The intcalc package

Heiko Oberdiek∗
<heiko.oberdiek at googlemail.com>

2016/05/16 v1.2

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 \v-\TeX{} . . . . . . . . . . . . . . . . . . . . . 9
  2.3.1 Abs, Sgn . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9
  2.3.2 Min, Max, Cmp . . . . . . . . . . . . . . . . . . . . . . . . . . . 10
  2.3.3 Fac . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10
2.4 Implementation based on \v-\TeX{} . . . . . . . . . . . . . . . . . . . . 11
  2.4.1 Num . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 11
  2.4.2 Inv, Abs, Sgn . . . . . . . . . . . . . . . . . . . . . . . . . . . 11
  2.4.3 Min, Max, Cmp . . . . . . . . . . . . . . . . . . . . . . . . . . . 11
  2.4.4 Inc, Dec . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12
  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 \v-\TeX{} . . . . . . . . . . . . . . . . . . . . . 17
  2.5.1 Num . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 17
  2.5.2 Inv, Abs, Sgn . . . . . . . . . . . . . . . . . . . . . . . . . . . 17
  2.5.3 Min, Max, Cmp . . . . . . . . . . . . . . . . . . . . . . . . . . . 18

∗Please report any issues at https://github.com/ho-tex/oberdiek/issues
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. \texttt{\intcalcAdd{10}{43}} returns \texttt{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 \texttt{\number}, \texttt{\csname}, file names, or other expandable contexts.

The package contains two implementations of the operations. If \varepsilon-\TeX is detected then the macros are implemented using its features (\texttt{\numexpr}). Otherwise the slower implementation without \varepsilon-\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 \texttt{\textbackslash numexpr} understands if \texttt{\varepsilon-\LaTeX} 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 \textcircled{Q}):

• The macros are fully expandable. Thus they can be used inside \texttt{\edef}, \texttt{\csname}, after \texttt{\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 \texttt{\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 \texttt{\varepsilon-\LaTeX} 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 case an undefined control sequence is called and causes a \TeX error message, example: \texttt{\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

\[
\texttt{\intcalcNum \{\langle x \rangle\}}
\]

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

0-9|?1-9][0-9]*
1.4.2 Inv, Abs, Sgn

\texttt{\intcalcInv \{\langle x \rangle\}\}}

Macro \texttt{\intcalcInv} switches the sign.

\texttt{Inv(x) := −x}

\texttt{\intcalcAbs \{\langle x \rangle\}\}}

Macro \texttt{\intcalcAbs} returns the absolute value of integer \langle x \rangle.

\texttt{Abs(x) := \mid x \mid}

\texttt{\intcalcSgn \{\langle x \rangle\}\}}

Macro \texttt{\intcalcSgn} encodes the sign of \langle x \rangle as number.

\texttt{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 \texttt{\ifcase}:

\texttt{\ifcase\intcalcSgn\{\langle x \rangle\}\}}

\$x=0$\$
\text{or}$\$
\$x>0$\$
\text{else}$\$
\$x<0$\$
\text{fi}

1.4.3 Min, Max, Cmp

\texttt{\intcalcMin \{\langle x \rangle\}\{\langle y \rangle\}\}}

Macro \texttt{\intcalcMin} returns the smaller of the two integers.

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

\texttt{\intcalcMax \{\langle x \rangle\}\{\langle y \rangle\}\}}

Macro \texttt{\intcalcMax} returns the larger of the two integers.

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

\texttt{\intcalcCmp \{\langle x \rangle\}\{\langle y \rangle\}\}}

Macro \texttt{\intcalcCmp} encodes the comparison result as number:

\texttt{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 \texttt{\ifcase}:
$x=y$
\or
\vrule
\$x>y$
\else
\vrule
\$x<y$
\fi

1.4.4 \textbf{Inc, Dec, Add, Sub}

\textbf{\textbackslash intcalcInc \{\langle x\rangle\}}

Macro \texttt{\textbackslash intcalcInc} increments \langle x\rangle by one.

\quad \texttt{Inc}(x) := x + 1

\textbf{\textbackslash intcalcDec \{\langle x\rangle\}}

Macro \texttt{\textbackslash intcalcDec} decrements \langle x\rangle by one.

\quad \texttt{Dec}(x) := x - 1

\textbf{\textbackslash intcalcAdd \{\langle x\rangle\} \{\langle y\rangle\}}

Macro \texttt{\textbackslash intcalcAdd} adds the two numbers.

\quad \texttt{Add}(x, y) := x + y

\textbf{\textbackslash intcalcSub \{\langle x\rangle\} \{\langle y\rangle\}}

Macro \texttt{\textbackslash intcalcSub} calculates the difference.

\quad \texttt{Sub}(x, y) := x - y

1.4.5 \textbf{Shl, Shr}

\textbf{\textbackslash intcalcShl \{\langle x\rangle\}}

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

\quad \texttt{Shl}(x) := x \times 2

\textbf{\textbackslash intcalcShr \{\langle x\rangle\}}

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

\quad \texttt{Shr}(x) := \texttt{Int}(x/2)

1.4.6 \textbf{Mul, Sqr, Fac, Pow}

\textbf{\textbackslash intcalcMul \{\langle x\rangle\} \{\langle y\rangle\}}

Macro \texttt{\textbackslash intcalcMul} calculates the product of \langle x\rangle and \langle y\rangle.

\quad \texttt{Mul}(x, y) := x \times y
\textbf{\texttt{\textbackslash intcalcSqr \{\langle x\rangle\}}} \\
Macro \texttt{intcalcSqr} returns the square product.
\[
\text{Sqr}(x) := x^2
\]

\textbf{\texttt{\textbackslash intcalcFac \{\langle x\rangle\}}} \\
Macro \texttt{intcalcFac} returns the factorial of \(\langle x\rangle\). Negative numbers are not permitted.
\[
\text{Fac}(x) := x! \quad \text{for } x \geq 0
\]
\[(0! = 1)\]

\textbf{\texttt{\textbackslash intcalcPow \{\langle x\rangle\} \{\langle y\rangle\}}} \\
Macro \texttt{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:
\[
\text{Pow}(x, y) := \text{Int}(x^y) \quad \text{for } x \neq 0 \text{ or } y \geq 0
\]
\[(0^0 = 1)\]

\textbf{1.4.7 Div, Mod} \\

\textbf{\texttt{\textbackslash intcalcDiv \{\langle x\rangle\} \{\langle y\rangle\}}} \\
Macro \texttt{intcalcDiv} performs an integer division. Argument \(\langle y\rangle\) must not be zero.
\[
\text{Div}(x, y) := \text{Int}(x/y) \quad \text{for } y \neq 0
\]

\textbf{\texttt{\textbackslash intcalcMod \{\langle x\rangle\} \{\langle y\rangle\}}} \\
Macro \texttt{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:
\[
-|y| < \text{Mod}(x, y) \leq 0 \quad \text{for } y < 0
\]
\[
0 \leq \text{Mod}(x, y) < y \quad \text{for } y \geq 0
\]

\textbf{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 \LaTeX{}.

2 \begin{group}\catcode61\catcode48\catcode32=10\relax%
3 \catcode13=5 % ^^M
4 \endlinechar=13 %
5 \catcode35=6 % #
6 \catcode39=12 % '
7 \catcode44=12 % ,
8 \catcode45=12 % -
9 \catcode46=12 % .
10 \catcode68=12 % :}
11 \catcode64=11 % @
12 \catcode123=1 % {
13 \catcode125=2 % }

7
2.2 Catcodes

[2016/05/16 v1.2 Expandable calculations with integers (HO)]
2.3 Macros independent of $\varepsilon$-TeX

2.3.1 Abs, Sgn

\def\InCa@Abs#1#2!{\ifx#1-% #2\else #1#2\fi}

\def\InCa@Sgn#1#2!{\ifx#1\relax \else #1\fi}
2.3.2 Min, Max, Cmp

\InCa@Min
\def\InCa@Min#1!#2!{%\ifnum#1<#2 \%\else \%\fi}
\InCa@Max
\def\InCa@Max#1!#2!{%\ifnum#1>#2 \%\else \%\fi}
\InCa@Cmp
\def\InCa@Cmp#1!#2!{%\ifnum#1=#2 \%\else \ifnum#1<#2 \-%\fi\%\fi}

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.
\ifnum#1<\z@
  0\IntCalcError:FacNegative\%
\else
  0\IntCalcError:FacOverflow\%
\fi
\fi
}{

\section*{2.4 Implementation based on $\varepsilon$-\TeX}

Only \texttt{\numexpr} is used from $\varepsilon$-\TeX.

