

GraphTheorySymbol: L^AT_EX Commands with Symbols for Graph Theory

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Abstract

This documentation is for L^AT_EX package GraphTheorySymbol. It provides symbols used in graph theory. The adjacency and incidence symbols, and the meta-logical operators symbols were created by the author of this package.

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1 Introduction

This documentation is for L^AT_EX package GraphTheorySymbol. It provides symbols used in graph theory. The adjacency and incidence symbols, and the meta-logical operators symbols were created by the author of this package.

This package is licenced under Lesser GNU General Public License version 3 or later (LGPLv3+). It means you are free do anything with it, but if you do improve the code of the symbols that we provide, please do share these improvements in a similar way. There is no restriction on other graph theory symbols/code, even if it would be a good fit for inclusion in this package. There is also no need to share in a similar way what you build with this package. The text of the licenses is available at: <https://www.gnu.org/licenses/>.

The git repository of this source code is also available at:
<https://github.com/LLyaudet/GraphTheorySymbol/>.
Clone it with this URL:
[git@github.com:LLyaudet/GraphTheorySymbol.git](https://github.com:LLyaudet/GraphTheorySymbol.git).

This package is available on CTAN:

<https://ctan.org/pkg/graph-theory-symbol>.

This is our first $\text{\LaTeX}$ package. It may be that our macros are quite slow and that a document making extensive use of these macros will be slow to compile. If you know how to produce better $\text{\LaTeX}$ code, please submit a pull request on GitHub.

2 Usage

2.1 Memo or for the impatient

Add in your preamble: `\usepackage{graph-theory-symbol}`.

For clarity, below we only show long macro names and short macro names; see Detailed usage section for intermediate length macro names.

Long name	Short name	Result	In context
<code>\GTSadjacency/</code>	<code>\GTSa/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSadjacencyRelation/</code>	<code>\GTSaR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSunadjacency/</code>	<code>\GTSu/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSunadjacencyRelation/</code>	<code>\GTSuR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyUp/</code>	<code>\GTSdAU/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyUpRelation/</code>	<code>\GTSdAUR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyUp/</code>	<code>\GTSnDAU/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyUpRelation/</code>	<code>\GTSnDAUR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyDown/</code>	<code>\GTSdAD/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyDownRelation/</code>	<code>\GTSdADR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyDown/</code>	<code>\GTSnDAD/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyDownRelation/</code>	<code>\GTSnDADR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSincidence/</code>	<code>\GTSi/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSincidenceRelation/</code>	<code>\GTSiR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedIncidence/</code>	<code>\GTSnI/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedIncidenceRelation/</code>	<code>\GTSnIR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSoutIncidence/</code>	<code>\GTSOI/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSoutIncidenceRelation/</code>	<code>\GTSOIR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedOutIncidence/</code>	<code>\GTSnOI/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedOutIncidenceRelation/</code>	<code>\GTSnOIR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSinIncidence/</code>	<code>\GTSiI/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSinIncidenceRelation/</code>	<code>\GTSiIR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedInIncidence/</code>	<code>\GTSnII/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedInIncidenceRelation/</code>	<code>\GTSnIIR/</code>	$\emptyset$	$v \emptyset e$

Long name	Short name	Result	In context
<code>\GTSadjacencyMonochrome/</code>	<code>\GTSaM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSadjacencyMonochromeRelation/</code>	<code>\GTSaMR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSunadjacencyMonochrome/</code>	<code>\GTSuM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSunadjacencyMonochromeRelation/</code>	<code>\GTSuMR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyUpMonochrome/</code>	<code>\GTSdAUM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyUpMonochromeRelation/</code>	<code>\GTSdAUMR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyUpMonochrome/</code>	<code>\GTSnDAUM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyUpMonochromeRelation/</code>	<code>\GTSnDAUMR/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyDownMonochrome/</code>	<code>\GTSdADM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSdirectedAdjacencyDownMonochromeRelation/</code>	<code>\GTSdADM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyDownMonochrome/</code>	<code>\GTSnDADM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSnegatedDirectedAdjacencyDownMonochromeRelation/</code>	<code>\GTSnDADM/</code>	$\emptyset$	$u \emptyset v$
<code>\GTSincidenceMonochrome/</code>	<code>\GTSiM/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSincidenceMonochromeRelation/</code>	<code>\GTSiMR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedIncidenceMonochrome/</code>	<code>\GTSnIM/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedIncidenceMonochromeRelation/</code>	<code>\GTSnIMR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSoutIncidenceMonochrome/</code>	<code>\GTSOIM/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSoutIncidenceMonochromeRelation/</code>	<code>\GTSOIMR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedOutIncidenceMonochrome/</code>	<code>\GTSnOIM/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedOutIncidenceMonochromeRelation/</code>	<code>\GTSnOIMR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSinIncidenceMonochrome/</code>	<code>\GTSiIM/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSinIncidenceMonochromeRelation/</code>	<code>\GTSiIMR/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedInIncidenceMonochrome/</code>	<code>\GTSnIIM/</code>	$\emptyset$	$v \emptyset e$
<code>\GTSnegatedInIncidenceMonochromeRelation/</code>	<code>\GTSnIIMR/</code>	$\emptyset$	$v \emptyset e$

<code>\GTSsetMainColor{blue}</code>			
Long name	Short name	Result	In context
<code>\GTSadjacency/</code>	<code>\GTSa/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSadjacencyRelation/</code>	<code>\GTSaR/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSunadjacency/</code>	<code>\GTSu/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSunadjacencyRelation/</code>	<code>\GTSuR/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSdirectedAdjacencyUp/</code>	<code>\GTSdAU/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSdirectedAdjacencyUpRelation/</code>	<code>\GTSdAUR/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSnegatedDirectedAdjacencyUp/</code>	<code>\GTSnDAU/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSnegatedDirectedAdjacencyUpRelation/</code>	<code>\GTSnDAUR/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSdirectedAdjacencyDown/</code>	<code>\GTSdAD/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSdirectedAdjacencyDownRelation/</code>	<code>\GTSdADR/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSnegatedDirectedAdjacencyDown/</code>	<code>\GTSnDAD/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSnegatedDirectedAdjacencyDownRelation/</code>	<code>\GTSnDADR/</code>		$u \overset{\circ}{\sim} v$
<code>\GTSincidence/</code>	<code>\GTSi/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSincidenceRelation/</code>	<code>\GTSiR/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSnegatedIncidence/</code>	<code>\GTSnI/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSnegatedIncidenceRelation/</code>	<code>\GTSnIR/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSoutIncidence/</code>	<code>\GTSOI/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSoutIncidenceRelation/</code>	<code>\GTSOIR/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSnegatedOutIncidence/</code>	<code>\GTSnOI/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSnegatedOutIncidenceRelation/</code>	<code>\GTSnOIR/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSinIncidence/</code>	<code>\GTSiI/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSinIncidenceRelation/</code>	<code>\GTSiIR/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSnegatedInIncidence/</code>	<code>\GTSnII/</code>		$v \overset{\circ}{\sim} e$
<code>\GTSnegatedInIncidenceRelation/</code>	<code>\GTSnIIR/</code>		$v \overset{\circ}{\sim} e$

Long name	Short name	Result	In context
<code>\GTSmetaNot/</code>	<code>\GTSmN/</code>	$\neg$	$\neg \overset{\circ}{\sim}$
<code>\GTSmetaAnd/</code>	<code>\GTSmA/</code>	$\wedge$	$\overset{\circ}{\sim} \wedge \overset{\circ}{\sim}$
<code>\GTSmetaOr/</code>	<code>\GTSmO/</code>	$\vee$	$\overset{\circ}{\sim} \vee \overset{\circ}{\sim}$

Meta-logic can be used for compound adjacency types, etc.

Implicit meta-and via concatenation, no space except around whole relations compositions, no parentheses via higher priority to meta-and, brackets when all possible adjacencies are specified between two vertices:

Tournament adjacency:

$\forall u, v, u \overset{\circ}{\sim} \overset{\circ}{\sim} v$.

Tournament adjacency with maybe some colored edge also, who knows?:

$\forall u, v, u \overset{\circ}{\sim} \overset{\circ}{\sim} v$.

Directed graph:

$\forall u, v, u \overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim} v$.

Oriented graph:

$\forall u, v, u \overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim} v$.

Tournament adjacency:

$\overset{\circ}{\sim} \overset{\circ}{\sim}$ is obtained with `\mathrel{\{\GTSdAD/\GTSnDAU/\GTSmO/\GTSnDAD/\GTSdAU/\}}`.

Tournament adjacency with maybe some colored edge also, who knows?:

$\overset{\circ}{\sim} \overset{\circ}{\sim}$ is obtained with `\mathrel{\{\GTSdAD/\GTSnDAU/\GTSmO/\GTSnDAD/\GTSdAU/\}}`.

Directed graph:

$\overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim}$ is obtained with

`\mathrel{\{\GTSdAD/\GTSnDAU/\GTSmO/\GTSnDAD/\GTSdAU/\GTSmO/\GTSdAD/\GTSdAU/\GTSmO/\GTSnDAD/\GTSnDAU/\}}`.

Oriented graph:

$\overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim} \overset{\circ}{\sim}$ is obtained with

`\mathrel{\{\GTSdAD/\GTSnDAU/\GTSmO/\GTSnDAD/\GTSdAU/\GTSmO/\GTSnDAD/\GTSnDAU/\}}`.

Prefix notation:

$\exists u, v, u \overset{\circ}{\sim} \overset{\circ}{\sim} v \Leftrightarrow \exists u, v, u \overset{\circ}{\sim} \overset{\circ}{\sim} v$.

$\exists v, e, v \overset{\circ}{\sim} \overset{\circ}{\sim} e \Leftrightarrow \exists v, e, v \overset{\circ}{\sim} \overset{\circ}{\sim} e$.

$\overset{\circ}{\sim} \overset{\circ}{\sim}$ is obtained with

`\mathrel{\{\GTSmO/\GTSxa[mC=red,d]\GTSxa[mC=green,d]\GTSxa[mC=blue,u]\}}`.

$\mathrel{\mathbb{V} \begin{smallmatrix} \textcolor{red}{+} & \textcolor{green}{+} & \textcolor{blue}{+} \end{smallmatrix}}$ is obtained with
`\mathrel{\{\ \backslashGTSm0/\backslashGTSxi[mC=red,i]\backslashGTSxi[mC=green,i]\backslashGTSxi[mC=blue,o]\}}`.

Apart from these symbol macros, versatile macros to call them all are available with options:
`\GTSxa[]`, `\GTSxadj[]`, or `\GTSxadjacency[]` for adjacency symbols,
`\GTSxi[]`, `\GTSxinc[]`, or `\GTSxincidence[]` for incidence symbols,
`\GTSxml[]`, or `\GTSxmetallogic[]` for meta-logic symbols,
`\GTSx[]{}{} for all symbols`
 $(\backslashGTSx[]\{a\} = \backslashGTSxa[], \backslashGTSx[]\{i\} = \backslashGTSxi[], \backslashGTSx[]\{m\} = \backslashGTSxml[])$.
See Detailed usage section for full syntax of these macros.

2.2 Detailed usage

First you need to add in your preamble: `\usepackage{graph-theory-symbol}`.

All symbols macros were designed with ease of use in mind: they are called with a trailing slash, they can be called in text mode or in math mode, a variant with relation spacing for math mode exists with suffix “relation”.

2.2.1 General macros

\GTS@newcommand This macro will enforce that the other macros are called with a trailing slash, avoiding problems with spaces after macro call.

Arguments:

`{<commandname>}` The name of the command to create.

`{<commandcode>}` The code of the command to create.

\GTS@newprotectedcommand This macro will enforce that the other macros are called with a trailing slash, avoiding problems with spaces after macro call.

Arguments:

`{<commandname>}` The name of the command to create.

`{<commandcode>}` The code of the command to create.

\GTSsetMainColor This macro will set the main color used in GraphTheorySymbol. This color has initial value “black”.

Argument:

`{<color>}` The color that must be used by GraphTheorySymbol afterward.

\GTSsetSecondColor This macro will set the second color used in GraphTheorySymbol. This color has initial value “gray”.

Argument:

`{<color>}` The color that must be used by GraphTheorySymbol afterward.

2.2.2 Standard adjacency macros

\GTS@a This macro will draw any of the adjacency symbols if the correct arguments are given. It is not expected to be used directly. See the macros derived from it and **\GTS@b**: **\GTSxadjacency**, **\GTSxadj**, and **\GTSxa**.

Arguments:

`{<mainColor>}` If non-empty, this color will be used as main color.

`{<secondColor>}` If non-empty, this color will be used as second color.

`{<drawSlash>}` Non-empty implies that a negation will be drawn.

`{<drawUpArrow>}` Non-empty implies that an up-arrow will be drawn.

`{<drawDownArrow>}` Non-empty implies that a down-arrow will be drawn.

\GTS@b This macro builds on top of **\GTS@a** to handle mathematical relation spacing if sixth argument is not empty. It is not expected to be used directly. See the macros derived from it and **\GTS@a**: **\GTSxadjacency**, **\GTSxadj**, and **\GTSxa**.

Arguments:

`{<mainColor>}` If non-empty, this color will be used as main color.

`{<secondColor>}` If non-empty, this color will be used as second color.

`{<drawSlash>}` Non-empty implies that a negation will be drawn.

`{<drawUpArrow>}` Non-empty implies that an up-arrow will be drawn.

`{<drawDownArrow>}` Non-empty implies that a down-arrow will be drawn.

`{<relation>}` Non-empty implies that relation spacing will be added.

\GTSxadjacency, **\GTSxadj**, **\GTSxa** Versatile macros for adjacency that can be given options.

Argument:

`[<optionsList>]` Sets the following options if not empty:

`mainColor=color1` or `mainC=color1` or `mColor=color1` or `mC=color1`,

`secondColor=color2` or `secondC=color2` or `sColor=color2` or `sC=color2`,

`monochrome` or `mono` or `mon` or `m` (equivalent to `mC=black,sC=black`),

`negated` or `not` or `n`,

up or u,
down or d,
relation or rel or r.

