

The `bitset` package

Heiko Oberdiek
<oberdiek@uni-freiburg.de>

2007/09/28 v1.0

Abstract

This package defines and implements the data type bit set, a vector of bits. The size of the vector may grow dynamically. Individual bits can be manipulated.

Contents

1	Documentation	3
1.1	Introduction	3
1.2	Glossary	3
1.3	Design principles	4
1.4	Operator overview	5
1.5	Package loading	5
1.6	Operators	5
1.6.1	Miscellaneous	6
1.6.2	Import	6
1.6.3	Export	6
1.6.4	Logical operators	7
1.6.5	Shifting	7
1.6.6	Bit manipulation	7
1.6.7	Bit retrieval	8
1.6.8	Bit set properties	8
1.6.9	Queries	8
2	Implementation	9
2.1	Reload check and package identification	9
2.2	Catcodes	10
2.3	Package loading	11
2.4	Help macros	11
2.4.1	Number constant	11
2.4.2	General basic macros	11
2.4.3	Tail recursion	12
2.4.4	Check macros	12
2.5	Miscellaneous	13
2.6	Import	13
2.6.1	From binary number	13
2.6.2	From octal/hex number	14
2.6.3	From decimal number	16
2.7	Export	17
2.7.1	To binary number	17
2.7.2	To octal/hexadecimal number	18
2.7.3	To decimal number	20
2.8	Logical operators	22
2.8.1	\bitsetAnd	22

2.8.2	<code>\bitsetAndNot</code>	23
2.8.3	<code>\bitsetOr</code>	24
2.8.4	<code>\bitsetXor</code>	25
2.8.5	Shifting	26
2.8.6	<code>\bitsetShiftLeft</code>	26
2.8.7	<code>\bitsetShiftRight</code>	26
2.9	Bit manipulation	27
2.9.1	Clear operation	28
2.9.2	Set operation	28
2.9.3	Flip operation	29
2.9.4	Range operators	30
2.10	Bit retrieval	32
2.10.1	<code>\bitsetGet</code>	32
2.10.2	<code>\bitsetNextClearBit</code> , <code>\bitsetNextSetBit</code>	32
2.10.3	<code>\bitsetGetSetBitList</code>	35
2.11	Bit set properties	35
2.12	Queries	36
3	Test	38
3.1	Catcode checks for loading	38
3.2	Macro tests	39
3.2.1	Preamble	39
3.2.2	Time	39
3.2.3	Detection of unwanted space	40
3.2.4	Test macros	40
3.2.5	Test sets	41
4	Installation	56
4.1	Download	56
4.2	Bundle installation	57
4.3	Package installation	57
4.4	Refresh file name databases	57
4.5	Some details for the interested	57
5	History	58
	[2007/09/28 v1.0]	58
6	Index	58

1 Documentation

1.1 Introduction

Annotations in the PDF format know entries whose values are integers. These numbers are interpreted as set of flags specifying properties. For example, annotation dictionaries can have a key `/F`. The bits of its integer value are interpreted the following way:

Bit position	Property name
1	Invisible
2	Hidden
3	Print
4	NoZoom
5	NoRotate
6	NoView
7	ReadOnly
...	...

Now, let's see how these values are set in package `hyperref` before it uses this package (before v6.77a):

```
\ifFld@hidden /F 6\else /F 4\fi
```

Where are the other flags? The following example for key `/Ff` in a widget annotation supports at least three properties:

```
\ifFld@multiline
  \ifFld@readonly /Ff 4097\else /Ff 4096\fi
\else
  \ifFld@password
    \ifFld@readonly /Ff 8193\else /Ff 8192\fi
  \else
    \ifFld@readonly /Ff 1\fi
\fi
\fi
```

But you see the point. It would be a nightmare to continue this way in supporting the missing flag settings. This kind of integers may have up to 32 bits.

Therefore I wanted a data structure for setting and clearing individual bits. Also it should provide an export as decimal number. The snippets above are executed in expansion contexts without \TeX 's stomach commands. It would be convenient to have an expandable conversion from the data structure to the integer that gets written to the PDF file.

This package `bitset` implements such a data structure. The interface is quite close to Java's class `BitSet` in order not to learn too many interfaces for the same kind of data structure.

1.2 Glossary

Bit set: A bit set is a vector of bits or flags. The vector size is unlimited and grows dynamically. An undefined bit set is treated as bit set where all bits are cleared.

Bit sets are addressed by name. A name should consist of letters or digits. Technically it must survive `\csname`, see \LaTeX 's environment names for other names with such a constraint. Package `babel`'s shorthands are not supported due to technical reasons. Shorthand support would break expandable operations.

Size: A size of a bit set is the number of bits in use. It's the number of the highest index, incremented by one. Sizes are in the range 0 up to 2147483647, the highest number supported by \TeX .

Index: Bit positions in a bit set are addressed by an index number. The bit vector is zero based. The first and least significant bit is addressed by index 0 and the highest possible bit by 2147483646.

Bit: A bit is encoded as 0 for cleared/disabled or 1 for set/enabled.

1.3 Design principles

Name conventions: To avoid conflicts with existing macro names, the operations are prefixed by the package name.

Zero based indexes: The first bit is addressed by zero. (Convention of array indexing in C, Java, ...)

Unlimited size: There is no restriction on the size of a bit set other than usual memory limitations. `\bitsetSetDec` and `\bitsetGetDec` transparently switch to package `bigintcalc` if the numbers get too large for `TEX`'s number limit.

Expandability: Any operation that does not change the bit set is expandable. And all operations that extract or calculate some result do this in exact two expansion steps. For example, a macro `\Macro` wants a bit set as decimal number. But the argument must be a plain number without macros. Thus you could prefix `\bitsetGetDec` with `\number`. However this won't work for bit sets with 31 or more bits because of `TEX`'s number limit of $2^{31} - 1$. then just hit the operator with two `\expandafter`:

```
\expandafter\expandafter\expandafter
\Macro\bitsetGetDec{foo}
```

`\bitsetGetDec` is hit first by the third `\expandafter` and then by the second one.

Format independence: This package is written as `LATEX` package, but it does not depend on `LATEX`. It will also work for other formats such as plain-`TEX`.

Independence from `TEX` engines: Vanilla `TEX` is all you need. Calculations are delegated to packages `intcalc` and `bigintcalc`. They don't need any special features, but they will switch to a little more efficient implementation if features such as `\numexpr` are available.

Numeric arguments: Anything that is accepted by `\number`. If ε -`TEX` is detected, also expressions for `\numexpr` are supported. The only exception so far is the number for `\bitsetSetDec`. The number might be too large for `\number` or `\numexpr`.

Error messages: In expandable contexts, only a limited set of `TEX` primitive commands work as expected. So called stomach commands behave like `\relax` and don't get expanded or executed. Unhappily also the error commands belong to this category. The expandable operations will throw an unknown control sequence instead to get `TEX`'s and user's attention. The name of these control sequences starts with `\BitSetError:` with the type of error after the colon.

1.4 Operator overview

Miscellaneous (section 1.6.1)

<code>\bitsetReset</code>	$\langle BitSet \rangle$
<code>\bitsetLet</code>	$\langle BitSet A \rangle \langle BitSet B \rangle$

Import (section 1.6.2)

<code>\bitsetSetBin</code> , <code>\bitsetSetOct</code> , <code>\bitsetSetHex</code>	$\langle BitSet \rangle \langle Value \rangle$
<code>\bitsetSetDec</code>	$\langle BitSet \rangle \langle Value \rangle$

Export^a (section 1.6.3)

<code>\bitsetGetBin</code> , <code>\bitsetGetOct</code> , <code>\bitsetGetHex</code>	$\langle BitSet \rangle \langle MinSize \rangle$
<code>\bitsetGetDec</code>	$\langle BitSet \rangle$

Logical operators (section 1.6.4)

<code>\bitsetAnd</code> , <code>\bitsetAndNot</code>	$\langle BitSet A \rangle \langle BitSet B \rangle$
<code>\bitsetOr</code> , <code>\bitsetXor</code>	$\langle BitSet A \rangle \langle BitSet B \rangle$

Shifting (section 1.6.5)

<code>\bitsetShiftLeft</code> , <code>\bitsetShiftRight</code>	$\langle BitSet \rangle \langle ShiftAmount \rangle$
--	--

Bit manipulation (section 1.6.6)

<code>\bitsetClear</code> , <code>\bitsetSet</code> , <code>\bitsetFlip</code>	$\langle BitSet \rangle \langle Index \rangle$
<code>\bitsetSetValue</code>	$\langle BitSet \rangle \langle Index \rangle \langle Value \rangle$
<code>\bitsetClearRange</code> , <code>\bitsetSetRange</code> , <code>\bitsetFlipRange</code>	$\langle BitSet \rangle \langle IndexFrom \rangle \langle IndexTo \rangle$
<code>\bitsetSetValueRange</code>	$\langle BitSet \rangle \langle IndexFrom \rangle \langle IndexTo \rangle$

Bit retrieval^a (section 1.6.7)

<code>\bitsetGet</code>	$\langle BitSet \rangle \langle Index \rangle$
<code>\bitsetNextClearBit</code> , <code>\bitsetNextSetBit</code>	$\langle BitSet \rangle \langle Index \rangle$
<code>\bitsetGetSetBitList</code>	$\langle BitSet \rangle$

Bit set properties (section 1.6.8)

<code>\bitsetSize</code> , <code>\bitsetCardinality</code>	$\langle BitSet \rangle$
--	--------------------------

Queries^b (section 1.6.9)

<code>\bitsetIsDefined</code> , <code>\bitsetIsEmpty</code>	$\langle BitSet \rangle \langle Then \rangle \langle Else \rangle$
<code>\bitsetEquals</code> , <code>\bitsetIntersects</code>	$\langle BitSet A \rangle \langle BitSet B \rangle \langle Then \rangle \langle Else \rangle$
<code>\bitsetQuery</code>	$\langle BitSet \rangle \langle Index \rangle \langle Then \rangle \langle Else \rangle$

^aMacros are expandable, full expansion by two steps.

^bMacros are expandable.

1.5 Package loading

The package can be used as normal L^AT_EX package:

```
\usepackage{bitset}
```

Also plain-T_EX is supported:

```
\input bitset.sty\relax
```

1.6 Operators

The following macros work on and with bit sets. A bit set $\langle BitSet \rangle$ is represented by a name. The should consist of letters and digits. Technically it must survive `\csname`. It is the same constraint that must be satisfied by label or environment names in L^AT_EX.

However active characters that are shorthands of package `babel` are not supported. Support for shorthands works by an assignment. But many operators such

as `\bitsetGetDec` must be usable in expandable contexts. There assignments will not be executed in the best case or they will cause errors.

The bits in a bit set are addressed by non-negative integers starting from zero. Thus negative index numbers cause an error message. Because index numbers are \TeX numbers. The largest index is 2147483647. But in practice memory limits and patience limits will be very likely reached much before.

1.6.1 Miscellaneous

There isn't a separate operation for bit set creation. For simplicity an undefined bit set is treated as bit set with all bits cleared.

`\bitsetReset {\langle BitSet \rangle}`

Macro `\bitsetReset` clears all bits. The result is an empty bit set. It may also be used as replacement for an operation “new”, because an undefined bit set is defined afterwards.

`\bitsetLet {\langle BitSet A \rangle} {\langle BitSet B \rangle}`

Macro `\bitsetLet` performs a simple assignment similar to \TeX 's `\let`. After the operation `\langle BitSet A \rangle` has the same value as `\langle BitSet B \rangle`. If `\langle BitSet B \rangle` is undefined, then `\langle BitSet A \rangle` will be the empty bit set.

Note: If `\langle BitSet A \rangle` exists, it will be overwritten.

1.6.2 Import

`\bitsetSetBin {\langle BitSet \rangle} {\langle BinaryNumber \rangle}`
`\bitsetSetOct {\langle BitSet \rangle} {\langle OctalNumber \rangle}`
`\bitsetSetHex {\langle BitSet \rangle} {\langle HexadecimalNumber \rangle}`

The numbers are interpreted as bit vectors and the flags in the bit `\langle BitSet \rangle` set are set accordingly. These numeric arguments are the only arguments where spaces are allowed. Then the numbers are easier to read.

`\bitsetSetDec {\langle BitSet \rangle} {\langle DecimalNumber \rangle}`

Macro `\bitsetSetDec` uses `\langle DecimalNumber \rangle` to set the bit set `\langle BitSet \rangle`. The numeric argument must expand to a plain number consisting of decimal digits without command tokens or spaces. Internally this argument is expanded only. It cannot be passed to `\number` or `\numexpr`, because the number may be too large for them. However `\number` or `\the\numexpr` may be used explicitly. This also helps for unexpandable number command tokens or registers (`\z@`, `\@ne`, `\count@`, ...). Also \LaTeX ' `\value` needs prefixing:

`\bitsetSetDec{foo}{\number\value{bar}}`

1.6.3 Export

`\bitsetGetBin {\langle BitSet \rangle} {\langle MinSize \rangle}`
`\bitsetGetOct {\langle BitSet \rangle} {\langle MinSize \rangle}`
`\bitsetGetHex {\langle BitSet \rangle} {\langle MinSize \rangle}`

These macros returns the bit set as binary, octal or hexadecimal number. If the bit size is smaller than `\langle MinSize \rangle` the gap is filled with leading zeros. Example:

```

\bitsetReset{abc}
\bitsetSet{abc}{2}
\bitsetGetBin{abc}{8} → 00000100
\bitsetSet{abc}{5}\bitsetSet{abc}{7}
\bitsetGetHex{abc}{16} → 00A2

```

Macro `\bitsetGetHex` uses the uppercase letters A to F. The catcode of the letters is one of 11 (letter) or 12 (other).

`\bitsetGetDec {⟨BitSet⟩}`

Macro `\bitsetGetDec` returns the bit set `⟨BitSet⟩` as decimal number. The returned number can be larger than T_EX's number limit of $2^{31} - 1$.

1.6.4 Logical operators

`\bitsetAnd {⟨BitSet A⟩} {⟨BitSet B⟩}`

$$A_{\text{new}} := A_{\text{old}} \text{ and } B \quad (\forall \text{ bits})$$

`\bitsetAndNot {⟨BitSet A⟩} {⟨BitSet B⟩}`

$$A_{\text{new}} := A_{\text{old}} \text{ and (not } B) \quad (\forall \text{ bits})$$

`\bitsetOr {⟨BitSet A⟩} {⟨BitSet B⟩}`

$$A_{\text{new}} := A_{\text{old}} \text{ or } B \quad (\forall \text{ bits})$$

`\bitsetXor {⟨BitSet A⟩} {⟨BitSet B⟩}`

$$A_{\text{new}} := A_{\text{old}} \text{ xor } B \quad (\forall \text{ bits})$$

1.6.5 Shifting

`\bitsetShiftLeft {⟨BitSet⟩} {⟨ShiftAmount⟩}`
`\bitsetShiftRight {⟨BitSet⟩} {⟨ShiftAmount⟩}`

A left shift by one is a multiplication by two, thus left shifting moves the flags to higher positions. The new created low positions are filled by zeros.

A right shift is the opposite, dividing by two, moving the bits to lower positions. The number will become smaller, the lowest bits are lost.

If the `⟨ShiftAmount⟩` is negative, it reverts the meaning of the shift operation. A left shift becomes a right shift. A `⟨ShiftAmount⟩` of zero is ignored.

1.6.6 Bit manipulation

`\bitsetClear {⟨BitSet⟩} {⟨Index⟩}`
`\bitsetSet {⟨BitSet⟩} {⟨Index⟩}`
`\bitsetFlip {⟨BitSet⟩} {⟨Index⟩}`

This macros manipulate a single bit in `⟨BitSet⟩` addressed by `\Index`. Macro `\bitsetClear` disables the bit, `\bitsetSet` enables it and `\bitsetFlip` reverts the current setting of the bit.

`\bitsetSetValue {⟨BitSet⟩} {⟨Index⟩} {⟨Bit⟩}`

Macro `\bitsetSetValue` puts bit `⟨Bit⟩` at position `⟨Index⟩` in bit set `⟨BitSet⟩`. `⟨Bit⟩` must be a valid T_EX number equals to zero (disabled/cleared) or one (enabled/set).

1.6.7 Bit retrieval

`\bitsetGet {⟨BitSet⟩} {⟨Index⟩}`

Macro `\bitsetGet` extracts the status of the bit at position `⟨Index⟩` in bit set `⟨BitSet⟩`. Digit 1 is returned if the bit is set/enabled. If the bit is cleared/disabled and in cases of an undefined bitset or an index number out of range the return value is 0.

`\bitsetNextClearBit {⟨BitSet⟩} {⟨Index⟩}`

Starting at position `⟨Index⟩` (inclusive) the bits are inspected. The first position without a set bit is returned. Possible results are decimal numbers: `⟨Index⟩`, `⟨Index⟩ + 1`, ..., (∞)

`\bitsetNextSetBit {⟨BitSet⟩} {⟨Index⟩}`

Starting at position `⟨Index⟩` (inclusive) the bits are inspected and the index position of the first found set bit is returned. If there isn't such a bit, then the result is -1. In summary possible results are decimal numbers: -1, `⟨Index⟩`, `⟨Index⟩ + 1`, ..., (∞)

`\bitsetGetSetBitList {⟨BitSet⟩}`

Macro `\bitsetGetSetBitList` is an application for `\bitsetNextSetBit`. The set bits are iterated and returned as comma separated list of index positions in increasing order. The list is empty in case of an empty bit set.

1.6.8 Bit set properties

`\bitsetSize {⟨BitSet⟩}`

Macro `\bitsetSize` returns number of bits in use. It is the same as the index number of the highest set/enabled bit incremented by one.

`\bitsetCardinality {⟨BitSet⟩}`

Macro `\bitsetCardinality` counts the number of set/enabled bits.

1.6.9 Queries

Also the query procedures are expandable. They ask for a piece of information about a bit set and execute code depending on the answer.

`\bitsetIsDefined {⟨BitSet⟩} {⟨Then⟩} {⟨Else⟩}`

If the bit set with the name `⟨BitSet⟩` exists the code given in `⟨Then⟩` is executed, otherwise `⟨Else⟩` is used.

`\bitsetIsEmpty {⟨BitSet⟩} {⟨Then⟩} {⟨Else⟩}`

If the bit set $\langle BitSet \rangle$ exists and at least one bit is set/enabled, the code in $\langle Then \rangle$ is executed, $\langle Else \rangle$ otherwise.

`\bitsetEquals {⟨BitSet A⟩} {⟨BitSet B⟩} {⟨Then⟩} {⟨Else⟩}`

Both bit sets are equal if and only if either both are undefined or both are defined and represents the same bit values at the same positions. Thus this definition is reflexive, symmetric, and transitive, enough for an equivalent relation.