\subsection*{2.4.1 Num}
\begin{verbatim}
\def\intcalcNum#1{\the\numexpr#1\relax}
\end{verbatim}

\subsection*{2.4.2 Inv, Abs, Sgn}
\begin{verbatim}
\def\intcalcInv#1{\number-\intcalcNum{#1}}
\def\intcalcAbs#1{\number\expandafter\InCa@Abs\the\numexpr#1!}
\def\intcalcSgn#1{\number\expandafter\InCa@Sgn\the\numexpr#1!}
\end{verbatim}

\subsection*{2.4.3 Min, Max, Cmp}
\begin{verbatim}
\def\intcalcMin#1#2{\number\expandafter\InCa@Min\the\numexpr#1!\the\numexpr#2!}
\def\intcalcMax#1#2{\number\expandafter\InCa@Max\the\numexpr#1!\the\numexpr#2!}
\def\intcalcCmp#1#2{\number\expandafter\InCa@Cmp\the\numexpr#1\the\numexpr#2!}
\end{verbatim}
2.4.4 Inc, Dec

\intcalcInc
\def\intcalcInc#1{\the\numexpr#1+1\relax}\

\intcalcDec
\def\intcalcDec#1{\the\numexpr#1-1\relax}\

\IntCalcInc
\def\IntCalcInc#1!{\the\numexpr#1+1\relax}\

\IntCalcDec
\def\IntCalcDec#1!{\the\numexpr#1-1\relax}\

2.4.5 Add, Sub

\intcalcAdd
\def\intcalcAdd#1#2{\the\numexpr#1+(#2)\relax}\

\intcalcSub
\def\intcalcSub#1#2{\the\numexpr#1-(#2)\relax}\

\IntCalcAdd
\def\IntCalcAdd#1!#2!{\the\numexpr#1+#2\relax}\

\IntCalcSub
\def\IntCalcSub#1!#2!{\the\numexpr#1-#2\relax}\

2.4.6 Shl, Shr

\intcalcShl
\def\intcalcShl#1{\the\numexpr(#1)*2\relax}\

\intcalcShr
\def\intcalcShr#1{\number\expandafter\InCa@Shr\the\numexpr#1!}\

\IntCalcShl
\def\IntCalcShl#1!{\the\numexpr#1*2\relax}
\IntCalcShr
\def\IntCalcShr#1!{% 
\the\numexpr\ifodd#1 (#1-1)\else#1\fi/2\relax 
}%

\InCa@Shr
\def\InCa@Shr#1#2!{% 
\ifx#1-% 
-\InCa@Shr#2!% 
\else 
\ifodd#1\#2 % 
\the\numexpr(#1\#2-1)/2\relax 
\else 
\the\numexpr#1\#2/2\relax 
\fi 
\fi 
\fi 
}%

2.4.7 Mul, Sqr, Fac

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

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

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

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

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

2.4.8 Pow

\intcalcPow
\def\intcalcPow#1#2{% 
\number\expandafter\InCa@Pow 
\the\numexpr#1\expandafter!% 
\the\numexpr#2! % 
}%

\InCa@Pow
\def\InCa@Pow#1#2!#3#4!{% 
\ifcase#3#4 % power = 0 
1% 
\or % power = 1 
#1#2% 
\or % power = 2 
}
\InCa@PowRec \pow(b, p) \{ 
  \PowRec(b, p, 1) 
\}
\PowRec(b, p, r) \{ 
  if \p\ == 1 then 
    return \(r \times b\) 
  else 
    ifodd p then 
      return \PowRec(b \times b, (p-1)/2, r \times b) \div 2 = (p-1)/2 
    else 
      return \PowRec(b \times b, (p-1)/2, r) 
  fi 
\}
\def\InCa@PowRec#1!#2!#3!{%
\ifnum#2\@ne 
  \the\numexpr#1\times#3\relax 
\else 
  \ifodd#2 %
    \expandafter\InCa@PowRec 
    \the\numexpr#1\times#1\expandafter!% 
    \the\numexpr(#2-1)/2\expandafter!% 
    \the\numexpr#1\times#3\expandafter\expandafter\expandafter!% 
  \else 
    \expandafter\InCa@PowRec 
    \the\numexpr#1\times#1\expandafter!% 
    \the\numexpr(#2-1)/2\expandafter!% 
    \number#3\expandafter\expandafter\expandafter!% 
  \fi 
\fi 
}%

\section*{2.4.9 Div, Mod}
\LaTeX's \texttt{\textbackslash divide} truncates, \LaTeX's \texttt{\textbackslash numexpr} rounds the result of a division. The rounding method is called \textquote{Symmetric Arithmetic Rounding} or \textquote{Round-Half-Up} (\textquote{Kaufmännisches Runden} in German):
\begin{verbatim}
1 = 3 divide 2 = 1.5 = numexpr 3/2 = 2
-1 = -3 divide 2 = -1.5 = numexpr -3/2 = -2

Macro \texttt{\intcalcDiv} follows \LaTeX\ and truncates. The calculation is done by the
following formula:

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

The operator ‘/’ is \texttt{\numexpr}’s division.
\end{verbatim}
\InCa@@Div
373 \def\InCa@@Div#1#2!#3#4!{% 
374 #1#3% 
375 \the\numexpr(#2-(#4-1)/2)/#4\relax 
376 }% 
\intcalcMod
377 \def\intcalcMod#1#2{% 
378 \number\expandafter\InCa@Mod 
379 \the\numexpr#1\expandafter!% 
380 \the\numexpr#2! % 
381 }% 
\InCa@Mod
382 \def\InCa@Mod#1!#2!{% 
383 \ifcase#2 % 
384 0\IntCalcError:DivisionByZero% 
385 \else 
386 \ifcase#1 % 
387 0% 
388 \else 
389 \expandafter\InCa@Mod 
390 \romannumeral 0% 
391 \ifnum#1<\z@ 
392 \expandafter-\number-#1% 
393 \else 
394 \expandafter+\number#1% 
395 \fi 
396 \expandafter!% 
397 \romannumeral 0% 
398 \ifnum#2<\z@ 
399 \expandafter-\number-#2% 
400 \else 
401 \expandafter+\number#2% 
402 \fi 
403 !% 
404 \fi 
405 \fi 
406 }% 
\IntCalcMod
407 \def\InCa@Temp#1{% 
408 \def\IntCalcMod##1!##2!{% 
409 \number 
410 \ifcase##2 % 
411 0\IntCalcError:DivisionByZero% 
412 \else 
413 \ifcase##1 % 
414 0% 
415 \else 
416 \the\numexpr##1-(##1-(##2-1)/2)/##2*##2\relax 
417 \fi 
418 \fi 
419 !% 
420 }% 
421 }% 
422 \InCa@Temp{ }% 
\InCa@Mod
423 \def\InCa@Mod#1!#2!#3#4!{% 
424 \if#3+ % 
425 \if#1+ %
\texttt{\\the\numexpr#2-\InCa@@Div+#2!*#4\relax}
\else
  \expandafter\InCa@ModX
  \the\numexpr-#2+\InCa@@Div+!#2!*#4!*#4!#4!
\fi
\else
  \-%
  \if#1+
    \expandafter\InCa@ModX
    \the\numexpr-#2+\InCa@@Div+#2!*#4!*#4!*#4!
  \else
    \the\numexpr#2-\InCa@@Div+!#2!*#4\relax
  \fi
\fi
}

\InCa@ModX
\def\InCa@ModX#1!#2!{%\ifcase#1 %0% \else \the\numexpr#1+#2% \fi%\expandafter\InCa@AtEnd\fi%

2.5 Implementation without \texttt{\varepsilon-\TeX}

2.5.1 \texttt{Num}

\\\texttt{\intcalcNum}
\def\intcalcNum#1{% \number\expandafter\InCa@FirstOfOne\number#1! %}

2.5.2 \texttt{Inv, Abs, Sgn}

\\\texttt{\intcalcInv}
\def\intcalcInv#1{% \number\expandafter\InCa@FirstOfOne\number-#1! %}

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

\\\texttt{\intcalcAbs}
\def\intcalcAbs#1{% \number\expandafter\InCa@Abs\number#1! %}

\\\texttt{\intcalcSgn}
\def\intcalcSgn#1{% \number\expandafter\InCa@Sgn\number#1! %}
2.5.3 Min, Max, Cmp

\intcalcMin
463 \def\intcalcMin#1#2{% 464 \number\expandafter\InCa@Min 465 \number\number#1\expandafter!\number#2! % 466 }
\intcalcMax
467 \def\intcalcMax#1#2{% 468 \number\expandafter\InCa@Max 469 \number\number#1\expandafter!\number#2! % 470 }
\intcalcCmp
471 \def\intcalcCmp#1#2{% 472 \number\expandafter\InCa@Cmp 473 \number\number#1\expandafter!\number#2! % 474 }

2.5.4 Inc, Dec

\intcalcInc
475 \def\intcalcInc#1{% 476 \number\expandafter\InCa@IncSwitch\number#1! % 477 }
\InCa@IncSwitch
478 \def\InCa@IncSwitch#1#2!{% 479 \ifx#1- 480 \csname InCa@Empty\InCa@Inc#1#2!\fi 481 \else 482 \csname InCa@Empty\InCa@Inc#1#2!\fi 483 \fi
484 \fi
485 \fi
486 \fi
487 }
\intcalcDec
488 \def\intcalcDec#1{% 489 \number\expandafter\InCa@DecSwitch\number#1! % 490 }
\InCa@DecSwitch
491 \def\InCa@DecSwitch#1#2!{% 492 \ifx#1- 493 \csname InCa@Empty\InCa@Dec#1#2!\fi 494 \else 495 \expandafter\InCa@Inc#1#2!\fi 496 \else 497 \ifx#10 498 \-1\fi 499 \else 500 \csname InCa@Empty\InCa@Dec#1#2!\fi 501 \InCa@Dec#1#2!\fi 502 \fi 503 \fi
504 }