\GTSadjacency, \GTSadj, \GTSa This macro will draw an adjacency symbol. A first drawing didn't include the small dots in the middle of the two circles corresponding to the graph vertices. But it was too similar to “spoon” and multimap symbols, and could be confused with a graph with only two vertices and one edge. Hence, these dots were added and they have the nice property to remind of the classical textual notation of adjacency relation as Adj(.,.).

A.\GTSadjacency/A.
or A.\GTSadj/A.
or A.\GTSa/A.
will yield $A \circ A$.
u \GTSadjacency/ v
or u \GTSadj/ v
or u \GTSa/ v
will yield $u \circ v$.
\$u \GTSadjacency/ v\$
or \$u \GTSadj/ v\$
or \$u \GTSa/ v\$
will yield $u \circ v$.

\GTSadjacencyRelation, \GTSadjRel, \GTSaR This macro will draw an adjacency symbol.
\$u\GTSadjacencyRelation/v\$
or \$u\GTSadjRel/v\$
or \$u\GTSaR/v\$
will yield $u \circ v$.

\GTSunadjacency, \GTSunadj, \GTSu This macro will draw an unadjacency symbol.
A.\GTSunadjacency/A.
or A.\GTSunadj/A.
or A.\GTSu/A.
will yield $A \oslash A$.
u \GTSunadjacency/ v
or u \GTSunadj/ v
or u \GTSu/ v
will yield $u \oslash v$.
\$u \GTSunadjacency/ v\$
or \$u \GTSunadj/ v\$
or \$u \GTSu/ v\$
will yield $u \oslash v$.

\GTSunadjacencyRelation, \GTSunadjRel, \GTSuR This macro will draw an unadjacency symbol.
\$u\GTSunadjacencyRelation/v\$
or \$u\GTSunadjRel/v\$
or \$u\GTSuR/v\$
will yield $u \oslash v$.

\GTSdirectedAdjacencyUp, \GTSdirAdjUp, \GTSdAU This macro will draw a directed adjacency upward symbol. The operand on the left of the symbol should be considered the source of the arc; the operand on the right of the symbol should be considered the target of the arc.

A.\GTSdirectedAdjacencyUp/A.
or A.\GTSdirAdjUp/A.
or A.\GTSdAU/A.
will yield $A \circlearrowright A$.
u \GTSdirectedAdjacencyUp/ v
or u \GTSdirAdjUp/ v
or u \GTSdAU/ v
will yield $u \circlearrowright v$.

`\GTSdirectedAdjacencyUp/ v$`
or `\GTSdirAdjUp/ v$`
or `\GTSdAU/ v$`
will yield $u \overset{\circ}{\rightharpoonup} v$.

`\GTSdirectedAdjacencyUpRelation, \GTSdirAdjUpRel, \GTSdAUR` This macro will draw a directed adjacency upward symbol with relation spacing in math mode.
`\GTSdirectedAdjacencyUpRelation/v$`
or `\GTSdirAdjUpRel/v$`
or `\GTSdAUR/v$`
will yield $u \overset{\circ}{\rightharpoonup} v$.

`\GTSnegatedDirectedAdjacencyUp, \GTSnegDirAdjUp, \GTSnDAU` This macro will draw a negated directed adjacency upward symbol.
`A.\GTSnegatedDirectedAdjacencyUp/A.`
or `A.\GTSnegDirAdjUp/A.`
or `A.\GTSnDAU/A.`
will yield $A \overset{\circ}{\nrightarrow} A$.
`u \GTSnegatedDirectedAdjacencyUp/ v`
or `u \GTSnegDirAdjUp/ v`
or `u \GTSnDAU/ v`
will yield $u \overset{\circ}{\nrightarrow} v$.
`$u \GTSnegatedDirectedAdjacencyUp/ v$`
or `$u \GTSnegDirAdjUp/ v$`
or `$u \GTSnDAU/ v$`
will yield $u \overset{\circ}{\nrightarrow} v$.

`\GTSnegatedDirectedAdjacencyUpRelation, \GTSnegDirAdjUpRel, \GTSnDAUR` This macro will draw a negated directed adjacency upward symbol with relation spacing in math mode.
`$u\GTSnegatedDirectedAdjacencyUpRelation/v$`
or `$u\GTSnegDirAdjUpRel/v$`
or `$u\GTSnDAUR/v$`
will yield $u \overset{\circ}{\nrightarrow} v$.

`\GTSdirectedAdjacencyDown, \GTSdirAdjDown, \GTSdAD` This macro will draw a directed adjacency downward symbol. The operand on the left of the symbol should be considered the target of the arc; the operand on the right of the symbol should be considered the source of the arc.
`A.\GTSdirectedAdjacencyDown/A.`
or `A.\GTSdirAdjDown/A.`
or `A.\GTSnDAD/A.`
will yield $A \overset{\circ}{\searrow} A$.
`u \GTSdirectedAdjacencyDown/ v`
or `u \GTSdirAdjDown/ v`
or `u \GTSnDAD/ v`
will yield $u \overset{\circ}{\searrow} v$.
`$u \GTSdirectedAdjacencyDown/ v$`
or `$u \GTSdirAdjDown/ v$`
or `$u \GTSnDAD/ v$`
will yield $u \overset{\circ}{\searrow} v$.

`\GTSdirectedAdjacencyDownRelation, \GTSdirAdjDownRel, \GTSdADR` This macro will draw a directed adjacency downward symbol with relation spacing in math mode.
`$u\GTSdirectedAdjacencyDownRelation/v$`
or `$u\GTSdirAdjDownRel/v$`
or `$u\GTSdADR/v$`
will yield $u \overset{\circ}{\searrow} v$.

`\GTSnegatedDirectedAdjacencyDown, \GTSnegDirAdjDown, \GTSnDAD` This macro will draw a negated directed adjacency downward symbol.
`A.\GTSnegatedDirectedAdjacencyDown/A.`

`or A.\GTSnegDirAdjDown/A.`
`or A.\GTSnDAD/A.`
 will yield $A \not\sim A$.
`u \GTSnegatedDirectedAdjacencyDown/ v`
`or u \GTSnegDirAdjDown/ v`
`or u \GTSnDAD/ v`
 will yield $u \not\sim v$.
`$u \GTSnegatedDirectedAdjacencyDown/ v$`
`or $u \GTSnegDirAdjDown/ v$`
`or $u \GTSnDAD/ v$`
 will yield $u \not\sim v$.

`\GTSnegatedDirectedAdjacencyDownRelation, \GTSnegDirAdjDownRel, \GTSnDADR`
 This macro will draw a negated directed adjacency downward symbol with relation spacing in math mode.

`$u\GTSnegatedDirectedAdjacencyDownRelation/v$`
`or $u\GTSnegDirAdjDownRel/v$`
`or $u\GTSnDADR/v$`
 will yield $u \not\sim v$.

2.2.3 Standard incidence macros

`\GTS@i` This macro will draw any of the incidence symbols if the correct arguments are given. It is not expected to be used directly. See the macros derived from it and `\GTS@j: \GTSxincidence, \GTSxinc, and \GTSxi`. The operand on the left of the symbol should be considered the vertex to which the edge/the operand on the right of the symbol is incident.

Arguments:

`{\langle mainColor \rangle}` If non-empty, this color will be used as main color.
`{\langle secondColor \rangle}` If non-empty, this color will be used as second color.
`{\langle drawSlash \rangle}` Non-empty implies that a negation will be drawn.
`{\langle drawUpArrow \rangle}` Non-empty implies that an up-arrow will be drawn.
`{\langle drawDownArrow \rangle}` Non-empty implies that a down-arrow will be drawn.

`\GTS@j` This macro builds on top of `\GTS@i` to handle mathematical relation spacing if sixth argument is not empty. It is not expected to be used directly. See the macros derived from it and `\GTS@i: \GTSxincidence, \GTSxinc, and \GTSxi`.

Arguments:

`{\langle mainColor \rangle}` If non-empty, this color will be used as main color.
`{\langle secondColor \rangle}` If non-empty, this color will be used as second color.
`{\langle drawSlash \rangle}` Non-empty implies that a negation will be drawn.
`{\langle drawUpArrow \rangle}` Non-empty implies that an up-arrow will be drawn.
`{\langle drawDownArrow \rangle}` Non-empty implies that a down-arrow will be drawn.
`{\langle relation \rangle}` Non-empty implies that relation spacing will be added.

`\GTSxincidence, \GTSxinc, \GTSxi` Versatile macros for incidence that can be given options.

Argument:

`[\langle optionsList \rangle]` Sets the following options if not empty:
`mainColor=color1 or mainC=color1 or mColor=color1 or mC=color1,`
`secondColor=color2 or secondC=color2 or sColor=color2 or sC=color2,`
`monochrome or mono or mon or m (equivalent to mC=black,sC=black),`
`negated or not or n,`
`in or i,`
`out or o,`
`relation or rel or r.`

`\GTSincidence, \GTSinc, \GTSi` This macro will draw an incidence symbol. The operand on the left of the symbol should be considered the vertex to which the edge/the operand on the right of the symbol is incident.

`A.\GTSincidence/A.`
`or A.\GTSinc/A.`

or $A.\backslash\text{GTSi}/A.$
 will yield $A.\downarrow A.$
 $v \backslash\text{GTSincidence}/ e$
 or $v \backslash\text{GTSinc}/ e$
 or $v \backslash\text{GTSi}/ e$
 will yield $v \downarrow e.$
 $\$v \backslash\text{GTSincidence}/ e\$$
 or $\$v \backslash\text{GTSinc}/ e\$$
 or $\$v \backslash\text{GTSi}/ e\$$
 will yield $v \downarrow e.$

$\backslash\text{GTSincidenceRelation}, \backslash\text{GTSincRel}, \backslash\text{GTSiR}$ This macro will draw an incidence symbol with relation spacing in math mode.
 $\$v\backslash\text{GTSincidenceRelation}/e\$$
 or $\$v\backslash\text{GTSincRel}/e\$$
 or $\$v\backslash\text{GTSiR}/e\$$
 will yield $v \downarrow e.$

$\backslash\text{GTSnegatedIncidence}, \backslash\text{GTSnegInc}, \backslash\text{GTSnI}$ This macro will draw a negated incidence symbol.
 $A.\backslash\text{GTSnegatedIncidence}/A.$
 or $A.\backslash\text{GTSnegInc}/A.$
 or $A.\backslash\text{GTSnI}/A.$
 will yield $A.\not\downarrow A.$
 $v \backslash\text{GTSnegatedIncidence}/ e$
 or $v \backslash\text{GTSnegInc}/ e$
 or $v \backslash\text{GTSnI}/ e$
 will yield $v \not\downarrow e.$
 $\$v \backslash\text{GTSnegatedIncidence}/ e\$$
 or $\$v \backslash\text{GTSnegInc}/ e\$$
 or $\$v \backslash\text{GTSnI}/ e\$$
 will yield $v \not\downarrow e.$

$\backslash\text{GTSnegatedIncidenceRelation}, \backslash\text{GTSnegIncRel}, \backslash\text{GTSnIR}$ This macro will draw a negated incidence symbol with relation spacing in math mode.
 $\$v\backslash\text{GTSnegatedIncidenceRelation}/e\$$
 or $\$v\backslash\text{GTSnegIncRel}/e\$$
 or $\$v\backslash\text{GTSnIR}/e\$$
 will yield $v \not\downarrow e.$

$\backslash\text{GTSoutIncidence}, \backslash\text{GTSoutInc}, \backslash\text{GTSoI}$ This macro will draw a directed incidence upward (out(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.
 $A.\backslash\text{GTSoutIncidence}/A.$
 or $A.\backslash\text{GTSoutInc}/A.$
 or $A.\backslash\text{GTSoI}/A.$
 will yield $A.\uparrow A.$
 $v \backslash\text{GTSoutIncidence}/ e$
 or $v \backslash\text{GTSoutInc}/ e$
 or $v \backslash\text{GTSoI}/ e$
 will yield $v \uparrow e.$
 $\$v \backslash\text{GTSoutIncidence}/ e\$$
 or $\$v \backslash\text{GTSoutInc}/ e\$$
 or $\$v \backslash\text{GTSoI}/ e\$$
 will yield $v \uparrow e.$

$\backslash\text{GTSoutIncidenceRelation}, \backslash\text{GTSoutIncRel}, \backslash\text{GTSoIR}$ This macro will draw a directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.
 $\$v\backslash\text{GTSoutIncidenceRelation}/e\$$
 or $\$v\backslash\text{GTSoutIncRel}/e\$$

or $\$v\backslash\text{GTS}\text{OIR}/e\$$
will yield $v \nrightarrow e$.

$\backslash\text{GTSnegatedOutIncidence}$, $\backslash\text{GTSnegOutInc}$, $\backslash\text{GTSnOI}$ This macro will draw a negated directed incidence upward (out(ward) incidence) symbol.

$A.\backslash\text{GTSnegatedOutIncidence}/A.$
or $A.\backslash\text{GTSnegOutInc}/A.$
or $A.\backslash\text{GTSnOI}/A.$
will yield $A.\nrightarrow A.$
 $v \backslash\text{GTSnegatedOutIncidence}/ e$
or $v \backslash\text{GTSnegOutInc}/ e$
or $v \backslash\text{GTSnOI}/ e$
will yield $v \nrightarrow e$.
 $\$v \backslash\text{GTSnegatedOutIncidence}/ e\$$
or $\$v \backslash\text{GTSnegOutInc}/ e\$$
or $\$v \backslash\text{GTSnOI}/ e\$$
will yield $v \nrightarrow e$.

$\backslash\text{GTSnegatedOutIncidenceRelation}$, $\backslash\text{GTSnegOutIncRel}$, $\backslash\text{GTSnOIR}$ This macro will draw a negated directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.

$\$v\backslash\text{GTSnegatedOutIncidenceRelation}/e\$$
or $\$v\backslash\text{GTSnegOutIncRel}/e\$$
or $\$v\backslash\text{GTSnOIR}/e\$$
will yield $v \nrightarrow e$.

$\backslash\text{GTSinIncidence}$, $\backslash\text{GTSinInc}$, $\backslash\text{GTSiI}$ This macro will draw a directed incidence downward (in(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.