`\bitsetIntersects {⟨BitSet A⟩} {⟨BitSet B⟩} {⟨Then⟩} {⟨Else⟩}`

If and only if $\langle BitSet A \rangle$ and $\langle BitSet B \rangle$ have at least one bit at the same position that is set, then code part $\langle Then \rangle$ is executed.

`\bitsetQuery {⟨BitSet⟩} {⟨Index⟩} {⟨Then⟩} {⟨Else⟩}`

It's just a wrapper for `\bitsetGet`. If the bit at position $\langle Index \rangle$ is enabled, code $\langle Then \rangle$ is called.

2 Implementation

The internal format of a bit set is quite simple, a sequence of digits 0 and 1. The least significant bit is left. A bit set without any flag set is encoded by 0. Also undefined bit sets are treated that way. After the highest bit that is set there are no further zeroes. A regular expression of valid bit sets values:

```
0|[01]*1
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@bitset.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{bitset}{The package is already loaded}%
29 \endgroup
30 \expandafter\endinput
31 \fi
32 \endgroup

```

Package identification:

```

33 \begingroup
34 \catcode35 6 % #
35 \catcode40 12 % (
36 \catcode41 12 % )
37 \catcode44 12 % ,
38 \catcode45 12 % -
39 \catcode46 12 % .
40 \catcode47 12 % /
41 \catcode58 12 % :
42 \catcode64 11 % @
43 \catcode123 1 % {
44 \catcode125 2 % }
45 \expandafter\ifx\csname ProvidesPackage\endcsname\relax
46 \def\x#1#2#3[#4]{\endgroup
47 \immediate\write-1{Package: #3 #4}%
48 \xdef#1{#4}%
49 }%
50 \else
51 \def\x#1#2[#3]{\endgroup
52 #2[{#3}]%
53 \ifx#1\relax
54 \xdef#1{#3}%
55 \fi
56 }%
57 \fi
58 \expandafter\x\csname ver@bitset.sty\endcsname
59 \ProvidesPackage{bitset}%
60 [2007/09/28 v1.0 Data type bit set (H0)]

```

2.2 Catcodes

```

61 \begingroup
62 \catcode123 1 % {
63 \catcode125 2 % }
64 \def\x{\endgroup
65 \expandafter\edef\csname BitSet@AtEnd\endcsname{%
66 \catcode35 \the\catcode35\relax
67 \catcode64 \the\catcode64\relax
68 \catcode123 \the\catcode123\relax
69 \catcode125 \the\catcode125\relax
70 }%
71 }%
72 \x
73 \catcode35 6 % #
74 \catcode64 11 % @
75 \catcode123 1 % {
76 \catcode125 2 % }
77 \def\TMP@EnsureCode#1#2{%
78 \edef\BitSet@AtEnd{%
79 \BitSet@AtEnd
80 \catcode#1 \the\catcode#1\relax
81 }%
82 \catcode#1 #2\relax

```

```

83 }
84 \TMP@EnsureCode{33}{12}% !
85 \TMP@EnsureCode{39}{12}% '
86 \TMP@EnsureCode{40}{12}% (
87 \TMP@EnsureCode{41}{12}% )
88 \TMP@EnsureCode{42}{12}% *
89 \TMP@EnsureCode{43}{12}% +
90 \TMP@EnsureCode{44}{12}% ,
91 \TMP@EnsureCode{45}{12}% -
92 \TMP@EnsureCode{46}{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 \TMP@EnsureCode{96}{12}% '
100 \begingroup\expandafter\expandafter\expandafter\endgroup
101 \expandafter\ifx\csname BitSet@TestMode\endcsname\relax
102 \else
103   \catcode63=9 % ? (ignore)
104 \fi
105 ? \let\BitSet@@TestMode\BitSet@TestMode

```

2.3 Package loading

```

106 \begingroup\expandafter\expandafter\expandafter\endgroup
107 \expandafter\ifx\csname RequirePackage\endcsname\relax
108   \input infwarerr.sty\relax
109   \input intcalc.sty\relax
110   \input bigintcalc.sty\relax
111 \else
112   \RequirePackage{infwarerr}[2007/09/09]%
113   \RequirePackage{intcalc}[2007/09/27]%
114   \RequirePackage{bigintcalc}[2007/09/27]%
115 \fi

```

2.4 Help macros

2.4.1 Number constant

```

\BitSet@MaxSize
116 \def\BitSet@MaxSize{2147483647}%

```

2.4.2 General basic macros

```

\BitSet@Empty
117 \def\BitSet@Empty{}

\BitSet@FirstOfOne
118 \def\BitSet@FirstOfOne#1{#1}

\BitSet@Gobble
119 \def\BitSet@Gobble#1{}

\BitSet@FirstOfTwo
120 \def\BitSet@FirstOfTwo#1#2{#1}

\BitSet@SecondOfTwo
121 \def\BitSet@SecondOfTwo#1#2{#2}

\BitSet@Space
122 \def\BitSet@Space{ }

```

\BitSet@ZapSpace

```

123 \def\BitSet@ZapSpace#1 #2{%
124   #1%
125   \ifx\BitSet@Empty#2%
126   \else
127     \expandafter\BitSet@ZapSpace
128   \fi
129   #2%
130 }

```

2.4.3 Tail recursion

\BitSet@Fi

```

131 \let\BitSet@Fi\fi

```

\BitSet@AfterFi

```

132 \def\BitSet@AfterFi#1#2\BitSet@Fi{\fi#1}

```

\BitSet@AfterFiFi

```

133 \def\BitSet@AfterFiFi#1#2\BitSet@Fi{\fi\fi#1}%

```

\BitSet@AfterFiFiFi

```

134 \def\BitSet@AfterFiFiFi#1#2\BitSet@Fi{\fi\fi\fi#1}%

```

2.4.4 Check macros

\BitSet@IfUndefined

```

135 \def\BitSet@IfUndefined#1{%
136   \expandafter\ifx\csname BS@#1\endcsname\relax
137     \expandafter\BitSet@FirstOfTwo
138   \else
139     \expandafter\BitSet@SecondOfTwo
140   \fi
141 }

```

\BitSet@CheckIndex

#1: continuation code
#2: BitSet
#3: Index

```

142 \def\BitSet@CheckIndex#1#2#3{%
143   \BitSet@IfUndefined{#2}{\bitsetReset{#2}}{}%
144   \expandafter\expandafter\expandafter\BitSet@@CheckIndex
145   \intcalcNum{#3}!%
146   {#2}{#1}%
147 }

```

\BitSet@@CheckIndex

#1: plain Index
#2: BitSet
#3: continuation code

```

148 \def\BitSet@@CheckIndex#1!#2#3{%
149   \ifnum#1<0 %
150     \BitSet@AfterFi{%
151       \@PackageError{bitset}{%
152         Invalid negative index (#1)%
153       }\@ehc
154     }%
155   \else
156     \BitSet@AfterFi{%
157       #3{#2}{#1}%
158     }%
159   \BitSet@Fi
160 }

```

2.5 Miscellaneous

\bitsetReset

```
161 \def\bitsetReset#1{%
162   \expandafter\def\csname BS@#1\endcsname{0}%
163 }
```

\bitsetLet

```
164 \def\bitsetLet#1#2{%
165   \BitSet@IfUndefined{#2}{%
166     \bitsetReset{#1}%
167   }{%
168     \expandafter\let\csname BS@#1\expandafter\endcsname
169       \csname BS@#2\endcsname
170   }%
171 }
```

2.6 Import

2.6.1 From binary number

\bitsetSetBin

```
172 \def\bitsetSetBin#1#2{%
173   \edef\BitSet@Temp{#2}%
174   \edef\BitSet@Temp{%
175     \expandafter\expandafter\expandafter\BitSet@ZapSpace
176     \expandafter\BitSet@Temp\BitSet@Space\BitSet@Empty
177   }%
178   \edef\BitSet@Temp{%
179     \expandafter\BitSet@KillZeros\BitSet@Temp\BitSet@Empty
180   }%
181   \ifx\BitSet@Temp\BitSet@Empty
182     \expandafter\let\csname BS@#1\endcsname\BitSet@Zero
183   \else
184     \expandafter\edef\csname BS@#1\endcsname{%
185       \expandafter\BitSet@Reverse\BitSet@Temp!%
186     }%
187   \fi
188 }
```

\BitSet@KillZeros

```
189 \def\BitSet@KillZeros#1{%
190   \ifx#10%
191     \expandafter\BitSet@KillZeros
192   \else
193     #1%
194   \fi
195 }
```

\BitSet@Reverse

```
196 \def\BitSet@Reverse#1#2!{%
197   \ifx\#2\%
198     #1%
199   \else
200     \BitSet@AfterFi{%
201       \BitSet@Reverse#2!#1%
202     }%
203   \BitSet@Fi
204 }
```

2.6.2 From octal/hex number

\bitsetSetOct

```
205 \def\bitsetSetOct{%
206   \BitSet@SetOctHex\BitSet@FromFirstOct
207 }
```

\bitsetSetHex

```
208 \def\bitsetSetHex{%
209   \BitSet@SetOctHex\BitSet@FromFirstHex
210 }
```

\BitSet@SetOctHex

```
211 \def\BitSet@SetOctHex#1#2#3{%
212   \edef\BitSet@Temp{#3}%
213   \edef\BitSet@Temp{%
214     \expandafter\expandafter\expandafter\BitSet@ZapSpace
215     \expandafter\BitSet@Temp\BitSet@Space\BitSet@Empty
216   }%
217   \edef\BitSet@Temp{%
218     \expandafter\BitSet@KillZeros\BitSet@Temp\BitSet@Empty
219   }%
220   \ifx\BitSet@Temp\BitSet@Empty
221     \expandafter\let\csname BS@#2\endcsname\BitSet@Zero
222   \else
223     \edef\BitSet@Temp{%
224       \expandafter#1\BitSet@Temp!%
225     }%
226     \ifx\BitSet@Temp\BitSet@Empty
227       \expandafter\let\csname BS@#2\endcsname\BitSet@Zero
228     \else
229       \expandafter\edef\csname BS@#2\endcsname{%
230         \expandafter\BitSet@Reverse\BitSet@Temp!%
231       }%
232     \fi
233   \fi
234 }
```

\BitSet@FromFirstOct

```
235 \def\BitSet@FromFirstOct#1{%
236   \ifx#1!%
237   \else
238     \ifcase#1 \BitSet@AfterFiFi\BitSet@FromFirstOct
239     \or 1%
240     \or 10%
241     \or 11%
242     \or 100%
243     \or 101%
244     \or 110%
245     \or 111%
246     \else \BitSetError:WrongOctalDigit%
247     \fi
248     \expandafter\BitSet@FromOct
249   \BitSet@Fi
250 }
```

\BitSet@FromOct

```
251 \def\BitSet@FromOct#1{%
252   \ifx#1!%
253   \else
254     \ifcase#1 000%
255     \or 001%
```

```

256     \or 010%
257     \or 011%
258     \or 100%
259     \or 101%
260     \or 110%
261     \or 111%
262     \else \BitSetError:WrongOctalDigit%
263     \fi
264     \expandafter\BitSet@FromOct
265 \fi
266 }

```

\BitSet@FromFirstHex

```

267 \def\BitSet@FromFirstHex#1{%
268   \ifx#1!%
269   \else
270     \ifx#10%
271       \BitSet@AfterFiFi\BitSet@FromFirstHex
272     \fi
273     \expandafter\ifx\csname BitSet@Hex#1\endcsname\relax
274     \BitSetError:InvalidHexDigit%
275   \else
276     \expandafter\expandafter\expandafter\BitSet@KillZeros
277     \csname BitSet@Hex#1\endcsname
278   \fi
279   \expandafter\BitSet@FromHex
280 \BitSet@Fi
281 }

```

\BitSet@FromHex

```

282 \def\BitSet@FromHex#1{%
283   \ifx#1!%
284   \else
285     \expandafter\ifx\csname BitSet@Hex#1\endcsname\relax
286     \BitSetError:InvalidHexDigit%
287   \else
288     \csname BitSet@Hex#1\endcsname
289   \fi
290   \expandafter\BitSet@FromHex
291 \fi
292 }

```

\BitSet@Hex[0..F]

```

293 \def\BitSet@Temp#1{%
294   \expandafter\def\csname BitSet@Hex#1\endcsname
295 }
296 \BitSet@Temp 0{0000}%
297 \BitSet@Temp 1{0001}%
298 \BitSet@Temp 2{0010}%
299 \BitSet@Temp 3{0011}%
300 \BitSet@Temp 4{0100}%
301 \BitSet@Temp 5{0101}%
302 \BitSet@Temp 6{0110}%
303 \BitSet@Temp 7{0111}%
304 \BitSet@Temp 8{1000}%
305 \BitSet@Temp 9{1001}%
306 \BitSet@Temp A{1010}%
307 \BitSet@Temp B{1011}%
308 \BitSet@Temp C{1100}%
309 \BitSet@Temp D{1101}%
310 \BitSet@Temp E{1110}%
311 \BitSet@Temp F{1111}%

```

```

312 \BitSet@Temp a{1010}%
313 \BitSet@Temp b{1011}%
314 \BitSet@Temp c{1100}%
315 \BitSet@Temp d{1101}%
316 \BitSet@Temp e{1110}%
317 \BitSet@Temp f{1111}%

```

2.6.3 From decimal number

\bitsetSetDec

```

318 \def\bitsetSetDec#1#2{%
319   \edef\BitSet@Temp{#2}%
320   \edef\BitSet@Temp{%
321     \expandafter\expandafter\expandafter\BitSet@ZapSpace
322     \expandafter\BitSet@Temp\BitSet@Space\BitSet@Empty
323   }%
324   \edef\BitSet@Temp{%
325     \expandafter\BitSet@KillZeros\BitSet@Temp\BitSet@Empty
326   }%
327   \ifx\BitSet@Temp\BitSet@Empty
328     \expandafter\let\csname BS@#1\endcsname\BitSet@Zero
329   \else
330     \ifcase\bigintcalcSgn{\BitSet@Temp} %
331       \expandafter\let\csname BS@#1\endcsname\BitSet@Zero
332     \or
333       \ifnum\bigintcalcCmp\BitSet@Temp\BitSet@MaxSize>0 %
334         \expandafter\edef\csname BS@#1\endcsname{%
335           \expandafter\BitSet@SetDecBig\BitSet@Temp!%
336         }%
337       \else
338         \expandafter\edef\csname BS@#1\endcsname{%
339           \expandafter\BitSet@SetDec\BitSet@Temp!%
340         }%
341       \fi
342     \else
343       \@PackageError{bitset}{%
344         Bit sets cannot be negative%
345       }\@ehc
346     \fi
347   \fi
348 }

```

\BitSet@SetDecBig

```

349 \def\BitSet@SetDecBig#1#2#3#4#5#6#7#8#9!{%
350   \ifx\#9\%
351     \BitSet@SetDec#1#2#3#4#5#6#7#8!%
352   \else
353     \ifcase\BigIntCalcOdd#1#2#4#5#6#7#8#9! %
354       0%
355     \or
356       1%
357   ? \else\BitSetError:ThisCannotHappen%
358     \fi
359     \BitSet@AfterFi{%
360       \expandafter\expandafter\expandafter\BitSet@SetDecBig
361       \BigIntCalcShr#1#2#3#4#5#6#7#8#9!!%
362     }%
363   \BitSet@Fi
364 }

```

\BitSet@SetDec

```

365 \def\BitSet@SetDec#1!{%

```



```

366 \ifcase#1 %
367 \or 1%
368 \else
369 \ifodd#1 %
370 1%
371 \else
372 0%
373 \fi
374 \BitSet@AfterFi{%
375 \expandafter\expandafter\expandafter\BitSet@SetDec
376 \IntCalcShr#1!!%
377 }%
378 \BitSet@Fi
379 }

```

2.7 Export

2.7.1 To binary number

\bitsetGetBin

```

380 \def\bitsetGetBin#1#2{%
381 \romannumeral0%
382 \expandafter\expandafter\expandafter\BitSet@@GetBin
383 \intcalcNum{#2}!{#1}%
384 }

```

\BitSet@@GetBin

```

385 \def\BitSet@@GetBin#1!#2{%
386 \BitSet@IfUndefined{#2}{%
387 \ifnum#1>1 %
388 \BitSet@AfterFi{%
389 \expandafter\expandafter\expandafter\BitSet@Fill
390 \IntCalcDec#1!!0%
391 }%
392 \else
393 \BitSet@AfterFi{ 0}%
394 \BitSet@Fi
395 }{%
396 \expandafter\expandafter\expandafter\BitSet@NumBinRev
397 \expandafter\expandafter\expandafter1%
398 \expandafter\expandafter\expandafter!%
399 \csname BS@#2\endcsname!!#1!%
400 }%
401 }

```

\BitSet@Fill #1: number of leading digits 0

#2: result

```

402 \def\BitSet@Fill#1!{%
403 \ifnum#1>0 %
404 \BitSet@AfterFi{%
405 \expandafter\expandafter\expandafter\BitSet@Fill
406 \IntCalcDec#1!!0%
407 }%
408 \else
409 \BitSet@AfterFi{ }%
410 \BitSet@Fi
411 }

```

\BitSet@NumBinRev #1: bit counter (including #2)

#2#3: reverted number

#4: result

#5: min size

```

412 \def\BitSet@NumBinRev#1!#2#3!{%
413   \ifx\#3\%
414     \BitSet@AfterFi{%
415       \BitSet@NumBinFill#1!#2%
416     }%
417   \else
418     \BitSet@AfterFi{%
419       \expandafter\expandafter\expandafter\BitSet@NumBinRev
420       \IntCalcInc#1!!#3!#2%
421     }%
422   \BitSet@Fi
423 }

```

\BitSet@NumBinFill

```

424 \def\BitSet@NumBinFill#1!#2!#3!{%
425   \ifnum#3>#1 %
426     \BitSet@AfterFi{%
427       \expandafter\expandafter\expandafter\BitSet@Fill
428       \IntCalcSub#3!#1!!#2%
429     }%
430   \else
431     \BitSet@AfterFi{ #2}%
432   \BitSet@Fi
433 }

```

2.7.2 To octal/hexadecimal number

\bitsetGetOct

```

434 \def\bitsetGetOct#1#2{%
435   \romannumeral0%
436   \bitsetIsEmpty{#1}{%
437     \expandafter\expandafter\expandafter\BitSet@@GetOctHex
438     \intcalcNum{#2}!3!230%
439   }{%
440     \expandafter\expandafter\expandafter\BitSet@@GetOct
441     \expandafter\expandafter\expandafter1%
442     \expandafter\expandafter\expandafter!%
443     \expandafter\expandafter\expandafter!%
444     \csname BS@#1\endcsname00%
445     \BitSet@Empty\BitSet@Empty\BitSet@Empty!{#2}%
446   }%
447 }