18
\IntCalcInc
505 \def\IntCalcInc#1!{% 
506 \number\csname InCa@Empty\InCa@Inc#1! %
507 }
\IntCalcDec
508 \def\IntCalcDec#1!{% 
509 \number\csname InCa@Empty\InCa@Dec#1! %
510 }
\InCa@Inc
511 \def\InCa@Inc#1#2{% 
512 \ifx#2%! 
513 \csname InCa@IncDigit#1\endcsname1 
514 \else 
515 \csname InCa@IncDigit#1 
516 \expandafter\InCa@Inc\expandafter#2 
517 \fi 
518 }
\InCa@IncDigit[0-8]
519 \def\InCa@Temp#1#2{% 
520 \expandafter\def\csname InCa@IncDigit#1\endcsname##1{% 
521 \endcsname 
522 0% 
523 \ifcase##1 %
524 #1% 
525 \else 
526 #2% 
527 \fi 
528 }% 
529 } 
530 \InCa@Temp 01 
531 \InCa@Temp 12 
532 \InCa@Temp 23 
533 \InCa@Temp 34 
534 \InCa@Temp 45 
535 \InCa@Temp 56 
536 \InCa@Temp 67 
537 \InCa@Temp 78 
538 \InCa@Temp 89 
\InCa@IncDigit9
539 \expandafter\def\csname InCa@IncDigit9\endcsname#1{% 
540 \expandafter\endcsname 
541 \ifcase#1 %
542 09% 
543 \else 
544 10% 
545 \fi 
546 }
\InCa@Dec
547 \def\InCa@Dec#1#2{% 
548 \ifx#2%! 
549 \csname InCa@DecDigit#1\endcsname1 
550 \else 
551 \csname InCa@DecDigit#1 
552 \expandafter\InCa@Dec\expandafter#2 
553 \fi 
554 }
\InCa@DecDigit[1-9]
\def\InCa@Temp#1#2{\%\expandafter\def\csname InCa@DecDigit#1\endcsname##1{\%\endcsname
0\%\ifcase##1 \%#1\%\else \%#2\%\fi\}%\InCa@Temp 98
\InCa@Temp 87
\InCa@Temp 76
\InCa@Temp 65
\InCa@Temp 54
\InCa@Temp 43
\InCa@Temp 32
\InCa@Temp 21
\InCa@Temp 10
\InCa@DecDigit0
\def\intcalcAdd#1#2{\%\number\expandafter\InCa@AddSwitch\number\number#1\expandafter!%\number#2! %\InCa@AddSwitch
2.5.5 Add, Sub
\intcalcSub
\def\intcalcSub#1#2{\%\number\expandafter\InCa@AddSwitch\number\number#1\expandafter!%\number-\number#2! %\InCa@AddSwitch
\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-
\begin{tabular}{|c|c|c|}
\hline
$x < 0$ & $y < 0$ & $x < y$ & Add($-x, -y$) \\
$\text{else}$ & $\text{else}$ & Add($-y, -x$) \\
$\text{else}$ & $y > 0$ & Sub($-x, y$) \\
$\text{else}$ & $x > -y$ & Sub($y, -x$) \\
$\text{else}$ & $y > 0$ & Sub($-y, x$) \\
$\text{else}$ & $x > y$ & Add($x, y$) \\
$\text{else}$ & $\text{else}$ & Add($y, x$) \\
\hline
\end{tabular}
\InCaSub
\def\InCaSub#1#2!#2!{
\ifnum#1=#2 0%
\else
\InCa@@Sub#1!#2!000000000\InCaSpace
\fi
}

\InCa@@Add
\def\InCa@@Add#1!#2!#3!#2!#3!#2{
\ifx\InCa@Empty#3\InCa@Empty
  \@ReturnAfterElseFi{\InCa@@@Add!!#1!#2%}
\else
  \@ReturnAfterFi{\InCa@@Sub#1!#3!#2%
    \InCa@Sub#1!#3!#2%
    \fi
  \InCa@@@Add#1!#3!#5#2!#4%
}

\InCa@@Sub
\def\InCa@@Sub#1#2!#2!#3!#2!#5#2!#4{
\ifx\InCa@Empty#3\InCa@Empty
  \@ReturnAfterElseFi{\InCa@ProcessSub#1#3!#5#2%
  \else
  \@ReturnAfterFi{\InCa@@Sub#1#3!#5#2!#4%
    \InCa@@@Sub#1#3!#5#2!#4%
\fi
\InCa@Sub#1#3!#5#2!#4%

\InCa@@@Add
\def\InCa@@@Add#1#3!#5#2!#3!#5#2!#4{
\ifx\InCa@Empty#3\InCa@Empty
  \csname InCa@Empty\@ReturnAfterElseFi{\InCa@ProcessAdd#1#3!#5#2%
  \else
  \@ReturnAfterFi{\InCa@@@Add#1#3!#5#2!#4%
    \InCa@ProcessAdd#1#3!#5#2%
}\fi
\InCa@Add#1#3!#5#2!#4%

\InCa@@@Sub
\def\InCa@@@Sub#1#3!#5#2!#3!#5#2!#4{
\ifx\InCa@Empty#3\InCa@Empty
  \csname @gobble\@ReturnAfterElseFi{\InCa@ProcessSub#1#3!#5#2%
  \else
  \@ReturnAfterFi{\InCa@@@Sub#1#3!#5#2!#4%
    \InCa@ProcessSub#1#3!#5#2%
\fi
\InCa@Sub#1#3!#5#2!#4%
\InCa@ProcessAdd
\def\InCa@ProcessAdd#1#2!#3#4{\%
  \ifx\InCa@Empty#2\InCa@Empty\%
  \csname InCa@AddDigit#1\endcsname#3%
  \romannumeral0#4%
  \else\%
  \csname InCa@AddDigit#1\csname InCa@DigitCarry#3\endcsname\@ReturnAfterFi{%
  \InCa@ProcessAdd#2!#4%
  \}%
  \}
}
\InCa@ProcessSub
\def\InCa@ProcessSub#1#2!#3#4{\%
  \ifx\InCa@Empty#2\InCa@Empty\%
  \csname InCa@SubDigit#1\endcsname#3%
  \romannumeral0#4%
  \else\%
  \csname InCa@SubDigit#1\csname InCa@DigitCarry#3\endcsname\@ReturnAfterFi{%
  \InCa@ProcessSub#2!#4%
  \}%
  \}
}
\InCa@DigitCarry[0-9]
\def\InCa@Temp#1#2{\%
  \expandafter\def\csname InCa@DigitCarry#1\endcsname##1{\%
    \ifcase##1 \endcsname#1\%
    \else \endcsname#2\%
    \fi\%
  }%
  \}
  \InCa@Temp 01
  \InCa@Temp 12
  \InCa@Temp 23
  \InCa@Temp 34
  \InCa@Temp 45
  \InCa@Temp 56
  \InCa@Temp 67
  \InCa@Temp 78
  \InCa@Temp 89
  \InCa@Temp 9{10}
\InCa@AddDigit0
\expandafter\def\csname InCa@AddDigit0\endcsname#1{\%
  \ifnum#1>9 \endcsname10\%
  \else \endcsname#1\%
  \fi\%
}
\InCa@AddDigit[1-9]
\def\InCa@Temp#1#2#3{%
\expandafter\def\csname InCa@AddDigit#1\endcsname##1{% 
\ifnum##1>#2%
\endcsname 1%
\else
\endcsname 0%
\fi
\ifcase##1
#1% 0
#3%
\or 2% 1
\or 3% 2
\or 4% 3
\or 5% 4
\or 6% 5
\or 7% 6
\or 8% 7
\or 9% 8
\or 0% 9
\fi
}%
\InCa@Temp 18{%
\or 2% 1
\or 3% 2
\or 4% 3
\or 5% 4
\or 6% 5
\or 7% 6
\or 8% 7
\or 9% 8
\or 0% 9
}%
\InCa@Temp 27{%
\or 3% 1
\or 4% 2
\or 5% 3
\or 6% 4
\or 7% 5
\or 8% 6
\or 9% 7
\or 0% 8
\or 1% 9
}%
\InCa@Temp 36{%
\or 4% 1
\or 5% 2
\or 6% 3
\or 7% 4
\or 8% 5
\or 9% 6
\or 0% 7
\or 1% 8
\or 2% 9
}%
\InCa@Temp 45{%
\or 5% 1
\or 6% 2
\or 7% 3
\or 8% 4
\or 9% 5
\or 0% 6
\or 1% 7
\or 2% 8
\or 3% 9
}%
\InCa@Temp 54{%
\or 6% 1
\or 7% 2
\or 8% 3
\or 9% 4
\or 0% 5
}
\InCaTemp 63{\%}
\or 1% 6
\or 2% 7
\or 3% 8
\or 4% 9
\}
\InCaTemp 72{\%}
\or 8% 1
\or 9% 2
\or 0% 3
\or 1% 4
\or 2% 5
\or 3% 6
\or 4% 7
\or 5% 8
\or 6% 9
\}
\InCaTemp 81{\%}
\or 9% 1
\or 0% 2
\or 1% 3
\or 2% 4
\or 3% 5
\or 4% 6
\or 5% 7
\or 6% 8
\or 7% 9
\}
\InCaTemp 90{\%}
\or 0% 1
\or 1% 2
\or 2% 3
\or 3% 4
\or 4% 5
\or 5% 6
\or 6% 7
\or 7% 8
\or 8% 9
\}
\endcsname 25
\intcalcShl