$A.\backslash\text{GTSinIncidence}/A.$
or $A.\backslash\text{GTSinInc}/A.$
or $A.\backslash\text{GTSiI}/A.$
will yield $A.\rightarrow A.$
 $v \backslash\text{GTSinIncidence}/ e$
or $v \backslash\text{GTSinInc}/ e$
or $v \backslash\text{GTSiI}/ e$
will yield $v \rightarrow e$.
 $\$v \backslash\text{GTSinIncidence}/ e\$$
or $\$v \backslash\text{GTSinInc}/ e\$$
or $\$v \backslash\text{GTSiI}/ e\$$
will yield $v \rightarrow e$.

$\backslash\text{GTSinIncidenceRelation}$, $\backslash\text{GTSinIncRel}$, $\backslash\text{GTSiIR}$ This macro will draw a directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.

$\$v\backslash\text{GTSinIncidenceRelation}/e\$$
or $\$v\backslash\text{GTSinIncRel}/e\$$
or $\$v\backslash\text{GTSiIR}/e\$$
will yield $v \rightarrow e$.

$\backslash\text{GTSnegatedInIncidence}$, $\backslash\text{GTSnegInInc}$, $\backslash\text{GTSnII}$ This macro will draw a negated directed incidence downward (in(ward) incidence) symbol.

$A.\backslash\text{GTSnegatedInIncidence}/A.$
or $A.\backslash\text{GTSnegInInc}/A.$
or $A.\backslash\text{GTSnII}/A.$
will yield $A.\nrightarrow A.$
 $v \backslash\text{GTSnegatedInIncidence}/ e$
or $v \backslash\text{GTSnegInInc}/ e$
or $v \backslash\text{GTSnII}/ e$
will yield $v \nrightarrow e$.
 $\$v \backslash\text{GTSnegatedInIncidence}/ e\$$

or $\$v \backslash\text{GTSnegInInc}/ e\$$
or $\$v \backslash\text{GTSnII}/ e\$$
will yield $v \not\bowtie e$.

$\backslash\text{GTSnegatedInIncidenceRelation}$, $\backslash\text{GTSnegInIncRel}$, $\backslash\text{GTSnIIR}$ This macro will draw a negated directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.
 $\$v\backslash\text{GTSnegatedInIncidenceRelation}/e\$$
or $\$v\backslash\text{GTSnegInIncRel}/e\$$
or $\$v\backslash\text{GTSnIIR}/e\$$
will yield $v \not\bowtie e$.

2.2.4 Monochrome adjacency macros

$\backslash\text{GTSadjacencyMonochrome}$, $\backslash\text{GTSadjMono}$, $\backslash\text{GTSadjMon}$, $\backslash\text{GTSaM}$ This macro will draw a monochrome adjacency symbol.
 $A.\backslash\text{GTSadjacencyMonochrome}/A.$
or $A.\backslash\text{GTSadjMono}/A.$
or $A.\backslash\text{GTSadjMon}/A.$
or $A.\backslash\text{GTSaM}/A.$
will yield $A.\circ A.$
 $u \backslash\text{GTSadjacencyMonochrome}/ v$
or $u \backslash\text{GTSadjMono}/ v$
or $u \backslash\text{GTSadjMon}/ v$
or $u \backslash\text{GTSaM}/ v$
will yield $u \circ v$.
 $\$u \backslash\text{GTSadjacencyMonochrome}/ v\$$
or $\$u \backslash\text{GTSadjMono}/ v\$$
or $\$u \backslash\text{GTSadjMon}/ v\$$
or $\$u \backslash\text{GTSaM}/ v\$$
will yield $u \circ v$.

$\backslash\text{GTSadjacencyMonochromeRelation}$, $\backslash\text{GTSadjMonoRel}$, $\backslash\text{GTSadjMonRel}$, $\backslash\text{GTSaMR}$
This macro will draw a monochrome adjacency symbol with relation spacing in math mode.
 $\$u\backslash\text{GTSadjacencyMonochromeRelation}/v\$$
or $\$u\backslash\text{GTSadjMonoRel}/v\$$
or $\$u\backslash\text{GTSadjMonRel}/v\$$
or $\$u\backslash\text{GTSaMR}/v\$$
will yield $u \circ v$.

$\backslash\text{GTSunadjacencyMonochrome}$, $\backslash\text{GTSunadjMono}$, $\backslash\text{GTSunadjMon}$, $\backslash\text{GTSuM}$ This macro will draw a monochrome unadjacency symbol.
 $A.\backslash\text{GTSunadjacencyMonochrome}/A.$
or $A.\backslash\text{GTSunadjMono}/A.$
or $A.\backslash\text{GTSunadjMon}/A.$
or $A.\backslash\text{GTSuM}/A.$
will yield $A.\circ A.$
 $u \backslash\text{GTSunadjacencyMonochrome}/ v$
or $u \backslash\text{GTSunadjMono}/ v$
or $u \backslash\text{GTSunadjMon}/ v$
or $u \backslash\text{GTSuM}/ v$
will yield $u \circ v$.
 $\$u \backslash\text{GTSunadjacencyMonochrome}/ v\$$
or $\$u \backslash\text{GTSunadjMono}/ v\$$
or $\$u \backslash\text{GTSunadjMon}/ v\$$
or $\$u \backslash\text{GTSuM}/ v\$$
will yield $u \circ v$.

$\backslash\text{GTSunadjacencyMonochromeRelation}$, $\backslash\text{GTSunadjMonoRel}$, $\backslash\text{GTSunadjMonRel}$, $\backslash\text{GTSuMR}$ This macro will draw a monochrome unadjacency symbol with relation spacing in math mode.
 $\$u\backslash\text{GTSunadjacencyMonochromeRelation}/v\$$

or $\$u\backslash\text{GTSunadjMonoRel}/v\$$
or $\$u\backslash\text{GTSunadjMonRel}/v\$$
or $\$u\backslash\text{GTSuMR}/v\$$
will yield $u \overset{\circ}{\circ} v$.

$\backslash\text{GTSdirectedAdjacencyUpMonochrome}$, $\backslash\text{GTSdirAdjUpMono}$, $\backslash\text{GTSdirAdjUpMon}$, $\backslash\text{GTSdAUM}$ This macro will draw a monochrome directed adjacency upward symbol. The operand on the left of the symbol should be considered the source of the arc; the operand on the right of the symbol should be considered the target of the arc.
 $\text{A}.\backslash\text{GTSdirectedAdjacencyUpMonochrome}/\text{A}.$
or $\text{A}.\backslash\text{GTSdirAdjUpMono}/\text{A}.$
or $\text{A}.\backslash\text{GTSdirAdjUpMon}/\text{A}.$
or $\text{A}.\backslash\text{GTSdAUM}/\text{A}.$
will yield $\text{A}.\overset{\circ}{\circ}\text{A}.$
 $u \backslash\text{GTSdirectedAdjacencyUpMonochrome}/ v$
or $u \backslash\text{GTSdirAdjUpMono}/ v$
or $u \backslash\text{GTSdirAdjUpMon}/ v$
or $u \backslash\text{GTSdAUM}/ v$
will yield $u \overset{\circ}{\circ} v$.
 $\$u \backslash\text{GTSdirectedAdjacencyUpMonochrome}/ v\$$
or $\$u \backslash\text{GTSdirAdjUpMono}/ v\$$
or $\$u \backslash\text{GTSdirAdjUpMon}/ v\$$
or $\$u \backslash\text{GTSdAUM}/ v\$$
will yield $u \overset{\circ}{\circ} v$.

$\backslash\text{GTSdirectedAdjacencyUpMonochromeRelation}$, $\backslash\text{GTSdirAdjUpMonoRel}$, $\backslash\text{GTSdirAdjUpMonRel}$, $\backslash\text{GTSdAUMR}$ This macro will draw a monochrome directed adjacency upward symbol with relation spacing in math mode.
 $\$u\backslash\text{GTSdirectedAdjacencyUpMonochromeRelation}/v\$$
or $\$u\backslash\text{GTSdirAdjUpMonoRel}/v\$$
or $\$u\backslash\text{GTSdirAdjUpMonRel}/v\$$
or $\$u\backslash\text{GTSdAUMR}/v\$$
will yield $u \overset{\circ}{\circ} v$.

$\backslash\text{GTSnegatedDirectedAdjacencyUpMonochrome}$, $\backslash\text{GTSnegDirAdjUpMono}$, $\backslash\text{GTSnegDirAdjUpMon}$, $\backslash\text{GTSnDAUM}$ This macro will draw a monochrome negated directed adjacency upward symbol.
 $\text{A}.\backslash\text{GTSnegatedDirectedAdjacencyUpMonochrome}/\text{A}.$
or $\text{A}.\backslash\text{GTSnegDirAdjUpMono}/\text{A}.$
or $\text{A}.\backslash\text{GTSnegDirAdjUpMon}/\text{A}.$
or $\text{A}.\backslash\text{GTSnDAUM}/\text{A}.$
will yield $\text{A}.\overset{\circ}{\circ}\text{A}.$
 $u \backslash\text{GTSnegatedDirectedAdjacencyUpMonochrome}/ v$
or $u \backslash\text{GTSnegDirAdjUpMono}/ v$
or $u \backslash\text{GTSnegDirAdjUpMon}/ v$
or $u \backslash\text{GTSnDAUM}/ v$
will yield $u \overset{\circ}{\circ} v$.
 $\$u \backslash\text{GTSnegatedDirectedAdjacencyUpMonochrome}/ v\$$
or $\$u \backslash\text{GTSnegDirAdjUpMono}/ v\$$
or $\$u \backslash\text{GTSnegDirAdjUpMon}/ v\$$
or $\$u \backslash\text{GTSnDAUM}/ v\$$
will yield $u \overset{\circ}{\circ} v$.

$\backslash\text{GTSnegatedDirectedAdjacencyUpMonochromeRelation}$, $\backslash\text{GTSnegDirAdjUpMonoRel}$, $\backslash\text{GTSnegDirAdjUpMonRel}$, $\backslash\text{GTSnDAUMR}$ This macro will draw a monochrome negated directed adjacency upward symbol with relation spacing in math mode.
 $\$u\backslash\text{GTSnegatedDirectedAdjacencyUpMonochromeRelation}/v\$$
or $\$u\backslash\text{GTSnegDirAdjUpMonoRel}/v\$$
or $\$u\backslash\text{GTSnegDirAdjUpMonRel}/v\$$

or $\$u\backslash\text{GTSnDAUMR}/v\$$
will yield $u \stackrel{\circ}{\circ} v$.

$\backslash\text{GTSdirectedAdjacencyDownMonochrome}$, $\backslash\text{GTSdirAdjDownMono}$, $\backslash\text{GTSdirAdjDownMon}$, $\backslash\text{GTSdADM}$ This macro will draw a monochrome directed adjacency downward symbol. The operand on the left of the symbol should be considered the target of the arc; the operand on the right of the symbol should be considered the source of the arc.

$A.\backslash\text{GTSdirectedAdjacencyDownMonochrome}/A.$

or $A.\backslash\text{GTSdirAdjDownMono}/A.$

or $A.\backslash\text{GTSdirAdjDownMon}/A.$

or $A.\backslash\text{GTSdADM}/A.$

will yield $A.\stackrel{\circ}{\circ}A.$

$u \backslash\text{GTSdirectedAdjacencyDownMonochrome}/ v$

or $u \backslash\text{GTSdirAdjDownMono}/ v$

or $u \backslash\text{GTSdirAdjDownMon}/ v$

or $u \backslash\text{GTSdADM}/ v$

will yield $u \stackrel{\circ}{\circ} v$.

$\$u \backslash\text{GTSdirectedAdjacencyDownMonochrome}/ v\$$

or $\$u \backslash\text{GTSdirAdjDownMono}/ v\$$

or $\$u \backslash\text{GTSdirAdjDownMon}/ v\$$

or $\$u \backslash\text{GTSdADM}/ v\$$

will yield $u \stackrel{\circ}{\circ} v$.

$\backslash\text{GTSdirectedAdjacencyDownMonochromeRelation}$, $\backslash\text{GTSdirAdjDownMonoRel}$, $\backslash\text{GTSdirAdjDownMonRel}$, $\backslash\text{GTSdADMR}$ This macro will draw a monochrome directed adjacency downward symbol with relation spacing in math mode.

$\$u\backslash\text{GTSdirectedAdjacencyDownMonochromeRelation}/v\$$

or $\$u\backslash\text{GTSdirAdjDownMonoRel}/v\$$

or $\$u\backslash\text{GTSdirAdjDownMonRel}/v\$$

or $\$u\backslash\text{GTSdADMR}/v\$$

will yield $u \stackrel{\circ}{\circ} v$.

$\backslash\text{GTSnegatedDirectedAdjacencyDownMonochrome}$, $\backslash\text{GTSnegDirAdjDownMono}$, $\backslash\text{GTSnegDirAdjDownMon}$, $\backslash\text{GTSnDADM}$ This macro will draw a monochrome negated directed adjacency downward symbol.

$A.\backslash\text{GTSnegatedDirectedAdjacencyDownMonochrome}/A.$

or $A.\backslash\text{GTSnegDirAdjDownMono}/A.$

or $A.\backslash\text{GTSnegDirAdjDownMon}/A.$

or $A.\backslash\text{GTSnDADM}/A.$

will yield $A.\stackrel{\circ}{\circ}A.$

$u \backslash\text{GTSnegatedDirectedAdjacencyDownMonochrome}/ v$

or $u \backslash\text{GTSnegDirAdjDownMono}/ v$

or $u \backslash\text{GTSnegDirAdjDownMon}/ v$

or $u \backslash\text{GTSnDADM}/ v$

will yield $u \stackrel{\circ}{\circ} v$.

$\$u \backslash\text{GTSnegatedDirectedAdjacencyDownMonochrome}/ v\$$

or $\$u \backslash\text{GTSnegDirAdjDownMono}/ v\$$

or $\$u \backslash\text{GTSnegDirAdjDownMon}/ v\$$

or $\$u \backslash\text{GTSnDADM}/ v\$$

will yield $u \stackrel{\circ}{\circ} v$.

$\backslash\text{GTSnegatedDirectedAdjacencyDownMonochromeRelation}$, $\backslash\text{GTSnegDirAdjDownMonoRel}$, $\backslash\text{GTSnegDirAdjDownMonRel}$, $\backslash\text{GTSnDADMR}$ This macro will draw a monochrome negated directed adjacency downward symbol with relation spacing in math mode.