```

\bitsetGetHex

```

448 \def\bitsetGetHex#1#2{%
449   \romannumeral0%
450   \bitsetIsEmpty{#1}{%
451     \expandafter\expandafter\expandafter\BitSet@@GetOctHex
452     \intcalcNum{#2}!4!340%
453   }{%
454     \expandafter\expandafter\expandafter\BitSet@@GetHex
455     \expandafter\expandafter\expandafter1%
456     \expandafter\expandafter\expandafter!%
457     \expandafter\expandafter\expandafter!%
458     \csname BS@#1\endcsname000%
459     \BitSet@Empty\BitSet@Empty\BitSet@Empty\BitSet@Empty!{#2}%
460   }%
461 }

```

\BitSet@@GetOct #1: number of digits
 #2: result
 #3#4#5: bits

```

462 \def\BitSet@@GetOct#1!#2!#3#4#5{%
463   \ifx#5\BitSet@Empty
464     \BitSet@AfterFi{%
465       \expandafter\expandafter\expandafter\BitSet@GetOctHex
466       \IntCalcDec#1!#2!23%
467     }%
468   \else
469     \BitSet@AfterFi{%
470       \expandafter\expandafter\expandafter\BitSet@@GetOct
471       \number\IntCalcInc#1!\expandafter\expandafter\expandafter!%
472       \csname BitSet@Oct#5#4#3\endcsname#2!%
473     }%
474   \BitSet@Fi
475 }

```

\BitSet@Oct[000..111]

```

476 \def\BitSet@Temp#1#2#3#4{%
477   \expandafter\def\csname BitSet@Oct#1#2#3\endcsname{#4}%
478 }
479 \BitSet@Temp0000%
480 \BitSet@Temp0011%
481 \BitSet@Temp0102%
482 \BitSet@Temp0113%
483 \BitSet@Temp1004%
484 \BitSet@Temp1015%
485 \BitSet@Temp1106%
486 \BitSet@Temp1117%

```

\BitSet@@GetHex #1: number of digits
#2: result
#3#4#5#6: bits

```

487 \def\BitSet@@GetHex#1!#2!#3#4#5#6{%
488   \ifx#6\BitSet@Empty
489     \BitSet@AfterFi{%
490       \expandafter\expandafter\expandafter\BitSet@GetOctHex
491       \IntCalcDec#1!#2!34%
492     }%
493   \else
494     \BitSet@AfterFi{%
495       \expandafter\expandafter\expandafter\BitSet@@GetHex
496       \number\IntCalcInc#1!\expandafter\expandafter\expandafter!%
497       \csname BitSet@Hex#6#5#4#3\endcsname#2!%
498     }%
499   \BitSet@Fi
500 }

```

\BitSet@Hex[0000..1111]

```

501 \def\BitSet@Temp#1#2#3#4#5{%
502   \expandafter\def\csname BitSet@Hex#1#2#3#4\endcsname{#5}%
503 }
504 \BitSet@Temp00000%
505 \BitSet@Temp00011%
506 \BitSet@Temp00102%
507 \BitSet@Temp00113%
508 \BitSet@Temp01004%
509 \BitSet@Temp01015%
510 \BitSet@Temp01106%
511 \BitSet@Temp01117%
512 \BitSet@Temp10008%
513 \BitSet@Temp10019%
514 \BitSet@Temp1010A%
515 \BitSet@Temp1011B%

```

```

516 \BitSet@Temp1100C%
517 \BitSet@Temp1101D%
518 \BitSet@Temp1110E%
519 \BitSet@Temp1111F%

\BitSet@GetOctHex Leading zeros  $(\#4 - \#1 * 3 + 2)/3$  if  $\#4 > \#1 * 3$ 
#1: digit size
#2: result
#3: bits per digit - 1
#4: bits per digit #5: garbage
#6: min size

520 \def\BitSet@GetOctHex#1!#2!#3#4#5!#6{%
521   \expandafter\BitSet@@GetOctHex
522   \number\intcalcNum{#6}\expandafter\expandafter\expandafter!%
523   \IntCalcMul#1!#4!!#3#4#2%
524 }

\BitSet@@GetOctHex #1: plain min size
#2: digits * (bits per digit)
#3: bits per digit - 1
#4: bits per digit

525 \def\BitSet@@GetOctHex#1!#2!#3#4{%
526   \ifnum#1>#2 %
527     \BitSet@AfterFi{%
528       \expandafter\expandafter\expandafter\expandafter
529       \expandafter\expandafter\expandafter\BitSet@Fill
530       \expandafter\IntCalcDiv\number
531       \expandafter\expandafter\expandafter\IntCalcAdd
532       \IntCalcSub#1!#2!!#3!!#4!!%
533     }%
534   \else
535     \BitSet@AfterFi{ }%
536   \BitSet@Fi
537 }

```

2.7.3 To decimal number

```

\bitsetGetDec

538 \def\bitsetGetDec#1{%
539   \romannumeral0%
540   \BitSet@IfUndefined{#1}{ 0}{%
541     \expandafter\expandafter\expandafter\BitSet@GetDec
542     \csname BS@#1\endcsname!%
543   }%
544 }

\BitSet@GetDec

545 \def\BitSet@GetDec#1#2!{%
546   \ifx\#2\%
547     \BitSet@AfterFi{ #1}%
548   \else
549     \BitSet@AfterFi{%
550       \BitSet@@GetDec2!#1!#2!%
551     }%
552   \BitSet@Fi
553 }

\BitSet@@GetDec #1: power of two
#2: result
#3#4: number

554 \def\BitSet@@GetDec#1!#2!#3#4!{%

```

```

555 \ifx\#4\%
556 \ifx#31%
557 \BitSet@AfterFiFi{%
558 \expandafter\expandafter\expandafter\BitSet@Space
559 \IntCalcAdd#1!#2!%
560 }%
561 \else
562 \BitSet@AfterFiFi{ #2}%
563 \fi
564 \else
565 \ifx#31%
566 \BitSet@AfterFiFi{%
567 \csname BitSet@N#1%
568 \expandafter\expandafter\expandafter\endcsname
569 \IntCalcAdd#1!#2!!#4!%
570 }%
571 \else
572 \BitSet@AfterFiFi{%
573 \csname BitSet@N#1\endcsname#2!#4!%
574 }%
575 \fi
576 \BitSet@Fi
577 }

```

\BitSet@N[1,2,4,...]

```

578 \def\BitSet@Temp#1#2{%
579 \expandafter\def\csname BitSet@N#1\endcsname{%
580 \BitSet@@GetDec#2!%
581 }%
582 }
583 \BitSet@Temp{1}{2}
584 \BitSet@Temp{2}{4}
585 \BitSet@Temp{4}{8}
586 \BitSet@Temp{8}{16}
587 \BitSet@Temp{16}{32}
588 \BitSet@Temp{32}{64}
589 \BitSet@Temp{64}{128}
590 \BitSet@Temp{128}{256}
591 \BitSet@Temp{256}{512}
592 \BitSet@Temp{512}{1024}
593 \BitSet@Temp{1024}{2048}
594 \BitSet@Temp{2048}{4096}
595 \BitSet@Temp{4096}{8192}
596 \BitSet@Temp{8192}{16384}
597 \BitSet@Temp{16384}{32768}
598 \BitSet@Temp{32768}{65536}
599 \BitSet@Temp{65536}{131072}
600 \BitSet@Temp{131072}{262144}
601 \BitSet@Temp{262144}{524288}
602 \BitSet@Temp{524288}{1048576}
603 \BitSet@Temp{1048576}{2097152}
604 \BitSet@Temp{2097152}{4194304}
605 \BitSet@Temp{4194304}{8388608}
606 \BitSet@Temp{8388608}{16777216}
607 \BitSet@Temp{16777216}{33554432}
608 \BitSet@Temp{33554432}{67108864}
609 \BitSet@Temp{67108864}{134217728}
610 \BitSet@Temp{134217728}{268435456}
611 \BitSet@Temp{268435456}{536870912}
612 \BitSet@Temp{536870912}{1073741824}

```

\BitSet@N1073741824

```

613 \expandafter\def\csname BitSet@N1073741824\endcsname{%
614   \BitSet@GetDecBig2147483648!%
615 }%

\BitSet@GetDecBig #1: current power of two
#2: result
#3#4: number

616 \def\BitSet@GetDecBig#1!#2!#3#4!{%
617   \ifx\#4\%
618     \ifx#31%
619       \BitSet@AfterFiFi{%
620         \expandafter\expandafter\expandafter\BitSet@Space
621         \BigIntCalcAdd#1!#2!%
622       }%
623     \else
624       \BitSet@AfterFiFi{ #2}%
625     \fi
626   \else
627     \ifx#31%
628       \BitSet@AfterFiFi{%
629         \expandafter\expandafter\expandafter\BitSet@GetDecBig
630         \BigIntCalcAdd#1!#2!!#1!#4!%
631       }%
632     \else
633       \BitSet@AfterFiFi{%
634         \expandafter\expandafter\expandafter\BitSet@GetDecBig
635         \BigIntCalcShl#1!!#2!#4!%
636       }%
637     \fi
638   \BitSet@Fi
639 }

\BitSet@@GetDecBig #1: result
#2: power of two
#3#4: number

640 \def\BitSet@@GetDecBig#1!#2!{%
641   \expandafter\expandafter\expandafter\BitSet@GetDecBig
642   \BigIntCalcShl#2!!#1!%
643 }

```

2.8 Logical operators

2.8.1 \bitsetAnd

\bitsetAnd Decision table for \bitsetAnd:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := empty
empty(A)			
cardinality(A)>0	A := empty	A := empty	A &= B

```

644 \def\bitsetAnd#1#2{%
645   \bitsetIsEmpty{#1}{%
646     \bitsetReset{#1}%
647   }{%
648     \bitsetIsEmpty{#2}{%
649       \bitsetReset{#1}%
650     }{%
651       \expandafter\edef\csname BS@#1\endcsname{%
652         \expandafter\expandafter\expandafter\BitSet@And
653         \csname BS@#1\expandafter\expandafter\expandafter\endcsname
654         \expandafter\expandafter\expandafter!%

```

```

655         \csname BS@#2\endcsname!!%
656     }%
657     \expandafter\ifx\csname BS@#1\endcsname\BitSet@Empty
658         \bitsetReset{#1}%
659     \fi
660 }%
661 }%
662 }

```

\BitSet@And

```

663 \def\BitSet@And#1#2!#3#4!#5!{%
664     \ifx\#2\%
665         \ifnum#1#3=11 #51\fi
666     \else
667         \ifx\#4\%
668             \ifnum#1#3=11 #51\fi
669         \else
670             \ifnum#1#3=11 %
671                 #51%
672                 \BitSet@AfterFiFiFi{%
673                     \BitSet@And#2!#4!%!%
674                 }%
675             \else
676                 \BitSet@AfterFiFiFi{%
677                     \BitSet@And#2!#4!#50!%
678                 }%
679             \fi
680         \fi
681     \BitSet@Fi
682 }

```

2.8.2 \bitsetAndNot

\bitsetAndNot Decision table for \bitsetAndNot:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := empty
empty(A)			
cardinality(A)>0			A &= !B

```

683 \def\bitsetAndNot#1#2{%
684     \bitsetIsEmpty{#1}{%
685         \bitsetReset{#1}%
686     }{%
687         \bitsetIsEmpty{#2}{%
688             }{%
689                 \expandafter\edef\csname BS@#1\endcsname{%
690                     \expandafter\expandafter\expandafter\BitSet@AndNot
691                     \csname BS@#1\expandafter\expandafter\expandafter\endcsname
692                     \expandafter\expandafter\expandafter!%
693                     \csname BS@#2\endcsname!!%
694                 }%
695                 \expandafter\ifx\csname BS@#1\endcsname\BitSet@Empty
696                     \bitsetReset{#1}%
697                 \fi
698             }%
699         }%
700     }

```

\BitSet@AndNot

```

701 \def\BitSet@AndNot#1#2!#3#4!#5!{%
702     \ifx\#2\%

```

```

703   \ifnum#1#3=10 #51\fi
704 \else
705   \ifx\\#4\\%
706     #5%
707     \ifnum#1#3=10 1\else 0\fi
708     #2%
709   \else
710     \ifnum#1#3=10 %
711       #51%
712       \BitSet@AfterFiFiFi{%
713         \BitSet@AndNot#2!#4!%!%
714       }%
715   \else
716     \BitSet@AfterFiFiFi{%
717       \BitSet@AndNot#2!#4!#50!%!%
718     }%
719   \fi
720 \fi
721 \BitSet@Fi
722 }

```

2.8.3 \bitsetOr

\bitsetOr Decision table for \bitsetOr:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := B
empty(A)			A := B
cardinality(A)>0			A = B

```

723 \def\bitsetOr#1#2{%
724   \bitsetIsEmpty{#2}{%
725     \BitSet@IfUndefined{#1}{\bitsetReset{#1}}{}}%
726   }{%
727     \bitsetIsEmpty{#1}{%
728       \expandafter\let\csname BS@#1\expandafter\endcsname
729         \csname BS@#2\endcsname
730     }{%
731       \expandafter\edef\csname BS@#1\endcsname{%
732         \expandafter\expandafter\expandafter\BitSet@Or
733         \csname BS@#1\expandafter\expandafter\expandafter\endcsname
734         \expandafter\expandafter\expandafter!%
735         \csname BS@#2\endcsname!%
736       }%
737     }%
738   }%
739 }

```

\BitSet@Or

```

740 \def\BitSet@Or#1#2!#3#4!{%
741   \ifnum#1#3>0 1\else 0\fi
742   \ifx\\#2\\%
743     #4%
744   \else
745     \ifx\\#4\\%
746       #2%
747     \else
748       \BitSet@AfterFiFiFi{%
749         \BitSet@Or#2!#4!%!%
750       }%
751     \fi
752   \BitSet@Fi
753 }

```


2.8.4 \bitsetXor

\bitsetXor Decision table for \bitsetXor:

	undef(B)	empty(B)	cardinality(B)>0
undef(A)	A := empty	A := empty	A := B
empty(A)			A := B
cardinality(A)>0			$A \hat{=} B$

```

754 \def\bitsetXor#1#2{%
755   \bitsetIsEmpty{#2}{%
756     \BitSet@IfUndefined{#1}{\bitsetReset{#1}}{}%
757   }{%
758     \bitsetIsEmpty{#1}{%
759       \expandafter\let\csname BS@#1\expandafter\endcsname
760         \csname BS@#2\endcsname
761     }{%
762       \expandafter\edef\csname BS@#1\endcsname{%
763         \expandafter\expandafter\expandafter\BitSet@Xor
764         \csname BS@#1\expandafter\expandafter\expandafter\endcsname
765         \expandafter\expandafter\expandafter!%
766         \csname BS@#2\endcsname!%!%
767       }%
768       \expandafter\ifx\csname BS@#1\endcsname\BitSet@Empty
769         \bitsetReset{#1}%
770       \fi
771     }%
772   }%
773 }

```

\BitSet@Xor

```

774 \def\BitSet@Xor#1#2!#3#4!#5!{%
775   \ifx\#2\%
776     \ifx#1#3%
777       \ifx\#4\%
778         \else
779           #50#4%
780         \fi
781       \else
782         #51#4%
783       \fi
784     \else
785       \ifx\#4\%
786         #5%
787         \ifx#1#30\else 1\fi
788         #2%
789       \else
790         \ifx#1#3%
791           \BitSet@AfterFiFiFi{%
792             \BitSet@Xor#2!#4!#50!%
793           }%
794         \else
795           #51%
796           \BitSet@AfterFiFiFi{%
797             \BitSet@Xor#2!#4!%!%
798           }%
799         \fi
800       \fi
801     \BitSet@Fi
802 }

```

2.8.5 Shifting

2.8.6 \bitsetShiftLeft

\bitsetShiftLeft

```
803 \def\bitsetShiftLeft#1#2{%
804   \BitSet@IfUndefined{#1}{%
805     \bitsetReset{#1}%
806   }{%
807     \bitsetIsEmpty{#1}{%
808       }{%
809         \expandafter\expandafter\expandafter\BitSet@ShiftLeft
810         \intcalcNum{#2}!{#1}%
811       }%
812     }%
813 }
```

\BitSet@ShiftLeft

```
814 \def\BitSet@ShiftLeft#1!#2{%
815   \ifcase\intcalcSgn{#1} %
816   \or
817     \begingroup
818       \uccode'm='0 %
819       \uppercase\expandafter{\expandafter\endgroup
820       \expandafter\edef\csname BS@#2\expandafter\endcsname
821       \expandafter{%
822         \romannumeral#1000\expandafter\BitSet@Space
823         \csname BS@#2\endcsname
824       }%
825     }%
826   \else
827     \expandafter\BitSet@ShiftRight\BitSet@Gobble#1!{#2}%
828   \fi
829 }
```

2.8.7 \bitsetShiftRight

\bitsetShiftRight

```
830 \def\bitsetShiftRight#1#2{%
831   \BitSet@IfUndefined{#1}{%
832     \bitsetReset{#1}%
833   }{%
834     \bitsetIsEmpty{#1}{%
835       }{%
836         \expandafter\expandafter\expandafter\BitSet@ShiftRight
837         \intcalcNum{#2}!{#1}%
838       }%
839     }%
840 }
```

\BitSet@ShiftRight

```
841 \def\BitSet@ShiftRight#1!#2{%
842   \ifcase\intcalcSgn{#1} %
843   \or
844     \expandafter\edef\csname BS@#2\endcsname{%
845       \expandafter\expandafter\expandafter\BitSet@Kill
846       \csname BS@#2\expandafter\endcsname\expandafter\BitSet@Empty
847       \expandafter=%
848       \expandafter{\expandafter}\expandafter{\expandafter}%
849       \romannumeral#1000!%
850     }%
851   \else
```

```

852     \expandafter\BitSet@ShiftLeft\BitSet@Gobble#1!{#2}%
853     \fi
854 }

```

\BitSet@Kill

```

855 \def\BitSet@Kill#1#2=#3#4#5{%
856     #3#4%
857     \ifx#5!%
858         \ifx#1\BitSet@Empty
859             0%
860         \else
861             #1#2%
862         \fi
863     \else
864         \ifx#1\BitSet@Empty
865             0%
866             \BitSet@AfterFiFi\BitSet@Cleanup
867         \else
868             \BitSet@Kill#2=%
869         \fi
870     \BitSet@Fi
871 }

```

2.9 Bit manipulation

\bitsetClear

```

872 \def\bitsetClear{%
873     \BitSet@CheckIndex\BitSet@Clear
874 }

```

\bitsetSet

```

875 \def\bitsetSet{%
876     \BitSet@CheckIndex\BitSet@Set
877 }

```

\bitsetFlip

```

878 \def\bitsetFlip{%
879     \BitSet@CheckIndex\BitSet@Flip
880 }

```

\bitsetSetValue

```

881 \def\bitsetSetValue#1#2#3{%
882     \expandafter\expandafter\expandafter\BitSet@SetValue
883     \intcalcNum{#3}!{#1}{#2}%
884 }

