 %
1284         0%
1285     \or
1286         #1%
1287     \or
1288         \csname InCa@Empty%
1289             \expandafter\InCa@Shl#1!%
1290     \else
1291         \ifnum#2<10 %
1292             \InCa@Tim{#1}#2%
1293         \else
1294             \InCa@ProcessMul!#2!#1!%
1295         \fi
1296     \fi
1297 }

```

\InCa@Mul

```

1298 \def\InCa@ProcessMul#1!#2#3!#4!{%
1299     \ifx\InCa@Empty#3\InCa@Empty
1300         \expandafter\InCa@Add\number
1301         #10\expandafter\expandafter\expandafter!%
1302         \InCa@Tim{#4}#2!%
1303     \else
1304         \ifx\InCa@Empty#1\InCa@Empty

```

```

1305     \expandafter\expandafter\expandafter\InCa@ProcessMul
1306     \InCa@Tim{#4}#2!%
1307     #3!#4!%
1308   \else
1309     \expandafter\InCa@ProcessMul\number
1310     \expandafter\InCa@Add\number%
1311     #10\expandafter\expandafter\expandafter!%
1312     \InCa@Tim{#4}#2!!%
1313     #3!#4!%
1314   \fi
1315 \fi
1316 }

```

2.5.9 Sqr, Fac

\intcalcSqr

```

1317 \def\intcalcSqr#1{%
1318   \number\expandafter\InCa@Sqr\number#1! %
1319 }

```

\InCa@Sqr

```

1320 \def\InCa@Sqr#1#2!{%
1321   \ifx#1-%
1322     \InCa@Mul#2!#2!%
1323   \else
1324     \InCa@Mul#1#2!#1#2!%
1325   \fi
1326 }

```

\intcalcFac

```

1327 \def\intcalcFac#1{%
1328   \number\expandafter\InCa@Fac\number#1! %
1329 }

```

2.5.10 Pow

\intcalcPow

```

1330 \def\intcalcPow#1#2{%
1331   \number\expandafter\InCa@Pow
1332   \number\number#1\expandafter!%
1333   \number#2! %
1334 }

```

\InCa@Pow

```

1335 \def\InCa@Pow#1#2!#3#4!{%
1336   \ifcase#3#4 % power = 0
1337     1%
1338   \or % power = 1
1339     #1#2%
1340   \or % power = 2
1341     \ifx#1-%
1342       \InCa@Mul#2!#2!%
1343     \else
1344       \InCa@Mul#1#2!#1#2!%
1345     \fi
1346   \else
1347     \ifcase#1#2 % basis = 0, power <> 0
1348       0%
1349     \ifx#3-% power < 0
1350       0\IntCalcError:DivisionByZero%
1351     \fi

```

```

1352 \or
1353 1% basis = 1
1354 \else
1355 \ifnum#1#2=\m@ne % basis = -1
1356 \ifodd#3#4 %
1357 -%
1358 \fi
1359 1%
1360 \else % |basis| > 1
1361 \ifx#3-% power < 0
1362 0%
1363 \else % power > 2
1364 \ifx#1-% basis < 0
1365 \ifodd#3#4 %
1366 -%
1367 \fi
1368 \InCa@PowRec#2!#3#4!1!%
1369 \else
1370 \InCa@PowRec#1#2!#3#4!1!%
1371 \fi
1372 \fi
1373 \fi
1374 \fi
1375 \fi
1376 }

\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
}

1377 \def\InCa@PowRec#1!#2!#3!{%
1378 \ifnum#2=\@ne
1379 \ifnum#1>#3 %
1380 \InCa@Mul#1!#3!%
1381 \else
1382 \InCa@Mul#3!#1!%
1383 \fi
1384 \else
1385 \expandafter\InCa@PowRec
1386 \number\InCa@Mul#1!#1!\expandafter!%
1387 \number\intcalcShr{#2}\expandafter!%
1388 \number
1389 \ifodd#2 %
1390 \ifnum#1>#3 %
1391 \InCa@Mul#1!#3!%
1392 \else
1393 \InCa@Mul#3!#1!%
1394 \fi
1395 \else
1396 #3%
1397 \fi
1398 \expandafter!%
1399 \fi

```

1400 }

2.5.11 Div

\intcalcDiv

```
1401 \def\intcalcDiv#1#2{%
1402   \number\expandafter\InCa@Div
1403   \number\number#1\expandafter!%
1404   \number#2! %
1405 }
```

\InCa@Div

```
1406 \def\InCa@Div#1!#2!{%
1407   \ifcase#2 %
1408     0\IntCalcError:DivisionByZero%
1409   \else
1410     \ifcase#1 %
1411       0%
1412     \else
1413       \expandafter\InCa@DivSwitch
1414       \number#1\expandafter!%
1415       \number#2!%
1416     \fi
1417   \fi
1418 }
```

\IntCalcDiv

```
1419 \def\InCa@Temp#1{%
1420   \def\IntCalcDiv##1!##2!{%
1421     \number
1422     \ifcase##2 %
1423       0\IntCalcError:DivisionByZero%
1424     \else
1425       \ifcase##1 %
1426         0%
1427       \else
1428         \InCa@@Div##1!##2!%
1429       \fi
1430     \fi
1431     #1%
1432   }%
1433 }
1434 \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	+	$\text{Div}(x, y)$

```
1435 \def\InCa@DivSwitch#1!#2!{%
1436   \ifnum#1<\z@
1437     \ifnum#2<\z@
1438       \expandafter\InCa@@Div\number-#1\expandafter!%
1439       \@gobble#2!%
1440     \else
1441       -%
1442     \expandafter\InCa@@Div\@gobble#1!#2!%
1443   \fi
1444   \else
```

```

1445     \ifnum#2<\z@
1446     -%
1447     \expandafter\InCa@@Div\number#1\expandafter!%
1448     \@gobble#2!%
1449     \else
1450     \InCa@@Div#1!#2!%
1451     \fi
1452 \fi
1453 }

\InCa@@Div
1454 \def\InCa@@Div#1!#2!{%
1455     \ifnum#1>#2 %
1456     \ifcase#2 % 0 already caught
1457 ?     \IntCalcError:ThisCannotHappen%
1458     \or % 1
1459     #1%
1460     \or % 2
1461     \InCa@Shr#1!%
1462     \else
1463     \InCa@DivStart!#1!#2!#2!%
1464     \fi
1465 \else
1466     \ifnum#1=#2 %
1467     1%
1468     \else
1469     0%
1470     \fi
1471 \fi
1472 }

\InCa@DivStart
1473 \def\InCa@DivStart#1!#2#3!#4#5{%
1474     \ifx#5!%
1475     \@ReturnAfterElseFi{%
1476     \InCa@DivStartI{#1#2}#3=!%
1477     }%
1478 \else
1479     \@ReturnAfterFi{%
1480     \InCa@DivStart{#1#2}!#3!#5%
1481     }%
1482 \fi
1483 }

\InCa@StartI
1484 \def\InCa@DivStartI#1!#2!{%
1485     \expandafter\InCa@DivStartII
1486     \number#2\expandafter\expandafter\expandafter!%
1487     \intcalcShl{#2}!%
1488     #1!%
1489 }

\InCa@StartII
1490 \def\InCa@DivStartII#1!#2!{%
1491     \expandafter\InCa@DivStartIII
1492     \number#1\expandafter!%
1493     \number#2\expandafter\expandafter\expandafter!%
1494     \intcalcShl{#2}!%
1495 }

\InCa@StartIII