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

\InCa@ShlSwitch

\def\InCa@ShlSwitch#1#2!{\ifx#1-%-\csname InCa@Empty\InCa@Shl#2!\%}

2.5.6 \texttt{Shl}, \texttt{Shr}

\intcalcShl
\IntCalcShr
\def\IntCalcShr#1!{\number\InCa@Shr#1!}
\InCa@Shr
\def\InCa@Shr#1#2{\InCa@ShrDigit#1!\ifx#2!\else\@ReturnAfterFi\fi\ifodd#1\else\@ReturnAfterElseFi\fi\InCa@Shr{1#2}}
\def\InCa@ShrDigit#1!{\ifcase#1 0\or 0\or 1\or 1\or 2\or 2\or 3\or 3\or 4\or 4\or 5\or 5\or 6\or 6\or 7\or 7\or 8\or 8\or 9\or 9\fi}
\InCa@Tim
\def\InCa@Templ#1{\def\InCa@Tim##1##2{\number\ifcase##2 0\or 1\or 2\or 2\or 3\or 4\or 5\or 5\or 6\or 6\or 7\or 7\or 8\or 8\or 9\or 9\else\csname InCa@Empty\InCa@ProcessTim##2##1!\fi}}
2.5.7 \InCa@Tim
\InCa@Tim Macro \InCa@Tim implements “Number times digit”.
\def\InCa@Temppl#1{\def\InCa@Tim#1#2{\number\ifcase#2 0\or 2\or 2\or 2\or 2\or 2\or 2\or 2\else\csname InCa@Empty\InCa@ProcessTim#2#1!\fi}}
\InCa@Temppl}
\InCa@Temp{ }
\InCa@ProcessTim
\def\InCa@ProcessTim#1#2#3{\
  \ifx#3!\
    \csname InCa@TimDigit#2\endcsname#10\
  \else\
    \csname InCa@TimDigit#2\csname InCa@Param#1\@ReturnAfterFi{\%}
  \InCa@ProcessTim#1#3\
  \fi\
}
\InCa@Temp[0-9]\def\InCa@Temp#1{\expandafter\def\csname InCa@Param#1\endcsname{#1}}\InCa@Temp 0\
\InCa@Temp 1\
\InCa@Temp 2\
\InCa@Temp 3\
\InCa@Temp 4\
\InCa@Temp 5\
\InCa@Temp 6\
\InCa@Temp 7\
\InCa@Temp 8\
\InCa@Temp 9\
\InCa@TimDigit0
\expandafter\def\csname InCa@TimDigit0\endcsname#1#2{\expandafter\ifcase##1 0\number\ifcase##1 0\else\csname InCa@AddDigit#1\endcsname #2\fi\fi!\}\
\InCa@TimDigit1
\expandafter\def\csname InCa@TimDigit1\endcsname#1#2{\ifcase#2 \% \endcsname 0\#1\else\csname InCa@AddDigit#1\endcsname #2\fi\fi\}\
\InCa@TimDigit[2-9]\def\InCa@Temp#1#2{\expandafter\def\csname InCa@TimDigit#1\endcsname##1{\expandafter\InCa@TimDigitCarry\number\ifcase##1 0\number\ifcase##1 0\else\#2\fi\fi!\}}
\InCa@Temp 8(\% 
\or 8\% 1
\or 16\% 2
\or 24\% 3
\or 32\% 4
\or 40\% 5
\or 48\% 6
\or 56\% 7
\or 64\% 8
\or 72\% 9
\)
\InCa@Temp 9(\%
\or 9\% 1
\or 18\% 2
\or 27\% 3
\or 36\% 4
\or 45\% 5
\or 54\% 6
\or 63\% 7
\or 72\% 8
\or 81\% 9
\)

\InCa@TimDigitCarry
\def\InCa@TimDigitCarry#1!{\%
\ifnum#1<10 \%
\csname InCa@AddDigit#1\expandafter\endcsname
\else
\@ReturnAfterFi{\%
\InCa@@TimDigitCarry#1!%
}\%
\fi
\%
\%
\)

\InCa@@TimDigitCarry
\def\InCa@@TimDigitCarry#1#2!#3{\%
\csname InCa@DigitCarry#1\%
\csname InCa@AddDigit#2\endcsname #3%
\)

2.5.8 Mul
\intcalcMul
\def\intcalcMul#1#2{\%
\number
\expandafter\InCa@MulSwitch
\number\number#1\expandafter!%
\number#2! %
\)

\InCa@MulSwitch Decision table for \InCa@MulSwitch.
\begin{center}
\begin{tabular}{|c|c|c|c|}
\hline
$x < 0$ & $y < 0$ & $x < y$ & $\text{Mul}(-x, -y)$ \\
\hline
else & $-x > y$ & $\text{Mul}(-x, y)$ & \\
\hline
else & $y < 0$ & $x > -y$ & $\text{Mul}(x, -y)$ \\
\hline
else & $x > y$ & $\text{Mul}(x, y)$ & \\
\hline
\end{tabular}
\end{center}
\InCa@Mul
\def\InCa@ProcessMul#1!#2#3!#4!{\
\ifx\InCa@Empty#3\InCa@Empty
\expandafter\InCa@Add\number#10\expandafter\expandafter\expandafter!%
\InCa@Tim{#4}#2!%
\else
\ifx\InCa@Empty#1\InCa@Empty
\expandafter\expandafter\expandafter\InCa@ProcessMul
\InCa@Tim{#4}#2!%
\else
\expandafter\InCa@ProcessMul\number
\expandafter\InCa@Add\number%
\expandafter\expandafter\expandafter\InCa@ProcessMul
\InCa@Tim{#4}#2!%
\else
\expandafter\InCa@Add\number%
\expandafter\InCa@Tim{#4}#2!%
\fi
\fi
\fi
}\}
\InCa@Mul
\def\intcalcSqr#1{\number\expandafter\InCa@Sqr\number#1! %}
\InCa@Sqr
\def\InCa@Sqr#1#2!{\ifx#1-%\InCa@Mul#2!#2!%
\else\InCa@Mul#1#2!#1#2!%
\fi}
\intcalcSqr
\intcalcFac
\def\intcalcFac#1{\number\expandafter\InCa@Fac\number#1! %}
\InCa@Fac
\intcalcPow
\def\intcalcPow#1#2{\number\expandafter\InCa@Pow
\number\number#1\expandafter!%
\number#2! %}
\InCa@Pow

2.5.9 Sqr, Fac

2.5.10 Pow
\InCa@Pow\def\InCa@Pow\#1!#2!\#3!#4!{}% 1348 \def\InCa@Pow#1#2!#3#4!f{% 1349 \ifcase#3#4 % power = 0 1350 1% 1351 \or % power = 1 1352 #1#2% 1353 \or % power = 2 1354 \ifx#1-1% 1355 \InCa@Mul#2!#2!%! 1356 \else 1357 \InCa@Mul#1!#1!#2!%! 1358 \fi 1359 \else 1360 \ifcase#1!#2 % basis = 0, power <> 0 1361 0% 1362 \ifx#3-3% power < 0 1363 0\IntCalcError:DivisionByZero% 1364 \fi 1365 \or 1366 1% basis = 1 1367 \else 1368 \ifnum#1!#2=\m@ne % basis = -1 1369 \ifodd#3!#4 % 1370 -% 1371 \fi 1372 1% 1373 \else % |basis| > 1 1374 \ifx#3-1% power < 0 1375 0% 1376 \else % power > 2 1377 \ifx#1-1% basis < 0 1378 \ifodd#3!#4 % 1379 -% 1380 \fi 1381 \InCa@PowRec#2!#3!#4!1!% 1382 \else 1383 \InCa@PowRec#1!#2!#3!#4!1!% 1384 \fi 1385 \fi 1386 \fi 1387 \fi 1388 \fi 1389 \} 1390 \def\InCa@PowRec#1!#2!#3!#4!{}% 1391 \InCa@PowRec Pow(b, p) { 1392 PowRec(b, p, 1) 1393 } 1394 PowRec(b, p, r) { 1395 if p == 1 then 1396 return r 1397 else 1398 ifodd p then 1399 return PowRec(b*b, p div 2, r*b) % p div 2 = (p-1)/2 1400 else 1401 return PowRec(b*b, p div 2, r) 1402 fi 1403 fi 1404 } 1405 \def\InCa@PowRec#1!#2!#3!#4!{}% 1390 \def\InCa@PowRec#1!#2!#3!#4!{}% 1391 \ifnum#2=\m@ne 1392 \ifnum#1>3% 1393 \InCa@Mul#1!#3!% 1394 \else 1395 \InCa@Mul#3!#1!% 1396 }
\fi
\else
\expandafter\InCa@PowRec\number\InCa@Mul\number\expandafter!\number\intcalcShr\number\ifodd\number\ifnum\number\InCa@Mul\number\InCa@Mul\number\InCa@Mul\number\number\expandafter!\number\fi
\else
\InCa@Mul\number\InCa@Mul\number\InCa@Mul\number\fi
\else
\InCa@Mul\number\InCa@Mul\number\inCa@Mul\number\expandafter!\number\fi
\expandafter!\fi
\fi
\fi

2.5.11 Div

\intcalcDiv
\def\intcalcDiv\number\expandafter\InCa@Div\number\number\expandafter!\number\expandafter!\ifcase\number\ifcase\number\InCa@Div\InCa@DivSwitch\number\InCa@DivSwitch\number\InCa@DivSwitch\number\InCa@DivSwitch\number\number\inCa@Temp{}\InCa@DivSwitch Decision table for \InCa@DivSwitch.
\begin{align*}
x < 0 & \quad y < 0 \quad + \quad \text{Div}(-x, -y) \\
\text{else} & \quad - \quad \text{Div}(-x, y) \\
\text{else} & \quad y < 0 \quad - \quad \text{Div}(x, -y) \\
\text{else} & \quad + \quad \text{Div}(x, y)
\end{align*}
\number\expandafter\expandafter\expandafter!%
\intcalcShl{(#2)}!%
\InCa@StartII
\def\InCa@DivStartII#1!#2!{
\expandafter\InCa@DivStartIII
\number#1\expandafter!%
\number#2\expandafter\expandafter\expandafter!%
\intcalcShl{#2}!%
\InCa@StartIII
\def\InCa@DivStartIII#1!#2!#3!{
\expandafter\InCa@DivStartIV
\number#1\expandafter!%
\number#2\expandafter!%
\number#3\expandafter!%
\number\InCa@Add#3!#2!expandafter\expandafter\expandafter!%
\intcalcShl{(#3)}!%
\InCa@StartIV
\def\InCa@DivStartIV#1!#2!#3!#4!#5!#6!#7!#8!#9/{
#9%
\ifnum#1<#4 % 0
\ifx#2=%
\else
\InCa@ProcessDiv(#1#2)#3!#4!#5!#6!#7!#8%
\fi
\else % 1-9
\InCa@ProcessDiv(#1#2)#3!#4!#5!#6!#7!#8%
\fi
\else % 2-9
\ifnum#1<#5 % 1
1%
\ifx#2=%
\else
\InCa@ProcessDiv\expandafter\expandafter\expandafter\expandafter\expandafter\expandafter!!%
\number\InCa@Sub#1!#4!!%
23%
\fi
\else % 2-9
\ifnum#1<#7 % 2 3 4 5
\ifnum#1<#6 % 2 3
\ReturnAfterElseFi{}
\expandafter\InCa@ProcessDiv
\number\InCa@Sub#1!#5!!%
23%
\ReturnAfterFi{}
\else % 4 5
\ReturnAfterFi{}
\expandafter\InCa@ProcessDiv
\number\InCa@Sub#1!#6!!%
45%
\fi
\fi
\intcalcMod
\def\intcalcMod#1#2{\%}