```

\BitSet@SetValue #1: plain value

#2: BitSet

#3: Index

```

885 \def\BitSet@SetValue#1!{%
886     \BitSet@CheckIndex{%
887         \ifcase#1 %
888             \expandafter\BitSet@Clear
889         \or
890             \expandafter\BitSet@Set
891         \else
892             \BitSet@ErrorInvalidBitValue{#1}%
893             \expandafter\expandafter\expandafter\BitSet@Gobble
894             \expandafter\BitSet@Gobble
895         \fi
896     }%
897 }

```

```

\BitSet@ErrorInvalidBitValue #1: Wrong bit value

898 \def\BitSet@ErrorInvalidBitValue#1{%
899   \@PackageError{bitset}{%
900     Invalid bit value (#1) not in range 0..1%
901   }\@ehc
902 }

```

2.9.1 Clear operation

```

\BitSet@Clear #1: BitSet
#2: plain and checked index

903 \def\BitSet@Clear#1#2{%
904   \edef\BitSet@Temp{%
905     \expandafter\expandafter\expandafter\BitSet@@Clear
906     \csname BS@#1\expandafter\endcsname
907     \expandafter\BitSet@Empty\expandafter=\expandafter!%
908     \romannumeral#2000!%
909   }%
910   \expandafter\let\csname BS@#1\expandafter\endcsname
911   \ifx\BitSet@Temp\BitSet@Empty
912     \BitSet@Zero
913   \else
914     \BitSet@Temp
915   \fi
916 }

```

```

\BitSet@@Clear

917 \def\BitSet@@Clear#1#2=#3!#4{%
918   \ifx#4!%
919     \ifx#1\BitSet@Empty
920       \else
921         \ifx\BitSet@Empty#2%
922           \else
923             #30#2%
924           \fi
925         \fi
926       \else
927         \ifx#1\BitSet@Empty
928           \BitSet@AfterFiFi\BitSet@Cleanup
929         \else
930           \ifx#10%
931             \BitSet@AfterFiFiFi{%
932               \BitSet@@Clear#2=#30!%
933             }%
934           \else
935             #31%
936             \BitSet@AfterFiFiFi{%
937               \BitSet@@Clear#2=!%
938             }%
939           \fi
940         \fi
941       \BitSet@Fi
942 }

```

2.9.2 Set operation

```

\BitSet@Set #1: BitSet
#2: plain and checked Index

943 \def\BitSet@Set#1#2{%
944   \expandafter\edef\csname BS@#1\endcsname{%
945     \expandafter\expandafter\expandafter\BitSet@@Set

```

```

946 \csname BS@#1\expandafter\endcsname
947 \expandafter\BitSet@Empty\expandafter=%
948 \expandafter{\expandafter}\expandafter{\expandafter}%
949 \romannumeral#2000!%
950 }%
951 }

```

\BitSet@@Set

```

952 \def\BitSet@@Set#1#2=#3#4#5{%
953   #3#4%
954   \ifx#5!%
955     1#2%
956   \else
957     \ifx#1\BitSet@Empty
958       0%
959       \BitSet@AfterFiFi\BitSet@@@Set
960     \else
961       #1%
962       \BitSet@@Set#2=%
963     \fi
964   \BitSet@Fi
965 }

```

\BitSet@@@Set

```

966 \def\BitSet@@@Set#1{%
967   \ifx#1!%
968     1%
969   \else
970     0%
971     \expandafter\BitSet@@@Set
972   \fi
973 }

```

2.9.3 Flip operation

\BitSet@Flip #1: BitSet

#2: plain and checked Index

```

974 \def\BitSet@Flip#1#2{%
975   \edef\BitSet@Temp{%
976     \expandafter\expandafter\expandafter\BitSet@@Flip
977     \csname BS@#1\expandafter\endcsname
978     \expandafter\BitSet@Empty\expandafter=\expandafter!%
979     \romannumeral#2000!%
980   }%
981   \expandafter\let\csname BS@#1\expandafter\endcsname
982   \ifx\BitSet@Temp\BitSet@Empty
983     \BitSet@Zero
984   \else
985     \BitSet@Temp
986   \fi
987 }

```

\BitSet@@@Flip

```

988 \def\BitSet@@@Flip#1#2=#3!#4{%
989   \ifx#4!%
990     \ifx#11%
991       \ifx\BitSet@Empty#2%
992         \else
993           #30#2%
994         \fi
995       \else
996         #31#2%

```

```

997     \fi
998   \else
999     \ifx#1\BitSet@Empty
1000       #30%
1001       \BitSet@AfterFiFi\BitSet@@@Set
1002     \else
1003       \ifx#10%
1004         \BitSet@AfterFiFiFi{%
1005           \BitSet@@Flip#2=#30!%
1006         }%
1007       \else
1008         #31%
1009         \BitSet@AfterFiFiFi{%
1010           \BitSet@@Flip#2=!%
1011         }%
1012       \fi
1013     \fi
1014   \BitSet@Fi
1015 }

```

2.9.4 Range operators

\bitsetClearRange

```

1016 \def\bitsetClearRange{%
1017   \BitSet@Range\BitSet@Clear
1018 }

```

\bitsetSetRange

```

1019 \def\bitsetSetRange{%
1020   \BitSet@Range\BitSet@Set
1021 }

```

\bitsetFlipRange

```

1022 \def\bitsetFlipRange{%
1023   \BitSet@Range\BitSet@Flip
1024 }

```

\bitsetSetValueRange

```

1025 \def\bitsetSetValueRange#1#2#3#4{%
1026   \expandafter\expandafter\expandafter\BitSet@SetValueRange
1027   \intcalcNum{#4}!{#1}{#2}{#3}%
1028 }

```

\BitSet@SetValueRange

```

1029 \def\BitSet@SetValueRange#1!#2#3#4{%
1030   \ifcase#1 %
1031     \BitSet@Range\BitSet@Clear{#2}{#3}{#4}%
1032   \or
1033     \BitSet@Range\BitSet@Set{#2}{#3}{#4}%
1034   \else
1035     \BitSet@ErrorInvalidBitValue{#1}%
1036   \fi
1037 }

```

\BitSet@Range #1: clear/set/flip macro

#2: BitSet

#3: Index from

#4: Index to

```

1038 \def\BitSet@Range#1#2#3#4{%
1039   \edef\BitSet@Temp{%
1040     \noexpand\BitSet@@Range\noexpand#1{#2}%

```

```

1041     \intcalcNum{#3}!\intcalcNum{#4}!%
1042 }%
1043 \BitSet@Temp
1044 }

\BitSet@@Range #1: clear/set/flip macro
#2: BitSet
#3: Index from
#4: Index to

1045 \def\BitSet@@Range#1#2#3!#4!{%
1046   \ifnum#3<0 %
1047     \BitSet@NegativeIndex#1{#2}#3!#4!0!#4!%
1048   \else
1049     \ifnum#4<0 %
1050       \BitSet@NegativeIndex#1{#2}#3!#4!#3!0!%
1051     \else
1052       \ifcase\intcalcCmp{#3}{#4} %
1053       \or
1054         \@PackageError{bitset}{%
1055           Wrong index numbers in range [#3..#4]\MessageBreak% hash-ok
1056           for clear/set/flip on bit set '#2'.\MessageBreak
1057           The lower index exceeds the upper index.\MessageBreak
1058           Canceling the operation as error recovery%
1059         }\@ehc
1060       \else
1061         \BitSet@@Range#3!#4!#1{#2}%
1062       \fi
1063     \fi
1064   \fi
1065 }

\BitSet@NegativeIndex

1066 \def\BitSet@NegativeIndex#1#2#3!#4!#5!#6!{%
1067   \@PackageError{bitset}{%
1068     Negative index in range [#3..#4]\MessageBreak % hash-ok
1069     for \string\bitset
1070     \ifx#1\BitSet@Clear
1071       Clear%
1072     \else
1073       \ifx#1\BitSet@Set
1074         Set%
1075       \else
1076         Flip%
1077       \fi
1078     \fi
1079     Range on bit set '#2'.\MessageBreak
1080     Using [#5..#6] as error recovery% hash-ok
1081   }\@ehc
1082   \BitSet@@Range#1{#2}#5!#6!%
1083 }

\BitSet@@Range

1084 \def\BitSet@@Range#1!#2!#3#4{%
1085   \ifnum#1<#2 %
1086     #3{#4}{#1}%
1087   \BitSet@AfterFi{%
1088     \expandafter\expandafter\expandafter\BitSet@@Range
1089     \IntCalcInc#1!#2!#3{#4}%
1090   }%
1091   \BitSet@Fi
1092 }

```

2.10 Bit retrieval

2.10.1 \bitsetGet

\bitsetGet

```
1093 \def\bitsetGet#1#2{%
1094   \number
1095   \expandafter\expandafter\expandafter\BitSet@Get
1096   \intcalcNum{#2}!\{#1}%
1097 }
```

\BitSet@Get #1: plain index
#2: BitSet

```
1098 \def\BitSet@Get#1!#2{%
1099   \ifnum#1<0 %
1100     \BitSet@AfterFi{%
1101       0 \BitSetError:NegativeIndex%
1102     }%
1103   \else
1104     \BitSet@IfUndefined{#2}{0}{%
1105       \expandafter\expandafter\expandafter\BitSet@@Get
1106       \csname BS@#2\expandafter\endcsname
1107       \expandafter!\expandafter=%
1108       \expandafter{\expandafter}\expandafter{\expandafter}%
1109       \romannumeral\intcalcNum{#1}000!%
1110     }%
1111     \expandafter\BitSet@Space
1112   \BitSet@Fi
1113 }
```

\BitSet@@Get

```
1114 \def\BitSet@@Get#1#2=#3#4#5{%
1115   #3#4%
1116   \ifx#5!%
1117     \ifx#1!%
1118       0%
1119     \else
1120       #1%
1121     \fi
1122   \else
1123     \ifx#1!%
1124       0%
1125       \BitSet@AfterFiFi\BitSet@Cleanup
1126     \else
1127       \BitSet@@Get#2=%
1128     \fi
1129   \BitSet@Fi
1130 }
```

2.10.2 \bitsetNextClearBit, \bitsetNextSetBit

\bitsetNextClearBit

```
1131 \def\bitsetNextClearBit#1#2{%
1132   \number
1133   \expandafter\expandafter\expandafter\BitSet@NextClearBit
1134   \intcalcNum{#2}!\{#1} %
1135 }
```

\BitSet@NextClearBit #1: Index
#2: BitSet

```
1136 \def\BitSet@NextClearBit#1!#2{%
1137   \ifnum#1<0 %
```



```

1138     \BitSet@NextClearBit0!{#2}%
1139     \BitSet@AfterFi{%
1140         \expandafter\BitSet@Space
1141         \expandafter\BitSetError:NegativeIndex\romannumeral0%
1142     }%
1143 \else
1144     \bitsetIsEmpty{#2}{#1}{%
1145         \expandafter\BitSet@Skip
1146         \number#1\expandafter\expandafter\expandafter!%
1147         \csname BS@#2\endcsname!!!!!!!!!=%
1148         {\BitSet@@NextClearBit#1!}%
1149     }%
1150 \BitSet@Fi
1151 }

\BitSet@@NextClearBit #1: index for next bit in #2
#2: next bit
1152 \def\BitSet@@NextClearBit#1!#2{%
1153     \ifx#2!%
1154         #1%
1155     \else
1156         \ifx#20%
1157             #1%
1158             \BitSet@AfterFiFi\BitSet@Cleanup
1159         \else
1160             \BitSet@AfterFiFi{%
1161                 \expandafter\expandafter\expandafter\BitSet@@NextClearBit
1162                 \IntCalcInc#1!!%
1163             }%
1164         \fi
1165     \BitSet@Fi
1166 }

\bitsetNextSetBit
1167 \def\bitsetNextSetBit#1#2{%
1168     \number
1169     \expandafter\expandafter\expandafter\BitSet@NextSetBit
1170     \intcalcNum{#2}{#1} %
1171 }

\BitSet@NextSetBit #1: Index
#2: BitSet
1172 \def\BitSet@NextSetBit#1!#2{%
1173     \ifnum#1<0 %
1174         \BitSet@NextSetBit0!{#2}%
1175         \BitSet@AfterFi{%
1176             \expandafter\BitSet@Space
1177             \expandafter\BitSetError:NegativeIndex\romannumeral0%
1178         }%
1179     \else
1180         \bitsetIsEmpty{#2}{-1}{%
1181             \expandafter\BitSet@Skip
1182             \number#1\expandafter\expandafter\expandafter!%
1183             \csname BS@#2\endcsname!!!!!!!!!=%
1184             {\BitSet@@NextSetBit#1!}%
1185         }%
1186     \BitSet@Fi
1187 }

\BitSet@@NextSetBit #1: index for next bit in #2
#2: next bit
1188 \def\BitSet@@NextSetBit#1!#2{%

```

```

1189 \ifx#2!%
1190 -1%
1191 \else
1192 \ifx#21%
1193 #1%
1194 \BitSet@AfterFiFi\BitSet@Cleanup
1195 \else
1196 \BitSet@AfterFiFi{%
1197 \expandafter\expandafter\expandafter\BitSet@@NextSetBit
1198 \IntCalcInc#1!!%
1199 }%
1200 \fi
1201 \BitSet@Fi
1202 }

\BitSet@Cleanup
1203 \def\BitSet@Cleanup#1!{%

\BitSet@Skip #1: number of bits to skip
#2: bits
#3: continuation code
1204 \def\BitSet@Skip#1!#2{%
1205 \ifx#2!%
1206 \BitSet@AfterFiFi{%
1207 \BitSet@SkipContinue%
1208 }%
1209 \else
1210 \ifcase#1 %
1211 \BitSet@AfterFiFi{%
1212 \BitSet@SkipContinue#2%
1213 }%
1214 \or
1215 \BitSet@AfterFiFi\BitSet@SkipContinue
1216 \or
1217 \BitSet@AfterFiFi{%
1218 \expandafter\BitSet@SkipContinue\BitSet@Gobble
1219 }%
1220 \else
1221 \ifnum#1>8 %
1222 \BitSet@AfterFiFiFi{%
1223 \expandafter\BitSet@Skip
1224 \number\IntCalcSub#1!8!\expandafter!%
1225 \BitSet@GobbleSeven
1226 }%
1227 \else
1228 \BitSet@AfterFiFiFi{%
1229 \expandafter\expandafter\expandafter\BitSet@Skip
1230 \IntCalcDec#1!!%
1231 }%
1232 \fi
1233 \fi
1234 \BitSet@Fi
1235 }

\BitSet@SkipContinue #1: remaining bits
#2: continuation code
1236 \def\BitSet@SkipContinue#1!#2=#3{%
1237 #3#1!%
1238 }

\BitSet@GobbleSeven
1239 \def\BitSet@GobbleSeven#1#2#3#4#5#6#7{%

```

2.10.3 \bitsetGetSetBitList

\bitsetGetSetBitList It's just a wrapper for \bitsetNextSetBit.

```

1240 \def\bitsetGetSetBitList#1{%
1241   \romannumeral0%
1242   \bitsetIsEmpty{#1}{ }{%
1243     \expandafter\BitSet@GetSetBitList
1244     \number\BitSet@NextSetBit0!{#1}!{#1}{ }!%
1245   }%
1246 }
```

```

\BitSet@GetSetBitList #1: found index
#2: BitSet
#3: comma #4: result

1247 \def\BitSet@GetSetBitList#1!#2#3#4!{%
1248   \ifnum#1<0 %
1249     \BitSet@AfterFi{ #4}%
1250   \else
1251     \BitSet@AfterFi{%
1252       \expandafter\BitSet@GetSetBitList\number
1253       \expandafter\expandafter\expandafter\BitSet@NextSetBit
1254       \IntCalcInc#1!!{#2}!{#2},#4#3#1!%
1255     }%
1256   \BitSet@Fi
1257 }
```

2.11 Bit set properties

\bitsetSize

```

1258 \def\bitsetSize#1{%
1259   \number
1260   \BitSet@IfUndefined{#1}{0 }{%
1261     \expandafter\expandafter\expandafter\BitSet@Size
1262     \expandafter\expandafter\expandafter1%
1263     \expandafter\expandafter\expandafter!%
1264     \csname BS@#1\endcsname!0!%
1265   }%
1266 }
```

```

\BitSet@Size #1: counter
#2#3: bits
#4: result

1267 \def\BitSet@Size#1!#2#3!#4!{%
1268   \ifx\#21%
1269     \ifx\#3\%
1270       \BitSet@AfterFiFi{#1 }%
1271     \else
1272       \BitSet@AfterFiFi{%
1273         \expandafter\expandafter\expandafter\BitSet@Size
1274         \IntCalcInc#1!!#3!#1!%
1275       }%
1276     \fi
1277   \else
1278     \ifx\#3\%
1279       \BitSet@AfterFiFi{#4 }%
1280     \else
1281       \BitSet@AfterFiFi{%
1282         \expandafter\expandafter\expandafter\BitSet@Size
1283         \IntCalcInc#1!!#3!#4!%
1284       }%
1285     \fi
1286 }
```

```

1286 \fi
1287 \BitSet@Fi
1288 }

\bitsetCardinality
1289 \def\bitsetCardinality#1{%
1290 \number
1291 \BitSet@IfUndefined{#1}{0 }{%
1292 \expandafter\expandafter\expandafter\BitSet@Cardinality
1293 \expandafter\expandafter\expandafter0%
1294 \expandafter\expandafter\expandafter!%
1295 \csname BS@#1\endcsname!%
1296 }%
1297 }

\BitSet@Cardinality #1: result
#2#3: bits
1298 \def\BitSet@Cardinality#1!#2#3!{%
1299 \ifx#21%
1300 \ifx\#3\%
1301 \BitSet@AfterFiFi{\IntCalcInc#1! }%
1302 \else
1303 \BitSet@AfterFiFi{%
1304 \expandafter\expandafter\expandafter\BitSet@Cardinality
1305 \IntCalcInc#1!!#3!%
1306 }%
1307 \fi
1308 \else
1309 \ifx\#3\%
1310 \BitSet@AfterFiFi{#1 }%
1311 \else
1312 \BitSet@AfterFiFi{%
1313 \BitSet@Cardinality#1!#3!%
1314 }%
1315 \fi
1316 \fi
1317 \BitSet@Fi
1318 }

```

2.12 Queries

```

\bitsetIsDefined
1319 \def\bitsetIsDefined#1{%
1320 \BitSet@IfUndefined{#1}%
1321 \BitSet@SecondOfTwo
1322 \BitSet@FirstOfTwo
1323 }

\bitsetIsEmpty
1324 \def\bitsetIsEmpty#1{%
1325 \BitSet@IfUndefined{#1}\BitSet@FirstOfTwo{%
1326 \expandafter\ifx\csname BS@#1\endcsname\BitSet@Zero
1327 \expandafter\BitSet@FirstOfTwo
1328 \else
1329 \expandafter\BitSet@SecondOfTwo
1330 \fi
1331 }%
1332 }

\BitSet@Zero
1333 \def\BitSet@Zero{0}