$\$u\backslash\text{GTSnegatedDirectedAdjacencyDownMonochromeRelation}/v\$$

or $\$u\backslash\text{GTSnegDirAdjDownMonoRel}/v\$$

or $\$u\backslash\text{GTSnegDirAdjDownMonRel}/v\$$

or $\$u\backslash\text{GTSnDADMR}/v\$$

will yield $u \stackrel{\circ}{\circ} v$.

2.2.5 Monochrome incidence macros

\GTSincidenceMonochrome, \GTSincMono, \GTSincMon, \GTSiM This macro will draw a monochrome incidence symbol. The operand on the left of the symbol should be considered the vertex to which the edge/the operand on the right of the symbol is incident.

A.\GTSincidenceMonochrome/A.

or **A.\GTSincMono/A.**

or **A.\GTSincMon/A.**

or **A.\GTSiM/A.**

will yield $A \downarrow A$.

v \GTSincidenceMonochrome/ e

or **v \GTSincMono/ e**

or **v \GTSincMon/ e**

or **v \GTSiM/ e**

will yield $v \downarrow e$.

\$v \GTSincidenceMonochrome/ e\$

or **\$v \GTSincMono/ e\$**

or **\$v \GTSincMon/ e\$**

or **\$v \GTSiM/ e\$**

will yield $v \downarrow e$.

\GTSincidenceMonochromeRelation, \GTSincMonoRel, \GTSincMonRel, \GTSiMR

This macro will draw a monochrome incidence symbol with relation spacing in math mode.

\$v\GTSincidenceMonochromeRelation/e\$

or **\$v\GTSincMonoRel/e\$**

or **\$v\GTSincMonRel/e\$**

or **\$v\GTSiMR/e\$**

will yield $v \downarrow e$.

\GTSnegatedIncidenceMonochrome, \GTSnegIncMono, \GTSnegIncMon, \GTSnIM

This macro will draw a monochrome negated incidence symbol.

A.\GTSnegatedIncidenceMonochrome/A.

or **A.\GTSnegIncMono/A.**

or **A.\GTSnegIncMon/A.**

or **A.\GTSnIM/A.**

will yield $A \not\downarrow A$.

v \GTSnegatedIncidenceMonochrome/ e

or **v \GTSnegIncMono/ e**

or **v \GTSnegIncMon/ e**

or **v \GTSnIM/ e**

will yield $v \not\downarrow e$.

\$v \GTSnegatedIncidenceMonochrome/ e\$

or **\$v \GTSnegIncMono/ e\$**

or **\$v \GTSnegIncMon/ e\$**

or **\$v \GTSnIM/ e\$**

will yield $v \not\downarrow e$.

\GTSnegatedIncidenceMonochromeRelation, \GTSnegIncMonoRel, \GTSnegIncMon-

Rel, \GTSnIMR This macro will draw a monochrome negated incidence symbol with relation spacing in math mode.

\$v\GTSnegatedIncidenceMonochromeRelation/e\$

or **\$v\GTSnegIncMonoRel/e\$**

or **\$v\GTSnegIncMonRel/e\$**

or **\$v\GTSnIMR/e\$**

will yield $v \not\downarrow e$.

\GTSoutIncidenceMonochrome, \GTSoutIncMono, \GTSoutIncMon, \GTSoIM This

macro will draw a monochrome directed incidence upward (out(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.

A.\GTSoutIncidenceMonochrome/A.

`or A.\GTSoutIncMono/A.`
`or A.\GTSoutIncMon/A.`
`or A.\GTSOIM/A.`
 will yield $A \downarrow A$.
`v \GTSoutIncidenceMonochrome/ e`
`or v \GTSoutIncMono/ e`
`or v \GTSoutIncMon/ e`
`or v \GTSOIM/ e`
 will yield $v \downarrow e$.
`$v \GTSoutIncidenceMonochrome/ e$`
`or $v \GTSoutIncMono/ e$`
`or $v \GTSoutIncMon/ e$`
`or $v \GTSOIM/ e$`
 will yield $v \downarrow e$.

`\GTSoutIncidenceMonochromeRelation, \GTSoutIncMonoRel, \GTSoutIncMonRel, \GTSOIMR` This macro will draw a monochrome directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.
`$v \GTSoutIncidenceMonochromeRelation/e$`
`or $v \GTSoutIncMonoRel/e$`
`or $v \GTSoutIncMonRel/e$`
`or $v \GTSOIMR/e$`
 will yield $v \downarrow e$.

`\GTSnegatedOutIncidenceMonochrome, \GTSnegOutIncMono, \GTSnegOutIncMon, \GTSnOIM` This macro will draw a monochrome negated directed incidence upward (out(ward) incidence) symbol.
`A.\GTSnegatedOutIncidenceMonochrome/A.`
`or A.\GTSnegOutIncMono/A.`
`or A.\GTSnegOutIncMon/A.`
`or A.\GTSnOIM/A.`
 will yield $A \uparrow A$.
`v \GTSnegatedOutIncidenceMonochrome/ e`
`or v \GTSnegOutIncMono/ e`
`or v \GTSnegOutIncMon/ e`
`or v \GTSnOIM/ e`
 will yield $v \uparrow e$.
`$v \GTSnegatedOutIncidenceMonochrome/ e$`
`or $v \GTSnegOutIncMono/ e$`
`or $v \GTSnegOutIncMon/ e$`
`or $v \GTSnOIM/ e$`
 will yield $v \uparrow e$.

`\GTSnegatedOutIncidenceMonochromeRelation, \GTSnegOutIncMonoRel, \GTSnegOutIncMonRel, \GTSnOIMR` This macro will draw a monochrome negated directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.
`$v \GTSnegatedOutIncidenceMonochromeRelation/e$`
`or $v \GTSnegOutIncMonoRel/e$`
`or $v \GTSnegOutIncMonRel/e$`
`or $v \GTSnOIMR/e$`
 will yield $v \uparrow e$.

`\GTSinIncidenceMonochrome, \GTSinIncMono, \GTSinIncMon, \GTSiIM` This macro will draw a monochrome directed incidence downward (in(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.
`A.\GTSinIncidenceMonochrome/A.`
`or A.\GTSinIncMono/A.`
`or A.\GTSinIncMon/A.`
`or A.\GTSiIM/A.`

will yield $A \Downarrow A$.
 $\backslash\text{GTSinIncidenceMonochrome}/ e$
or $\backslash\text{GTSinIncMono}/ e$
or $\backslash\text{GTSinIncMon}/ e$
or $\backslash\text{GTSiIM}/ e$
will yield $v \Downarrow e$.
 $\$v \backslash\text{GTSinIncidenceMonochrome}/ e\$$
or $\$v \backslash\text{GTSinIncMono}/ e\$$
or $\$v \backslash\text{GTSinIncMon}/ e\$$
or $\$v \backslash\text{GTSiIM}/ e\$$
will yield $v \Downarrow e$.

$\backslash\text{GTSinIncidenceMonochromeRelation}$, $\backslash\text{GTSinIncMonoRel}$, $\backslash\text{GTSinIncMonRel}$, $\backslash\text{GTSiIMR}$ This macro will draw a monochrome directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.
 $\$v \backslash\text{GTSinIncidenceMonochromeRelation}/ e\$$
or $\$v \backslash\text{GTSinIncMonoRel}/ e\$$
or $\$v \backslash\text{GTSinIncMonRel}/ e\$$
or $\$v \backslash\text{GTSiIMR}/ e\$$
will yield $v \Downarrow e$.

$\backslash\text{GTSnegatedInIncidenceMonochrome}$, $\backslash\text{GTSnegInIncMono}$, $\backslash\text{GTSnegInIncMon}$, $\backslash\text{GTSniIM}$ This macro will draw a monochrome negated directed incidence downward (in(ward) incidence) symbol.
 $A.\backslash\text{GTSnegatedInIncidenceMonochrome}/ A.$
or $A.\backslash\text{GTSnegInIncMono}/ A.$
or $A.\backslash\text{GTSnegInIncMon}/ A.$
or $A.\backslash\text{GTSniIM}/ A.$
will yield $A \Downarrow A$.
 $\backslash\text{GTSnegatedInIncidenceMonochrome}/ e$
or $\backslash\text{GTSnegInIncMono}/ e$
or $\backslash\text{GTSnegInIncMon}/ e$
or $\backslash\text{GTSniIM}/ e$
will yield $v \Downarrow e$.
 $\$v \backslash\text{GTSnegatedInIncidenceMonochrome}/ e\$$
or $\$v \backslash\text{GTSnegInIncMono}/ e\$$
or $\$v \backslash\text{GTSnegInIncMon}/ e\$$
or $\$v \backslash\text{GTSniIM}/ e\$$
will yield $v \Downarrow e$.

$\backslash\text{GTSnegatedInIncidenceMonochromeRelation}$, $\backslash\text{GTSnegInIncMonoRel}$, $\backslash\text{GTSnegInIncMonRel}$, $\backslash\text{GTSniIMR}$ This macro will draw a monochrome negated directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.
 $\$v \backslash\text{GTSnegatedInIncidenceMonochromeRelation}/ e\$$
or $\$v \backslash\text{GTSnegInIncMonoRel}/ e\$$
or $\$v \backslash\text{GTSnegInIncMonRel}/ e\$$
or $\$v \backslash\text{GTSniIMR}/ e\$$
will yield $v \Downarrow e$.

2.2.6 Meta-logic macros

$\backslash\text{GTSmetaNot}$, $\backslash\text{GTSmN}$ This macro will draw a meta-not or relation-not symbol.
 $A.\backslash\text{GTSmetaNot}/ A.$
or $A.\backslash\text{GTSmN}/ A.$
will yield $A \Downarrow A$.
 $u \backslash\text{GTSmetaNot}/ \backslash\text{GTSdAU}/ v$
or $u \backslash\text{GTSmN}/ \backslash\text{GTSdAU}/ v$
will yield $u \Downarrow v$.
 $\$u \backslash\text{GTSmetaNot}/ \backslash\text{GTSdAU}/ v\$$
or $\$u \backslash\text{GTSmN}/ \backslash\text{GTSdAU}/ v\$$
will yield $u \Downarrow v$.

\GTSMetaAnd, \GTSMa This macro will draw a meta-and or relations-and symbol. This is your duty to check that all relations have same arity. It should be easy as long as you remain in the realm of graphs/2-structures/binary structures. We didn't use Tarski's notation, since square cup has taken the preemptive meaning of disjoint union. Similarly, doublewedge or other wedge symbols have taken various meanings, whilst we want an unambiguous symbol.

Look at the discussion after all logical symbols for less trivial uses and recommendations.

A.\GTSMetaAnd/A.

or A.\GTSMa/A.

will yield $A.\bigwedge A$.

u \GTSDAD/\GTSMetaAnd/\GTSDAU/ v

or u \GTSDAD/\GTSMa/\GTSDAU/ v

will yield $u \bigwedge^m v$.

\$u \GTSDAD/ \GTSMetaAnd/ \GTSDAU/ v\$

or \$u \GTSDAD/ \GTSMa/ \GTSDAU/ v\$

will yield $u \bigwedge^m v$.

\GTSMetaAndRelation, \GTSMetaAndRel, \GTSMAR This macro will draw a meta-and symbol with relation spacing in math mode.

\$u \GTSDAD/\GTSMetaAndRelation/\GTSDAU/ v\$

or \$u \GTSDAD/\GTSMetaAndRel/\GTSDAU/ v\$

or \$u \GTSDAD/\GTSMAR/\GTSDAU/ v\$

will yield $u \bigwedge^m v$.

\GTSMetaOr, \GTSMo This macro will draw a meta-or or relations-or symbol. This is your duty to check that all relations have same arity. It should be easy as long as you remain in the realm of graphs/2-structures/binary structures. We didn't use Tarski's notation, since square cup has taken the preemptive meaning of disjoint union. Similarly, doublewedge or other wedge symbols have taken various meanings, whilst we want an unambiguous symbol.

Look at the discussion after all logical symbols for less trivial uses and recommendations.

A.\GTSMetaOr/A.

or A.\GTSMo/A.

will yield $A.\bigvee A$.

u \GTSDAD/\GTSMetaOr/\GTSDAU/ v

or u \GTSDAD/\GTSMo/\GTSDAU/ v

will yield $u \bigvee^m v$.

\$u \GTSDAD/ \GTSMetaOr/ \GTSDAU/ v\$

or \$u \GTSDAD/ \GTSMo/ \GTSDAU/ v\$

will yield $u \bigvee^m v$.

\GTSMetaOrRelation, \GTSMetaOrRel, \GTSMOR This macro will draw a meta-or symbol with relation spacing in math mode.

\$u \GTSDAD/\GTSMetaOrRelation/\GTSDAU/ v\$

or \$u \GTSDAD/\GTSMetaOrRel/\GTSDAU/ v\$

or \$u \GTSDAD/\GTSMOR/\GTSDAU/ v\$

will yield $u \bigvee^m v$.

\GTsxmetallogic, \GTsxm Versatile macros for meta-logic symbols that can be given options.

Argument:

[*<optionsList>*] Sets the following options if not empty:

not or n,

and or a,

or or o,

relation or rel or r.

Of course first three options are incompatible, and the fourth is compatible only with the second and third options.

\GTsx One macro to rule them all. Versatile macro for all symbols that can be given options, and a symbol type mandatory switch.

Argument:

`[\langle optionsList \rangle]` Sets the following options if not empty:

- If $\{\langle symbolType \rangle\}$ below is a, see \GTSxa:
mainColor=color1 or mainC=color1 or mColor=color1 or mC=color1,
secondColor=color2 or secondC=color2 or sColor=color2 or sC=color2,
monochrome or mono or mon or m (equivalent to mC=black,sC=black),
negated or not or n,
up or u,
down or d,
relation or rel or r.
- If $\{\langle symbolType \rangle\}$ below is i, see \GTSxi:
mainColor=color1 or mainC=color1 or mColor=color1 or mC=color1,
secondColor=color2 or secondC=color2 or sColor=color2 or sC=color2,
monochrome or mono or mon or m (equivalent to mC=black,sC=black),
negated or not or n,
in or i,
out or o,
relation or rel or r.
- If $\{\langle symbolType \rangle\}$ below is m, see \GTSxml:
not or n,
and or a,
or or o,
relation or rel or r.