```

```

1496 \def\InCa@DivStartIII#1!#2!#3!{%
1497   \expandafter\InCa@DivStartIV
1498   \number#1\expandafter!%
1499   \number#2\expandafter!%
1500   \number#3\expandafter!%
1501   \number\InCa@Add#3!#2!\expandafter\expandafter\expandafter!%
1502   \intcalcShl{#3}!%
1503 }

```

\InCa@StartIV

```

1504 \def\InCa@DivStartIV#1!#2!#3!#4!#5!#6!{%
1505   \InCa@ProcessDiv#6!#1!#2!#3!#4!#5!/%
1506 }

```

\InCa@ProcessDiv

```

1507 \def\InCa@ProcessDiv#1#2#3!#4!#5!#6!#7!#8!#9/{%
1508   #9%
1509   \ifnum#1<#4 % 0
1510     0%
1511     \ifx#2=%
1512     \else
1513       \InCa@ProcessDiv{#1#2}#3!#4!#5!#6!#7!#8!%
1514     \fi
1515   \else % 1-9
1516     \ifnum#1<#5 % 1
1517       1%
1518       \ifx#2=%
1519       \else
1520         \expandafter\InCa@ProcessDiv\expandafter{%
1521           \number\InCa@Sub#1!#4!%
1522           #2%
1523           }#3!#4!#5!#6!#7!#8!%
1524       \fi
1525     \else % 2-9
1526       \ifnum#1<#7 % 2 3 4 5
1527       \ifnum#1<#6 % 2 3
1528         \@ReturnAfterElseFi{%
1529           \expandafter\InCa@@ProcessDiv
1530           \number\InCa@Sub#1!#5!%
1531           23%
1532         }%
1533       \else % 4 5
1534         \@ReturnAfterFi{%
1535           \expandafter\InCa@@ProcessDiv
1536           \number\InCa@Sub#1!#6!%
1537           45%
1538         }%
1539       \fi
1540       #2#3!#4!#5!#6!#7!#8!%
1541     \else % 6 7 8 9
1542       \ifnum#1<#8 % 6 7
1543         \@ReturnAfterElseFi{%
1544           \expandafter\InCa@@ProcessDiv
1545           \number\InCa@Sub#1!#7!%
1546           67%
1547         }%
1548       \else % 8 9
1549         \@ReturnAfterFi{%
1550           \expandafter\InCa@@ProcessDiv
1551           \number\InCa@Sub#1!#8!%
1552           89%
1553         }%

```

```

1554     \fi
1555     #2#3!#4!#5!#6!#7!#8!%
1556     \fi
1557     \fi
1558     \fi
1559     \ifx#2=%
1560     \expandafter\@gobble
1561     \fi
1562     /%
1563 }

```

\InCa@@ProcessDiv

```

1564 \def\InCa@@ProcessDiv#1!#2#3#4#5!#6!{%
1565   \ifnum#1<#6 %
1566     #2%
1567     \@ReturnAfterElseFi{%
1568       \ifx#4=%
1569       \expandafter\InCa@CleanupIV
1570       \else
1571       \@ReturnAfterFi{%
1572         \InCa@ProcessDiv{#1#4}#5!#6!%
1573       }%
1574     \fi
1575   }%
1576   \else
1577     #3%
1578     \@ReturnAfterFi{%
1579       \ifx#4=%
1580       \expandafter\InCa@CleanupIV
1581       \else
1582       \@ReturnAfterFi{%
1583         \expandafter\InCa@ProcessDiv\expandafter{%
1584           \number\InCa@Sub#1!#6! %
1585           #4%
1586         }#5!#6!%
1587       }%
1588     \fi
1589   }%
1590   \fi
1591 }

```

\InCa@CleanupIV

```

1592 \def\InCa@CleanupIV#1!#2!#3!#4!{}

```

2.5.12 Mod

\intcalcMod

```

1593 \def\intcalcMod#1#2{%
1594   \number\expandafter\InCa@Mod
1595   \number\number#1\expandafter!%
1596   \number#2! %
1597 }

```

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

```

if      y = 0   DivisionByZero
elsif  y < 0   - Mod(-x, -y)
elsif  x = 0   0
elsif  y = 1   0
elsif  y = 2   ifodd(x) ? 1 : 0
elsif  x < 0   z ← x - (x/y) * y;   (z < 0) ? z + y : z
else        x - (x/y) * y

```

```

1598 \def\InCa@Mod#1!#2!{%
1599   \ifcase#2 %
1600     0\IntCalcError:DivisionByZero%
1601   \else
1602     \ifnum#2<\z@
1603       -%
1604       \expandafter\InCa@Mod
1605       \number-#1\expandafter!%
1606       \number-#2!%
1607     \else
1608       \ifcase#1 %
1609         0%
1610       \else
1611         \ifcase#2 % 0 already caught
1612 ?       \IntCalcError:ThisCannotHappen%
1613         \or % 1
1614         0%
1615         \or % 2
1616         \ifodd#1 1\else 0\fi
1617       \else
1618         \ifnum#1<\z@
1619           \expandafter\InCa@ModShift
1620           \number-%
1621           \expandafter\InCa@Sub
1622           \number\@gobble#1\expandafter!%
1623           \number\intcalcMul{#2}{%
1624             \expandafter\InCa@Div\@gobble#1!#2!%
1625           }!%
1626           !#2!%
1627         \else
1628           \expandafter\InCa@Sub\number#1\expandafter!%
1629           \number\intcalcMul{#2}{\InCa@Div#1!#2!}%
1630         \fi
1631       \fi
1632     \fi
1633   \fi
1634 \fi
1635 }

```

\IntCalcMod

```

1636 \def\InCa@Temp#1{%
1637   \def\IntCalcMod##1!##2!{%
1638     \number
1639     \ifcase##2 %
1640       0\IntCalcError:DivisionByZero%
1641     \else
1642       \ifcase##1 %
1643         0%
1644       \else
1645         \ifcase##2 % 0 already caught
1646 ?       \IntCalcError:ThisCannotHappen
1647         \or % 1
1648         0%
1649         \or % 2
1650         \ifodd ##1 1\else 0\fi
1651       \else
1652         \expandafter\InCa@Sub\number##1\expandafter!%
1653         \number\intcalcMul{##2}{\InCa@Div##1!##2!}%
1654       \fi
1655     \fi
1656   \fi
1657   #1%
1658 }%