```

\bitsetQuery

```
1334 \def\bitsetQuery#1#2{%
1335   \ifnum\bitsetGet{#1}-{#2}=1 %
1336     \expandafter\BitSet@FirstOfTwo
1337   \else
1338     \expandafter\BitSet@SecondOfTwo
1339   \fi
1340 }
```

\bitsetEquals

```
1341 \def\bitsetEquals#1#2{%
1342   \BitSet@IfUndefined{#1}{%
1343     \BitSet@IfUndefined{#2}\BitSet@FirstOfTwo\BitSet@SecondOfTwo
1344   }{%
1345     \BitSet@IfUndefined{#2}\BitSet@SecondOfTwo{%
1346       \expandafter\ifx\csname BS@#1\expandafter\endcsname
1347         \csname BS@#2\endcsname
1348       \expandafter\BitSet@FirstOfTwo
1349     \else
1350       \expandafter\BitSet@SecondOfTwo
1351     \fi
1352   }%
1353 }%
1354 }
```

\bitsetIntersects

```
1355 \def\bitsetIntersects#1#2{%
1356   \bitsetIsEmpty{#1}\BitSet@SecondOfTwo{%
1357     \bitsetIsEmpty{#2}\BitSet@SecondOfTwo{%
1358       \expandafter\expandafter\expandafter\BitSet@Intersects
1359       \csname BS@#1\expandafter\expandafter\expandafter\endcsname
1360       \expandafter\expandafter\expandafter!%
1361       \csname BS@#2\endcsname!%
1362     }%
1363   }%
1364 }
```

\BitSet@Intersects

```
1365 \def\BitSet@Intersects#1#2!#3#4!{%
1366   \ifnum#1#3=11 %
1367     \BitSet@AfterFi\BitSet@FirstOfTwo
1368   \else
1369     \ifx\#2\%
1370       \BitSet@AfterFiFi\BitSet@SecondOfTwo
1371     \else
1372       \ifx\#4\%
1373         \BitSet@AfterFiFiFi\BitSet@SecondOfTwo
1374       \else
1375         \BitSet@AfterFiFiFiFi{%
1376           \BitSet@Intersects#2!#4!%
1377         }%
1378       \fi
1379     \fi
1380   \BitSet@Fi
1381 }

1382 \BitSet@AtEnd
1383 </package>
```

3 Test

3.1 Catcode checks for loading

```
1384 <*test1>
1385 \catcode'\{=1 %
1386 \catcode'\}=2 %
1387 \catcode'\#=6 %
1388 \catcode'\@=11 %
1389 \expandafter\ifx\csname count@\endcsname\relax
1390 \countdef\count@=255 %
1391 \fi
1392 \expandafter\ifx\csname @gobble\endcsname\relax
1393 \long\def\@gobble#1{}%
1394 \fi
1395 \expandafter\ifx\csname @firstofone\endcsname\relax
1396 \long\def\@firstofone#1{#1}%
1397 \fi
1398 \expandafter\ifx\csname loop\endcsname\relax
1399 \expandafter\@firstofone
1400 \else
1401 \expandafter\@gobble
1402 \fi
1403 {%
1404 \def\loop#1\repeat{%
1405 \def\body{#1}%
1406 \iterate
1407 }%
1408 \def\iterate{%
1409 \body
1410 \let\next\iterate
1411 \else
1412 \let\next\relax
1413 \fi
1414 \next
1415 }%
1416 \let\repeat=\fi
1417 }%
1418 \def\RestoreCatcodes{}
1419 \count@=0 %
1420 \loop
1421 \edef\RestoreCatcodes{%
1422 \RestoreCatcodes
1423 \catcode\the\count@=\the\catcode\count@\relax
1424 }%
1425 \ifnum\count@<255 %
1426 \advance\count@ 1 %
1427 \repeat
1428
1429 \def\RangeCatcodeInvalid#1#2{%
1430 \count@=#1\relax
1431 \loop
1432 \catcode\count@=15 %
1433 \ifnum\count@<#2\relax
1434 \advance\count@ 1 %
1435 \repeat
1436 }
1437 \def\Test{%
1438 \RangeCatcodeInvalid{0}{47}%
1439 \RangeCatcodeInvalid{58}{64}%
1440 \RangeCatcodeInvalid{91}{96}%
1441 \RangeCatcodeInvalid{123}{255}%
```

```

1442 \catcode'\@=12 %
1443 \catcode'\=0 %
1444 \catcode'\{=1 %
1445 \catcode'\}=2 %
1446 \catcode'\#=6 %
1447 \catcode'\[=12 %
1448 \catcode'\]=12 %
1449 \catcode'\%=14 %
1450 \catcode'\ =10 %
1451 \catcode13=5 %
1452 \input bitset.sty\relax
1453 \RestoreCatcodes
1454 }
1455 \Test
1456 \csname @@end\endcsname
1457 \end
1458 </test1>

```

3.2 Macro tests

3.2.1 Preamble

```

1459 <*test2>
1460 \NeedsTeXFormat{LaTeX2e}
1461 \nofiles
1462 \documentclass{article}
1463 \makeatletter
1464 <*noetex>
1465 \let\SavedNumexpr\numexpr
1466 \let\SavedIfcsname\ifcsname
1467 \let\SavedCurrentgrouplevel\currentgrouplevel
1468 \def\ETeXDisable{%
1469   \let\ifcsname\@undefined
1470   \let\numexpr\@undefined
1471   \let\currentgrouplevel\@undefined
1472 }
1473 \ETeXDisable
1474 </noetex>
1475 \makeatletter
1476 \chardef\BitSet@TestMode=1 %
1477 \makeatother
1478 \usepackage{bitset}[2007/09/28]
1479 <*noetex>
1480 \def\ETeXEnable{%
1481   \let\numexpr\SavedNumexpr
1482   \let\ifcsname\SavedIfcsname
1483   \let\currentgrouplevel\SavedCurrentgrouplevel
1484 }
1485 \ETeXEnable
1486 </noetex>
1487 \usepackage{qstest}
1488 \IncludeTests{*}
1489 \LogTests{log}{*}{*}
1490 \makeatletter

```

3.2.2 Time

```

1491 \begingroup\expandafter\expandafter\expandafter\endgroup
1492 \expandafter\ifx\csname pdfresettimer\endcsname\relax
1493 \else
1494   \newcount\SummaryTime
1495   \newcount\TestTime
1496   \SummaryTime=\z@
1497   \newcommand*{\PrintTime}[2]{%

```

```

1498 \typeout{%
1499 [Time #1: \strip@pt\dimexpr\number#2sp\relax\space s]%
1500 }%
1501 }%
1502 \newcommand*{\StartTime}[1]{%
1503 \renewcommand*{\TimeDescription}{#1}%
1504 \pdfresettimer
1505 }%
1506 \newcommand*{\TimeDescription}{}%
1507 \newcommand*{\StopTime}{%
1508 \TestTime=\pdfelapsedtime
1509 \global\advance\SummaryTime\TestTime
1510 \PrintTime\TimeDescription\TestTime
1511 }%
1512 \let\saved@qstest\qstest
1513 \let\saved@endqstest\endqstest
1514 \def\qstest#1#2{%
1515 \saved@qstest{#1}{#2}%
1516 \StartTime{#1}%
1517 }%
1518 \def\endqstest{%
1519 \StopTime
1520 \saved@endqstest
1521 }%
1522 \AtEndDocument{%
1523 \PrintTime{summary}\SummaryTime
1524 }%
1525 \fi

```

3.2.3 Detection of unwanted space

```

1526 \let\orig@qstest\qstest
1527 \let\orig@endqstest\endqstest
1528 \def\qstest#1#2{%
1529 \orig@qstest{#1}{#2}%
1530 \setbox0\hbox\bgroup\begingroup\ignorespaces
1531 }
1532 \def\endqstest{%
1533 \endgroup\egroup
1534 \Expect*{\the\wd0}{0.0pt}%
1535 \orig@endqstest
1536 }

```

3.2.4 Test macros

```

1537 \newcounter{Test}
1538
1539 \def\TestError#1#2{%
1540 \begingroup
1541 \setcounter{Test}{0}%
1542 \sbox0{%
1543 \def\@PackageError##1##2##3{%
1544 \stepcounter{Test}%
1545 \begingroup
1546 \let\MessageBreak\relax
1547 \noetex
1548 \ETEXEnable
1549 \noetex
1550 \Expect{##1}{bitset}%
1551 \Expect*{##2}*{#1}%
1552 \endgroup
1553 }%
1554 \noetex
1555 \ETEXDisable
1556 \noetex

```



```

1557     #2%
1558 }%
1559 \Expect*{\theTest}{1}%
1560 \Expect*{\the\wd0}{0.0pt}%
1561 \endgroup
1562 }
1563
1564 \def\TestErrorNegativeIndex#1#2{%
1565   \TestError{Invalid negative index (#1)}{#2}%
1566 }
1567
1568 \def\TestGetterUndefined#1{%
1569   \CheckUndef{dummy}%
1570   \expandafter\expandafter\expandafter\Expect
1571   \expandafter\expandafter\expandafter{#1{dummy}}{0}%
1572 }
1573
1574 \def\ExpectBitSet#1#2{%
1575   \expandafter\expandafter\expandafter\Expect
1576   \expandafter\expandafter\expandafter
1577   {\csname BS@#1\endcsname}*{#2}%
1578 }
1579 \def\Check#1#2{%
1580   \ExpectBitSet{#1}{#2}%
1581 }
1582 \def\CheckUndef#1{%
1583   \begingroup
1584     \Expect*{%
1585       \expandafter
1586       \ifx\csname BS@#1\endcsname\relax true\else false\fi
1587     }{true}%
1588   \endgroup
1589 }
1590 \def\RevCheck#1#2{%
1591   \ExpectBitSet{#1}{\Reverse#2!!}%
1592 }
1593 \def\Set#1#2{%
1594   \expandafter\def\csname BS@#1\endcsname{#2}%
1595 }
1596 \def\RevSet#1#2{%
1597   \expandafter\edef\csname BS@#1\endcsname{%
1598     \Reverse#2!!%
1599   }%
1600 }
1601 \def\Reverse#1#2!#3!{%
1602   \ifx\#2\%
1603     #1#3%
1604     \expandafter\@gobble
1605   \else
1606     \expandafter\@firstofone
1607   \fi
1608   {\Reverse#2!#1#3!}%
1609 }

```

3.2.5 Test sets

```

1610 \begin{qstest}{Let}{Let}
1611   \CheckUndef{abc}%
1612   \CheckUndef{xyz}%
1613   \bitsetLet{xyz}{abc}%
1614   \CheckUndef{abc}%
1615   \Check{xyz}{0}%
1616   \Set{abc}{1}%
1617   \Check{abc}{1}%

```

```

1618 \Check{xyz}{0}%
1619 \bitsetLet{xyz}{abc}%
1620 \Check{abc}{1}%
1621 \Check{xyz}{1}%
1622 \Set{xyz}{11}%
1623 \Check{abc}{1}%
1624 \Check{xyz}{11}%
1625 \end{qstest}
1626
1627 \begin{qstest}{Reset}{Reset}
1628 \bitsetReset{xyz}%
1629 \Check{xyz}{0}%
1630 \bitsetReset{abc}%
1631 \Check{abc}{0}%
1632 \Set{abc}{10101}%
1633 \bitsetReset{abc}%
1634 \Check{abc}{0}%
1635 \end{qstest}
1636
1637 \begin{qstest}{Get/Query}{Get/Query}
1638 \expandafter\expandafter\expandafter\Expect
1639 \expandafter\expandafter\expandafter{%
1640 \bitsetGet{dummy}{0}%
1641 }{0}%
1642 \begingroup
1643 \expandafter\def\csname BitSetError:NegativeIndex\endcsname{}%
1644 \Set{abc}{1}%
1645 \Expect*{\bitsetQuery{abc}{-1}{true}{false}}{false}%
1646 \endgroup
1647 \def\Test#1#2#3{%
1648 \Set{abc}{#1}%
1649 \expandafter\expandafter\expandafter\Expect
1650 \expandafter\expandafter\expandafter{\bitsetGet{abc}{#2}}{#3}%
1651 \Expect*{\bitsetQuery{abc}{#2}{true}{false}}%
1652 *{\ifcase#3 false\or true\else error\fi}%
1653 }%
1654 \Test{1}{100}{0}%
1655 \Test{0}{0}{0}%
1656 \Test{1}{0}{1}%
1657 \Test{11}{1}{1}%
1658 \Test{111}{1}{1}%
1659 \Test{101}{1}{0}%
1660 \Test{101}{2}{1}%
1661 \Test{10100110011}{10}{1}%
1662 \end{qstest}
1663
1664 \begin{qstest}{Size}{Size}
1665 \TestGetterUndefined\bitsetSize
1666 \def\Test#1#2{%
1667 \Set{abc}{#1}%
1668 \expandafter\expandafter\expandafter\Expect
1669 \expandafter\expandafter\expandafter{\bitsetSize{abc}}{#2}%
1670 }%
1671 \Test{0}{0}%
1672 \Test{1}{1}%
1673 \Test{00}{0}%
1674 \Test{0000000}{0}%
1675 \Test{10}{1}%
1676 \Test{01}{2}%
1677 \Test{11}{2}%
1678 \Test{010}{2}%
1679 \Test{011}{3}%

```

```

1680 \Test{100110011}{9}%
1681 \Test{0000011111000001111100000}{20}%
1682 \Test{000000000000000000000000011111111111111111111}{45}%
1683 \end{qstest}
1684
1685 \begin{qstest}{Cardinality}{Cardinality}
1686 \TestGetterUndefined\bitsetCardinality
1687 \def\Test#1#2{%
1688 \Set{abc}{#1}%
1689 \expandafter\expandafter\expandafter\Expect
1690 \expandafter\expandafter\expandafter{%
1691 \bitsetCardinality{abc}%
1692 }{#2}%
1693 }%
1694 \Test{0}{0}%
1695 \Test{1}{1}%
1696 \Test{00}{0}%
1697 \Test{0000000}{0}%
1698 \Test{10}{1}%
1699 \Test{01}{1}%
1700 \Test{11}{2}%
1701 \Test{010}{1}%
1702 \Test{011}{2}%
1703 \Test{100110011}{5}%
1704 \Test{0000011111000001111100000}{10}%
1705 \Test{000000000000000000000000011111111111111111111}{20}%
1706 \end{qstest}
1707
1708 \begin{qstest}{NextClearBit/NextSetBit}{NextClearBit/NextSetBit}
1709 \def\Test#1#2{%
1710 \expandafter\expandafter\expandafter\Expect
1711 \expandafter\expandafter\expandafter{%
1712 \TestOp{abc}{#1}%
1713 }{#2}%
1714 }%
1715 \def\Clear{\let\TestOp\bitsetNextClearBit}%
1716 \def\Set{\let\TestOp\bitsetNextSetBit}%
1717 \begingroup
1718 \catcode'\:=11 %
1719 \bitsetSetBin{abc}{1}%
1720 \Clear
1721 \Test{-1}{1\BitSetError:NegativeIndex}%
1722 \Set
1723 \Test{-1}{0\BitSetError:NegativeIndex}%
1724 \endgroup
1725 \let\BS@abc\@undefined
1726 \Clear
1727 \Test{0}{0}%
1728 \Test{1}{1}%
1729 \Test{2}{2}%
1730 \Test{100}{100}%
1731 \Set
1732 \Test{0}{-1}%
1733 \Test{1}{-1}%
1734 \Test{100}{-1}%
1735 \bitsetReset{abc}%
1736 \Clear
1737 \Test{0}{0}%
1738 \Test{1}{1}%
1739 \Test{2}{2}%
1740 \Test{100}{100}%
1741 \Set

```

```

1742 \Test{0}{-1}%
1743 \Test{1}{-1}%
1744 \Test{100}{-1}%
1745 \bitsetSetBin{abc}{1}%
1746 \Clear
1747 \Test{0}{1}%
1748 \Test{1}{1}%
1749 \Test{2}{2}%
1750 \Test{100}{100}%
1751 \Set
1752 \Test{0}{0}%
1753 \Test{1}{-1}%
1754 \Test{100}{-1}%
1755 \bitsetSetBin{abc}{111000111000111000111}%
1756 \Clear
1757 \Test{0}{3}%
1758 \Test{1}{3}%
1759 \Test{2}{3}%
1760 \Test{3}{3}%
1761 \Test{4}{4}%
1762 \Test{5}{5}%
1763 \Test{6}{9}%
1764 \Test{7}{9}%
1765 \Test{8}{9}%
1766 \Test{9}{9}%
1767 \Test{10}{10}%
1768 \Test{11}{11}%
1769 \Test{12}{15}%
1770 \Test{13}{15}%
1771 \Test{14}{15}%
1772 \Test{15}{15}%
1773 \Test{16}{16}%
1774 \Test{17}{17}%
1775 \Test{18}{21}%
1776 \Test{19}{21}%
1777 \Test{20}{21}%
1778 \Test{21}{21}%
1779 \Test{22}{22}%
1780 \Test{100}{100}%
1781 \Set
1782 \Test{0}{0}%
1783 \Test{1}{1}%
1784 \Test{2}{2}%
1785 \Test{3}{6}%
1786 \Test{4}{6}%
1787 \Test{5}{6}%
1788 \Test{6}{6}%
1789 \Test{7}{7}%
1790 \Test{8}{8}%
1791 \Test{9}{12}%
1792 \Test{10}{12}%
1793 \Test{11}{12}%
1794 \Test{12}{12}%
1795 \Test{13}{13}%
1796 \Test{14}{14}%
1797 \Test{15}{18}%
1798 \Test{16}{18}%
1799 \Test{17}{18}%
1800 \Test{18}{18}%
1801 \Test{19}{19}%
1802 \Test{20}{20}%
1803 \Test{21}{-1}%