`{⟨symbolType⟩}` a mandatory switch; it can take value `a` for adjacency, `i` for incidence, `m` for meta-logic.

2.3 Good practices

As is customary in algebra and logic, the conjunction/multiplication can be replaced by concatenation, and has higher priority than disjunction. So the following formulas are equivalent; we recommend using the shortest one:

Tournament adjacency:

$$\forall u, v, u \text{ --- } \bigvee^m \text{ --- } v$$

is preferred over

$$\forall u, v, u \text{ --- } \bigwedge \bigvee \bigwedge \bigvee \bigwedge \bigvee \bigwedge \bigvee v,$$
$$\text{or } \forall u, v, u \left(\bigwedge_{i=1}^m \bigcirc_i \right) \bigvee \left(\bigwedge_{i=1}^m \bigcirc_i \right) v,$$

or even $\forall u, v, ((u \overset{\circ}{\wedge} v) \wedge (u \overset{\circ}{\vee} v)) \vee ((u \overset{\circ}{\vee} v) \wedge (u \overset{\circ}{\wedge} v))$.

Note the use of macros without Relation suffix above, and adding a single `\mathrel{}` around the composition of all relations:

$$\backslash\mathrm{mathrel}\{\backslash\mathrm{GTSdAD}/\backslash\mathrm{GTSnDAU}/\backslash\mathrm{GTSmO}/\backslash\mathrm{GTSnDAD}/\backslash\mathrm{GTSdAU}/\}.$$

This is the spacing practice that we recommend, although for very long compositions, it may be quite unreadable, and then spacing everything with Relation could/should be preferred.

We also recommend using brackets when the composition reflects all of the adjacencies between two vertices:

Tournament adjacency:

$$\forall u, v, u \left[\begin{array}{c} \textcircled{\bullet} \textcircled{\bullet} \textcircled{\bullet} \\ \textcircled{\bullet} \textcircled{\bullet} \textcircled{\bullet} \end{array} \right] v.$$

Tournament adjacency with maybe some colored edge also, who knows?:

$$\forall u, v, u \text{ --- } \overset{\text{m}}{\underset{\text{m}}{\vee}} \text{ --- } v.$$

Directed graph:

$$\forall u, v, u \left[\begin{array}{c} \text{m} \quad \text{m} \quad \text{m} \quad \text{m} \\ \text{stick} \quad \text{stick} \quad \text{stick} \quad \text{stick} \end{array} \right] v.$$

Oriented graph:

[illegible]

Finally, we recommend prefix notation without “big” symbol for a sequence of consecutive ors or ands (with parentheses if needed):

$$\exists u, v, u \left[\bigvee_{\mathbf{m}} \begin{array}{c} \text{---} \text{---} \text{---} \\ \text{---} \text{---} \text{---} \\ \text{---} \text{---} \text{---} \end{array} \right] v.$$
$$\exists v, e, v \left[\overset{\text{m}}{\underset{\text{V}}{\text{V}}} \text{---} \text{---} \text{---} \text{---} \right] e.$$

3 Implementation

```

1 \*package)
2 \RequirePackage{amsmath}
3 \RequirePackage{amssymb}
4 \RequirePackage{graphicx}
5 \RequirePackage{keyval}
6 \RequirePackage{fdsymbol}
7 \RequirePackage{lua-unicode-math}
8 \RequirePackage{xcolor}
9
10 \def\GTS@mainColor{black}
11 \def\GTS@secondColor{gray}
12 \def\GTS@mainColorBackup{black}
13 \def\GTS@secondColorBackup{gray}
14 \def\GTS@drawSlash{}
15 \def\GTS@drawUpArrow{}
16 \def\GTS@drawDownArrow{}
17

```

\GTS@newcommand This macro will enforce that the other macros are called with a trailing slash, avoiding problems with spaces after macro call.

Arguments:

{\<commandname>} The name of the command to create.

{\<commandcode>} The code of the command to create.

```

18 \ifdefinable{\GTS@newcommand}{\def\GTS@newcommand#1#2{%
19   \ifdefinable{#1}{\def#1/{#2}}
20 }}

```

\GTS@newprotectedcommand This macro will enforce that the other macros are called with a trailing slash, avoiding problems with spaces after macro call.

Arguments:

{\<commandname>} The name of the command to create.

{\<commandcode>} The code of the command to create.

```

21 \ifdefinable{\GTS@newprotectedcommand}{\def\GTS@newprotectedcommand#1#2{%
22   \ifdefinable{#1}{\protected\def#1/{#2}}
23 }}

```

\GTSsetMainColor This macro will set the main color used in GraphTheorySymbol. This color has initial value “black”.

Argument:

{\<color>} The color that must be used by GraphTheorySymbol afterward.

```

24 \newcommand{\GTSsetMainColor}[1]{%
25 \edef\GTS@mainColorTemp{#1}%
26 \edef\GTS@mainColorBackup{\GTS@mainColor}%
27 \edef\GTS@mainColor{\GTS@mainColorTemp}%
28 }

```

\GTSsetSecondColor This macro will set the second color used in GraphTheorySymbol. This color has initial value “gray”.

Argument:

{\<color>} The color that must be used by GraphTheorySymbol afterward.

```

29 \newcommand{\GTSsetSecondColor}[1]{%
30 \edef\GTS@secondColorTemp{#1}%
31 \edef\GTS@secondColorBackup{\GTS@secondColor}%
32 \edef\GTS@secondColor{\GTS@secondColorTemp}%
33 }

```

\GTS@a This macro will draw any adjacency symbol given the correct parameters. Its use is purely technical. See the macros derived from it and \GTS@b: \GTSxadjacency, \GTSxadj, and \GTSxa.

Arguments:

{\<mainColor>} If non-empty, this color will be used as main color.

{\<secondColor>} If non-empty, this color will be used as second color.

{\<drawSlash>} Non-empty implies that a negation will be drawn.

{\<drawUpArrow>} Non-empty implies that an up-arrow will be drawn.

{\<drawDownArrow>} Non-empty implies that a down-arrow will be drawn.

```

34 \newcommand{\GTS@a}[5]{%
35 \if#1\empty\else%
36 \GTSsetMainColor{#1}%
37 \fi%
38 \if#2\empty\else%
39 \GTSsetSecondColor{#2}%
40 \fi%
41 \text{\ensuremath{%
42 \raisebox{-0.32ex}{\scalebox{1.5}[1.5]{%
43 %
44 \raisebox{0.7ex}{\scalebox{0.7}[0.7]{%
45 $\mathcolor{\GTS@secondColor}{\circ}$%
46 }}%
47 \hspace{-0.39ex}%
48 \raisebox{1.05ex}{\scalebox{0.1}[0.1]{%
49 $\mathcolor{\GTS@secondColor}{\bullet}$%
50 }}%
51 \hspace{-0.12ex}%
52 \raisebox{0.11ex}{\scalebox{0.1}[0.73]{%
53 $\mathcolor{\GTS@mainColor}{\smallblacksquare}$%
54 }}%
55 \hspace{-0.40ex}%
56 \raisebox{-0.3ex}{\scalebox{0.7}[0.7]{%
57 $\mathcolor{\GTS@secondColor}{\circ}$%
58 }}%
59 \hspace{-0.39ex}%
60 \raisebox{0.05ex}{\scalebox{0.1}[0.1]{%
61 $\mathcolor{\GTS@secondColor}{\bullet}$%
62 }}%
63 \hspace{0.27ex}%
if GTS@drawUpArrow empty else
64 \if#4\empty\else%
65 \hspace{-0.65ex}%
66 \raisebox{-0.18ex}{\scalebox{0.5}[0.5]{%
67 \textcolor{\GTS@mainColor}{\textasciicircum}%
68 }}%
69 \fi%
if GTS@drawDownArrow empty else
70 \if#5\empty\else%
71 \hspace{-0.65ex}%
72 \raisebox{1.37ex}{\scalebox{0.5}[-0.5]{%
73 \textcolor{\GTS@mainColor}{\textasciicircum}%
74 }}%
75 \fi%
if GTS@drawSlash empty else
76 \if#3\empty\else%
77 \hspace{-0.65ex}%
78 \raisebox{0.25ex}{\scalebox{0.6}[0.6]{%
79 \textcolor{black}{/}%
80 }}%
81 \fi%
82 %
83 }}%
84 }}%
85 \if#1\empty\else%
86 \GTSsetMainColor{\GTS@mainColorBackup}%
87 \fi%
88 \if#2\empty\else%
89 \GTSsetSecondColor{\GTS@secondColorBackup}%
90 \fi%
91 }

```

\GTS@b This macro will handle wrapping in mathematical relation spacing if needed. Its use is purely technical. See the macros derived from it and **\GTS@a**: **\GTSxadjacency**, **\GTSxadj**, and

`\GTSxa.`

Arguments:

`{\mainColor}` If non-empty, this color will be used as main color.

`{\secondColor}` If non-empty, this color will be used as second color.

`{\drawSlash}` Non-empty implies that a negation will be drawn.

`{\drawUpArrow}` Non-empty implies that an up-arrow will be drawn.

`{\drawDownArrow}` Non-empty implies that a down-arrow will be drawn.

`{\relation}` Non-empty implies that relation spacing will be added.

```
92 \newcommand{\GTS@b}[6]{%
93 \if#61%
94 \mathrel{\GTS@a{#1}{#2}{#3}{#4}{#5}}%
95 \else%
96 \GTS@a{#1}{#2}{#3}{#4}{#5}%
97 \fi%
98 }
```

`\GTSxadjacency`, `\GTSxadj`, `\GTSxa` Versatile macros for adjacency that can be given options.

Argument:

`[\optionsList]` Sets the following options if not empty:

`mainColor=color1` or `mainC=color1` or `mColor=color1` or `mC=color1`,

`secondColor=color2` or `secondC=color2` or `sColor=color2` or `sC=color2`,

`monochrome` or `mono` or `mon` or `m` (equivalent to `mC=black,sC=black`),

`negated` or `not` or `n`,

`up` or `u`,

`down` or `d`,

`relation` or `rel` or `r`.

```
99 \define@key{GTSxa}{mainColor}{\def\GTS@@mainColor{#1}}
100 \define@key{GTSxa}{mainC}{\def\GTS@@mainColor{#1}}
101 \define@key{GTSxa}{mColor}{\def\GTS@@mainColor{#1}}
102 \define@key{GTSxa}{mC}{\def\GTS@@mainColor{#1}}
103 \define@key{GTSxa}{secondColor}{\def\GTS@@secondColor{#1}}
104 \define@key{GTSxa}{secondC}{\def\GTS@@secondColor{#1}}
105 \define@key{GTSxa}{sColor}{\def\GTS@@secondColor{#1}}
106 \define@key{GTSxa}{sC}{\def\GTS@@secondColor{#1}}
107 \define@key{GTSxa}{monochrome}[1]%
108 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
109 \define@key{GTSxa}{mono}[1]%
110 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
111 \define@key{GTSxa}{mon}[1]%
112 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
113 \define@key{GTSxa}{m}[1]%
114 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
115 \define@key{GTSxa}{negated}[1]{\def\GTS@@drawSlash{1}}
116 \define@key{GTSxa}{not}[1]{\def\GTS@@drawSlash{1}}
117 \define@key{GTSxa}{n}[1]{\def\GTS@@drawSlash{1}}
118 \define@key{GTSxa}{up}[1]{\def\GTS@@drawUpArrow{1}}
119 \define@key{GTSxa}{u}[1]{\def\GTS@@drawUpArrow{1}}
120 \define@key{GTSxa}{down}[1]{\def\GTS@@drawDownArrow{1}}
121 \define@key{GTSxa}{d}[1]{\def\GTS@@drawDownArrow{1}}
122 \define@key{GTSxa}{relation}[1]{\def\GTS@@relation{1}}
123 \define@key{GTSxa}{rel}[1]{\def\GTS@@relation{1}}
124 \define@key{GTSxa}{r}[1]{\def\GTS@@relation{1}}
125
126 \newcommand{\GTSxa}[1][]{%
127 \def\GTS@@mainColor{}%
128 \def\GTS@@secondColor{}%
129 \def\GTS@@drawSlash{}%
130 \def\GTS@@drawUpArrow{}%
131 \def\GTS@@drawDownArrow{}%
132 \def\GTS@@relation{}%
133 \setkeys{GTSxa}{#1}%
134 \GTS@b{\GTS@@mainColor}{\GTS@@secondColor}{\GTS@@drawSlash}%
135 {\GTS@@drawUpArrow}{\GTS@@drawDownArrow}{\GTS@@relation}%
136 }
137
```

138 `\newcommand{\GTSxadj}[1][\GTSxa{#1}]`

139

140 `\newcommand{\GTSxadjacency}[1][\GTSxa{#1}]`

\GTSadjacency, \GTSadj, \GTSa This macro will draw an adjacency symbol.

141 `\GTS@newcommand{\GTSadjacency}{\GTS@a{}{}{}{}}{}`

142 `\GTS@newcommand{\GTSadj}{\GTS@a{}{}{}{}}{}`

143 `\GTS@newcommand{\GTSa}{\GTS@a{}{}{}{}}{}`

\GTSadjacencyRelation, \GTSadjRel, \GTSaR This macro will draw an adjacency symbol with relation spacing in math mode.

144 `\GTS@newcommand{\GTSadjacencyRelation}{\mathrel{\GTSa/}}`

145 `\GTS@newcommand{\GTSadjRel}{\mathrel{\GTSa/}}`

146 `\GTS@newcommand{\GTSaR}{\mathrel{\GTSa/}}`

\GTSunadjacency, \GTSunadj, \GTSu This macro will draw an unadjacency symbol.

147 `\GTS@newcommand{\GTSunadjacency}{\GTS@a{}{}{1}{}{}}{}`

148 `\GTS@newcommand{\GTSunadj}{\GTS@a{}{}{1}{}{}}{}`

149 `\GTS@newcommand{\GTSu}{\GTS@a{}{}{1}{}{}}{}`

\GTSunadjacencyRelation, \GTSunadjRel, \GTSuR This macro will draw an unadjacency symbol with relation spacing in math mode.