```



```

1659 }
1660 \InCa@Temp{ }%

```

\InCa@ModShift

```

1661 \def\InCa@ModShift#1!#2!{%
1662   \ifnum#1<\z@
1663     \expandafter\InCa@Sub\number#2\expandafter!%
1664     \@gobble#1!%
1665   \else
1666     #1%
1667   \fi
1668 }

```

2.5.13 Help macros

\InCa@Empty

```

1669 \def\InCa@Empty{}

```

\@gobble

```

1670 \expandafter\ifx\csname \@gobble\endcsname\relax
1671   \long\def\@gobble#1{}%
1672 \fi

```

\@ReturnAfterFi

```

1673 \long\def\@ReturnAfterFi#1\fi{\fi#1}%

```

\@ReturnAfterElseFi

```

1674 \long\def\@ReturnAfterElseFi#1\else#2\fi{\fi#1}%

```

```

1675 \InCa@AtEnd

```

```

1676 \</package>

```

3 Test

3.1 Catcode checks for loading

```

1677 \<*test1>
1678 \catcode'\{=1 %
1679 \catcode'\}=2 %
1680 \catcode'\#=6 %
1681 \catcode'\@=11 %
1682 \expandafter\ifx\csname count@\endcsname\relax
1683   \countdef\count@=255 %
1684 \fi
1685 \expandafter\ifx\csname \@gobble\endcsname\relax
1686   \long\def\@gobble#1{}%
1687 \fi
1688 \expandafter\ifx\csname @firstofone\endcsname\relax
1689   \long\def\@firstofone#1{#1}%
1690 \fi
1691 \expandafter\ifx\csname loop\endcsname\relax
1692   \expandafter\@firstofone
1693 \else
1694   \expandafter\@gobble
1695 \fi
1696 {%
1697   \def\loop#1\repeat{%
1698     \def\body{#1}%
1699     \iterate
1700   }%

```

```

1701 \def\iterate{%
1702   \body
1703   \let\next\iterate
1704   \else
1705   \let\next\relax
1706   \fi
1707   \next
1708 }%
1709 \let\repeat=\fi
1710 }%
1711 \def\RestoreCatcodes{}
1712 \count@=0 %
1713 \loop
1714   \edef\RestoreCatcodes{%
1715     \RestoreCatcodes
1716     \catcode\the\count@=\the\catcode\count@\relax
1717   }%
1718   \ifnum\count@<255 %
1719     \advance\count@ 1 %
1720 \repeat
1721
1722 \def\RangeCatcodeInvalid#1#2{%
1723   \count@=#1\relax
1724   \loop
1725     \catcode\count@=15 %
1726     \ifnum\count@<#2\relax
1727       \advance\count@ 1 %
1728     \repeat
1729 }
1730 \expandafter\ifx\csname LoadCommand\endcsname\relax
1731 \def\LoadCommand{\input intcalc.sty\relax}%
1732 \fi
1733 \def\Test{%
1734   \RangeCatcodeInvalid{0}{47}%
1735   \RangeCatcodeInvalid{58}{64}%
1736   \RangeCatcodeInvalid{91}{96}%
1737   \RangeCatcodeInvalid{123}{255}%
1738   \catcode'\@=12 %
1739   \catcode'\=0 %
1740   \catcode'\{=1 %
1741   \catcode'\}=2 %
1742   \catcode'\#=6 %
1743   \catcode'\[=12 %
1744   \catcode'\]=12 %
1745   \catcode'\%=14 %
1746   \catcode'\ =10 %
1747   \catcode13=5 %
1748   \LoadCommand
1749   \RestoreCatcodes
1750 }
1751 \Test
1752 \csname @@end\endcsname
1753 \end
1754 \</test1>

```

3.2 Macro tests

3.2.1 Preamble with test macro definitions

```

1755 \<test2 | test4>
1756 \NeedsTeXFormat{LaTeX2e}
1757 \nofiles
1758 \documentclass{article}

```

```

1759 <noetex> \let \SavedNumexpr \numexpr
1760 <noetex> \let \numexpr \UNDEFINED
1761 \makeatletter
1762 \chardef \InCa@TestMode=1 %
1763 \makeatother
1764 \usepackage{intcalc}[2007/09/27]
1765 <noetex> \let \numexpr \SavedNumexpr
1766 \usepackage{qstest}
1767 \IncludeTests{*}
1768 \LogTests{log}{*}{*}
1769 </test2 | test4>
1770 <*test2>
1771 \newcommand*{\TestSpaceAtEnd}[1]{%
1772 <noetex> \let \SavedNumexpr \numexpr
1773 <noetex> \let \numexpr \UNDEFINED
1774 \edef\resultA{#1}%
1775 \edef\resultB{#1 }%
1776 <noetex> \let \numexpr \SavedNumexpr
1777 \Expect*{\resultA\space}*{\resultB}%
1778 }
1779 \newcommand*{\TestResult}[2]{%
1780 <noetex> \let \SavedNumexpr \numexpr
1781 <noetex> \let \numexpr \UNDEFINED
1782 \edef\result{#1}%
1783 <noetex> \let \numexpr \SavedNumexpr
1784 \Expect*{\result}{#2}%
1785 }
1786 \newcommand*{\TestResultTwoExpansions}[2]{%
1787 <*noetex>
1788 \begingroup
1789 \let \numexpr \UNDEFINED
1790 \expandafter\expandafter\expandafter
1791 \endgroup
1792 </noetex>
1793 \expandafter\expandafter\expandafter\Expect
1794 \expandafter\expandafter\expandafter{#1}{#2}%
1795 }
1796 \newcount\TestCount
1797 <etex> \newcommand*{\TestArg}[1]{\numexpr#1\relax}
1798 <noetex> \newcommand*{\TestArg}[1]{#1}
1799 \newcommand*{\TestTeXDivide}[2]{%
1800 \TestCount=\TestArg{#1}\relax
1801 \divide\TestCount by \TestArg{#2}\relax
1802 \Expect*{\intcalcDiv{#1}{#2}}*{\the\TestCount}%
1803 }
1804 \newcommand*{\Test}[2]{%
1805 \TestResult{#1}{#2}%
1806 \TestResultTwoExpansions{#1}{#2}%
1807 \TestSpaceAtEnd{#1}%
1808 }
1809 \newcommand*{\TestExch}[2]{\Test{#2}{#1}}
1810 \newcommand*{\TestInv}[2]{%
1811 \Test{\intcalcInv{#1}}{#2}%
1812 }
1813 \newcommand*{\TestNum}[2]{%
1814 \Test{\intcalcNum{#1}}{#2}%
1815 }
1816 \newcommand*{\TestAbs}[2]{%
1817 \Test{\intcalcAbs{#1}}{#2}%
1818 }
1819 \newcommand*{\TestSgn}[2]{%
1820 \Test{\intcalcSgn{#1}}{#2}%