```

```

1804 \Test{22}{-1}%
1805 \Test{100}{-1}%
1806 \bitsetSetBin{abc}{1111111}%
1807 \Clear
1808 \Test{6}{7}%
1809 \Test{7}{7}%
1810 \Test{8}{8}%
1811 \Test{100}{100}%
1812 \Set
1813 \Test{6}{6}%
1814 \Test{7}{-1}%
1815 \Test{8}{-1}%
1816 \Test{100}{-1}%
1817 \bitsetSetBin{abc}{11111111}%
1818 \Clear
1819 \Test{7}{8}%
1820 \Test{8}{8}%
1821 \Test{9}{9}%
1822 \Test{100}{100}%
1823 \Set
1824 \Test{7}{7}%
1825 \Test{8}{-1}%
1826 \Test{9}{-1}%
1827 \Test{100}{-1}%
1828 \bitsetSetBin{abc}{111111111}%
1829 \Clear
1830 \Test{8}{9}%
1831 \Test{9}{9}%
1832 \Test{10}{10}%
1833 \Test{100}{100}%
1834 \Set
1835 \Test{8}{8}%
1836 \Test{9}{-1}%
1837 \Test{10}{-1}%
1838 \Test{100}{-1}%
1839 \bitsetSetBin{abc}{1111111111}%
1840 \Clear
1841 \Test{9}{10}%
1842 \Test{10}{10}%
1843 \Test{11}{11}%
1844 \Test{100}{100}%
1845 \Set
1846 \Test{9}{9}%
1847 \Test{10}{-1}%
1848 \Test{11}{-1}%
1849 \Test{100}{-1}%
1850 \end{qstest}
1851
1852 \begin{qstest}{GetSetBitList}{GetSetBitList}
1853 \let\BS@abc\@undefined
1854 \expandafter\expandafter\expandafter\Expect
1855 \expandafter\expandafter\expandafter{%
1856 \bitsetGetSetBitList{abc}%
1857 }{}%
1858 \def\Test#1#2{%
1859 \bitsetSetBin{abc}{#1}%
1860 \expandafter\expandafter\expandafter\Expect
1861 \expandafter\expandafter\expandafter{%
1862 \bitsetGetSetBitList{abc}%
1863 }{#2}%
1864 }%
1865 \Test{0}{}%

```

```

1866 \Test{1}{0}%
1867 \Test{10}{1}%
1868 \Test{11}{0,1}%
1869 \Test{10110100}{2,4,5,7}%
1870 \Test{101101001010011}{0,1,4,6,9,11,12,14}%
1871 \end{qstest}
1872
1873 \begin{qstest}{GetDec}{GetDec}
1874 \TestGetterUndefined\bitsetGetDec
1875 \def\Test#1#2{%
1876     \RevSet{abc}{#1}%
1877 \noetex
1878     \begingroup\expandafter\expandafter\expandafter\endgroup
1879 \noetex
1880     \expandafter\expandafter\expandafter\Expect
1881     \expandafter\expandafter\expandafter{%
1882         \bitsetGetDec{abc}%
1883     }{#2}%
1884 }%
1885 \Test{0}{0}%
1886 \Test{1}{1}%
1887 \Test{10}{2}%
1888 \Test{11}{3}%
1889 \Test{100}{4}%
1890 \Test{101}{5}%
1891 \Test{110}{6}%
1892 \Test{111}{7}%
1893 \Test{1000}{8}%
1894 \Test{000111}{7}%
1895 \Test{1111111111111111}
1896     1111111111111111}{2147483647}%
1897 \Test{000111111111111111}
1898     1111111111111111}{2147483647}%
1899 \Test{1000000000000000}
1900     0000000000000000}{2147483648}%
1901 \Test{1000000000000000}
1902     0000000000000000}{4294967296}%
1903 \Test{000100000000000000}
1904     0000000000000000}{4294967296}%
1905 \Test{1100000000000000}
1906     0000000000000001}{6442450947}%
1907 \end{qstest}
1908
1909 \begin{qstest}{Clear}{Clear}
1910 \def\Test#1#2#3{%
1911     \RevSet{abc}{#1}%
1912     \bitsetClear{abc}{#2}%
1913     \Expect*{\BS@abc}*{\Reverse#3!!}%
1914 }%
1915 \bitsetClear{abc}{2}%
1916 \RevCheck{abc}{0}%
1917 \TestErrorNegativeIndex{-1}{\bitsetClear{abc}{-1}}%
1918 \RevCheck{abc}{0}%
1919 \Test{0}{0}{0}%
1920 \Test{1}{0}{0}%
1921 \Test{111}{1}{101}%
1922 \Test{111}{30}{111}%
1923 \Test{0000111}{5}{0000111}% 111 would also be ok
1924 \Test{10000111}{5}{10000111}%
1925 \Test{1001001}{3}{1000001}%
1926 \end{qstest}
1927

```

```

1928 \begin{qstest}{Set}{Set}
1929   \def\Test#1#2#3{%
1930     \RevSet{abc}{#1}%
1931     \bitsetSet{abc}{#2}%
1932     \Expect*{\BS@abc}*{\Reverse#3!!}%
1933   }%
1934   \bitsetSet{abc}{2}%
1935   \RevCheck{abc}{100}%
1936   \TestErrorNegativeIndex{-1}{\bitsetSet{abc}{-1}}%
1937   \RevCheck{abc}{100}%
1938   \Test{0}{0}{1}%
1939   \Test{1}{0}{1}%
1940   \Test{100}{1}{110}%
1941   \Test{111}{1}{111}%
1942   \Test{11}{1}{11}%
1943   \Test{11}{2}{111}%
1944   \Test{11}{3}{1011}%
1945   \Test{111}{10}{1000000111}%
1946   \Test{0000111}{5}{0100111}% 100111 would also be ok
1947   \Test{10000111}{5}{10100111}%
1948   \Test{1000001}{3}{1001001}%
1949   \Test{1001001}{3}{1001001}%
1950 \end{qstest}
1951
1952 \begin{qstest}{Flip}{Flip}
1953   \def\Test#1#2#3{%
1954     \RevSet{abc}{#1}%
1955     \bitsetFlip{abc}{#2}%
1956     \Expect*{\BS@abc}*{\Reverse#3!!}%
1957   }%
1958   \bitsetFlip{abc}{2}%
1959   \RevCheck{abc}{100}%
1960   \TestErrorNegativeIndex{-1}{\bitsetFlip{abc}{-1}}%
1961   \RevCheck{abc}{100}%
1962   \Test{0}{0}{1}%
1963   \Test{1}{0}{0}%
1964   \Test{0}{2}{100}%
1965   \Test{100}{1}{110}%
1966   \Test{111}{1}{101}%
1967   \Test{11}{1}{1}%
1968   \Test{11}{2}{111}%
1969   \Test{11}{3}{1011}%
1970   \Test{111}{10}{1000000111}%
1971   \Test{0000111}{5}{0100111}% 100111 would also be ok
1972   \Test{10000111}{5}{10100111}%
1973   \Test{1000001}{3}{1001001}%
1974   \Test{1001001}{3}{1000001}%
1975   \Test{11111}{2}{11011}%
1976 \end{qstest}
1977
1978 \begin{qstest}{SetValue}{SetValue}
1979   \def\Test#1#2{%
1980     \TestError{Invalid bit value (#2) not in range 0..1}{%
1981       \bitsetSetValue{abc}{#1}{#2}%
1982     }%
1983   }%
1984   \Test{0}{-1}%
1985   \Test{0}{2}%
1986   \Test{0}{10}%
1987   \def\Test#1#2#3{%
1988     \let\BS@abc\undefined
1989     \bitsetSetValue{abc}{#1}{#2}%

```

```

1990     \bitsetSetBin{result}{#3}%
1991     \Expect*{\BS@abc}*{\BS@result}%
1992 }%
1993 \Test{0}{0}{0}%
1994 \Test{0}{1}{1}%
1995 \Test{1}{0}{0}%
1996 \Test{1}{1}{10}%
1997 \def\Test#1#2#3#4{%
1998     \bitsetSetBin{abc}{#1}%
1999     \bitsetSetBin{result}{#4}%
2000     \bitsetSetValue{abc}{#2}{#3}%
2001     \Expect*{\BS@abc}*{\BS@result}%
2002 }%
2003 \Test{0}{0}{0}{0}%
2004 \Test{0}{0}{0}{0}%
2005 \Test{0}{0}{1}{1}%
2006 \Test{0}{1}{0}{0}%
2007 \Test{0}{1}{1}{10}%
2008 \Test{1010}{2}{1}{1110}%
2009 \Test{1010}{4}{1}{11010}%
2010 \Test{1010}{6}{1}{1001010}%
2011 \Test{1010}{1}{0}{1000}%
2012 \Test{1010}{2}{0}{1010}%
2013 \Test{1010}{3}{0}{10}%
2014 \Test{1010}{4}{0}{1010}%
2015 \Test{1010}{6}{0}{1010}%
2016 \Test{1010}{2}{\csname iffalse\endcsname 0\else 1\fi}{1110}%
2017 \Test{1010}{1}{\csname iffalse\endcsname 1\else 0\fi}{1000}%
2018 \end{qstest}
2019
2020 \begin{qstest}{IsDefined}{IsDefined}
2021     \let\BS@abc\@undefined
2022     \Expect*{\bitsetIsDefined{abc}{true}{false}}{false}%
2023     \bitsetReset{abc}%
2024     \Expect*{\bitsetIsDefined{abc}{true}{false}}{true}%
2025 \end{qstest}
2026
2027 \begin{qstest}{IsEmpty}{IsEmpty}
2028     \let\BS@abc\@undefined
2029     \Expect*{\bitsetIsEmpty{abc}{true}{false}}{true}%
2030     \bitsetReset{abc}%
2031     \Expect*{\bitsetIsEmpty{abc}{true}{false}}{true}%
2032     \bitsetSet{abc}{1}%
2033     \Expect*{\bitsetIsEmpty{abc}{true}{false}}{false}%
2034 \end{qstest}
2035
2036 \begin{qstest}{Equals}{Equals}
2037     \def\Test#1#2#3{%
2038         \Expect*{\bitsetEquals{#1}{#2}{true}{false}}{#3}%
2039     }%
2040     \let\BS@abc\@undefined
2041     \Test{abc}{abc}{true}%
2042     \Test{abc}{foo}{true}%
2043     \Test{foo}{abc}{true}%
2044     \bitsetReset{abc}%
2045     \Test{abc}{abc}{true}%
2046     \Test{abc}{foo}{false}%
2047     \Test{foo}{abc}{false}%
2048     \bitsetReset{foo}%
2049     \Test{abc}{foo}{true}%
2050     \Test{foo}{abc}{true}%
2051     \bitsetSet{abc}{4}%

```



```

2052 \Test{abc}{foo}{false}%
2053 \Test{foo}{abc}{false}%
2054 \bitsetFlip{foo}{4}%
2055 \Test{abc}{foo}{true}%
2056 \Test{foo}{abc}{true}%
2057 \end{qstest}
2058
2059 \begin{qstest}{Intersects}{Intersects}
2060 \def\Test#1{%
2061 \Expect*{\bitsetIntersects{abc}{foo}{true}{false}}{#1}%
2062 }%
2063 \let\BS@abc\@undefined
2064 \let\BS@foo\@undefined
2065 \Test{false}%
2066 \Set{abc}{0}%
2067 \Test{false}%
2068 \Set{foo}{0}%
2069 \Test{false}%
2070 \let\BS@abc\@undefined
2071 \Test{false}%
2072 \Set{foo}{1}%
2073 \Test{false}%
2074 \Set{abc}{0}%
2075 \Test{false}%
2076 \Set{abc}{1}%
2077 \Test{true}%
2078 \let\BS@foo\@undefined
2079 \Test{false}%
2080 \Set{foo}{0}%
2081 \Test{false}%
2082 \def\Test#1#2#3{%
2083 \bitsetSetBin{abc}{#1}%
2084 \bitsetSetBin{foo}{#2}%
2085 \Expect*{\bitsetIntersects{abc}{foo}{true}{false}}{#3}%
2086 }%
2087 \Test{1010}{0101}{false}%
2088 \Test{0}{10}{false}%
2089 \Test{1}{11}{true}%
2090 \Test{11}{1}{true}%
2091 \Test{10}{1}{false}%
2092 \end{qstest}
2093
2094 \begin{qstest}{And/AndNot/Or/Xor}{And/AndNot/Or/Xor}
2095 \def\@Test#1#2#3#4#5{%
2096 \begingroup
2097 #5%
2098 \begingroup
2099 \let\BS@foo\@undefined
2100 \csname bitset#1\endcsname{abc}{foo}%
2101 \CheckUndef{foo}%
2102 \Check{abc}{#2}%
2103 \endgroup
2104 \begingroup
2105 \bitsetReset{foo}%
2106 \csname bitset#1\endcsname{abc}{foo}%
2107 \Check{foo}{0}%
2108 \Check{abc}{#3}%
2109 \endgroup
2110 \begingroup
2111 \def\BS@foo{0101}%
2112 \csname bitset#1\endcsname{abc}{foo}%
2113 \Check{foo}{0101}%

```

```

2114         \Check{abc}{#4}%
2115     \endgroup
2116 \endgroup
2117 }%
2118 \def\Test#1{%
2119     \def\Op{#1}%
2120     \Test@
2121 }%
2122 \def\Test@#1#2#3#4#5#6#7#8#9{%
2123     \@Test\Op{#1}{#2}{#3}{%
2124         \let\BS@abc\undefined
2125     }%
2126     \@Test\Op{#4}{#5}{#6}{%
2127         \bitsetReset{abc}%
2128     }%
2129     \@Test\Op{#7}{#8}{#9}{%
2130         \def\BS@abc{1001}%
2131     }%
2132 }%
2133 \Test{And}%
2134     {0}{0}{0}%
2135     {0}{0}{0}%
2136     {0}{0}{0001}%
2137 \Test{AndNot}%
2138     {0}{0}{0}%
2139     {0}{0}{0}%
2140     {1001}{1001}{1}%
2141 \Test{Or}%
2142     {0}{0}{0101}%
2143     {0}{0}{0101}%
2144     {1001}{1001}{1101}%
2145 \Test{Xor}%
2146     {0}{0}{0101}%
2147     {0}{0}{0101}%
2148     {1001}{1001}{11}%
2149 \def\Test#1#2#3{%
2150     \bitsetSetBin{abc}{#1}%
2151     \bitsetSetBin{foo}{#2}%
2152     \csname \bitset\Op\endcsname{abc}{foo}%
2153     \RevCheck{foo}{#2}%
2154     \RevCheck{abc}{#3}%
2155 }%
2156 \def\Op{And}%
2157 \Test{1}{111}{1}%
2158 \Test{111}{1}{1}%
2159 \Test{10}{111}{10}%
2160 \Test{111}{10}{10}%
2161 \Test{111}{1000}{0}%
2162 \Test{1000}{111}{0}%
2163 \def\Op{AndNot}%
2164 \Test{1010}{11}{1000}%
2165 \Test{100}{100}{0}%
2166 \Test{111}{1111}{0}%
2167 \Test{100}{111}{0}%
2168 \def\Op{Or}%
2169 \Test{0}{0}{0}%
2170 \Test{1}{0}{1}%
2171 \Test{0}{1}{1}%
2172 \Test{1}{1}{1}%
2173 \Test{1000}{10}{1010}%
2174 \Test{10}{1000}{1010}%
2175 \def\Op{Xor}%

```

```

2176 \Test{0}{0}{0}%
2177 \Test{1}{0}{1}%
2178 \Test{0}{1}{1}%
2179 \Test{1}{1}{0}%
2180 \Test{1000}{10}{1010}%
2181 \Test{10}{1000}{1010}%
2182 \Test {110011001100}%
2183 {111000111000111}%
2184 {111110100001011}%
2185 \Test{111000111000111}%
2186 {110011001100}%
2187 {111110100001011}%
2188 \end{qstest}
2189
2190 \begin{qstest}{GetUndef}{GetUndef, GetBin, GetOct, GetHex}
2191 \def\TestUndef#1#2{%
2192 \let\BS@abc\@undefined
2193 \expandafter\expandafter\expandafter\Expect
2194 \expandafter\expandafter\expandafter{%
2195 \x{abc}{#1}%
2196 }{#2}%
2197 }%
2198 \let\x\bitsetGetBin
2199 \TestUndef{-1}{0}%
2200 \TestUndef{0}{0}%
2201 \TestUndef{1}{0}%
2202 \TestUndef{2}{00}%
2203 \TestUndef{8}{00000000}%
2204 \let\x\bitsetGetOct
2205 \TestUndef{-1}{0}%
2206 \TestUndef{0}{0}%
2207 \TestUndef{1}{0}%
2208 \TestUndef{2}{0}%
2209 \TestUndef{3}{0}%
2210 \TestUndef{4}{00}%
2211 \TestUndef{5}{00}%
2212 \TestUndef{6}{00}%
2213 \TestUndef{7}{000}%
2214 \TestUndef{8}{000}%
2215 \TestUndef{9}{000}%
2216 \TestUndef{10}{0000}%
2217 \let\x\bitsetGetHex
2218 \TestUndef{-1}{0}%
2219 \TestUndef{0}{0}%
2220 \TestUndef{1}{0}%
2221 \TestUndef{2}{0}%
2222 \TestUndef{3}{0}%
2223 \TestUndef{4}{0}%
2224 \TestUndef{5}{00}%
2225 \TestUndef{6}{00}%
2226 \TestUndef{7}{00}%
2227 \TestUndef{8}{00}%
2228 \TestUndef{9}{000}%
2229 \TestUndef{10}{000}%
2230 \TestUndef{12}{000}%
2231 \TestUndef{13}{0000}%
2232 \TestUndef{16}{0000}%
2233 \TestUndef{17}{00000}%
2234 \end{qstest}
2235
2236 \begin{qstest}{SetBin}{SetBin}
2237 \def\Test#1#2{%

```

```

2238 \let\BS@abc\@undefined
2239 \bitsetSetBin{abc}{#1}%
2240 \expandafter\Expect\expandafter{\BS@abc}{#2}%
2241 }%
2242 \Test{}{0}%
2243 \Test{0}{0}%
2244 \Test{1}{1}%
2245 \Test{10}{01}%
2246 \Test{11}{11}%
2247 \Test{010}{01}%
2248 \Test{011}{11}%
2249 \Test{0010}{01}%
2250 \Test{1010}{0101}%
2251 \end{qstest}
2252
2253 \begin{qstest}{SetOct}{SetOct}
2254 \def\Test#1#2{%
2255 \bitsetSetOct{abc}{#1}%
2256 \expandafter\Expect\expandafter{\BS@abc}{#2}%
2257 }%
2258 \Test{}{0}%
2259 \Test{0}{0}%
2260 \Test{000}{0}%
2261 \Test{1}{1}%
2262 \Test{001}{1}%
2263 \Test{010}{0001}%
2264 \Test{020}{00001}%
2265 \Test{42}{010001}%
2266 \Test{377}{11111111}%
2267 \Test{0377}{11111111}%
2268 \Test{76543210}{000100010110001101011111}%
2269 \Test{ 0 7 0 7 1 }{100111000111}%
2270 \end{qstest}
2271
2272 \begin{qstest}{SetHex}{SetHex}
2273 \def\Test#1#2{%
2274 \bitsetSetHex{abc}{#1}%
2275 \expandafter\Expect\expandafter{\BS@abc}{#2}%
2276 }%
2277 \Test{}{0}%
2278 \Test{0}{0}%
2279 \Test{000}{0}%
2280 \Test{1}{1}%
2281 \Test{001}{1}%
2282 \Test{010}{00001}%
2283 \Test{020}{000001}%
2284 \Test{42}{0100001}%
2285 \Test{3F}{111111}%
2286 \Test{03F}{111111}%
2287 \Test{43210}{0000100001001100001}%
2288 \Test{98765}{10100110111000011001}%
2289 \Test{FEDCBA}{010111010011101101111111}%
2290 \Test{ 0 F 0 F 1 }{1000111100001111}%
2291 \end{qstest}
2292
2293 \begin{qstest}{SetDec}{SetDec}
2294 \def\Test#1#2{%
2295 \bitsetSetDec{abc}{#1}%
2296 \expandafter\Expect\expandafter{\BS@abc}{#2}%
2297 }%
2298 \Test{}{0}%
2299 \Test{0}{0}%

