simplebnf — A simple package to format Backus-Naur form[*]

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This package provides a simple way for typesetting grammars in Backus-Naur form (BNF). It features a flexible configuration system, allowing for the customization of the domain-specific language (DSL) used in typesetting the grammar. Additionally, the package comes with sensible defaults.

Below is the metagrammar of the DSL as defined in this package, which is typeset using the package itself.[1]

Gramar	G	::=	P	production
		|	$P \, \overset{\circ}{\circ}$	production w/ a trailing delimiter
		|	$P \, \overset{\circ}{\circ} \, G$	production sequence
Production	P	::=	$L \twoheadrightarrow R$	
LHS	L	::=	v	metavariable
		|	$v \mathbin{/\!\!/} c$	annotated metavariable
RHS	R	::=	$[\!]$	delimiter
		|	$A \, [\!] \, R$	alternative sequence
Alternative	A	::=	f	syntactic form
		|	$f \mathbin{/\!\!/} c$	annotated syntactic form
Prod. delimiter	$\overset{\circ}{\circ}$	::=	`;;`	default symbol
		|	$\cdots$	user-defined
Rule relation	$\twoheadrightarrow$	::=	`::=`	::=
		|	`->`	$\rightarrow$
		|	`\in`	$\in$
		|	$\cdots$	user-defined
Annot. symbol	$/\!\!/$	::=	`:`	default symbol
		|	$\cdots$	user-defined
Alt. delimiter	$[\!]$	::=	`|`	new-line delimiter
		|	`||`	single-line delimiter
		|	$\cdots$	user-defined
	v, f, c	$\in$	TₑX tl	valid TₑX token lists

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[1]The code is shown in Appendix.

1   Tutorial for the impatient

Typesetting a grammar is as simple as typing the BNF grammar in the bnf environment:

```
\begin{center}
\begin{bnf}
  $\tau$ : \textsf{Type} ::=
  | \texttt{num} : numbers
  | \texttt{str} : strings
  ;;
  $e$ : \textsf{Expr} ::=
  | $x$ : variable
  | $n$ : numeral
  | \texttt{$e$ + $e$} : addition
  | \texttt{$e$ * $e$} :
    multiplication
  | \texttt{$e$
    \textasciicircum{} $e$} :
    concatenation
  | \texttt{len($e$)} : length
  | \texttt{let $x$ = $e_1$ in
    $e_2$} : definition
\end{bnf}
\end{center}
```

Type	τ	::=	num	numbers
		|	str	strings
Expr	e	::=	x	variable
		|	n	numeral
		|	$e + e$	addition
		|	$e * e$	multiplication
		|	$e \char`\^ e$	concatenation
		|	len(e)	length
		|	let $x = e_1$ in e_2	definition

Typically, each column in the BNF grammar has the same font style. In the example above, the comments in the first column, e.g., Type, is typeset in sans-serif, and the second column in math mode, e.g., τ. The column for the right-hand side is (mostly) typeset in typewriter font with a bit of non-terminals like e typeset in math mode.

simplebnf provides a straightforward way to customize the font styles for each column[2]:

```
\begin{bnf}[
  colspec = {llcll},
  column{1} = {font = \sffamily},
  column{2} = {mode = dmath},
  column{4} = {font = \ttfamily},
]
  \tau : Type ::=
  | num : numbers
  | str : strings
  ;;
  e : Expr ::=
  | $x$ : variable
  | $n$ : numeral
  | $e$ + $e$ : addition
  | $e$ * $e$ : multiplication
  | $e$ \textasciicircum{} $e$ : concatenation
  | len($e$) : length
  | let $x$ = $e_1$ in $e_2$ : definition
\end{bnf}
```

If you find yourself using the same configuration repeatedly, you can fix the desired configuration using \SetBNFLayout. Once set using \SetBNFLayout, the configuration is applied to all subsequent bnf environments:

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[2]Note that you must provide a manual alignment specification with the key colspec.

```
% Some where above...
\SetBNFLayout{
  colspec = {llcll},
  column{1} = {font = \sffamily},
  column{2} = {mode = dmath},
  column{4} = {font = \ttfamily},
}
% ...
\begin{bnf}
  \tau : Type ::=
  | num : numbers
  | str : strings
  ;;
  e : Expr ::=
  | $x$ : variable
  | $n$ : numeral
  | $e$ + $e$ : addition
  | $e$ * $e$ : multiplication
  | $e$ \textasciicircum{} $e$ : concatenation
  | len($e$) : length
  | let $x$ = $e_1$ in $e_2$ : definition
\end{bnf}
```

Since these customizations are provided by the backend tabularray[3], consult its documentation for more details. The corresponding command is `\SetTblrInner`.