```

```

1821 }
1822 \newcommand*{\TestMin}[3]{%
1823   \Test{\intcalcMin{#1}{#2}}{#3}%
1824 }
1825 \newcommand*{\TestMax}[3]{%
1826   \Test{\intcalcMax{#1}{#2}}{#3}%
1827 }
1828 \newcommand*{\TestCmp}[3]{%
1829   \Test{\intcalcCmp{#1}{#2}}{#3}%
1830 }
1831 \newcommand*{\TestInc}[2]{%
1832   \Test{\intcalcInc{#1}}{#2}%
1833   \ifnum\intcalcNum{#1}>-1 %
1834     \edef\x{%
1835       \noexpand\Test{%
1836         \noexpand\IntCalcInc\intcalcNum{#1}!%
1837       }{#2}%
1838     }%
1839     \x
1840   \fi
1841 }
1842 \newcommand*{\TestDec}[2]{%
1843   \Test{\intcalcDec{#1}}{#2}%
1844   \ifnum\intcalcNum{#1}>0 %
1845     \edef\x{%
1846       \noexpand\Test{%
1847         \noexpand\IntCalcDec\intcalcNum{#1}!%
1848       }{#2}%
1849     }%
1850     \x
1851   \fi
1852 }
1853 \newcommand*{\TestAdd}[3]{%
1854   \Test{\intcalcAdd{#1}{#2}}{#3}%
1855   \ifnum\intcalcNum{#1}>0 %
1856     \ifnum\intcalcNum{#2}> 0 %
1857       \ifnum\intcalcCmp{#1}{#2}>0 %
1858         \edef\x{%
1859           \noexpand\Test{%
1860             \noexpand\IntCalcAdd
1861             \intcalcNum{#1}!\intcalcNum{#2}!%
1862           }{#3}%
1863         }%
1864         \x
1865       \else
1866         \edef\x{%
1867           \noexpand\Test{%
1868             \noexpand\IntCalcAdd
1869             \intcalcNum{#2}!\intcalcNum{#1}!%
1870           }{#3}%
1871         }%
1872         \x
1873       \fi
1874     \fi
1875   \fi
1876 }
1877 \newcommand*{\TestSub}[3]{%
1878   \Test{\intcalcSub{#1}{#2}}{#3}%
1879   \ifnum\intcalcNum{#1}>0 %
1880     \ifnum\intcalcNum{#2}> 0 %
1881       \ifnum\intcalcCmp{#1}{#2}>0 %
1882         \edef\x{%

```

```

1883         \noexpand\Test{%
1884             \noexpand\IntCalcSub
1885             \intcalcNum{#1}!\intcalcNum{#2}!%
1886         }{#3}%
1887     }%
1888     \x
1889     \fi
1890     \fi
1891     \fi
1892 }
1893 \newcommand*{\TestShl}[2]{%
1894     \Test{\intcalcShl{#1}}{#2}%
1895     \edef\x{%
1896         \noexpand\Test{%
1897             \noexpand\IntCalcShl\intcalcAbs{#1}!%
1898             }{\intcalcAbs{#2}}%
1899     }%
1900     \x
1901 }
1902 \newcommand*{\TestShr}[2]{%
1903     \Test{\intcalcShr{#1}}{#2}%
1904     \edef\x{%
1905         \noexpand\Test{%
1906             \noexpand\IntCalcShr\intcalcAbs{#1}!%
1907             }{\intcalcAbs{#2}}%
1908     }%
1909     \x
1910 }
1911 \newcommand*{\TestMul}[3]{%
1912     \Test{\intcalcMul{#1}{#2}}{#3}%
1913     \edef\x{%
1914         \noexpand\Test{%
1915             \noexpand\IntCalcMul\intcalcAbs{#1}!\intcalcAbs{#2}!%
1916             }{\intcalcAbs{#3}}%
1917     }%
1918     \x
1919 }
1920 \newcommand*{\TestSqr}[2]{%
1921     \Test{\intcalcSqr{#1}}{#2}%
1922 }
1923 \newcommand*{\TestFac}[2]{%
1924     \expandafter\TestExch\expandafter{\the\numexpr#2}{\intcalcFac{#1}}%
1925 }
1926 \newcommand*{\TestPow}[3]{%
1927     \Test{\intcalcPow{#1}{#2}}{#3}%
1928 }
1929 \newcommand*{\TestDiv}[3]{%
1930     \Test{\intcalcDiv{#1}{#2}}{#3}%
1931     \TestTeXDivide{#1}{#2}%
1932     \edef\x{%
1933         \noexpand\Test{%
1934             \noexpand\IntCalcDiv\intcalcAbs{#1}!\intcalcAbs{#2}!%
1935             }{\intcalcAbs{#3}}%
1936     }%
1937 }
1938 \newcommand*{\TestMod}[3]{%
1939     \Test{\intcalcMod{#1}{#2}}{#3}%
1940     \ifcase\ifcase\intcalcSgn{#1} 0%
1941         \or
1942         \ifcase\intcalcSgn{#2} 1%
1943         \or 0%
1944         \else 1%

```

```

1945         \fi
1946     \else
1947         \ifcase\intcalcSgn{#2} 1%
1948         \or 1%
1949         \else 0%
1950     \fi
1951     \fi\relax
1952 \edef\x{%
1953     \noexpand\Test{%
1954         \noexpand\IntCalcMod
1955         \intcalcAbs{#1}!\intcalcAbs{#2}!%
1956     }\intcalcAbs{#3}}%
1957 }%
1958 \x
1959 \fi
1960 }
1961 </test2>

```

3.2.2 Time

```

1962 <*test2>
1963 \begingroup\expandafter\expandafter\expandafter\endgroup
1964 \expandafter\ifx\csname pdfresettimer\endcsname\relax
1965 \else
1966     \makeatletter
1967     \newcount\SummaryTime
1968     \newcount\TestTime
1969     \SummaryTime=\z@
1970     \newcommand*\PrintTime}[2]{%
1971         \typeout{%
1972             [Time #1: \strip@pt\dimexpr\number#2sp\relax\space s]%
1973         }%
1974     }%
1975     \newcommand*\StartTime#[1]{%
1976         \renewcommand*\TimeDescription}{#1}%
1977         \pdfresettimer
1978     }%
1979     \newcommand*\TimeDescription{}%
1980     \newcommand*\StopTime{%
1981         \TestTime=\pdfelapsedtime
1982         \global\advance\SummaryTime\TestTime
1983         \PrintTime\TimeDescription\TestTime
1984     }%
1985     \let\saved@qstest\qstest
1986     \let\saved@endqstest\endqstest
1987     \def\qstest#1#2{%
1988         \saved@qstest{#1}{#2}%
1989         \StartTime{#1}%
1990     }%
1991     \def\endqstest{%
1992         \StopTime
1993         \saved@endqstest
1994     }%
1995     \AtEndDocument{%
1996         \PrintTime{summary}\SummaryTime
1997     }%
1998     \makeatother
1999 \fi
2000 </test2>