150 `\GTS@newcommand{\GTSunadjacencyRelation}{\mathrel{\GTSu/}}`

151 `\GTS@newcommand{\GTSunadjRel}{\mathrel{\GTSu/}}`

152 `\GTS@newcommand{\GTSuR}{\mathrel{\GTSu/}}`

\GTSdirectedAdjacencyUp, \GTSdirAdjUp, \GTSdAU This macro will draw a directed adjacency upward symbol. The operand on the left of the symbol should be considered the source of the arc; the operand on the right of the symbol should be considered the target of the arc.

153 `\GTS@newcommand{\GTSdirectedAdjacencyUp}{\GTS@a{}{}{1}{}{}}{}`

154 `\GTS@newcommand{\GTSdirAdjUp}{\GTS@a{}{}{1}{}{}}{}`

155 `\GTS@newcommand{\GTSdAU}{\GTS@a{}{}{1}{}{}}{}`

\GTSdirectedAdjacencyUpRelation, \GTSdirAdjUpRel, \GTSdAUR This macro will draw a directed adjacency upward symbol with relation spacing in math mode.

156 `\GTS@newcommand{\GTSdirectedAdjacencyUpRelation}{\mathrel{\GTSdAU/}}`

157 `\GTS@newcommand{\GTSdirAdjUpRel}{\mathrel{\GTSdAU/}}`

158 `\GTS@newcommand{\GTSdAUR}{\mathrel{\GTSdAU/}}`

\GTSnegatedDirectedAdjacencyUp, \GTSnegDirAdjUp, \GTSnDAU This macro will draw a negated directed adjacency upward symbol.

159 `\GTS@newcommand{\GTSnegatedDirectedAdjacencyUp}{\GTS@a{}{}{1}{1}{}{}}{}`

160 `\GTS@newcommand{\GTSnegDirAdjUp}{\GTS@a{}{}{1}{1}{}{}}{}`

161 `\GTS@newcommand{\GTSnDAU}{\GTS@a{}{}{1}{1}{}{}}{}`

\GTSnegatedDirectedAdjacencyUpRelation, \GTSnegDirAdjUpRel, \GTSnDAUR This macro will draw a negated directed adjacency upward symbol with relation spacing in math mode.

162 `\GTS@newcommand{\GTSnegatedDirectedAdjacencyUpRelation}{\%`

163 `\mathrel{\GTSnDAU/}}%`

164 }

165 `\GTS@newcommand{\GTSnegDirAdjUpRel}{\mathrel{\GTSnDAU/}}`

166 `\GTS@newcommand{\GTSnDAUR}{\mathrel{\GTSnDAU/}}`

\GTSdirectedAdjacencyDown, \GTSdirAdjDown, \GTSdAD This macro will draw a directed adjacency downward symbol. The operand on the left of the symbol should be considered the target of the arc; the operand on the right of the symbol should be considered the source of the arc.

167 `\GTS@newcommand{\GTSdirectedAdjacencyDown}{\GTS@a{}{}{}{1}{}{}}{}`

168 `\GTS@newcommand{\GTSdirAdjDown}{\GTS@a{}{}{}{1}{}{}}{}`

169 `\GTS@newcommand{\GTSdAD}{\GTS@a{}{}{}{1}{}{}}{}`

\GTSdirectedAdjacencyDownRelation, \GTSdirAdjDownRel, \GTSdADR This macro will draw a directed adjacency downward symbol with relation spacing in math mode.

170 `\GTS@newcommand{\GTSdirectedAdjacencyDownRelation}{\mathrel{\GTSdAD/}}`

171 `\GTS@newcommand{\GTSdirAdjDownRel}{\mathrel{\GTSdAD/}}`

172 `\GTS@newcommand{\GTSdADR}{\mathrel{\GTSdAD/}}`

\GTSnegatedDirectedAdjacencyDown, \GTSnegDirAdjDown, \GTSnDAD This macro will draw a negated directed adjacency downward symbol.

```
173 \GTS@newcommand{\GTSnegatedDirectedAdjacencyDown}{\GTS@a{}}{1}{1}{1}
174 \GTS@newcommand{\GTSnegDirAdjDown}{\GTS@a{}}{1}{1}{1}
175 \GTS@newcommand{\GTSnDAD}{\GTS@a{}}{1}{1}{1}
```

\GTSnegatedDirectedAdjacencyDownRelation, \GTSnegDirAdjDownRel, \GTSnDADR This macro will draw a negated directed adjacency downward symbol with relation spacing in math mode.

```
176 \GTS@newcommand{\GTSnegatedDirectedAdjacencyDownRelation}{%
177 \mathrel{\GTSnDAD}/}%
178 }
179 \GTS@newcommand{\GTSnegDirAdjDownRel}{\mathrel{\GTSnDAD}/}%
180 \GTS@newcommand{\GTSnDADR}{\mathrel{\GTSnDAD}/}%

```

\GTS@i This macro will draw any incidence symbol given the correct parameters. Its use is purely technical. See the macros derived from it and **\GTS@j**: **\GTSxincidence**, **\GTSxinc**, and **\GTSxi**. The operand on the left of the symbol should be considered the vertex to which the edge/the operand on the right of the symbol is incident.

Arguments:

{*mainColor*} If non-empty, this color will be used as main color.
 {*secondColor*} If non-empty, this color will be used as second color.
 {*drawSlash*} Non-empty implies that a negation will be drawn.
 {*drawUpArrow*} Non-empty implies that an up-arrow will be drawn.
 {*drawDownArrow*} Non-empty implies that a down-arrow will be drawn.

```
181 \newcommand{\GTS@i}[5]{%
182 \if#1\empty\else%
183 \GTSsetMainColor{#1}%
184 \fi%
185 \if#2\empty\else%
186 \GTSsetSecondColor{#2}%
187 \fi%
188 \text{\ensuremath{%
189 \raisebox{-0.22ex}{\scalebox{2.05}[2.05]{%
190 %
191 \raisebox{-0.3ex}{\scalebox{0.7}[0.7]{%
192 $\mathcolor{\GTS@secondColor}{\circ}$%
193 }}}}
194 \hspace{-0.39ex}%
195 \raisebox{0.05ex}{\scalebox{0.1}[0.1]{%
196 $\mathcolor{\GTS@secondColor}{\bullet}$%
197 }}}}
198 \hspace{-0.12ex}%
199 \raisebox{0.11ex}{\scalebox{0.1}[0.73]{%
200 $\mathcolor{\GTS@secondColor}{\smallblacksquare}$%
201 }}}}
202 \hspace{-0.18ex}%
203 \raisebox{0.15ex}{\scalebox{0.2}[0.2]{%
204 $\mathcolor{\GTS@mainColor}{\smallblacksquare}$%
205 }}}}
206 \hspace{0.2ex}%
if GTS@drawUpArrow empty else
207 \if#4\empty\else%
208 \hspace{-0.65ex}%
209 \raisebox{-0.18ex}{\scalebox{0.5}[0.5]{%
210 \textcolor{\GTS@secondColor}{\textasciicircum}%
211 }}}}
212 \fi%
if GTS@drawDownArrow empty else
213 \if#5\empty\else%
214 \hspace{-0.65ex}%
215 \raisebox{1.37ex}{\scalebox{0.5}[-0.5]{%
216 \textcolor{\GTS@secondColor}{\textasciicircum}%

```

```

217 } }%
218 \fi%
if GTS@drawSlash empty else
219 \if#3\empty\else%
220 \hspace{-0.65ex}%
221 \raisebox{0.1ex}{\scalebox{0.5}[0.5]{%
222 \textcolor{black}{/}%
223 } }%
224 \fi%
225 %
226 } }%
227 } }%
228 \if#1\empty\else%
229 \GTSsetMainColor{\GTS@mainColorBackup}%
230 \fi%
231 \if#2\empty\else%
232 \GTSsetSecondColor{\GTS@secondColorBackup}%
233 \fi%
234 }

```

\GTS@j This macro will handle wrapping in mathematical relation spacing if needed. Its use is purely technical. See the macros derived from it and **\GTS@i**: **\GTSxincidence**, **\GTSxinc**, and **\GTSxi**. Arguments:

{<mainColor>} If non-empty, this color will be used as main color.
{<secondColor>} If non-empty, this color will be used as second color.
{<drawSlash>} Non-empty implies that a negation will be drawn.
{<drawUpArrow>} Non-empty implies that an up-arrow will be drawn.
{<drawDownArrow>} Non-empty implies that a down-arrow will be drawn.
{<relation>} Non-empty implies that relation spacing will be added.

```

235 \newcommand{\GTS@j}[6]{%
236 \if#61%
237 \mathrel{\GTS@i{#1}{#2}{#3}{#4}{#5}}%
238 \else%
239 \GTS@i{#1}{#2}{#3}{#4}{#5}%
240 \fi%
241 }

```

\GTSxincidence, **\GTSxinc**, **\GTSxi** Versatile macros for incidence that can be given options. Argument:

[*<optionsList>*] Sets the following options if not empty:
mainColor=color1 or **mainC=**color1 or **mColor=**color1 or **mC=**color1,
secondColor=color2 or **secondC=**color2 or **sColor=**color2 or **sC=**color2,
monochrome or **mono** or **mon** or **m** (equivalent to **mC=black,sC=black**),
negated or **not** or **n**,
in or **i**,
out or **o**,
relation or **rel** or **r**.

```

242 \define@key{GTSxi}{mainColor}{\def\GTS@@mainColor{#1}}
243 \define@key{GTSxi}{mainC}{\def\GTS@@mainColor{#1}}
244 \define@key{GTSxi}{mColor}{\def\GTS@@mainColor{#1}}
245 \define@key{GTSxi}{mC}{\def\GTS@@mainColor{#1}}
246 \define@key{GTSxi}{secondColor}{\def\GTS@@secondColor{#1}}
247 \define@key{GTSxi}{secondC}{\def\GTS@@secondColor{#1}}
248 \define@key{GTSxi}{sColor}{\def\GTS@@secondColor{#1}}
249 \define@key{GTSxi}{sC}{\def\GTS@@secondColor{#1}}
250 \define@key{GTSxi}{monochrome}[1]%
251 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
252 \define@key{GTSxi}{mono}[1]%
253 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
254 \define@key{GTSxi}{mon}[1]%
255 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
256 \define@key{GTSxi}{m}[1]%
257 {\def\GTS@@mainColor{black}\def\GTS@@secondColor{black}}
258 \define@key{GTSxi}{negated}[1]{\def\GTS@@drawSlash{1}}

```

```

259 \define@key{GTSxi}{not}[1]{\def\GTS@@drawSlash{1}}
260 \define@key{GTSxi}{n}[1]{\def\GTS@@drawSlash{1}}
261 \define@key{GTSxi}{out}[1]{\def\GTS@@drawUpArrow{1}}
262 \define@key{GTSxi}{o}[1]{\def\GTS@@drawUpArrow{1}}
263 \define@key{GTSxi}{in}[1]{\def\GTS@@drawDownArrow{1}}
264 \define@key{GTSxi}{i}[1]{\def\GTS@@drawDownArrow{1}}
265 \define@key{GTSxi}{relation}[1]{\def\GTS@@relation{1}}
266 \define@key{GTSxi}{rel}[1]{\def\GTS@@relation{1}}
267 \define@key{GTSxi}{r}[1]{\def\GTS@@relation{1}}
268
269 \newcommand{\GTSxi}[1][]{\%
270 \def\GTS@@mainColor{}%
271 \def\GTS@@secondColor{}%
272 \def\GTS@@drawSlash{}%
273 \def\GTS@@drawUpArrow{}%
274 \def\GTS@@drawDownArrow{}%
275 \def\GTS@@relation{}%
276 \setkeys{GTSxi}{#1}%
277 \GTS@j{\GTS@@mainColor}{\GTS@@secondColor}{\GTS@@drawSlash}%
278 {\GTS@@drawUpArrow}{\GTS@@drawDownArrow}{\GTS@@relation}%
279 }
280
281 \newcommand{\GTSxinc}[1][]{\GTSxi[#1]}
282
283 \newcommand{\GTSxincidence}[1][]{\GTSxi[#1]}

```

\GTSincidence, \GTSinc, \GTSi This macro will draw an incidence symbol. The operand on the left of the symbol should be considered the vertex to which the edge/the operand on the right of the symbol is incident.

```

284 \GTS@newcommand{\GTSincidence}{\GTS@i{}{}{}{}}
285 \GTS@newcommand{\GTSinc}{\GTS@i{}{}{}{}}
286 \GTS@newcommand{\GTSi}{\GTS@i{}{}{}{}}

```

\GTSincidenceRelation, \GTSincRel, \GTSiR This macro will draw an incidence symbol with relation spacing in math mode.

```

287 \GTS@newcommand{\GTSincidenceRelation}{\mathrel{\GTSi/}}
288 \GTS@newcommand{\GTSincRel}{\mathrel{\GTSi/}}
289 \GTS@newcommand{\GTSiR}{\mathrel{\GTSi/}}

```

\GTSnegatedIncidence, \GTSnegInc, \GTSnI This macro will draw a negated incidence symbol.

```

290 \GTS@newcommand{\GTSnegatedIncidence}{\GTS@i{}{}{1}{}{}}
291 \GTS@newcommand{\GTSnegInc}{\GTS@i{}{}{1}{}{}}
292 \GTS@newcommand{\GTSnI}{\GTS@i{}{}{1}{}{}}

```

\GTSnegatedIncidenceRelation, \GTSnegIncRel, \GTSnIR This macro will draw a negated incidence symbol with relation spacing in math mode.

```

293 \GTS@newcommand{\GTSnegatedIncidenceRelation}{\mathrel{\GTSnI/}}
294 \GTS@newcommand{\GTSnegIncRel}{\mathrel{\GTSnI/}}
295 \GTS@newcommand{\GTSnIR}{\mathrel{\GTSnI/}}