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

\begin{verbatim}
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
\end{verbatim}
\texttt{\begin{verbatim}
1656    \else
1657    \ifcase##2 % 0 already catched
1658        \IntCalcError:ThisCannotHappen
1659    \or % 1
1660    \or % 2
1661    \ifodd \number##1 \else 0\fi
1662    \else
1663    \expandafter\InCa@Sub\number##1\expandafter!%
1664    \number\intcalcMul{##2}{\InCa@Div##1!##2!}!%
1665    \fi
1666    \fi
1667    \fi
1668    \fi
1669    \fi
1670    \else
1671    \fi
1672 \fi
1673 \InCa@Temp{ }%
\end{verbatim}}%
\InCa@ModShift
\begin{verbatim}
1674    \def\InCa@ModShift#1!#2!{% #1!
1675        \ifnum#1<\z@
1676            \expandafter\InCa@Sub\number#2\expandafter!%
1677            \@gobble#1!%
1678        \else
1679            \fi
1680        \fi
1681 \fi}
\end{verbatim}
\texttt{\hspace{2em}}\InCa@Empty
\begin{verbatim}
1682    \def\InCa@Empty{}
\end{verbatim}
\texttt{\hspace{2em}}\@gobble
\begin{verbatim}
1683    \expandafter\ifx\csname @gobble\endcsname\relax
1684        \long\def\@gobble#1{}%
1685    \fi
\end{verbatim}
\texttt{\hspace{2em}}\@ReturnAfterFi
\begin{verbatim}
1686    \long\def\@ReturnAfterFi#1\fi{\fi#1}%
\end{verbatim}
\texttt{\hspace{2em}}\@ReturnAfterElseFi
\begin{verbatim}
1687    \long\def\@ReturnAfterElseFi#1\else#2\fi{\fi#1}%
1688 \InCa@AtEnd%
1689 \langle/\package\rangle
\end{verbatim}

\section{Test}

\subsection{Catcode checks for loading}
\begin{verbatim}
(*test1*)
1690 \catcode\{"=1 %
1691 \catcode\'=2 %
1692 \catcode\#=6 %
1693 \catcode\@=11 %
1694 \expandafter\ifx\csname count\endcsname\relax
1695 \countdef\count@=255 %
1696 \fi
\end{verbatim}
\expandafter\ifx\csname @gobble\endcsname \relax
\long\def\@gobble#1{}%
\fi
\expandafter\ifx\csname @firstofone\endcsname \relax
\long\def\@firstofone#1{#1}%
\fi
\expandafter\ifx\csname loop\endcsname \relax
\else
\expandafter\@gobble
\fi
{%
\def\loop#1\repeat{%
\def\body{#1}%
\iterate
}%
\def\iterate{%
\body
\let\next\iterate
\else
\let\next\relax
\fi
\next% }
\let\repeat=\fi
%
\def\RestoreCatcodes{}% 
\count@=0%
\loop
\edef\RestoreCatcodes{%
\RestoreCatcodes
\catcode\the\count@=\the\catcode\count@\relax
}%
\ifnum\count@<255%
\advance\count@ 1%
\repeat
%
\def\RangeCatcodeInvalid#1#2{%
\count@=#1\relax
\loop
\catcode\count@=15
\ifnum\count@<#2\relax
\advance\count@ 1
\repeat
}
\def\RangeCatcodeCheck#1#2#3{%
\count@=#1\relax
\loop
\ifnum#3=\catcode\count@
\else
\errmessage{Character \the\count@ with wrong catcode \the\catcode\count@ instead of \number#3}%
\fi
\ifnum\count@<#2\relax
\advance\count@ 1
\repeat
}
\def\space{ }
\expandafter\ifx\csname LoadCommand\endcsname \relax
}
\def\LoadCommand{\input intcalc.sty\relax}\
\def\Test{%
\RangeCatcodeInvalid{0}{47}\
\RangeCatcodeInvalid{58}{64}\
\RangeCatcodeInvalid{91}{96}\
\RangeCatcodeInvalid{123}{255}\
\catcode`@=12 %
\catcode`\=0 %
\catcode`%=14 %
\LoadCommand
\RangeCatcodeCheck{0}{36}{15}\
\RangeCatcodeCheck{37}{37}{14}\
\RangeCatcodeCheck{38}{47}{15}\
\RangeCatcodeCheck{48}{57}{12}\
\RangeCatcodeCheck{58}{63}{15}\
\RangeCatcodeCheck{64}{64}{12}\
\RangeCatcodeCheck{65}{90}{11}\
\RangeCatcodeCheck{91}{91}{15}\
\RangeCatcodeCheck{92}{92}{0}\
\RangeCatcodeCheck{93}{96}{15}\
\RangeCatcodeCheck{97}{122}{11}\
\RangeCatcodeCheck{123}{255}{15}\
\RestoreCatcodes
}
\Test
csname @@end\endcsname
end
⟨/
test1⟩

3.2 Macro tests

3.2.1 Preamble with test macro definitions
\NeedsTeXFormat{LaTeX2e}
ofiles\documentclass{article}
⟨
oetex⟩\let\SavedNumexpr=numexpr\let\numexpr=UNDEFINED\makeatletter\chardef\InCa@TestMode=1 %\makeatother\usepackage{intcalc}[2016/05/16]\ IncludeTests{*}
\LogTests{log}{*}{*}
\newcommand*{\TestSpaceAtEnd}[1]{⟨\noetex⟩\let\SavedNumexpr=numexpr\let\numexpr=\UNDEFINED\makeatletter\chardef\InCa@TestMode=1 %\makeatother\edef\resultA{#1}\
\edef\resultB{#1 }\langle\noetex⟩\let\numexpr=\SavedNumexpr
\Expect*{\resultA\space}*{\resultB}\n\EndTests*\LogTests{log}{*}{*}
\newcommand*{\TestResult}[2]{⟨\noetex⟩\let\SavedNumexpr=numexpr\let\numexpr=\UNDEFINED\edef\result{#1}\langle\noetex⟩\let\numexpr=\SavedNumexpr
43
\font*{noetex}{langle noetex\rangle}
\begin{group}
let \numexpr UNDEFINED
\expandafter \expandafter \expandafter \endgroup
(\langle noetex\rangle)
\expandafter \expandafter \expandafter \Expect \expandafter \expandafter \expandafter \{#1\} \{#2\}%
\end{group}
\newcommand*{\TestResultTwoExpansions}[2]{\langle etex\rangle \newcommand*{\TestArg}[1]{\numexpr#1\relax} \langle noetex\rangle \newcommand*{\TestArg}[1]{#1} \newcommand*{\TestTeXDivide}[2]{\TestCount=\TestArg{#1}\relax \divide \TestCount \testArg{#2}\relax \Expect*{\intcalcDiv{#1}{#2}} \the \TestCount}%
\newcommand*{\Test}[2]{\TestResult{#1}{#2} \TestResultTwoExpansions{#1}{#2} \TestSpaceAtEnd{#1}}
\newcommand*{\TestExch}[2]{\Test{#2}{#1}}
\newcommand*{\TestInv}[2]{\Test{\intcalcInv{#1}}{#2}}
\newcommand*{\TestNum}[2]{\Test{\intcalcNum{#1}}{#2}}
\newcommand*{\TestAbs}[2]{\Test{\intcalcAbs{#1}}{#2}}
\newcommand*{\TestSgn}[2]{\Test{\intcalcSgn{#1}}{#2}}
\newcommand*{\TestMin}[3]{\Test{\intcalcMin{#1}{#2}}{#3}}
\newcommand*{\TestMax}[3]{\Test{\intcalcMax{#1}{#2}}{#3}}
\newcommand*{\TestCmp}[3]{\Test{\intcalcCmp{#1}{#2}}{#3}}
\newcommand*{\TestInc}[2]{\Test{\intcalcInc{#1}}{#2}}
\newcommand*{\TestDec}[2]{\Test{\intcalcDec{#1}}{#2}}
\newcommand*{\Test}[2]{\TestInc{\intcalcInc\intcalcNum{#1}!}{#2}}
\iffn\intcalcNum{#1}>-1 \edef\x{\Test{\IntCalcInc\intcalcNum{#1}!}{#2}}\fi
\iffn\intcalcNum{#1}>0 \edef\x{\Test{\intcalcDec{#1}}{#2}}\fi

\end{group}
\def\TestAdd{\noexpand\IntCalcAdd{\intcalcNum{\#1}}{\intcalcNum{\#2}}\x{\intcalcNum{\#3}}\x{\intcalcAdd{\intcalcAbs{\#1}}{\intcalcAbs{\#2}}}}
\newcommand*{\TestSub}{\noexpand\IntCalcSub{\intcalcNum{\#1}}{\intcalcNum{\#2}}\x{\intcalcNum{\#3}}\x{\intcalcSub{\intcalcAbs{\#1}}{\intcalcAbs{\#2}}}}
\newcommand*{\TestShl}{\noexpand\IntCalcShl{\intcalcAbs{\#1}}{\intcalcAbs{\#2}}}}
\newcommand*{\TestShr}{\noexpand\IntCalcShr{\intcalcAbs{\#1}}{\intcalcAbs{\#2}}}}
\newcommand*{\TestMul}[3]{%  \Test{\intcalcMul{#1}{#2}}{#3}  
\edef\x{%  \noexpand\Test{%  \noexpand\IntCalcMul\intcalcAbs{#1}\intcalcAbs{#2}!\intcalcAbs{#3}}  
}%  \x  
\newcommand*{\TestDiv}[3]{%  \Test{\intcalcDiv{#1}{#2}}{#3}  
\TestTeXDivide{#1}{#2}  
\edef\x{%  \noexpand\Test{%  \noexpand\IntCalcDiv\intcalcAbs{#1}!\intcalcAbs{#2}!\intcalcAbs{#3}}  
}%  \x  
\newcommand*{\TestMod}[3]{%  \Test{\intcalcMod{#1}{#2}}{#3}  
\ifcase\ifcase\intcalcSgn{#1} 0\or 1\else 1\fi  
\fi\relax  
\edef\x{%  \noexpand\Test{%  \noexpand\IntCalcMod\intcalcAbs{#1}!\intcalcAbs{#2}!\intcalcAbs{#3}}  
}%  \x  
}  
%  3.2.2 Time  
\begin{group}
\expandafter\expandafter\expandafter\endgroup
\expandafter\ifx\csname pdfresettimer\endcsname\relax
\else
\makeatletter
\newcount\SummaryTime
\newcount\TestTime
\expandafter\IntCalcDiv\intcalcAbs{#1}!\intcalcAbs{#2}!\intcalcAbs{#3}
\x  
\end{group}
\pdfresettimer
3.2.3 Test 4: additional mod/div operations