```

3.2.3 Test 4: additional mod/div operations

```

2001 <*test4>
2002 \newcommand*\TestDo}[2]{%
2003     \ifcase\numexpr#2\relax

```

```

2004 \else
2005   \edef\temp{\intcalcMod{#1}{#2}}%
2006   \Expect*{%
2007     \the\numexpr
2008     \intcalcMul{%
2009       \intcalcDiv{\intcalcAbs{#1}}{\intcalcAbs{#2}}}%
2010     }{\intcalcAbs{#2}}}%
2011     +\intcalcMod{\intcalcAbs{#1}}{\intcalcAbs{#2}}\relax
2012   }*{\the\numexpr\intcalcAbs{#1}\relax}%
2013 \fi
2014 }
2015 \newcommand*{\TestOne}[2]{%
2016   \TestDo{#1}{#1}%
2017 }
2018 \newcommand*{\TestTwo}[3]{%
2019   \TestDo{#1}{#2}%
2020   \TestDo{#2}{#1}%
2021 }
2022 \let\TestNum\TestOne
2023 \let\TestInv\TestOne
2024 \let\TestAbs\TestOne
2025 \let\TestSgn\TestOne
2026 \let\TestMin\TestTwo
2027 \let\TestMax\TestTwo
2028 \let\TestCmp\TestTwo
2029 \let\TestInc\TestOne
2030 \let\TestDec\TestOne
2031 \let\TestAdd\TestTwo
2032 \let\TestSub\TestTwo
2033 \let\TestShl\TestOne
2034 \let\TestShr\TestOne
2035 \let\TestMul\TestTwo
2036 \let\TestSqr\TestOne
2037 \def\TestFac#1#2{}
2038 \let\TestPow\TestTwo
2039 \let\TestDiv\TestTwo
2040 \let\TestMod\TestTwo
2041 \end{test4}

```

3.2.4 Test sets

```

2042 \test2 | test4)
2043 \makeatletter
2044
2045 \begin{qstest}{num}{num}%
2046   \TestNum{0}{0}%
2047   \TestNum{1}{1}%
2048   \TestNum{-1}{-1}%
2049   \TestNum{10}{10}%
2050   \TestNum{-10}{-10}%
2051   \TestNum{2147483647}{2147483647}%
2052   \TestNum{-2147483647}{-2147483647}%
2053   \TestNum{ 0 }{0}%
2054   \TestNum{ 1 }{1}%
2055   \TestNum{--1}{1}%
2056   \TestNum{ - + - + 4 }{4}%
2057   \TestNum{\z@}{0}%
2058   \TestNum{\@ne}{1}%
2059   \TestNum{\m@ne}{-1}%
2060 \etex
2061   \TestNum{-10+30}{20}%
2062   \TestNum{10-30}{-20}%
2063 \etex
2064 \end{qstest}

```

```

2065
2066 \begin{qstest}{inv}{inv}%
2067   \TestInv{0}{0}%
2068   \TestInv{1}{-1}%
2069   \TestInv{-1}{1}%
2070   \TestInv{10}{-10}%
2071   \TestInv{-10}{10}%
2072   \TestInv{2147483647}{-2147483647}%
2073   \TestInv{-2147483647}{2147483647}%
2074   \TestInv{ 0 }{0}%
2075   \TestInv{ 1 }{-1}%
2076   \TestInv{--1}{-1}%
2077   \TestInv{\z@}{0}%
2078   \TestInv{\@ne}{-1}%
2079   \TestInv{\m@ne}{1}%
2080 \etex
2081   \TestInv{-10+30}{-20}%
2082   \TestInv{10-30}{20}%
2083 \etex
2084 \end{qstest}
2085
2086 \begin{qstest}{abs}{abs}%
2087   \TestAbs{0}{0}%
2088   \TestAbs{1}{1}%
2089   \TestAbs{-1}{1}%
2090   \TestAbs{10}{10}%
2091   \TestAbs{-10}{10}%
2092   \TestAbs{2147483647}{2147483647}%
2093   \TestAbs{-2147483647}{2147483647}%
2094   \TestAbs{ 0 }{0}%
2095   \TestAbs{ 1 }{1}%
2096   \TestAbs{--1}{1}%
2097   \TestAbs{\z@}{0}%
2098   \TestAbs{\@ne}{1}%
2099   \TestAbs{\m@ne}{1}%
2100 \etex
2101   \TestAbs{-10+30}{20}%
2102   \TestAbs{10-30}{20}%
2103 \etex
2104 \end{qstest}
2105
2106 \begin{qstest}{sign}{sign}%
2107   \TestSgn{0}{0}%
2108   \TestSgn{1}{1}%
2109   \TestSgn{-1}{-1}%
2110   \TestSgn{10}{1}%
2111   \TestSgn{-10}{-1}%
2112   \TestSgn{2147483647}{1}%
2113   \TestSgn{-2147483647}{-1}%
2114   \TestSgn{ 0 }{0}%
2115   \TestSgn{ 2 }{1}%
2116   \TestSgn{-2 }{-1}%
2117   \TestSgn{--2}{1}%
2118   \TestSgn{\z@}{0}%
2119   \TestSgn{\@ne}{1}%
2120   \TestSgn{\m@ne}{-1}%
2121 \etex
2122   \TestSgn{-10+30}{1}%
2123   \TestSgn{10-30}{-1}%
2124 \etex
2125 \end{qstest}
2126