```

\GTSoutIncidence, \GTSoutInc, \GTSoI This macro will draw a directed incidence upward (out(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.

```

296 \GTS@newcommand{\GTSoutIncidence}{\GTS@i{}{}{1}{}{}}
297 \GTS@newcommand{\GTSoutInc}{\GTS@i{}{}{1}{}{}}
298 \GTS@newcommand{\GTSoI}{\GTS@i{}{}{1}{}{}}

```

\GTSoutIncidenceRelation, \GTSoutIncRel, \GTSoIR This macro will draw a directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.

```

299 \GTS@newcommand{\GTSoutIncidenceRelation}{\mathrel{\GTSoI/}}
300 \GTS@newcommand{\GTSoutIncRel}{\mathrel{\GTSoI/}}
301 \GTS@newcommand{\GTSoIR}{\mathrel{\GTSoI/}}

```

\GTSnegatedOutIncidence, \GTSnegOutInc, \GTSnOI This macro will draw a negated directed incidence upward (out(ward) incidence) symbol.

```
302 \GTS@newcommand{\GTSnegatedOutIncidence}{\GTS@i{}{}{1}{1}}
303 \GTS@newcommand{\GTSnegOutInc}{\GTS@i{}{}{1}{1}}
304 \GTS@newcommand{\GTSnOI}{\GTS@i{}{}{1}{1}}
```

\GTSnegatedOutIncidenceRelation, \GTSnegOutIncRel, \GTSnOIR This macro will draw a negated directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.

```
305 \GTS@newcommand{\GTSnegatedOutIncidenceRelation}{\mathrel{\GTSnOI/}}
306 \GTS@newcommand{\GTSnegOutIncRel}{\mathrel{\GTSnOI/}}
307 \GTS@newcommand{\GTSnOIR}{\mathrel{\GTSnOI/}}
```

\GTSinIncidence, \GTSinInc, \GTSiI This macro will draw a directed incidence downward (in(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.

```
308 \GTS@newcommand{\GTSinIncidence}{\GTS@i{}{}{}{1}}
309 \GTS@newcommand{\GTSinInc}{\GTS@i{}{}{}{1}}
310 \GTS@newcommand{\GTSiI}{\GTS@i{}{}{}{1}}
```

\GTSinIncidenceRelation, \GTSinIncRel, \GTSiIR This macro will draw a directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.

```
311 \GTS@newcommand{\GTSinIncidenceRelation}{\mathrel{\GTSiI/}}
312 \GTS@newcommand{\GTSinIncRel}{\mathrel{\GTSiI/}}
313 \GTS@newcommand{\GTSiIR}{\mathrel{\GTSiI/}}
```

\GTSnegatedInIncidence, \GTSnegInInc, \GTSnII This macro will draw a negated directed incidence downward (in(ward) incidence) symbol.

```
314 \GTS@newcommand{\GTSnegatedInIncidence}{\GTS@i{}{}{1}{1}}
315 \GTS@newcommand{\GTSnegInInc}{\GTS@i{}{}{1}{1}}
316 \GTS@newcommand{\GTSnII}{\GTS@i{}{}{1}{1}}
```

\GTSnegatedInIncidenceRelation, \GTSnegInIncRel, \GTSnIIR This macro will draw a negated directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.

```
317 \GTS@newcommand{\GTSnegatedInIncidenceRelation}{\mathrel{\GTSnII/}}
318 \GTS@newcommand{\GTSnegInIncRel}{\mathrel{\GTSnII/}}
319 \GTS@newcommand{\GTSnIIR}{\mathrel{\GTSnII/}}
```

\GTSadjacencyMonochrome, \GTSadjMono, \GTSadjMon, \GTSaM This macro will draw a monochrome adjacency symbol.

```
320 \GTS@newcommand{\GTSadjacencyMonochrome}{\GTS@a{black}{black}{}{}}
321 \GTS@newcommand{\GTSadjMono}{\GTS@a{black}{black}{}{}}
322 \GTS@newcommand{\GTSadjMon}{\GTS@a{black}{black}{}{}}
323 \GTS@newcommand{\GTSaM}{\GTS@a{black}{black}{}{}}
```

\GTSadjacencyMonochromeRelation, \GTSadjMonoRel, \GTSadjMonRel, \GTSaMR This macro will draw a monochrome adjacency symbol with relation spacing in math mode.

```
324 \GTS@newcommand{\GTSadjacencyMonochromeRelation}{\mathrel{\GTSaM/}}
325 \GTS@newcommand{\GTSadjMonoRel}{\mathrel{\GTSaM/}}
326 \GTS@newcommand{\GTSadjMonRel}{\mathrel{\GTSaM/}}
327 \GTS@newcommand{\GTSaMR}{\mathrel{\GTSaM/}}
```

\GTSunadjacencyMonochrome, \GTSunadjMono, \GTSunadjMon, \GTSuM This macro will draw a monochrome unadjacency symbol.

```
328 \GTS@newcommand{\GTSunadjacencyMonochrome}{\GTS@a{black}{black}{1}{}}
329 \GTS@newcommand{\GTSunadjMono}{\GTS@a{black}{black}{1}{}}
330 \GTS@newcommand{\GTSunadjMon}{\GTS@a{black}{black}{1}{}}
331 \GTS@newcommand{\GTSuM}{\GTS@a{black}{black}{1}{}}
```

\GTSunadjacencyMonochromeRelation, \GTSunadjMonoRel, \GTSunadjMonRel, \GTSuMR This macro will draw a monochrome unadjacency symbol with relation spacing in math mode.

```
332 \GTS@newcommand{\GTSunadjacencyMonochromeRelation}{\mathrel{\GTSuM/}}
333 \GTS@newcommand{\GTSunadjMonoRel}{\mathrel{\GTSuM/}}
334 \GTS@newcommand{\GTSunadjMonRel}{\mathrel{\GTSuM/}}
335 \GTS@newcommand{\GTSuMR}{\mathrel{\GTSuM/}}
```

\GTSdirectedAdjacencyUpMonochrome, \GTSdirAdjUpMono, \GTSdirAdjUpMon, \GTSdAUM This macro will draw a monochrome directed adjacency upward symbol. The operand on the left of the symbol should be considered the source of the arc; the operand on the right of the symbol should be considered the target of the arc.

```
336 \GTS@newcommand{\GTSdirectedAdjacencyUpMonochrome}{%
337 \GTS@a{black}{black}{1}{1}}%
338 }
339 \GTS@newcommand{\GTSdirAdjUpMono}{\GTS@a{black}{black}{1}{1}}
340 \GTS@newcommand{\GTSdirAdjUpMon}{\GTS@a{black}{black}{1}{1}}
341 \GTS@newcommand{\GTSdAUM}{\GTS@a{black}{black}{1}{1}}
```

\GTSdirectedAdjacencyUpMonochromeRelation, \GTSdirAdjUpMonoRel, \GTSdirAdjUpMonRel, \GTSdAUMR This macro will draw a monochrome directed adjacency upward symbol with relation spacing in math mode.

```
342 \GTS@newcommand{\GTSdirectedAdjacencyUpMonochromeRelation}{%
343 \mathrel{\GTSdAUM/}}%
344 }
345 \GTS@newcommand{\GTSdirAdjUpMonoRel}{\mathrel{\GTSdAUM/}}
346 \GTS@newcommand{\GTSdirAdjUpMonRel}{\mathrel{\GTSdAUM/}}
347 \GTS@newcommand{\GTSdAUMR}{\mathrel{\GTSdAUM/}}
```

\GTSnegatedDirectedAdjacencyUpMonochrome, \GTSnegDirAdjUpMono, \GTSnegDirAdjUpMon, \GTSnDAUM This macro will draw a monochrome negated directed adjacency upward symbol.

```
348 \GTS@newcommand{\GTSnegatedDirectedAdjacencyUpMonochrome}{%
349 \GTS@a{black}{black}{1}{1}}%
350 }
351 \GTS@newcommand{\GTSnegDirAdjUpMono}{\GTS@a{black}{black}{1}{1}}
352 \GTS@newcommand{\GTSnegDirAdjUpMon}{\GTS@a{black}{black}{1}{1}}
353 \GTS@newcommand{\GTSnDAUM}{\GTS@a{black}{black}{1}{1}}
```

\GTSnegatedDirectedAdjacencyUpMonochromeRelation, \GTSnegDirAdjUpMonoRel, \GTSnegDirAdjUpMonRel, \GTSnDAUMR This macro will draw a monochrome negated directed adjacency upward symbol with relation spacing in math mode.

```
354 \GTS@newcommand{\GTSnegatedDirectedAdjacencyUpMonochromeRelation}{%
355 \mathrel{\GTSnDAUM/}}%
356 }
357 \GTS@newcommand{\GTSnegDirAdjUpMonoRel}{\mathrel{\GTSnDAUM/}}
358 \GTS@newcommand{\GTSnegDirAdjUpMonRel}{\mathrel{\GTSnDAUM/}}
359 \GTS@newcommand{\GTSnDAUMR}{\mathrel{\GTSnDAUM/}}
```

\GTSdirectedAdjacencyDownMonochrome, \GTSdirAdjDownMono, \GTSdirAdjDownMon, \GTSdADM This macro will draw a monochrome directed adjacency downward symbol. The operand on the left of the symbol should be considered the target of the arc; the operand on the right of the symbol should be considered the source of the arc.

```
360 \GTS@newcommand{\GTSdirectedAdjacencyDownMonochrome}{%
361 \GTS@a{black}{black}{1}{1}}%
362 }
363 \GTS@newcommand{\GTSdirAdjDownMono}{\GTS@a{black}{black}{1}{1}}
364 \GTS@newcommand{\GTSdirAdjDownMon}{\GTS@a{black}{black}{1}{1}}
365 \GTS@newcommand{\GTSdADM}{\GTS@a{black}{black}{1}{1}}
```

\GTSdirectedAdjacencyDownMonochromeRelation, \GTSdirAdjDownMonoRel, \GTSdirAdjDownMonRel, \GTSdADMR This macro will draw a monochrome directed adjacency downward symbol with relation spacing in math mode.

```
366 \GTS@newcommand{\GTSdirectedAdjacencyDownMonochromeRelation}{%
367 \mathrel{\GTSdADM/}}%
368 }
369 \GTS@newcommand{\GTSdirAdjDownMonoRel}{\mathrel{\GTSdADM/}}
370 \GTS@newcommand{\GTSdirAdjDownMonRel}{\mathrel{\GTSdADM/}}
371 \GTS@newcommand{\GTSdADMR}{\mathrel{\GTSdADM/}}
```

\GTSnegatedDirectedAdjacencyDownMonochrome, \GTSnegDirAdjDownMono, \GT-SnegDirAdjDownMon, \GTSnDADM This macro will draw a monochrome negated directed adjacency downward symbol.

```
372 \GTS@newcommand{\GTSnegatedDirectedAdjacencyDownMonochrome}{%
373 \GTS@a{black}{black}{1}{1}}%
374 }
375 \GTS@newcommand{\GTSnegDirAdjDownMono}{\GTS@a{black}{black}{1}{1}}
376 \GTS@newcommand{\GTSnegDirAdjDownMon}{\GTS@a{black}{black}{1}{1}}
377 \GTS@newcommand{\GTSnDADM}{\GTS@a{black}{black}{1}{1}}
```

\GTSnegatedDirectedAdjacencyDownMonochromeRelation, \GTSnegDirAdjDownMonoRel, \GTSnegDirAdjDownMonRel, \GTSnDADMR This macro will draw a monochrome negated directed adjacency downward symbol with relation spacing in math mode.

```
378 \GTS@newcommand{\GTSnegatedDirectedAdjacencyDownMonochromeRelation}{%
379 \mathrel{\GTSnDADM/}}%
380 }
381 \GTS@newcommand{\GTSnegDirAdjDownMonoRel}{\mathrel{\GTSnDADM/}}
382 \GTS@newcommand{\GTSnegDirAdjDownMonRel}{\mathrel{\GTSnDADM/}}
383 \GTS@newcommand{\GTSnDADMR}{\mathrel{\GTSnDADM/}}
```

\GTSincidenceMonochrome, \GTSincMono, \GTSincMon, \GTSiM This macro will draw a monochrome incidence symbol. The operand on the left of the symbol should be considered the vertex to which the edge/the operand on the right of the symbol is incident.

```
384 \GTS@newcommand{\GTSincidenceMonochrome}{\GTS@i{black}{black}{1}{1}}
385 \GTS@newcommand{\GTSincMono}{\GTS@i{black}{black}{1}{1}}
386 \GTS@newcommand{\GTSincMon}{\GTS@i{black}{black}{1}{1}}
387 \GTS@newcommand{\GTSiM}{\GTS@i{black}{black}{1}{1}}
```

\GTSincidenceMonochromeRelation, \GTSincMonoRel, \GTSincMonRel, \GTSiMR This macro will draw a monochrome incidence symbol with relation spacing in math mode.

```
388 \GTS@newcommand{\GTSincidenceMonochromeRelation}{\mathrel{\GTSiM/}}
389 \GTS@newcommand{\GTSincMonoRel}{\mathrel{\GTSiM/}}
390 \GTS@newcommand{\GTSincMonRel}{\mathrel{\GTSiM/}}
391 \GTS@newcommand{\GTSiMR}{\mathrel{\GTSiM/}}
```

\GTSnegatedIncidenceMonochrome, \GTSnegIncMono, \GTSnegIncMon, \GTSnIM This macro will draw a monochrome negated incidence symbol.

```
392 \GTS@newcommand{\GTSnegatedIncidenceMonochrome}{%
393 \GTS@i{black}{black}{1}{1}}%
394 }
395 \GTS@newcommand{\GTSnegIncMono}{\GTS@i{black}{black}{1}{1}}
396 \GTS@newcommand{\GTSnegIncMon}{\GTS@i{black}{black}{1}{1}}
397 \GTS@newcommand{\GTSnIM}{\GTS@i{black}{black}{1}{1}}
```

\GTSnegatedIncidenceMonochromeRelation, \GTSnegIncMonoRel, \GTSnegIncMonRel, \GTSnIMR This macro will draw a monochrome negated incidence symbol with relation spacing in math mode.

```
398 \GTS@newcommand{\GTSnegatedIncidenceMonochromeRelation}{\mathrel{\GTSnIM/}}
399 \GTS@newcommand{\GTSnegIncMonoRel}{\mathrel{\GTSnIM/}}
400 \GTS@newcommand{\GTSnegIncMonRel}{\mathrel{\GTSnIM/}}
401 \GTS@newcommand{\GTSnIMR}{\mathrel{\GTSnIM/}}
```