\newcommand*{\TestDo}[2]{\% 
  \ifcase\numexpr#2\relax 
  \else \edef\temp{\intcalcMod{#1}{#2}}% 
  \Expect*{\% \the\numexpr \intcalcMul{\intcalcDiv{\intcalcAbs{#1}}{\intcalcAbs{#2}}}{\intcalcAbs{#2}}\relax}*
  \fi \]
\newcommand*{\TestOne}[2]{\TestDo{#1}{#1}}\]
\newcommand*{\TestTwo}[3]{\TestDo{#1}{#2} \TestDo{#2}{#1}}\]
\let\TestNum\TestOne \let\TestInv\TestOne \let\TestAbs\TestOne \let\TestSgn\TestOne \let\TestMin\TestTwo \let\TestMax\TestTwo \let\TestCmp\TestTwo \let\TestInc\TestOne

\AtEndDocument{\% \PrintTime{summary}\SummaryTime \% \makeatother \%}
3.2.4 Test sets

\begin{qstest}{num}{num}\
\TestNum{0}{0}\
\TestNum{1}{1}\
\TestNum{-1}{-1}\
\TestNum{10}{10}\
\TestNum{-10}{-10}\
\TestNum{2147483647}{2147483647}\
\TestNum{-2147483647}{2147483647}\
\TestNum{0}{0}\
\TestNum{1}{1}\
\TestNum{-1}{1}\
\TestNum{10}{10}\
\TestNum{-10}{10}\
\TestNum{2147483647}{-2147483647}\
\TestNum{-2147483647}{2147483647}\
\TestNum{0}{0}\
\TestNum{1}{-1}\
\TestNum{-1}{-1}\
\TestNum{10}{10}\
\TestNum{-10}{-10}\
\TestNum{2147483647}{-2147483647}\
\TestNum{-2147483647}{2147483647}\
\TestNum{0}{0}\
\TestNum{1}{1}\
\TestNum{-1}{1}\
\TestNum{10}{10}\
\TestNum{-10}{10}\
\TestNum{2147483647}{-2147483647}\
\TestNum{-2147483647}{2147483647}\
\TestNum{0}{0}\
\TestNum{1}{-1}\
\TestNum{-1}{-1}\
\TestNum{10}{10}\
\TestNum{-10}{-10}\
\TestNum{2147483647}{-2147483647}\
\TestNum{-2147483647}{2147483647}\
\TestNum{0}{0}\
\TestNum{1}{1}\
\TestNum{-1}{1}\
\TestNum{10}{10}\
\TestNum{-10}{10}\
\TestNum{2147483647}{-2147483647}\
\TestNum{-2147483647}{2147483647}\
\end{qstest}
\begin{qstest}{sign}{sign}\
\TestSgn{0}{0}\
\TestSgn{1}{1}\
\TestSgn{-1}{-1}\
\TestSgn{10}{1}\
\TestSgn{-10}{-1}\
\TestSgn{2147483647}{1}\
\TestSgn{-2147483647}{-1}\
\TestSgn{ 0 }{0}\
\TestSgn{ 2 }{1}\
\TestSgn{ -2 }{-1}\
\TestSgn{--2}{1}\
\TestSgn{\z@}{0}\
\TestSgn{\@ne}{1}\
\TestSgn{\m@ne}{-1}\
\TestSgn{-10+30}{1}\
\TestSgn{10-30}{-1}\
\end{qstest}

\begin{qstest}{min}{min}\
\TestMin{0}{1}{0}\
\TestMin{1}{0}{0}\
\TestMin{-10}{-20}{-20}\
\TestMin{ 1 }{ 2 }{1}\
\TestMin{ 2 }{ 1 }{1}\
\TestMin{1}{1}{1}\
\TestMin{\z@}{\@ne}{0}\
\TestMin{\@ne}{\m@ne}{-1}\
\TestMin{1+2}{3+4}{3}\
\TestMin{10-30}{-1}\
\end{qstest}

\begin{qstest}{max}{max}\
\TestMax{0}{1}{1}\
\TestMax{1}{0}{1}\
\TestMax{-10}{-20}{-10}\
\TestMax{ 1 }{ 2 }{2}\
\TestMax{ 2 }{ 1 }{2}\
\TestMax{1}{1}{1}\
\TestMax{\z@}{\@ne}{1}\
\TestMax{\@ne}{\m@ne}{1}\
\TestMax{1+2}{3+4}{7}\
\end{qstest}
\begin{qstest}{cmp}{cmp}\%
\TestCmp{0}{0}{1}\%
\TestCmp{-21}{17}{-1}\%
\TestCmp{3}{4}{-1}\%
\TestCmp{-10}{10}{0}\%
\TestCmp{-10}{-11}{1}\%
\TestCmp{100}{5}{1}\%
\TestCmp{-2147483647}{2147483647}{-1}\%
\TestCmp{2147483647}{2147483647}{0}\%
\TestCmp{-2147483647}{2147483647}{-1}\%
\TestCmp{2147483647}{2147483647}{0}\%
\TestCmp{\z@}{\@ne}{-1}\%
\TestCmp{\@ne}{\m@ne}{1}\%
\TestCmp{4}{5}{-1}\%
\TestCmp{-3}{-7}{1}\%
\end{qstest}\%
\begin{qstest}{fac}{fac}\%
\TestFac{0}{1}\%
\TestFac{1}{1}\%
\TestFac{2}{2}\%
\TestFac{3}{2*3}\%
\TestFac{4}{2*3*4}\%
\TestFac{5}{2*3*4*5}\%
\TestFac{6}{2*3*4*5*6}\%
\TestFac{7}{2*3*4*5*6*7}\%
\TestFac{8}{2*3*4*5*6*7*8}\%
\TestFac{9}{2*3*4*5*6*7*8*9}\%
\TestFac{10}{2*3*4*5*6*7*8*9*10}\%
\TestFac{11}{2*3*4*5*6*7*8*9*10*11}\%
\TestFac{12}{2*3*4*5*6*7*8*9*10*11*12}\%
\end{qstest}\%
\begin{qstest}{inc}{inc}\%
\TestInc{0}{1}\%
\TestInc{1}{2}\%
\TestInc{-1}{0}\%
\TestInc{10}{11}\%
\TestInc{-10}{-9}\%
\TestInc{999}{1000}\%
\TestInc{-1000}{-999}\%
\TestInc{129}{130}\%
\TestInc{-2147483647}{2147483647}\%
\TestInc{-2147483647}{-2147483647}\%
\end{qstest}\%
\begin{qstest}{dec}{dec}\%
\TestDec{0}{-1}\%
\TestDec{1}{0}\%
\TestDec{-1}{-2}\%
\TestDec{10}{9}\%
\TestDec{-10}{-11}\%
\TestDec{1000}{999}\%
\TestDec{-999}{-1000}\%
\TestDec{130}{129}\%
\TestDec{2147483647}{2147483646}\%
\TestDec{-2147483647}{-2147483646}\%
\end{qstest}\%

\begin{qstest}{add}{add}\
\TestAdd{0}{0}{0}\
\TestAdd{1}{0}{1}\
\TestAdd{0}{1}{1}\
\TestAdd{1}{2}{3}\
\TestAdd{-1}{-1}{-2}\
\TestAdd{2147483646}{1}{2147483647}\
\TestAdd{-2147483647}{2147483647}{0}\
\TestAdd{20}{-5}{15}\
\TestAdd{-4}{-1}{5}\
\TestAdd{-1}{-4}{-5}\
\TestAdd{-4}{1}{-3}\
\TestAdd{-1}{4}{3}\
\TestAdd{4}{-1}{3}\
\TestAdd{1}{-4}{-3}\
\TestAdd{-4}{-1}{-5}\
\TestAdd{-1}{-4}{-5}\
\TestAdd{876543210}{111111111}{987654321}\
\TestAdd{999999999}{2}{1000000001}\
\TestAdd{100}{50+150}{300}\
\TestAdd{2147483647}{10-2147483647}{10}\
\end{qstest}

\begin{qstest}{sub}{sub}\
\TestSub{0}{0}{0}\
\TestSub{1}{0}{1}\
\TestSub{1}{2}{-1}\
\TestSub{-1}{-1}{0}\
\TestSub{2147483646}{-1}{2147483647}\
\TestSub{-2147483647}{-2147483647}{0}\
\TestSub{-4}{-1}{-3}\
\TestSub{-1}{-4}{3}\
\TestSub{-4}{1}{-5}\
\TestSub{-1}{4}{-5}\
\TestSub{4}{-1}{5}\
\TestSub{1}{-4}{5}\
\TestSub{-4}{-1}{-3}\
\TestSub{-1}{-4}{3}\
\TestSub{1000000000}{2}{999999998}\
\TestSub{987654321}{111111111}{876543210}\
\TestSub{100}{50+150}{-100}\
\TestSub{2147483647}{-10+2147483647}{10}\
\end{qstest}
\begin{qstest}{shl}{shl}
\TestShl{0}{0}\
\TestShl{1}{2}\
\TestShl{5621}{11242}\
\TestShl{1073741823}{2147483646}\
\TestShl{-1}{-2}\
\TestShl{-5621}{-11242}\
\end{qstest}