```



```

2127 \begin{qstest}{min}{min}%
2128   \TestMin{0}{1}{0}%
2129   \TestMin{1}{0}{0}%
2130   \TestMin{-10}{-20}{-20}%
2131   \TestMin{ 1 }{ 2 }{1}%
2132   \TestMin{ 2 }{ 1 }{1}%
2133   \TestMin{1}{1}{1}%
2134   \TestMin{\z@}{\@ne}{0}%
2135   \TestMin{\@ne}{\m@ne}{-1}%
2136 \etex
2137   \TestMin{1+2}{3+4}{3}%
2138 \etex
2139 \end{qstest}
2140
2141 \begin{qstest}{max}{max}%
2142   \TestMax{0}{1}{1}%
2143   \TestMax{1}{0}{1}%
2144   \TestMax{-10}{-20}{-10}%
2145   \TestMax{ 1 }{ 2 }{2}%
2146   \TestMax{ 2 }{ 1 }{2}%
2147   \TestMax{1}{1}{1}%
2148   \TestMax{\z@}{\@ne}{1}%
2149   \TestMax{\@ne}{\m@ne}{1}%
2150 \etex
2151   \TestMax{1+2}{3+4}{7}%
2152 \etex
2153 \end{qstest}
2154
2155 \begin{qstest}{cmp}{cmp}%
2156   \TestCmp{0}{0}{0}%
2157   \TestCmp{-21}{17}{-1}%
2158   \TestCmp{3}{4}{-1}%
2159   \TestCmp{-10}{-10}{0}%
2160   \TestCmp{-10}{-11}{1}%
2161   \TestCmp{100}{5}{1}%
2162   \TestCmp{2147483647}{-2147483647}{1}%
2163   \TestCmp{-2147483647}{2147483647}{-1}%
2164   \TestCmp{2147483647}{2147483647}{0}%
2165   \TestCmp{\z@}{\@ne}{-1}%
2166   \TestCmp{\@ne}{\m@ne}{1}%
2167   \TestCmp{ 4 }{ 5 }{-1}%
2168   \TestCmp{ -3 }{ -7 }{1}%
2169 \etex
2170   \TestCmp{1+2}{3+4}{-1}%
2171 \etex
2172 \end{qstest}
2173
2174 \begin{qstest}{fac}{fac}
2175   \TestFac{0}{1}%
2176   \TestFac{1}{1}%
2177   \TestFac{2}{2}%
2178   \TestFac{3}{2*3}%
2179   \TestFac{4}{2*3*4}%
2180   \TestFac{5}{2*3*4*5}%
2181   \TestFac{6}{2*3*4*5*6}%
2182   \TestFac{7}{2*3*4*5*6*7}%
2183   \TestFac{8}{2*3*4*5*6*7*8}%
2184   \TestFac{9}{2*3*4*5*6*7*8*9}%
2185   \TestFac{10}{2*3*4*5*6*7*8*9*10}%
2186   \TestFac{11}{2*3*4*5*6*7*8*9*10*11}%
2187   \TestFac{12}{2*3*4*5*6*7*8*9*10*11*12}%
2188 \end{qstest}

```

```

2189
2190 \begin{qstest}{inc}{inc}%
2191   \TestInc{0}{1}%
2192   \TestInc{1}{2}%
2193   \TestInc{-1}{0}%
2194   \TestInc{10}{11}%
2195   \TestInc{-10}{-9}%
2196   \TestInc{999}{1000}%
2197   \TestInc{-1000}{-999}%
2198   \TestInc{129}{130}%
2199   \TestInc{2147483646}{2147483647}%
2200   \TestInc{-2147483647}{-2147483646}%
2201 \end{qstest}
2202
2203 \begin{qstest}{dec}{dec}%
2204   \TestDec{0}{-1}%
2205   \TestDec{1}{0}%
2206   \TestDec{-1}{-2}%
2207   \TestDec{10}{9}%
2208   \TestDec{-10}{-11}%
2209   \TestDec{1000}{999}%
2210   \TestDec{-999}{-1000}%
2211   \TestDec{130}{129}%
2212   \TestDec{2147483647}{2147483646}%
2213   \TestDec{-2147483646}{-2147483647}%
2214 \end{qstest}
2215
2216 \begin{qstest}{add}{add}%
2217   \TestAdd{0}{0}{0}%
2218   \TestAdd{1}{0}{1}%
2219   \TestAdd{0}{1}{1}%
2220   \TestAdd{1}{2}{3}%
2221   \TestAdd{-1}{-1}{-2}%
2222   \TestAdd{2147483646}{1}{2147483647}%
2223   \TestAdd{-2147483647}{2147483647}{0}%
2224   \TestAdd{20}{-5}{15}%
2225   \TestAdd{-4}{-1}{-5}%
2226   \TestAdd{-1}{-4}{-5}%
2227   \TestAdd{-4}{1}{-3}%
2228   \TestAdd{-1}{4}{3}%
2229   \TestAdd{4}{-1}{3}%
2230   \TestAdd{1}{-4}{-3}%
2231   \TestAdd{-4}{-1}{-5}%
2232   \TestAdd{-1}{-4}{-5}%
2233   \TestAdd{ -4 }{ -1 }{-5}%
2234   \TestAdd{ -1 }{ -4 }{-5}%
2235   \TestAdd{ -4 }{ 1 }{-3}%
2236   \TestAdd{ -1 }{ 4 }{3}%
2237   \TestAdd{ 4 }{ -1 }{3}%
2238   \TestAdd{ 1 }{ -4 }{-3}%
2239   \TestAdd{ -4 }{ -1 }{-5}%
2240   \TestAdd{ -1 }{ -4 }{-5}%
2241   \TestAdd{876543210}{111111111}{987654321}%
2242   \TestAdd{999999999}{2}{1000000001}%
2243 \etex
2244   \TestAdd{100}{50+150}{300}%
2245   \TestAdd{2147483647}{10-2147483647}{10}%
2246 \etex
2247 \end{qstest}
2248
2249 \begin{qstest}{sub}{sub}
2250   \TestSub{0}{0}{0}%

```

```

2251 \TestSub{1}{0}{1}%
2252 \TestSub{1}{2}{-1}%
2253 \TestSub{-1}{-1}{0}%
2254 \TestSub{2147483646}{-1}{2147483647}%
2255 \TestSub{-2147483647}{-2147483647}{0}%
2256 \TestSub{-4}{-1}{-3}%
2257 \TestSub{-1}{-4}{3}%
2258 \TestSub{-4}{1}{-5}%
2259 \TestSub{-1}{4}{-5}%
2260 \TestSub{4}{-1}{5}%
2261 \TestSub{1}{-4}{5}%
2262 \TestSub{-4}{-1}{-3}%
2263 \TestSub{-1}{-4}{3}%
2264 \TestSub{ -4 }{ -1 }{-3}%
2265 \TestSub{ -1 }{ -4 }{3}%
2266 \TestSub{ -4 }{ 1 }{-5}%
2267 \TestSub{ -1 }{ 4 }{-5}%
2268 \TestSub{ 4 }{ -1 }{5}%
2269 \TestSub{ 1 }{ -4 }{5}%
2270 \TestSub{ -4 }{ -1 }{-3}%
2271 \TestSub{ -1 }{ -4 }{3}%
2272 \TestSub{1000000000}{2}{999999998}%
2273 \TestSub{987654321}{111111111}{876543210}%
2274 \etex
2275 \TestSub{100}{50+150}{-100}%
2276 \TestSub{2147483647}{-10+2147483647}{10}%
2277 \etex
2278 \end{qstest}
2279
2280 \begin{qstest}{shl}{shl}
2281 \TestShl{0}{0}%
2282 \TestShl{1}{2}%
2283 \TestShl{5621}{11242}%
2284 \TestShl{1073741823}{2147483646}%
2285 \TestShl{-1}{-2}%
2286 \TestShl{-5621}{-11242}%
2287 \end{qstest}
2288
2289 \begin{qstest}{shr}{shr}
2290 \TestShr{0}{0}%
2291 \TestShr{1}{0}%
2292 \TestShr{2}{1}%
2293 \TestShr{3}{1}%
2294 \TestShr{4}{2}%
2295 \TestShr{5}{2}%
2296 \TestShr{6}{3}%
2297 \TestShr{7}{3}%
2298 \TestShr{8}{4}%
2299 \TestShr{9}{4}%
2300 \TestShr{10}{5}%
2301 \TestShr{11}{5}%
2302 \TestShr{12}{6}%
2303 \TestShr{13}{6}%
2304 \TestShr{14}{7}%
2305 \TestShr{15}{7}%
2306 \TestShr{16}{8}%
2307 \TestShr{17}{8}%
2308 \TestShr{18}{9}%
2309 \TestShr{19}{9}%
2310 \TestShr{20}{10}%
2311 \TestShr{21}{10}%
2312 \TestShr{22}{11}%