\GTSoutIncidenceMonochrome, \GTSoutIncMono, \GTSoutIncMon, \GTSoIM This macro will draw a monochrome directed incidence upward (out(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.

```
402 \GTS@newcommand{\GTSoutIncidenceMonochrome}{\GTS@i{black}{black}{1}{1}}
403 \GTS@newcommand{\GTSoutIncMono}{\GTS@i{black}{black}{1}{1}}
404 \GTS@newcommand{\GTSoutIncMon}{\GTS@i{black}{black}{1}{1}}
405 \GTS@newcommand{\GTSoIM}{\GTS@i{black}{black}{1}{1}}
```

\GTSoutIncidenceMonochromeRelation, \GTSoutIncMonoRel, \GTSoutIncMonRel, \GTS-SoIMR This macro will draw a monochrome directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.

```

406 \GTS@newcommand{\GTSoutIncidenceMonochromeRelation}{\mathrel{\GTSoIM/}}
407 \GTS@newcommand{\GTSoutIncMonoRel}{\mathrel{\GTSoIM/}}
408 \GTS@newcommand{\GTSoutIncMonRel}{\mathrel{\GTSoIM/}}
409 \GTS@newcommand{\GTSoIMR}{\mathrel{\GTSoIM/}}

```

\GTSnegatedOutIncidenceMonochrome, \GTSnegOutIncMono, \GTSnegOutIncMon, \GTSnOIM This macro will draw a monochrome negated directed incidence upward (out(ward) incidence) symbol.

```

410 \GTS@newcommand{\GTSnegatedOutIncidenceMonochrome}{%
411 \GTS@i{black}{black}{1}{1}{1}}%
412 }
413 \GTS@newcommand{\GTSnegOutIncMono}{\GTS@i{black}{black}{1}{1}{1}}
414 \GTS@newcommand{\GTSnegOutIncMon}{\GTS@i{black}{black}{1}{1}{1}}
415 \GTS@newcommand{\GTSnOIM}{\GTS@i{black}{black}{1}{1}{1}}

```

\GTSnegatedOutIncidenceMonochromeRelation, \GTSnegOutIncMonoRel, \GTSnegOutIncMonRel, \GTSnOIMR This macro will draw a monochrome negated directed incidence upward (out(ward) incidence) symbol with relation spacing in math mode.

```

416 \GTS@newcommand{\GTSnegatedOutIncidenceMonochromeRelation}{%
417 \mathrel{\GTSnOIM/}}%
418 }
419 \GTS@newcommand{\GTSnegOutIncMonoRel}{\mathrel{\GTSnOIM/}}
420 \GTS@newcommand{\GTSnegOutIncMonRel}{\mathrel{\GTSnOIM/}}
421 \GTS@newcommand{\GTSnOIMR}{\mathrel{\GTSnOIM/}}

```

\GTSinIncidenceMonochrome, \GTSinIncMono, \GTSinIncMon, \GTSiIM This macro will draw a monochrome directed incidence downward (in(ward) incidence) symbol. The operand on the left of the symbol should be considered the vertex to which the arc/the operand on the right of the symbol is incident.

```

422 \GTS@newcommand{\GTSinIncidenceMonochrome}{\GTS@i{black}{black}{-}{-}{1}}
423 \GTS@newcommand{\GTSinIncMono}{\GTS@i{black}{black}{-}{-}{1}}
424 \GTS@newcommand{\GTSinIncMon}{\GTS@i{black}{black}{-}{-}{1}}
425 \GTS@newcommand{\GTSiIM}{\GTS@i{black}{black}{-}{-}{1}}

```

\GTSinIncidenceMonochromeRelation, \GTSinIncMonoRel, \GTSinIncMonRel, \GTSiIMR This macro will draw a monochrome directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.

```

426 \GTS@newcommand{\GTSinIncidenceMonochromeRelation}{\mathrel{\GTSiIM/}}
427 \GTS@newcommand{\GTSinIncMonoRel}{\mathrel{\GTSiIM/}}
428 \GTS@newcommand{\GTSinIncMonRel}{\mathrel{\GTSiIM/}}
429 \GTS@newcommand{\GTSiIMR}{\mathrel{\GTSiIM/}}

```

\GTSnegatedInIncidenceMonochrome, \GTSnegInIncMono, \GTSnegInIncMon, \GTSnIIM This macro will draw a monochrome negated directed incidence downward (in(ward) incidence) symbol.

```

430 \GTS@newcommand{\GTSnegatedInIncidenceMonochrome}{%
431 \GTS@i{black}{black}{1}{-}{1}}%
432 }
433 \GTS@newcommand{\GTSnegInIncMono}{\GTS@i{black}{black}{1}{-}{1}}
434 \GTS@newcommand{\GTSnegInIncMon}{\GTS@i{black}{black}{1}{-}{1}}
435 \GTS@newcommand{\GTSnIIM}{\GTS@i{black}{black}{1}{-}{1}}

```

\GTSnegatedInIncidenceMonochromeRelation, \GTSnegInIncMonoRel, \GTSnegInIncMonRel, \GTSnIIMR This macro will draw a monochrome negated directed incidence downward (in(ward) incidence) symbol with relation spacing in math mode.

```

436 \GTS@newcommand{\GTSnegatedInIncidenceMonochromeRelation}{%
437 \mathrel{\GTSnIIM/}}%
438 }
439 \GTS@newcommand{\GTSnegInIncMonoRel}{\mathrel{\GTSnIIM/}}
440 \GTS@newcommand{\GTSnegInIncMonRel}{\mathrel{\GTSnIIM/}}
441 \GTS@newcommand{\GTSnIIMR}{\mathrel{\GTSnIIM/}}

```

\GTSmetaNot, \GTSmN This macro will draw a meta-not or relation-not symbol.

```

442 \GTS@newprotectedcommand{\GTSmN}{%

```

```

443 \text{\ensuremath{%
444 \raisebox{-0.44ex}{\scalebox{1}[1]{%
445 \raisebox{0ex}{\scalebox{1}[1]{\not$}}}%
446 \hspace{-1.46ex}%
447 \raisebox{1.2ex}{\scalebox{0.7}[0.7]{m}}}%
448 \hspace{0.2ex}%
449 }}%
450 }}%
451 }
452 \GTS@newcommand{\GTSmetaNot}{\GTSmN/}

```

\GTSmetaAnd, \GTSmA This macro will draw a meta-and or relations-and symbol. This is your duty to check that all relations have same arity. It should be easy as long as you remain in the realm of graphs/2-structures/binary structures. We didn't use Tarski's notation, since square cup has taken the preemptive meaning of disjoint union. Similarly, doublewedge or other wedge symbols have taken various meanings, whilst we want an unambiguous symbol.

```

453 \GTS@newprotectedcommand{\GTSmA}{%
454 \text{\ensuremath{%
455 \raisebox{-0.44ex}{\scalebox{0.95}[0.95]{%
456 \raisebox{0ex}{\scalebox{1}[1]{\wedge$}}}%
457 \hspace{-1.46ex}%
458 \raisebox{1.5ex}{\scalebox{0.7}[0.7]{m}}}%
459 }}%
460 }}%
461 }
462 \GTS@newcommand{\GTSmetaAnd}{\GTSmA/}

```

\GTSmetaAndRelation, \GTSmetaAndRel, \GTSmAR This macro will draw a meta-and symbol with relation spacing in math mode.

```

463 \GTS@newcommand{\GTSmetaAndRelation}{\mathrel{\GTSmA/}}
464 \GTS@newcommand{\GTSmetaAndRel}{\mathrel{\GTSmA/}}
465 \GTS@newcommand{\GTSmAR}{\mathrel{\GTSmA/}}

```

\GTSmetaOr, \GTSmO This macro will draw a meta-or or relations-or symbol. This is your duty to check that all relations have same arity. It should be easy as long as you remain in the realm of graphs/2-structures/binary structures ;). We didn't use Tarski's notation, since square cup has taken the preemptive meaning of disjoint union. Similarly, doublevee or other vee symbols have taken various meanings, whilst we want an unambiguous symbol.

```

466 \GTS@newprotectedcommand{\GTSmO}{%
467 \text{\ensuremath{%
468 \raisebox{-0.44ex}{\scalebox{0.95}[0.95]{%
469 \raisebox{0ex}{\scalebox{1}[1]{\vee$}}}%
470 \hspace{-1.46ex}%
471 \raisebox{1.5ex}{\scalebox{0.7}[0.7]{m}}}%
472 }}%
473 }}%
474 }
475 \GTS@newcommand{\GTSmetaOr}{\GTSmO/}

```

\GTSmetaOrRelation, \GTSmetaOrRel, \GTSmOR This macro will draw a meta-or symbol with relation spacing in math mode.

```

476 \GTS@newcommand{\GTSmetaOrRelation}{\mathrel{\GTSmO/}}
477 \GTS@newcommand{\GTSmetaOrRel}{\mathrel{\GTSmO/}}
478 \GTS@newcommand{\GTSmOR}{\mathrel{\GTSmO/}}

```

\GTSxmetallogic, \GTSxml Versatile macros for meta-logic symbols that can be given options.

Argument:

[*<optionsList>*] Sets the following options if not empty:

not or **n**,

and or **a**,

or or **o**,

relation or **rel** or **r**.

Of course first three options are incompatible, and the fourth is compatible only with the second and third options.

```

479 \define@key{GTSxml}{not}[1]{\def\GTS@@drawMetaNot{1}}
480 \define@key{GTSxml}{n}[1]{\def\GTS@@drawMetaNot{1}}
481 \define@key{GTSxml}{and}[1]{\def\GTS@@drawMetaAnd{1}}
482 \define@key{GTSxml}{a}[1]{\def\GTS@@drawMetaAnd{1}}
483 \define@key{GTSxml}{or}[1]{\def\GTS@@drawMetaOr{1}}
484 \define@key{GTSxml}{o}[1]{\def\GTS@@drawMetaOr{1}}
485 \define@key{GTSxml}{relation}[1]{\def\GTS@@relation{1}}
486 \define@key{GTSxml}{rel}[1]{\def\GTS@@relation{1}}
487 \define@key{GTSxml}{r}[1]{\def\GTS@@relation{1}}
488
489 \newcommand{\GTSxml}[1][]{\%
490 \def\GTS@@drawMetaNot{}%
491 \def\GTS@@drawMetaAnd{}%
492 \def\GTS@@drawMetaOr{}%
493 \def\GTS@@relation{}%
494 \setkeys{GTSxml}{#1}%
495 \if\GTS@@drawMetaNot1%
496 \GTSmN/%
497 \else\if\GTS@@drawMetaAnd1%
498 \if\GTS@@relation{1}%
499 \GTSmAR/%
500 \else%
501 \GTSmA/%
502 \fi%
503 \else\if\GTS@@drawMetaOr1%
504 \if\GTS@@relation{1}%
505 \GTSmOR/%
506 \else%
507 \GTSmO/%
508 \fi%
509 \else%
510 Wrong call to \textbackslash{}GTSxml%
511 \fi%
512 \fi%
513 \fi%
514 }
515
516 \newcommand{\GTSxmetallogic}[1][]{\GTSxml[#1]}

```

\GTSx One macro to rule them all. Versatile macro for all symbols that can be given options, and a symbol type mandatory switch.

Argument:

[*(optionsList)*] Sets the following options if not empty:

- If $\{\langle symbolType \rangle\}$ below is a, see \GTSxa:
mainColor=color1 or mainC=color1 or mColor=color1 or mC=color1,
secondColor=color2 or secondC=color2 or sColor=color2 or sC=color2,
monochrome or mono or mon or m (equivalent to mC=black,sC=black),
negated or not or n,
up or u,
down or d,
relation or rel or r.
- If $\{\langle symbolType \rangle\}$ below is i, see \GTSxi:
mainColor=color1 or mainC=color1 or mColor=color1 or mC=color1,
secondColor=color2 or secondC=color2 or sColor=color2 or sC=color2,
monochrome or mono or mon or m (equivalent to mC=black,sC=black),
negated or not or n,
in or i,
out or o,
relation or rel or r.
- If $\{\langle symbolType \rangle\}$ below is m, see \GTSxml:
not or n,

and or a,
or or o,
relation or rel or r.

$\{\langle symbolType \rangle\}$ a mandatory switch; it can take value **a** for adjacency, **i** for incidence, **m** for meta-logic.

```
517 \newcommand{\GTSx}[2][]{\%
518 \if#2a%
519 \GTSxa[#1]%
520 \else\if#2i%
521 \GTSxi[#1]%
522 \else\if#2m%
523 \GTSxmi[#1]%
524 \else%
525 Wrong call to \textbackslash{\GTSx}%
526 \fi%
527 \fi%
528 \fi%
529 }

530 \endinput
531 \</package>
```

4 Acknowledgments

Thank You God! Thank You Father! Thank You Jesus! Thank You Holy-Spirit!

5 Support

This package is gratis and free. But if you can star it on GitHub, it is a nice encouragement.

6 Change History

v0.1.0 – 2026-08-01	v1.4.0 – 2026-09-12
General: Initial version 1	General: New macros for symbols for logical operations on relations 1
v1.0.0 – 2026-08-26	v1.5.0 – 2026-09-12
General: First public release 1	General: One macro to rule them all 1
v1.1.0 – 2026-08-29	v1.5.1 – 2026-09-13
General: Added a memo 1	General: Use noprint option of doc package to avoid too big left margins, and use paragraph command instead 1
v1.1.1 – 2026-08-30	v1.5.2 – 2026-09-14
General: Small corrections and improvements 1	General: Add A4, USLetter, and Book variants of PDFs. 1
v1.2.0 – 2026-09-06	v1.6.0 – 2026-09-18
General: CTAN URL, new macros for same set of symbols 1	General: Add verbatim code for compound adjacency in memo. 1
v1.2.1 – 2026-09-08	
General: Smaller tests output 1	
v1.3.0 – 2026-09-08	
General: New macros for monochrome symbols 1	

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