```

```

2300 \Test{000}{0}%
2301 \Test{1}{1}%
2302 \Test{7}{111}%
2303 \Test{8}{0001}%
2304 \Test{001}{1}%
2305 \Test{010}{0101}%
2306 \Test{020}{00101}%
2307 \Test{53}{101011}%
2308 \Test{255}{11111111}%
2309 \Test{256}{000000001}%
2310 \Test{999999999}{11111111001001101011001110111}%
2311 \Test{1000000000}{000000000101001101011001110111}%
2312 \Test{4210987654}{0110000101001001011111101011111}%
2313 \Test{2147483647}{1111111111111111111111111111111}%
2314 \Test{2147483648}{00000000000000000000000000000001}%
2315 \end{qstest}
2316
2317 \begin{qstest}{GetBin}{GetBin}
2318 \def\TestUndef#1#2{%
2319 \let\BS@abc\@undefined
2320 \expandafter\expandafter\expandafter\Expect
2321 \expandafter\expandafter\expandafter{%
2322 \bitsetGetBin{abc}{#1}%
2323 }{#2}%
2324 }%
2325 \TestUndef{-1}{0}%
2326 \TestUndef{0}{0}%
2327 \TestUndef{1}{0}%
2328 \TestUndef{2}{00}%
2329 \TestUndef{8}{00000000}%
2330 \def\Test#1#2{%
2331 \bitsetSetBin{abc}{#2}%
2332 \expandafter\expandafter\expandafter\Expect
2333 \expandafter\expandafter\expandafter{%
2334 \bitsetGetBin{abc}{#1}%
2335 }{#2}%
2336 }%
2337 \Test{-1}{0}%
2338 \Test{0}{0}%
2339 \Test{1}{0}%
2340 \Test{1}{1}%
2341 \Test{2}{01}%
2342 \Test{2}{10}%
2343 \Test{3}{010}%
2344 \Test{2}{00}%
2345 \Test{2}{01}%
2346 \Test{8}{00101100}%
2347 \Test{2}{10101}%
2348 \Test{-100}{11011}%
2349 \end{qstest}
2350
2351 \begin{qstest}{GetOct}{GetOct}
2352 \def\Test#1#2#3{%
2353 \edef\x{\zap@space#1 \@empty}%
2354 \edef\x{\noexpand\bitsetSetBin{abc}{\x}}%
2355 \x
2356 \expandafter\expandafter\expandafter\Expect
2357 \expandafter\expandafter\expandafter{%
2358 \bitsetGetOct{abc}{#2}%
2359 }{#3}%
2360 }%
2361 \Test{111 110 101 100 011 010 001 000}{0}{76543210}%

```

```

2362 \Test{000 111}{0}{7}%
2363 \Test{101 000}{-1}{50}%
2364 \Test{111}{-1}{7}%
2365 \Test{111}{0}{7}%
2366 \Test{111}{1}{7}%
2367 \Test{111}{3}{7}%
2368 \Test{111}{4}{07}%
2369 \Test{111}{6}{07}%
2370 \Test{111}{7}{007}%
2371 \Test{111 010}{6}{72}%
2372 \Test{111 010}{7}{072}%
2373 \Test{011 111}{0}{37}%
2374 \Test{011 111}{6}{37}%
2375 \Test{011 111}{7}{037}%
2376 \Test{001 111}{0}{17}%
2377 \Test{001 111}{6}{17}%
2378 \Test{001 111}{7}{017}%
2379 \end{qstest}
2380
2381 \begin{qstest}{GetHex}{GetHex}
2382 \def\Test#1#2#3{%
2383 \bitsetSetBin{abc}{#1}%
2384 \expandafter\expandafter\expandafter\Expect
2385 \expandafter\expandafter\expandafter{%
2386 \bitsetGetHex{abc}{#2}%
2387 }{#3}%
2388 }%
2389 \Test{1111 1110 1101 1100 1011 1010 1001 1000}{0}{FEDCBA98}%
2390 \Test{0111 0110 0101 0100 0011 0010 0001 0000}{0}{76543210}%
2391 \Test{0000 1111}{0}{F}%
2392 \Test{0101 0000}{-1}{50}%
2393 \Test{1111}{-1}{F}%
2394 \Test{1111}{0}{F}%
2395 \Test{1111}{1}{F}%
2396 \Test{1111}{4}{F}%
2397 \Test{1111}{5}{0F}%
2398 \Test{1111}{8}{0F}%
2399 \Test{1111}{9}{00F}%
2400 \Test{1111 0010}{8}{F2}%
2401 \Test{1111 0010}{9}{0F2}%
2402 \Test{0111 1111}{0}{7F}%
2403 \Test{0111 1111}{8}{7F}%
2404 \Test{0111 1111}{9}{07F}%
2405 \Test{0011 1111}{0}{3F}%
2406 \Test{0011 1111}{8}{3F}%
2407 \Test{0011 1111}{9}{03F}%
2408 \Test{0001 1111}{0}{1F}%
2409 \Test{0001 1111}{8}{1F}%
2410 \Test{0001 1111}{9}{01F}%
2411 \end{qstest}
2412
2413 \begin{qstest}{Range}{Range}
2414 \TestError{%
2415 Wrong index numbers in range [9..8]\MessageBreak% hash-ok
2416 for clear/set/flip on bit set 'abc'.\MessageBreak
2417 The lower index exceeds the upper index.\MessageBreak
2418 Canceling the operation as error recovery%
2419 }{%
2420 \bitsetSetRange{abc}{9}{8}%
2421 }%
2422 \def\TestErrorNegInd#1#2#3#4#5#6{%
2423 \TestError{%

```

```

2424     Negative index in range [#2..#3]\MessageBreak % hash-ok
2425     for \string\bitset #1Range on bit set 'abc'.\MessageBreak
2426     Using [#4..#5] as error recovery% hash-ok
2427 }{%
2428     \csname bitset#1Range\endcsname{abc}{#2}{#3}%
2429     \global\let\BS@global\BS@abc
2430 }%
2431     \Check{global}{#6}%
2432 }%
2433 \Set{abc}{111}%
2434 \TestErrorNegInd{Clear}{-1}{0}{0}{0}{111}%
2435 \TestErrorNegInd{Clear}{0}{-1}{0}{0}{111}%
2436 \TestErrorNegInd{Clear}{-2}{2}{0}{2}{001}%
2437 \bitsetReset{abc}%
2438 \TestErrorNegInd{Set}{-1}{0}{0}{0}{0}%
2439 \TestErrorNegInd{Set}{0}{-1}{0}{0}{0}%
2440 \TestErrorNegInd{Set}{-2}{2}{0}{2}{11}%
2441 \Set{abc}{101}%
2442 \TestErrorNegInd{Flip}{-1}{0}{0}{0}{101}%
2443 \TestErrorNegInd{Flip}{0}{-1}{0}{0}{101}%
2444 \TestErrorNegInd{Flip}{-2}{2}{0}{2}{011}%
2445 \def\Test#1#2#3#4{%
2446     \bitsetSetBin{abc}{#1}%
2447     \csname bitset\TestOp Range\endcsname{abc}{#2}{#3}%
2448     \Expect*{\bitsetGetBin{abc}{0}}{#4}%
2449 }%
2450 \def\TestOp{Clear}%
2451 \Test{0}{0}{1}{0}%
2452 \Test{1111}{1}{2}{1101}%
2453 \Test{1111}{1}{3}{1001}%
2454 \Test{111111100000000}{12}{14}{1100111100000000}%
2455 \def\TestOp{Set}%
2456 \Test{0}{0}{1}{1}%
2457 \Test{1000}{1}{2}{1010}%
2458 \Test{0}{1}{2}{10}%
2459 \Test{1}{12}{15}{111000000000001}%
2460 \Test{1111}{1}{3}{1111}%
2461 \Test{100000000000000}{12}{14}{101100000000000}%
2462 \def\TestOp{Flip}%
2463 \Test{0}{0}{1}{1}%
2464 \Test{1}{0}{1}{0}%
2465 \Test{10101010}{1}{5}{10110100}%
2466 \def\Test#1#2#3#4#5{%
2467     \bitsetSetBin{abc}{#1}%
2468     \bitsetSetValueRange{abc}{#2}{#3}{#4}%
2469     \Expect*{\bitsetGetBin{abc}{0}}{#5}%
2470 }%
2471 \Test{0}{0}{1}{0}{0}%
2472 \Test{0}{0}{1}{1}{1}%
2473 \Test{1010}{1}{3}{0}{1000}%
2474 \Test{1010}{1}{3}{1}{1110}%
2475 \end{qstest}
2476
2477 \begin{qstest}{ShiftLeft/ShiftRight}{ShiftLeft/ShiftRight}
2478     \def\@Test#1#2{%
2479         \let\BS@abc\@undefined
2480         \csname bitsetShift#1\endcsname{abc}{#2}%
2481         \Expect*{\BS@abc}{0}%
2482     }%
2483     \def\Test#1{%
2484         \@Test{Left}{#1}%
2485         \@Test{Right}{#1}%

```

[illegible]

4 Installation

4.1 Download

Package. This package is available on CTAN¹:

CTAN:macros/latex/contrib/oberdiek/bitset.dtx The source file.

CTAN:macros/latex/contrib/oberdiek/bitset.pdf Documentation.

¹ftp://ftp.ctan.org/tex-archive/

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

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

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

4.2 Bundle installation

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

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

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

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

4.3 Package installation

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

```
tex bitset.dtx
```

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

<code>bitset.sty</code>	→ <code>tex/generic/oberdiek/bitset.sty</code>
<code>bitset.pdf</code>	→ <code>doc/latex/oberdiek/bitset.pdf</code>
<code>test/bitset-test1.tex</code>	→ <code>doc/latex/oberdiek/test/bitset-test1.tex</code>
<code>test/bitset-test2.tex</code>	→ <code>doc/latex/oberdiek/test/bitset-test2.tex</code>
<code>test/bitset-test3.tex</code>	→ <code>doc/latex/oberdiek/test/bitset-test3.tex</code>
<code>bitset.dtx</code>	→ <code>source/latex/oberdiek/bitset.dtx</code>

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_EX distribution (teT_EX, miK_TE_X, ...) relies on file name databases, you must refresh these. For example, teT_EX users run `texhash` or `mktextlsr`.

4.5 Some details for the interested

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

```
pdftk bitset.pdf unpack_files output .
```

Unpacking with L^AT_EX. The .dtx chooses its action depending on the format:

plain-T_EX: Run docstrip and extract the files.

L^AT_EX: Generate the documentation.