```

```

2313 \TestShr{11241}{5620}%
2314 \TestShr{73054202}{36527101}%
2315 \TestShr{2147483646}{1073741823}%
2316 \TestShr{-1}{0}%
2317 \TestShr{-2}{-1}%
2318 \TestShr{-3}{-1}%
2319 \TestShr{-11241}{-5620}%
2320 \end{qstest}
2321
2322 \begin{qstest}{mul}{mul}
2323 \TestMul{0}{0}{0}%
2324 \TestMul{1}{0}{0}%
2325 \TestMul{0}{1}{0}%
2326 \TestMul{1}{1}{1}%
2327 \TestMul{3}{1}{3}%
2328 \TestMul{1}{-3}{-3}%
2329 \TestMul{-4}{-5}{20}%
2330 \TestMul{3}{7}{21}%
2331 \TestMul{7}{3}{21}%
2332 \TestMul{3}{-7}{-21}%
2333 \TestMul{7}{-3}{-21}%
2334 \TestMul{-3}{7}{-21}%
2335 \TestMul{-7}{3}{-21}%
2336 \TestMul{-3}{-7}{21}%
2337 \TestMul{-7}{-3}{21}%
2338 \TestMul{12}{11}{132}%
2339 \TestMul{999}{333}{332667}%
2340 \TestMul{1000}{4321}{4321000}%
2341 \TestMul{12345}{173955}{2147474475}%
2342 \TestMul{1073741823}{2}{2147483646}%
2343 \TestMul{2}{1073741823}{2147483646}%
2344 \TestMul{-1073741823}{2}{-2147483646}%
2345 \TestMul{2}{-1073741823}{-2147483646}%
2346 \etex
2347 \TestMul{2+3}{5+7}{60}%
2348 \TestMul{2147483647}{2147483647/2147483647}{2147483647}%
2349 \etex
2350 \end{qstest}
2351
2352 \begin{qstest}{sqr}{sqr}
2353 \TestSqr{0}{0}%
2354 \TestSqr{1}{1}%
2355 \TestSqr{2}{4}%
2356 \TestSqr{3}{9}%
2357 \TestSqr{4}{16}%
2358 \TestSqr{9}{81}%
2359 \TestSqr{10}{100}%
2360 \TestSqr{46340}{2147395600}%
2361 \TestSqr{-1}{1}%
2362 \TestSqr{-2}{4}%
2363 \TestSqr{-46340}{2147395600}%
2364 \end{qstest}
2365
2366 \begin{qstest}{pow}{pow}
2367 \TestPow{-2}{0}{1}%
2368 \TestPow{-1}{0}{1}%
2369 \TestPow{0}{0}{1}%
2370 \TestPow{1}{0}{1}%
2371 \TestPow{2}{0}{1}%
2372 \TestPow{3}{0}{1}%
2373 \TestPow{-2}{1}{-2}%
2374 \TestPow{-1}{1}{-1}%

```

```

2375 \TestPow{1}{1}{1}%
2376 \TestPow{2}{1}{2}%
2377 \TestPow{3}{1}{3}%
2378 \TestPow{-2}{2}{4}%
2379 \TestPow{-1}{2}{1}%
2380 \TestPow{0}{2}{0}%
2381 \TestPow{1}{2}{1}%
2382 \TestPow{2}{2}{4}%
2383 \TestPow{3}{2}{9}%
2384 \TestPow{0}{1}{0}%
2385 \TestPow{1}{-2}{1}%
2386 \TestPow{1}{-1}{1}%
2387 \TestPow{-1}{-2}{1}%
2388 \TestPow{-1}{-1}{-1}%
2389 \TestPow{-1}{3}{-1}%
2390 \TestPow{-1}{4}{1}%
2391 \TestPow{-2}{-1}{0}%
2392 \TestPow{-2}{-2}{0}%
2393 \TestPow{2}{3}{8}%
2394 \TestPow{2}{4}{16}%
2395 \TestPow{2}{5}{32}%
2396 \TestPow{2}{6}{64}%
2397 \TestPow{2}{7}{128}%
2398 \TestPow{2}{8}{256}%
2399 \TestPow{2}{9}{512}%
2400 \TestPow{2}{10}{1024}%
2401 \TestPow{-2}{3}{-8}%
2402 \TestPow{-2}{4}{16}%
2403 \TestPow{-2}{5}{-32}%
2404 \TestPow{-2}{6}{64}%
2405 \TestPow{-2}{7}{-128}%
2406 \TestPow{-2}{8}{256}%
2407 \TestPow{-2}{9}{-512}%
2408 \TestPow{-2}{10}{1024}%
2409 \TestPow{3}{3}{27}%
2410 \TestPow{3}{4}{81}%
2411 \TestPow{3}{5}{243}%
2412 \TestPow{-3}{3}{-27}%
2413 \TestPow{-3}{4}{81}%
2414 \TestPow{-3}{5}{-243}%
2415 \TestPow{2}{30}{1073741824}%
2416 \TestPow{-3}{19}{-1162261467}%
2417 \TestPow{5}{13}{1220703125}%
2418 \TestPow{-7}{11}{-1977326743}%
2419 \end{qstest}
2420
2421 \begin{qstest}{div}{div}
2422 \TestDiv{1}{1}{1}%
2423 \TestDiv{2}{1}{2}%
2424 \TestDiv{-2}{1}{-2}%
2425 \TestDiv{2}{-1}{-2}%
2426 \TestDiv{-2}{-1}{2}%
2427 \TestDiv{15}{2}{7}%
2428 \TestDiv{-16}{2}{-8}%
2429 \TestDiv{1}{2}{0}%
2430 \TestDiv{1}{3}{0}%
2431 \TestDiv{2}{3}{0}%
2432 \TestDiv{-2}{3}{0}%
2433 \TestDiv{2}{-3}{0}%
2434 \TestDiv{-2}{-3}{0}%
2435 \TestDiv{13}{3}{4}%
2436 \TestDiv{-13}{-3}{4}%