\begin{qstest}{shr}{shr}
\TestShr{0}{0}\
\TestShr{1}{0}\
\TestShr{2}{1}\
\TestShr{3}{1}\
\TestShr{4}{2}\
\TestShr{5}{2}\
\TestShr{6}{3}\
\TestShr{7}{3}\
\TestShr{8}{4}\
\TestShr{9}{4}\
\TestShr{10}{5}\
\TestShr{11}{5}\
\TestShr{12}{6}\
\TestShr{13}{6}\
\TestShr{14}{7}\
\TestShr{15}{7}\
\TestShr{16}{8}\
\TestShr{17}{8}\
\TestShr{18}{9}\
\TestShr{19}{9}\
\TestShr{20}{10}\
\TestShr{21}{10}\
\TestShr{22}{11}\
\TestShr{11241}{5620}\
\TestShr{73054202}{36527101}\
\TestShr{2147483646}{1073741823}\
\TestShr{-1}{0}\
\TestShr{-2}{-1}\
\TestShr{-3}{-1}\
\TestShr{-11241}{-5620}\
\end{qstest}

\begin{qstest}{mul}{mul}
\TestMul{0}{0}{0}\
\TestMul{1}{0}{0}\
\TestMul{0}{1}{0}\
\TestMul{1}{1}{1}\
\TestMul{3}{1}{3}\
\TestMul{1}{-3}{-3}\
\TestMul{-4}{-5}{20}\
\TestMul{3}{7}{21}\
\TestMul{7}{3}{21}\
\TestMul{3}{-7}{-21}\
\TestMul{7}{-3}{-21}\
\TestMul{-3}{7}{-21}\
\TestMul{-7}{3}{-21}\
\TestMul{-3}{-7}{21}\
\TestMul{-7}{-3}{21}\
\TestMul{12}{11}{132}\
\end{qstest}
\TestMul{999}{333}{332667}\
\TestMul{1000}{4321}{4321000}\
\TestMul{12345}{173955}{2147474475}\
\TestMul{1073741823}{2}{2147483646}\
\TestMul{2}{1073741823}{2147483646}\
\TestMul{-1073741823}{2}{-2147483646}\
\TestMul{2}{-1073741823}{-2147483646}\
\TestMul{2+3}{5+7}{60}\
\TestMul{2147483647}{2147483647/2147483647}{2147483647}\
\TestPow{-2}{0}{1}\
\TestPow{-1}{0}{1}\
\TestPow{0}{0}{1}\
\TestPow{1}{0}{1}\
\TestPow{2}{0}{1}\
\TestPow{3}{0}{1}\
\TestPow{2}{1}{2}\
\TestPow{3}{1}{3}\
\TestPow{4}{1}{16}\
\TestPow{9}{1}{81}\
\TestPow{10}{1}{100}\
\TestPow{46340}{1}{2147395600}\
\TestPow{-2}{1}{-2}\
\TestPow{-1}{1}{-1}\
\TestPow{1}{1}{1}\
\TestPow{2}{1}{2}\
\TestPow{3}{1}{3}\
\TestPow{4}{1}{16}\
\TestPow{5}{1}{32}\
\TestPow{2}{2}{4}\
\TestPow{2}{3}{8}\
\TestPow{2}{4}{16}\
\TestPow{2}{5}{32}\
\TestPow{2}{6}{64}\
\TestPow{2}{7}{128}\
\TestPow{2}{8}{256}\
\TestPow{2}{9}{512}\
\TestPow{2}{10}{1024}
\begin{qstest}
\TestDiv{1}{1}{1}\
\TestDiv{(2)}{1}{2}\
\TestDiv{(-2)}{1}{-2}\
\TestDiv{(2)}{-1}{-2}\
\TestDiv{(-2)}{-1}{2}\
\TestDiv{2}{3}{7}\
\TestDiv{-16}{2}{-8}\
\TestDiv{1}{2}{0}\
\TestDiv{2}{3}{0}\
\TestDiv{-2}{3}{0}\
\TestDiv{2}{-3}{0}\
\TestDiv{-2}{-3}{0}\
\TestDiv{13}{3}{4}\
\TestDiv{-13}{3}{-4}\
\TestDiv{-13}{-3}{4}\
\TestDiv{-6}{5}{-1}\
\TestDiv{-5}{5}{-1}\
\TestDiv{-4}{5}{0}\
\TestDiv{-3}{5}{0}\
\TestDiv{-2}{5}{0}\
\TestDiv{-1}{5}{0}\
\TestDiv{0}{5}{0}\
\TestDiv{1}{5}{0}\
\TestDiv{2}{5}{0}\
\TestDiv{3}{5}{0}\
\TestDiv{4}{5}{0}\
\TestDiv{5}{5}{0}\
\TestDiv{6}{5}{1}\
\TestDiv{(-5)}{4}{-1}\
\TestDiv{(-4)}{4}{-1}\
\TestDiv{-3}{4}{0}\
\TestDiv{-2}{4}{0}\
\TestDiv{(-1)}{4}{0}\
\TestDiv{0}{4}{0}\
\TestDiv{1}{4}{0}\
\TestDiv{2}{4}{0}\
\TestDiv{3}{4}{0}\
\TestDiv{4}{4}{1}\
\TestDiv{5}{4}{1}\
\TestDiv{12345}{678}{18}
\end{qstest}
\begin{qstest}\{\text{mod}\}\{\text{mod}\}
\TestDiv{32372}{5952}\{5\}\%
\TestDiv{284271294}{18162}\{15651\}\%
\TestDiv{217652429}{12561}\{17327\}\%
\TestDiv{462028434}{5439}\{84947\}\%
\TestDiv{2147483647}{1000}\{2147483\}\%
\TestDiv{2147483647}{-1000}\{-2147483\}\%
\TestDiv{-2147483647}{1000}\{-2147483\}\%
\TestDiv{-2147483647}{-1000}\{2147483\}\%
\end{qstest}

\begin{qstest}\{\mod\}\{\mod\}
\TestMod{-6}{5}\{4\}\%
\TestMod{-5}{5}\{0\}\%
\TestMod{-4}{5}\{1\}\%
\TestMod{-3}{5}\{2\}\%
\TestMod{-2}{5}\{3\}\%
\TestMod{-1}{5}\{4\}\%
\TestMod{0}{5}\{0\}\%
\TestMod{1}{5}\{1\}\%
\TestMod{2}{5}\{2\}\%
\TestMod{3}{5}\{3\}\%
\TestMod{4}{5}\{4\}\%
\TestMod{5}{5}\{0\}\%
\TestMod{6}{5}\{1\}\%
\TestMod{7}{5}\{2\}\%
\TestMod{8}{5}\{3\}\%
\TestMod{9}{5}\{4\}\%
\TestMod{10}{5}\{5\}\%
\TestMod{-6}{4}\{-1\}\%
\TestMod{-5}{4}\{-2\}\%
\TestMod{-4}{4}\{-3\}\%
\TestMod{-3}{4}\{-4\}\%
\TestMod{-2}{4}\{-5\}\%
\TestMod{-1}{4}\{-6\}\%
\TestMod{0}{4}\{-7\}\%
\TestMod{1}{4}\{-8\}\%
\TestMod{2}{4}\{-9\}\%
\TestMod{3}{4}\{-10\}\%
\TestMod{4}{4}\{-11\}\%
\TestMod{5}{4}\{-12\}\%
\TestMod{6}{4}\{-13\}\%
\TestMod{7}{4}\{-14\}\%
\TestMod{8}{4}\{-15\}\%
\TestMod{9}{4}\{-16\}\%
\TestMod{10}{4}\{-17\}\%
\TestMod{-6}{3}\{-1\}\%
\TestMod{-5}{3}\{-2\}\%
\TestMod{-4}{3}\{-3\}\%
\TestMod{-3}{3}\{-4\}\%
\TestMod{-2}{3}\{-5\}\%
\TestMod{-1}{3}\{-6\}\%
\TestMod{0}{3}\{-7\}\%
\TestMod{1}{3}\{-8\}\%
\TestMod{2}{3}\{-9\}\%
\TestMod{3}{3}\{-10\}\%
\TestMod{4}{3}\{-11\}\%
\TestMod{5}{3}\{-12\}\%
\TestMod{6}{3}\{-13\}\%
\TestMod{7}{3}\{-14\}\%
\TestMod{8}{3}\{-15\}\%
\TestMod{9}{3}\{-16\}\%
\TestMod{10}{3}\{-17\}\%
\TestMod{-6}{2}\{-1\}\%
\TestMod{-5}{2}\{-2\}\%
\TestMod{-4}{2}\{-3\}\%
\TestMod{-3}{2}\{-4\}\%
\TestMod{-2}{2}\{-5\}\%
\TestMod{-1}{2}\{-6\}\%
\TestMod{0}{2}\{-7\}\%
\TestMod{1}{2}\{-8\}\%
\TestMod{2}{2}\{-9\}\%
\TestMod{3}{2}\{-10\}\%
\TestMod{4}{2}\{-11\}\%
\TestMod{5}{2}\{-12\}\%
\TestMod{6}{2}\{-13\}\%
\TestMod{7}{2}\{-14\}\%
\TestMod{8}{2}\{-15\}\%
\TestMod{9}{2}\{-16\}\%
\TestMod{10}{2}\{-17\}\%
\end{qstest}