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

```
latex \let\install=y\input{bitset.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 pdfL^AT_EX:

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

5 History

[2007/09/28 v1.0]

- First version.

6 Index

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

Symbols		1300, 1309, 1369, 1372, 1443, 1602
\#	1387, 1446	\{ 1385, 1444
\%	1449	\} 1386, 1445
\:	1718	\] 1448
\@	1388, 1442	
\@PackageError		
..	151, 343, 899, 1054, 1067, 1543	_ 1450
\@Test	2095,	
	2123, 2126, 2129, 2478, 2484, 2485	A
\@ehc	153, 345, 901, 1059, 1081	\advance 1426, 1434, 1509
\@empty	2353	\AtEndDocument 1522
\@firstofone	1396, 1399, 1606	
\@gobble	1393, 1401, 1604	B
\@undefined	1469, 1470, 1471,	\begin 1610, 1627, 1637, 1664,
	1725, 1853, 1988, 2021, 2028,	1685, 1708, 1852, 1873, 1909,
	2040, 2063, 2064, 2070, 2078,	1928, 1952, 1978, 2020, 2027,
	2099, 2124, 2192, 2238, 2319, 2479	2036, 2059, 2094, 2190, 2236,
\[1447	2253, 2272, 2293, 2317, 2351,
\]	197, 350, 413, 546, 555,	2381, 2413, 2477, 2525, 2530, 2534
	617, 664, 667, 702, 705, 742,	\BigIntCalcAdd 621, 630
	745, 775, 777, 785, 1269, 1278,	\bigintcalcCmp 333
		\BigIntCalcOdd 353

\bigintcalcSgn	330	\BitSet@Fill	389, <u>402</u> , 427, 529
\BigIntCalcShl	635, 642	\BitSet@FirstOfOne	<u>118</u>
\BigIntCalcShr	361	\BitSet@FirstOfTwo	<u>120</u> , 137, 1322,
\bitset	1069, 2425		1325, 1327, 1336, 1343, 1348, 1367
\BitSet@@@Range	1061, 1084, 1088	\BitSet@Flip	879, <u>974</u> , 1023
\BitSet@@@Set	959, <u>966</u> , 1001	\BitSet@FromFirstHex	209, <u>267</u>
\BitSet@@@CheckIndex	144, <u>148</u>	\BitSet@FromFirstOct	206, <u>235</u>
\BitSet@@@Clear	905, <u>917</u>	\BitSet@FromHex	279, <u>282</u>
\BitSet@@@Flip	976, <u>988</u>	\BitSet@FromOct	248, <u>251</u>
\BitSet@@@Get	1105, <u>1114</u>	\BitSet@Get	1095, <u>1098</u>
\BitSet@@@GetBin	382, <u>385</u>	\BitSet@GetDec	541, <u>545</u>
\BitSet@@@GetDec	550, <u>554</u> , 580	\BitSet@GetDecBig	614, <u>616</u> , 641
\BitSet@@@GetDecBig	629, <u>640</u>	\BitSet@GetOctHex	465, 490, <u>520</u>
\BitSet@@@GetHex	454, <u>487</u>	\BitSet@GetSetBitList ...	<u>1243</u> , <u>1247</u>
\BitSet@@@GetOct	440, <u>462</u>	\BitSet@Gobble	
\BitSet@@@GetOctHex ..	437, 451, 521, <u>525</u>		119, 827, 852, 893, 894, 1218
\BitSet@@@NextClearBit ...	1148, <u>1152</u>	\BitSet@GobbleSeven	1225, <u>1239</u>
\BitSet@@@NextSetBit	1184, <u>1188</u>	\BitSet@Hex[0..F]	<u>293</u>
\BitSet@@@Range ..	1040, <u>1045</u> , 1082, <u>1084</u>	\BitSet@Hex[0000..1111]	<u>501</u>
\BitSet@@@Set	945, <u>952</u>	\BitSet@IfUndefined	
\BitSet@@@TestMode	105		135, 143, 165, 386, 540,
\BitSet@AfterFi			725, 756, 804, 831, 1104, 1260,
	132, 150, 156, 200, 359, 374,		1291, 1320, 1325, 1342, 1343, 1345
	388, 393, 404, 409, 414, 418,	\BitSet@Intersects	1358, <u>1365</u>
	426, 431, 464, 469, 489, 494,	\BitSet@Kill	845, <u>855</u>
	527, 535, 547, 549, 1087, 1100,	\BitSet@KillZeros	
	1139, 1175, 1206, 1249, 1251, 1367		179, <u>189</u> , 218, 276, 325
\BitSet@AfterFiFi		\BitSet@MaxSize	<u>116</u> , 333
	133, 238, 271, 557, 562,	\BitSet@N1073741824	<u>613</u>
	566, 572, 619, 624, 628, 633,	\BitSet@N[1,2,4,...]	<u>578</u>
	748, 866, 928, 959, 1001, 1125,	\BitSet@NegativeIndex	1047, 1050, <u>1066</u>
	1158, 1160, 1194, 1196, 1211,	\BitSet@NextClearBit	1133, <u>1136</u>
	1215, 1217, 1270, 1272, 1279,	\BitSet@NextSetBit	
	1281, 1301, 1303, 1310, 1312, 1370		1169, <u>1172</u> , 1244, 1253
\BitSet@AfterFiFiFi	134, 672, 676,	\BitSet@NumBinFill	415, <u>424</u>
	712, 716, 791, 796, 931, 936,	\BitSet@NumBinRev	396, <u>412</u>
	1004, 1009, 1222, 1228, 1373, 1375	\BitSet@Oct[000..111]	<u>476</u>
\BitSet@And	652, <u>663</u>	\BitSet@Or	732, <u>740</u>
\BitSet@AndNot	690, <u>701</u>	\BitSet@Range	
\BitSet@AtEnd	78, 79, 1382		1017, 1020, 1023, 1031, 1033, <u>1038</u>
\BitSet@Cardinality	1292, <u>1298</u>	\BitSet@Reverse	185, <u>196</u> , 230
\BitSet@CheckIndex		\BitSet@SecondOfTwo	<u>121</u> ,
	142, 873, 876, 879, 886		139, 1321, 1329, 1338, 1343,
\BitSet@Cleanup			1345, 1350, 1356, 1357, 1370, 1373
	866, 928, 1125, 1158, 1194, <u>1203</u>	\BitSet@Set	
\BitSet@Clear			876, 890, <u>943</u> , 1020, 1033, 1073
	873, 888, <u>903</u> , 1017, 1031, 1070	\BitSet@SetDec	339, 351, <u>365</u>
\BitSet@Empty	<u>117</u> , 125,	\BitSet@SetDecBig	335, <u>349</u>
	176, 179, 181, 215, 218, 220,	\BitSet@SetOctHex	206, 209, <u>211</u>
	226, 322, 325, 327, 445, 459,	\BitSet@SetValue	882, <u>885</u>
	463, 488, 657, 695, 768, 846,	\BitSet@SetValueRange ...	1026, <u>1029</u>
	858, 864, 907, 911, 919, 921,	\BitSet@ShiftLeft	809, <u>814</u> , 852
	927, 947, 957, 978, 982, 991, 999	\BitSet@ShiftRight	827, 836, <u>841</u>
\BitSet@ErrorInvalidBitValue ...		\BitSet@Size	1261, <u>1267</u>
	892, <u>898</u> , 1035	\BitSet@Skip	1145, 1181, <u>1204</u>
\BitSet@Fi	<u>131</u> , 132, 133, 134, 159,	\BitSet@SkipContinue	
	203, 249, 280, 363, 378, 394,		1207, 1212, 1215, 1218, <u>1236</u>
	410, 422, 432, 474, 499, 536,	\BitSet@Space	<u>122</u> , 176, 215,
	552, 576, 638, 681, 721, 752,		322, 558, 620, 822, 1111, 1140, 1176
	801, 870, 941, 964, 1014, 1091,	\BitSet@Temp	
	1112, 1129, 1150, 1165, 1186,		173, 174, 176, 178, 179, 181,
	1201, 1234, 1256, 1287, 1317, 1380		185, 212, 213, 215, 217, 218,

220, 223, 224, 226, 230, 293,
 296, 297, 298, 299, 300, 301,
 302, 303, 304, 305, 306, 307,
 308, 309, 310, 311, 312, 313,
 314, 315, 316, 317, 319, 320,
 322, 324, 325, 327, 330, 333,
 335, 339, 476, 479, 480, 481,
 482, 483, 484, 485, 486, 501,
 504, 505, 506, 507, 508, 509,
 510, 511, 512, 513, 514, 515,
 516, 517, 518, 519, 578, 583,
 584, 585, 586, 587, 588, 589,
 590, 591, 592, 593, 594, 595,
 596, 597, 598, 599, 600, 601,
 602, 603, 604, 605, 606, 607,
 608, 609, 610, 611, 612, 904,
 911, 914, 975, 982, 985, 1039, 1043
 \BitSet@TestMode 105, 1476
 \BitSet@Xor 763, 774
 \BitSet@ZapSpace .. 123, 175, 214, 321
 \BitSet@Zero 182, 221,
 227, 328, 331, 912, 983, 1326, 1333
 \bitsetAnd 7, 644
 \bitsetAndNot 7, 683
 \bitsetCardinality 8, 1289, 1686, 1691
 \bitsetClear .. 7, 872, 1912, 1915, 1917
 \bitsetClearRange 1016
 \bitsetEquals 9, 1341, 2038
 \BitSetError ... 246, 262, 274, 286,
 357, 1101, 1141, 1177, 1721, 1723
 \bitsetFlip 878, 1955, 1958, 1960, 2054
 \bitsetFlipRange 1022
 \bitsetGet
 .. 8, 1093, 1335, 1640, 1650, 2531
 \bitsetGetBin 6, 380,
 2198, 2322, 2334, 2448, 2469, 2496
 \bitsetGetDec 7, 538, 1874, 1882
 \bitsetGetHex 448, 2217, 2386
 \bitsetGetOct 434, 2204, 2358
 \bitsetGetSetBitList
 8, 1240, 1856, 1862
 \bitsetIntersects 9, 1355, 2061, 2085
 \bitsetIsDefined . 8, 1319, 2022, 2024
 \bitsetIsEmpty .. 9, 436, 450, 645,
 648, 684, 687, 724, 727, 755,
 758, 807, 834, 1144, 1180, 1242,
 1324, 1356, 1357, 2029, 2031, 2033
 \bitsetLet 6, 164, 1613, 1619
 \bitsetNextClearBit ... 8, 1131, 1715
 \bitsetNextSetBit 8, 1167, 1716
 \bitsetOr 7, 723
 \bitsetQuery 9, 1334, 1645, 1651
 \bitsetReset 6, 143,
 161, 166, 646, 649, 658, 685,
 696, 725, 756, 769, 805, 832,
 1628, 1630, 1633, 1735, 2023,
 2030, 2044, 2048, 2105, 2127, 2437
 \bitsetSet 875,
 1931, 1934, 1936, 2032, 2051, 2526
 \bitsetSetBin .. 6, 172, 1719, 1745,
 1755, 1806, 1817, 1828, 1839,
 1859, 1990, 1998, 1999, 2083,
 2084, 2150, 2151, 2239, 2331,
 2354, 2383, 2446, 2467, 2493, 2494
 \bitsetSetDec 6, 318, 2295
 \bitsetSetHex 208, 2274
 \bitsetSetOct 205, 2255
 \bitsetSetRange 1019, 2420
 \bitsetSetValue 8, 881, 1981, 1989, 2000
 \bitsetSetValueRange 1025, 2468
 \bitsetShiftLeft 7, 803
 \bitsetShiftRight 830
 \bitsetSize 8, 1258, 1665, 1669
 \bitsetXor 7, 754
 \body 1405, 1409
 \BS@abc 1725, 1853, 1913, 1932, 1956,
 1988, 1991, 2001, 2021, 2028,
 2040, 2063, 2070, 2124, 2130,
 2192, 2238, 2240, 2256, 2275,
 2296, 2319, 2429, 2479, 2481, 2527
 \BS@foo 2064, 2078, 2099, 2111
 \BS@global 2429, 2527
 \BS@result 1991, 2001

C

 \catcode 3, 4, 5, 6, 7, 18, 19,
 20, 34, 35, 36, 37, 38, 39, 40, 41,
 42, 43, 44, 62, 63, 66, 67, 68, 69,
 73, 74, 75, 76, 80, 82, 103, 1385,
 1386, 1387, 1388, 1423, 1432,
 1442, 1443, 1444, 1445, 1446,
 1447, 1448, 1449, 1450, 1451, 1718
 \chardef 1476
 \Check 1579,
 1615, 1617, 1618, 1620, 1621,
 1623, 1624, 1629, 1631, 1634,
 2102, 2107, 2108, 2113, 2114, 2431
 \CheckUndef
 1569, 1582, 1611, 1612, 1614, 2101
 \Clear 1715, 1720, 1726, 1736,
 1746, 1756, 1807, 1818, 1829, 1840
 \count@ 1390, 1419, 1423,
 1425, 1426, 1430, 1432, 1433, 1434
 \countdef 1390
 \csname 8, 21, 45, 58, 65, 101,
 107, 136, 162, 168, 169, 182,
 184, 221, 227, 229, 273, 277,
 285, 288, 294, 328, 331, 334,
 338, 399, 444, 458, 472, 477,
 497, 502, 542, 567, 573, 579,
 613, 651, 653, 655, 657, 689,
 691, 693, 695, 728, 729, 731,
 733, 735, 759, 760, 762, 764,
 766, 768, 820, 823, 844, 846,
 906, 910, 944, 946, 977, 981,
 1106, 1147, 1183, 1264, 1295,
 1326, 1346, 1347, 1359, 1361,
 1389, 1392, 1395, 1398, 1456,
 1492, 1577, 1586, 1594, 1597,
 1643, 2016, 2017, 2100, 2106,
 2112, 2152, 2428, 2447, 2480, 2495
 \currentgrouplevel .. 1467, 1471, 1483

D

 \dimexpr 1499

<code>\documentclass</code>	1462	858, 864, 911, 918, 919, 921, 927, 930, 954, 957, 967, 982, 989, 990, 991, 999, 1003, 1070, 1073, 1116, 1117, 1123, 1153, 1156, 1189, 1192, 1205, 1268, 1269, 1278, 1299, 1300, 1309, 1326, 1346, 1369, 1372, 1389, 1392, 1395, 1398, 1492, 1586, 1602
E		
<code>\empty</code>	12	
<code>\end</code> ..	1457, 1625, 1635, 1662, 1683, 1706, 1850, 1871, 1907, 1926, 1950, 1976, 2018, 2025, 2034, 2057, 2092, 2188, 2234, 2251, 2270, 2291, 2315, 2349, 2379, 2411, 2475, 2523, 2528, 2532, 2535	
<code>\endcsname</code> ..	8, 21, 45, 58, 65, 101, 107, 136, 162, 168, 169, 182, 184, 221, 227, 229, 273, 277, 285, 288, 294, 328, 331, 334, 338, 399, 444, 458, 472, 477, 497, 502, 542, 568, 573, 579, 613, 651, 653, 655, 657, 689, 691, 693, 695, 728, 729, 731, 733, 735, 759, 760, 762, 764, 766, 768, 820, 823, 844, 846, 906, 910, 944, 946, 977, 981, 1106, 1147, 1183, 1264, 1295, 1326, 1346, 1347, 1359, 1361, 1389, 1392, 1395, 1398, 1456, 1492, 1577, 1586, 1594, 1597, 1643, 2016, 2017, 2100, 2106, 2112, 2152, 2428, 2447, 2480, 2495	
<code>\endinput</code>	30	
<code>\endqstest</code>	1513, 1518, 1527, 1532	
<code>\ETeXDisable</code>	1468, 1473, 1555	
<code>\ETeXEnable</code>	1480, 1485, 1548	
<code>\Expect</code>	1534, 1550, 1551, 1559, 1560, 1570, 1575, 1584, 1638, 1645, 1649, 1651, 1668, 1689, 1710, 1854, 1860, 1880, 1913, 1932, 1956, 1991, 2001, 2022, 2024, 2029, 2031, 2033, 2038, 2061, 2085, 2193, 2240, 2256, 2275, 2296, 2320, 2332, 2356, 2384, 2448, 2469, 2481, 2496	
<code>\ExpectBitSet</code>	1574, 1580, 1591	
H		
<code>\hbox</code>	1530	
I		
<code>\ifcase</code> 9, 238, 254, 330, 353, 366, 815, 842, 887, 1030, 1052, 1210, 1652		
<code>\ifcsname</code>	1466, 1469, 1482	
<code>\ifnum</code>	149, 333, 387, 403, 425, 526, 665, 668, 670, 703, 707, 710, 741, 1046, 1049, 1085, 1099, 1137, 1173, 1221, 1248, 1335, 1366, 1425, 1433	
<code>\ifodd</code>	369	
<code>\ifx</code> ...	10, 12, 21, 45, 53, 101, 107, 125, 136, 181, 190, 197, 220, 226, 236, 252, 268, 270, 273, 283, 285, 327, 350, 413, 463, 488, 546, 555, 556, 565, 617, 618, 627, 657, 664, 667, 695, 702, 705, 742, 745, 768, 775, 776, 777, 785, 787, 790, 857,	
<code>\ignorespaces</code>	1530	
<code>\immediate</code>	23, 47	
<code>\IncludeTests</code>	1488	
<code>\input</code>	108, 109, 110, 1452	
<code>\IntCalcAdd</code>	531, 559, 569	
<code>\intcalcCmp</code>	1052	
<code>\IntCalcDec</code> ...	390, 406, 466, 491, 1230	
<code>\IntCalcDiv</code>	530	
<code>\IntCalcInc</code>	420, 471, 496, 1089, 1162, 1198, 1254, 1274, 1283, 1301, 1305	
<code>\IntCalcMul</code>	523	
<code>\intcalcNum</code>	145, 383, 438, 452, 522, 810, 837, 883, 1027, 1041, 1096, 1109, 1134, 1170	
<code>\intcalcSgn</code>	815, 842	
<code>\IntCalcShr</code>	376	
<code>\IntCalcSub</code>	428, 532, 1224	
<code>\iterate</code>	1406, 1408, 1410	
L		
<code>\LogTests</code>	1489	
<code>\loop</code>	1404, 1420, 1431	
M		
<code>\makeatletter</code>	1463, 1475, 1490	
<code>\makeatother</code>	1477	
<code>\MessageBreak</code>	1055, 1056, 1057, 1068, 1079, 1546, 2415, 2416, 2417, 2424, 2425	
N		
<code>\NeedsTeXFormat</code>	1460	
<code>\newcommand</code>	1497, 1502, 1506, 1507	
<code>\newcount</code>	1494, 1495	
<code>\newcounter</code>	1537	
<code>\next</code>	1410, 1412, 1414	
<code>\nofiles</code>	1461	
<code>\number</code>	471, 496, 522, 530, 1094, 1132, 1146, 1168, 1182, 1224, 1244, 1252, 1259, 1290, 1499	
<code>\numexpr</code>	1465, 1470, 1481	
O		
<code>\Op</code>	2119, 2123, 2126, 2129, 2152, 2156, 2163, 2168, 2175, 2495, 2498, 2509	
<code>\orig@endqstest</code>	1527, 1535	
<code>\orig@qstest</code>	1526, 1529	
P		
<code>\PackageInfo</code>	26	
<code>\pdfelapsedtime</code>	1508	
<code>\pdfresettimer</code>	1504	
<code>\PrintTime</code>	1497, 1510, 1523	
<code>\ProvidesPackage</code>	59	
Q		
<code>\qstest</code>	1512, 1514, 1526, 1528	

R		1827, 1830, 1831, 1832, 1833,
\RangeCatcodeInvalid	1429, 1438, 1439, 1440, 1441	1835, 1836, 1837, 1838, 1841,
\renewcommand	1503	1842, 1843, 1844, 1846, 1847,
\repeat	1404, 1416, 1427, 1435	1848, 1849, 1858, 1865, 1866,
\RequirePackage	112, 113, 114	1867, 1868, 1869, 1870, 1875,
\RestoreCatcodes	1418, 1421, 1422, 1453	1885, 1886, 1887, 1888, 1889,
\RevCheck	1590, 1916, 1918,	1890, 1891, 1892, 1893, 1894,
	1935, 1937, 1959, 1961, 2153, 2154	1895, 1897, 1899, 1901, 1903,
\Reverse	1591,	1905, 1910, 1919, 1920, 1921,
	1598, 1601, 1608, 1913, 1932, 1956	1922, 1923, 1924, 1925, 1929,
\RevSet ..	1596, 1876, 1911, 1930, 1954	1938, 1939, 1940, 1941, 1942,
\romannumeral	381,	1943, 1944, 1945, 1946, 1947,
	435, 449, 539, 822, 849, 908,	1948, 1949, 1953, 1962, 1963,
	949, 979, 1109, 1141, 1177, 1241	1964, 1965, 1966, 1967, 1968,
S		1969, 1970, 1971, 1972, 1973,
\saved@endqstest	1513, 1520	1974, 1975, 1979, 1984, 1985,
\saved@qstest	1512, 1515	1986, 1987, 1993, 1994, 1995,
\SavedCurrentgrouplevel ..	1467, 1483	1996, 1997, 2003, 2004, 2005,
\SavedIfcsname	1466, 1482	2006, 2007, 2008, 2009, 2010,
\SavedNumexpr	1465, 1481	2011, 2012, 2013, 2014, 2015,
\sbox	1542	2016, 2017, 2037, 2041, 2042,
\Set ..	1593, 1616, 1622, 1632, 1644,	2043, 2045, 2046, 2047, 2049,
	1648, 1667, 1688, 1716, 1722,	2050, 2052, 2053, 2055, 2056,
	1731, 1741, 1751, 1781, 1812,	2060, 2065, 2067, 2069, 2071,
	1823, 1834, 1845, 2066, 2068,	2073, 2075, 2077, 2079, 2081,
	2072, 2074, 2076, 2080, 2433, 2441	2082, 2087, 2088, 2089, 2090,
\setbox	1530	2091, 2118, 2133, 2137, 2141,
\setcounter	1541	2145, 2149, 2157, 2158, 2159,
\space	1499	2160, 2161, 2162, 2164, 2165,
\StartTime	1502, 1516	2166, 2167, 2169, 2170, 2171,
\stepcounter	1544	2172, 2173, 2174, 2176, 2177,
\StopTime	1507, 1519	2178, 2179, 2180, 2181, 2182,
\strip@pt	1499	2185, 2237, 2242, 2243, 2244,
\SummaryTime ...	1494, 1496, 1509, 1523	2245, 2246, 2247, 2248, 2249,
T		2250, 2254, 2258, 2259, 2260,
\Test	1437, 1455, 1647, 1654,	2261, 2262, 2263, 2264, 2265,
	1655, 1656, 1657, 1658, 1659,	2266, 2267, 2268, 2269, 2273,
	1660, 1661, 1666, 1671, 1672,	2277, 2278, 2279, 2280, 2281,
	1673, 1674, 1675, 1676, 1677,	2282, 2283, 2284, 2285, 2286,
	1678, 1679, 1680, 1681, 1682,	2287, 2288, 2289, 2290, 2294,
	1687, 1694, 1695, 1696, 1697,	2298, 2299, 2300, 2301, 2302,
	1698, 1699, 1700, 1701, 1702,	2303, 2304, 2305, 2306, 2307,
	1703, 1704, 1705, 1709, 1721,	2308, 2309, 2310, 2311, 2312,
	1723, 1727, 1728, 1729, 1730,	2313, 2314, 2330, 2337, 2338,
	1732, 1733, 1734, 1737, 1738,	2339, 2340, 2341, 2342, 2343,
	1739, 1740, 1742, 1743, 1744,	2344, 2345, 2346, 2347, 2348,
	1747, 1748, 1749, 1750, 1752,	2352, 2361, 2362, 2363, 2364,
	1753, 1754, 1757, 1758, 1759,	2365, 2366, 2367, 2368, 2369,
	1760, 1761, 1762, 1763, 1764,	2370, 2371, 2372, 2373, 2374,
	1765, 1766, 1767, 1768, 1769,	2375, 2376, 2377, 2378, 2382,
	1770, 1771, 1772, 1773, 1774,	2389, 2390, 2391, 2392, 2393,
	1775, 1776, 1777, 1778, 1779,	2394, 2395, 2396, 2397, 2398,
	1780, 1782, 1783, 1784, 1785,	2399, 2400, 2401, 2402, 2403,
	1786, 1787, 1788, 1789, 1790,	2404, 2405, 2406, 2407, 2408,
	1791, 1792, 1793, 1794, 1795,	2409, 2410, 2445, 2451, 2452,
	1796, 1797, 1798, 1799, 1800,	2453, 2454, 2456, 2457, 2458,
	1801, 1802, 1803, 1804, 1805,	2459, 2460, 2461, 2463, 2464,
	1808, 1809, 1810, 1811, 1813,	2465, 2466, 2471, 2472, 2473,
	1814, 1815, 1816, 1819, 1820,	2474, 2483, 2487, 2488, 2489,
	1821, 1822, 1824, 1825, 1826,	2490, 2491, 2492, 2499, 2500,
		2501, 2502, 2503, 2504, 2505,
		2506, 2507, 2508, 2510, 2511,

2512, 2513, 2514, 2515, 2516,	\theTest	1559
2517, 2518, 2519, 2520, 2521, 2522	\TimeDescription . . .	1503, 1506, 1510
\Test@	\TMP@EnsureCode	77, 84, 85, 86, 87, 88, 89,
\TestError 1539, 1565, 1980, 2414, 2423	90, 91, 92, 93, 94, 95, 96, 97, 98, 99	
\TestErrorNegativeIndex	\typeout	1498
1564, 1917, 1936, 1960		
\TestErrorNegInd		
2422, 2434, 2435, 2436,	U	
2438, 2439, 2440, 2442, 2443, 2444	\uccode	818
\TestGetterUndefined	\uppercase	819
1568, 1665, 1686, 1874	\usepackage	1478, 1487
\TestOp		
1712, 1715, 1716, 2447, 2450, 2455, 2462	W	
\TestTime	\wd	1534, 1560
1495, 1508, 1509, 1510	\write	23, 47
\TestUndef 2191, 2199, 2200, 2201,		
2202, 2203, 2205, 2206, 2207,	X	
2208, 2209, 2210, 2211, 2212,	\x	8, 10, 12, 22, 26, 28,
2213, 2214, 2215, 2216, 2218,	46, 51, 58, 64, 72, 2195, 2198,	
2219, 2220, 2221, 2222, 2223,	2204, 2217, 2353, 2354, 2355, 2531	
2224, 2225, 2226, 2227, 2228,		
2229, 2230, 2231, 2232, 2233,	Z	
2318, 2325, 2326, 2327, 2328, 2329	\z@	1496
\the . 66, 67, 68, 69, 80, 1423, 1534, 1560	\zap@space	2353