```

```

2437 \TestDiv{-13}{3}{-4}%
2438 \TestDiv{-6}{5}{-1}%
2439 \TestDiv{-5}{5}{-1}%
2440 \TestDiv{-4}{5}{0}%
2441 \TestDiv{-3}{5}{0}%
2442 \TestDiv{-2}{5}{0}%
2443 \TestDiv{-1}{5}{0}%
2444 \TestDiv{0}{5}{0}%
2445 \TestDiv{1}{5}{0}%
2446 \TestDiv{2}{5}{0}%
2447 \TestDiv{3}{5}{0}%
2448 \TestDiv{4}{5}{0}%
2449 \TestDiv{5}{5}{1}%
2450 \TestDiv{6}{5}{1}%
2451 \TestDiv{-5}{4}{-1}%
2452 \TestDiv{-4}{4}{-1}%
2453 \TestDiv{-3}{4}{0}%
2454 \TestDiv{-2}{4}{0}%
2455 \TestDiv{-1}{4}{0}%
2456 \TestDiv{0}{4}{0}%
2457 \TestDiv{1}{4}{0}%
2458 \TestDiv{2}{4}{0}%
2459 \TestDiv{3}{4}{0}%
2460 \TestDiv{4}{4}{1}%
2461 \TestDiv{5}{4}{1}%
2462 \TestDiv{12345}{678}{18}%
2463 \TestDiv{32372}{5952}{5}%
2464 \TestDiv{284271294}{18162}{15651}%
2465 \TestDiv{217652429}{12561}{17327}%
2466 \TestDiv{462028434}{5439}{84947}%
2467 \TestDiv{2147483647}{1000}{2147483}%
2468 \TestDiv{2147483647}{-1000}{-2147483}%
2469 \TestDiv{-2147483647}{1000}{-2147483}%
2470 \TestDiv{-2147483647}{-1000}{2147483}%
2471 \end{qstest}
2472
2473 \begin{qstest}{mod}{mod}
2474 \TestMod{-6}{5}{4}%
2475 \TestMod{-5}{5}{0}%
2476 \TestMod{-4}{5}{1}%
2477 \TestMod{-3}{5}{2}%
2478 \TestMod{-2}{5}{3}%
2479 \TestMod{-1}{5}{4}%
2480 \TestMod{0}{5}{0}%
2481 \TestMod{1}{5}{1}%
2482 \TestMod{2}{5}{2}%
2483 \TestMod{3}{5}{3}%
2484 \TestMod{4}{5}{4}%
2485 \TestMod{5}{5}{0}%
2486 \TestMod{6}{5}{1}%
2487 \TestMod{-5}{4}{3}%
2488 \TestMod{-4}{4}{0}%
2489 \TestMod{-3}{4}{1}%
2490 \TestMod{-2}{4}{2}%
2491 \TestMod{-1}{4}{3}%
2492 \TestMod{0}{4}{0}%
2493 \TestMod{1}{4}{1}%
2494 \TestMod{2}{4}{2}%
2495 \TestMod{3}{4}{3}%
2496 \TestMod{4}{4}{0}%
2497 \TestMod{5}{4}{1}%
2498 \TestMod{-6}{-5}{-1}%

```

```

2499 \TestMod{-5}{-5}{0}%
2500 \TestMod{-4}{-5}{-4}%
2501 \TestMod{-3}{-5}{-3}%
2502 \TestMod{-2}{-5}{-2}%
2503 \TestMod{-1}{-5}{-1}%
2504 \TestMod{0}{-5}{0}%
2505 \TestMod{1}{-5}{-4}%
2506 \TestMod{2}{-5}{-3}%
2507 \TestMod{3}{-5}{-2}%
2508 \TestMod{4}{-5}{-1}%
2509 \TestMod{5}{-5}{0}%
2510 \TestMod{6}{-5}{-4}%
2511 \TestMod{-5}{-4}{-1}%
2512 \TestMod{-4}{-4}{0}%
2513 \TestMod{-3}{-4}{-3}%
2514 \TestMod{-2}{-4}{-2}%
2515 \TestMod{-1}{-4}{-1}%
2516 \TestMod{0}{-4}{0}%
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2518 \TestMod{2}{-4}{-2}%
2519 \TestMod{3}{-4}{-1}%
2520 \TestMod{4}{-4}{0}%
2521 \TestMod{5}{-4}{-3}%
2522 \TestMod{2147483647}{1000}{647}%
2523 \TestMod{2147483647}{-1000}{-353}%
2524 \TestMod{-2147483647}{1000}{353}%
2525 \TestMod{-2147483647}{-1000}{-647}%
2526 \TestMod{ 0 }{ 4 }{0}%
2527 \TestMod{ 1 }{ 4 }{1}%
2528 \TestMod{ -1 }{ 4 }{3}%
2529 \TestMod{ 0 }{ -4 }{0}%
2530 \TestMod{ 1 }{ -4 }{-3}%
2531 \TestMod{ -1 }{ -4 }{-1}%
2532 <*etex>
2533 \TestMod{1+2}{1+3}{3}%
2534 \TestMod{1-2}{1+3}{3}%
2535 \TestMod{1-2}{1-4}{-1}%
2536 \TestMod{1+2}{1-4}{0}%
2537 \TestMod{1+2}{1-5}{-1}%
2538 </etex>
2539 \end{qstest}
2540 </test2 | test4>
2541
2542 <*test2>
2543 \newcommand*{\TestError}[2]{%
2544 \begin{group}
2545 \expandafter\def\csname IntCalcError:#1\endcsname{%
2546 \Expect*{#2}{0}%
2547 \expandafter\def\csname IntCalcError:#1\endcsname{ERROR}%
2548 \Expect*{#2}{0ERROR }%
2549 \end{group}
2550 }
2551 \begin{qstest}{error}{error}
2552 \TestError{FacNegative}{\intcalcFac{-1}}%
2553 \TestError{FacNegative}{\intcalcFac{-2147483647}}%
2554 \TestError{FacOverflow}{\intcalcFac{13}}%
2555 \TestError{FacOverflow}{\intcalcFac{2147483647}}%
2556 \TestError{DivisionByZero}{\intcalcPow{0}{-1}}%
2557 \TestError{DivisionByZero}{\intcalcDiv{1}{0}}%
2558 \TestError{DivisionByZero}{\intcalcMod{1}{0}}%
2559 \TestError{DivisionByZero}{\IntCalcDiv1!0!}%
2560 \TestError{DivisionByZero}{\IntCalcMod1!0!}%

```

```

2561 \end{qstest}
2562 </test2>
2563
2564 <*test2 | test4>
2565 \begin{document}
2566 \end{document}
2567 </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:install/macros/latex/contrib/oberdiek.tds.zip](#)

TDS refers to the standard “A Directory Structure for \TeX 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- \TeX :

```
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 $\text{\texttt{pdfLaTeX}}$:

```
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.

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