\begin{qstest}\{\mod\}\{\mod\}
\TestDiv{2147483647}{1000}\{647\}\%
\TestDiv{2147483647}{-1000}\{-353\}\%
\TestDiv{-2147483647}{1000}\{-353\}\%
\TestDiv{-2147483647}{-1000}\{647\}\%
\end{qstest}
\TestMod{-2147483647}{-1000}{-647}\
\TestMod{ 0 }{ 4 }{0}\
\TestMod{ 1 }{ 4 }{1}\
\TestMod{ -1 }{ 4 }{3}\
\TestMod{ 0 }{ -4 }{0}\
\TestMod{ 1 }{ -4 }{-3}\
\TestMod{ -1 }{ -4 }{-1}\
\TestMod{1+2}{1+3}{3}\
\TestMod{1-2}{1+3}{3}\
\TestMod{1-2}{1-4}{-1}\
\TestMod{1+2}{1-4}{0}\
\TestMod{1+2}{1-5}{-1}\
\TestMod{ 1 }{ 4 }{1}\
\TestMod{ -1 }{ 4 }{3}\
\TestMod{ 0 }{ -4 }{0}\
\TestMod{ 1 }{ -4 }{-3}\
\TestMod{ -1 }{ -4 }{-1}\
\langle*\etex\rangle\
\begin{qstest}{error}{error}\
\TestError{FacNegative}{\intcalcFac{-1}}\
\TestError{FacNegative}{\intcalcFac{-2147483647}}\
\TestError{FacOverflow}{\intcalcFac{13}}\
\TestError{FacOverflow}{\intcalcFac{2147483647}}\
\TestError{ DivisionByZero }{\intcalcDiv{1}{0}}\
\TestError{ DivisionByZero }{\intcalcDiv{1}{0}}\
\TestError{ DivisionByZero }{\intcalcDiv{1}{0}}\
\TestError{ DivisionByZero }{\intcalcMod{1}{0}}\
\TestError{ DivisionByZero }{\intcalcMod{1}{0}}\
\end{qstest}\n\langle/\etex\rangle\
\begin{document}\n\end{document}\n\langle/\etex\rangle\
\langle/*test2\rangle\test4\langle/*test2\rangle\test4\langle/*test2\rangle\test4\langle/*test2\rangle\test4\langle/*test2\rangle\test4

4 Installation

4.1 Download

Package. This package is available on CTAN\textsuperscript{1}:


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 \texttt{texmf} in their name are usually organized this way.

\textsuperscript{1}http://ctan.org/pkg/intcalc
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\(\bar{E}\)X:

```
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     \rightarrow  \text{tex/generic/oberdiek/intcalc.sty}
intcalc.pdf     \rightarrow  \text{doc/latex/oberdiek/intcalc.pdf}
test/intcalc-test1.tex \rightarrow  \text{doc/latex/oberdiek/test/intcalc-test1.tex}
test/intcalc-test2.tex \rightarrow  \text{doc/latex/oberdiek/test/intcalc-test2.tex}
test/intcalc-test3.tex \rightarrow  \text{doc/latex/oberdiek/test/intcalc-test3.tex}
test/intcalc-test4.tex \rightarrow  \text{doc/latex/oberdiek/test/intcalc-test4.tex}
intcalc.dtx     \rightarrow  \text{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.

4.4 Refresh file name databases

If your T\(\bar{E}\)X distribution (te\(\bar{E}\)X, mikt\(\bar{E}\)X, ...) relies on file name databases, you must refresh these. For example, te\(\bar{E}\)X users run texhash or mktexlar.

4.5 Some details for the interested

**Unpacking with \(\LaTeX\).** The .dtx chooses its action depending on the format:

- **plain \(\TeX\):** Run docstrip and extract the files.
- **\(\LaTeX\):** Generate the documentation.

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

```
l\et\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 .dtx or the .drv to generate the documentation. The process can be configured by the configuration file 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 pdf\TeX:

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

5 Catalogue

The following XML file can be used as source for the \TeX Catalogue. The elements \texttt{caption} and \texttt{description} are imported from the original XML file from the Catalogue. The name of the XML file in the Catalogue is \texttt{intcalc.xml}.

```
<?xml version='1.0' encoding='us-ascii'?>
<!DOCTYPE entry SYSTEM 'catalogue.dtd'>
<entry datestamp='$Date$' modifier='$Author$' id='intcalc'>
  <name>intcalc</name>
  <caption>Expandable arithmetic operations with integers.</caption>
  <authorref id='auth:oberdiek'/>
  <copyright owner='Heiko Oberdiek' year='2007'/>
  <license type='lppl1.3'/>
  <version number='1.2'/>
  <description>
    This package provides expandable arithmetic operations
    with integers, using the e-\TeX extension \texttt{\numexpr} if it
    is available.
    <p/>
    The package is part of the \texttt{\xref refid='oberdiek'}oberdiek\texttt{/xref}
    bundle.
    </description>
</entry>
```

6 History

[2007/09/09 v1.0]
- First version.

[2007/09/27 v1.1]
- \texttt{\intcalcNum} added.
- \texttt{\intcalcShl} and \texttt{\intcalcShr} allow negative numbers. The sign is preserved.
- Reuse \texttt{\gobble} instead of own macro \texttt{\IntCalc@Gobble}.
- Small fixes.
• Shorter internal prefix.
• Some programmer’s interface.

[2016/05/16 v1.2]
• Documentation updates.

7 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; plain numbers refer to the code lines where the entry is used.

Symbols
\# ............................................ 1693
\% ............................................ 1769
\@ ............................................. 1694, 1767
\@ReturnAfterElseFi ....................... 660, 671, 683, 695,
                                      1055, 1488, 1541, 1556, 1580, 1687
\@ReturnAfterFi .............................. 664, 675, 687, 699, 710, 721,
                                             1009, 1053, 1107, 1240, 1492,
                                             1547, 1562, 1584, 1591, 1595, 1686
\@firstofone ................................ 1702, 1705
\@gobble .................................... 601, 604, 609, 612, 619, 622,
                                           1260, 1263, 1268, 1271, 1279,
                                           1281, 1452, 1455, 1461, 1573,
                                           1635, 1637, 1677, 1683, 1699, 1707
\@ne ........................................... 311,
                                           1391, 2092, 2112, 2132, 2153,
                                           2168, 2169, 2182, 2183, 2199, 2200
\@undefined .................................. 58
\\ ............................................. 1768
\{ ............................................. 1691
\} ............................................. 1692

A
\advance .................................. 1732, 1740, 1755, 2016
\aftergroup .................................. 29
\AtEndDocument ............................... 2029

B
\begin 2079, 2100, 2120, 2140, 2161,
       2175, 2189, 2208, 2224, 2237,
       2250, 2283, 2314, 2323, 2356,
       2386, 2400, 2455, 2507, 2584, 2597
\body ...................................... 1711, 1715

C
\catcode 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 33, 34,
         36, 37, 38, 39, 40, 41, 42, 43, 44,
         45, 46, 47, 48, 49, 69, 70, 72, 73,
         74, 78, 79, 80, 81, 82, 83, 84, 87,
         88, 90, 91, 92, 93, 97, 99, 116,
         1691, 1692, 1693, 1694, 1729,
         1738, 1746, 1750, 1767, 1768, 1769
\chardef .................................... 1796
\count@ .................................... 1696, 1725, 1729, 1731,
                                        1732, 1736, 1738, 1739, 1740,
                                        1744, 1746, 1749, 1750, 1754, 1755
\countdef .................................. 1696
\csname .................................... 14, 21, 50,
                                           66, 76, 114, 184, 481, 484, 494,
                                           500, 506, 509, 513, 515, 520,
                                           539, 549, 551, 556, 575, 682,
                                           694, 706, 709, 717, 720, 727,
                                           745, 753, 865, 992, 995, 1001,
                                           1006, 1008, 1014, 1018, 1095,
                                           1104, 1106, 1113, 1127, 1131,
                                           1135, 1139, 1238, 1246, 1247,
                                           1301, 1683, 1695, 1698, 1701,
                                           1704, 1759, 1786, 1998, 2578, 2580
\dimexpr .................................... 2006
\divide ...................................... 1835
\documentclass ................................ 1792
\empty ...................................... 17, 18
\end ........................................... 1787,
                                           2098, 2118, 2138, 2159, 2173,
                                           2187, 2206, 2222, 2235, 2248,
                                           2281, 2312, 2321, 2354, 2384,
                                           2398, 2453, 2505, 2573, 2594, 2598
\endcsname .................................. 14, 21, 50, 66, 76, 114, 184,
                                           513, 520, 521, 539, 540, 549,
                                           556, 557, 575, 576, 706, 717,
                                           727, 729, 731, 745, 747, 749,
                                           753, 755, 757, 865, 867, 869,
                                           1006, 1014, 1015, 1018, 1019,
                                           1104, 1113, 1114, 1127, 1128,
                                           1131, 1133, 1135, 1139, 1238,
                                           1247, 1683, 1695, 1698, 1701,
                                           1704, 1759, 1786, 1998, 2578, 2580
\endinput .................................... 29, 112
\endlinechar 4, 35, 71, 77, 89
\endqstest .................................. 2020, 2025
\errmessage .................................. 1748
\Expect ...................................... 1811,
                                           1818, 1827, 1836, 2040, 2579, 2581
\if .......................................... 424, 425, 433
\begin{verbatim}
\TestShr .................. 1936, 2068, 2325, 2326, 2327, 2328, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353
\TestSpaceAtEnd ........... 1805, 1841
\TestSqr .................. 1954, 2070, 2387, 2393, 2394, 2395, 2396, 2397
\TestSub ............... 1911, 2066, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2309, 2310
\TeXDivide .................. 1833, 1965
\TestTime ............... 2002, 2015, 2016, 2017
\TestTwo ... 2052, 2060, 2061, 2062, 2065, 2066, 2069, 2072, 2073, 2074
\typeout .................. 2005
\U
\UNDEFINED ............ 1794, 1807, 1815, 1823
\usepackage ........... 1798, 1800
\W
\write .................. 23, 52
\X
\Z
\zat ................... 176, 341, 348, 391, 398, 396, 597, 616, 1256, 1257, 1275, 1449, 1450, 1458, 1615, 1631, 1675, 2003, 2091, 2111, 2131, 2152, 2168, 2182, 2199
\end{verbatim}