For more advanced customization, such as changing default delimiters and symbols, continue to section 2 – *Configuration*.

2 Configuration

While the default configuration should be sufficient for most use cases, some grammars may require using different delimiters and symbols. For example, the language itself may contain `->` as a syntactic form, which conflicts with one of the default symbols for the rule relation.

To this end, simplebnf provides a number of options to configure the DSL used to typeset the grammar. Some examples of customizable symbols include the delimiters for productions and alternatives, the relation symbol between the left-hand side and the right-hand side, the annotation symbol, and more.

The default configuration is shown in Table 1.

Table 1: Default key-values for the configuration of simplebnf.

Key	Default value
prod-delim	;;
new-line-delim	|
single-line-delim	//
comment	:
relation	{::=|->|:in:}

Table 1: Default key-values for the configuration of simplebnf. (Continued)

relation-sym-map	`{`
	`{::=} = {\ensuremath{\Coloneqq}},`
	`{->} = {\ensuremath{\to}},`
	`{:in:} = {\ensuremath{\in}},`
	`}`
or-sym	`$|$`
prod-sep	`2pt`
row-sep	`0pt`

An exmaple of customizing the configuration is shown below:

```
\begin{center}
\begin{bnf}(
  prod-delim = {--},
  new-line-delim = {\&},
  single-line-delim = {\&\&},
  comment = {//},
  relation-sym-map =
    {
      {->} = {\ensuremath{\hookrightarrow}},
      {:in:} = {\ensuremath{\in}},
    },
  or-sym = {},
)[
  colspec = {llcll},
  column{1} = {font = \sffamily},
  column{2} = {mode = dmath},
  column{4} = {font = \ttfamily},
]
  \tau // Type ->
  & num // numbers
  & str // strings
  --
  e // Expr ->
  & $x$ // variable
  & $n$ // numeral
  & $e$ + $e$ // addition
  & $e$ * $e$ // multiplication
  & $e$ \textasciicircum{} $e$ // concatenation
  & len($e$) // length
  & let $x$ = $e_1$ in $e_2$ // definition
\end{bnf}
\end{center}
```

Type	τ	$\hookrightarrow$	num	numbers
			str	strings
Expr	e	$\hookrightarrow$	x	variable
			n	numeral
			$e + e$	addition
			$e * e$	multiplication
			e ^ e	concatenation
			$\mathrm{len}(e)$	length
			let $x = e_1$ in e_2	definition

Furthermore, the configuration can be set globally using \SetBNFConfig, similar to \SetBNFLayout:

```
% Some where above...
\SetBNFConfig{
  prod-delim = {--},
  new-line-delim = {\&},
  single-line-delim = {\&\&},
  comment = {//},
  relation-sym-map =
    {
      {->} = {\ensuremath{\hookrightarrow}},
      {:in:} = {\ensuremath{\in}},
    },
  or-sym = {},
}
% ...
\begin{bnf}[
  colspec = {llcll},
  column{1} = {font = \sffamily},
  column{2} = {mode = dmath},
  column{4} = {font = \ttfamily},
]
  \tau // Type ->
  & num // numbers
  & str // strings
  --
  e // Expr ->
  & $x$ // variable
  & $n$ // numeral
  & $e$ + $e$ // addition
  & $e$ * $e$ // multiplication
  & $e$ \textasciicircum{} $e$ // concatenation
  & len($e$) // length
  & let $x$ = $e_1$ in $e_2$ // definition
\end{bnf}
```

2.1 Production delimiter

The default production delimiter prod-delim is ;;. This will separate different productions in the same grammar.

2.2 New-line alternative delimiter

The default new-line alternative delimiter new-line-delim is \|, which will actually match verbatim \| in the grammar. This will separate different alternatives into different lines in the same production.

2.3 Single-line alternative delimiter

The default single-line alternative delimiter single-line-delim is //. The difference between the single-line alternative delimiter and the new-line alternative delimiter is that the former will not add a new line after the delimiter.

For consecutive alternatives delimited by the single-line alternative delimiter, only the last of them can be annotated.

Note that the single-line alternative delimiter must not contain the new-line alternative delimiter as a substring.

2.4 Annotation delimiter

The default annotation delimiter `comment` is `:`. This will separate the syntactic form and the annotation within the alternative.

2.5 Rule relations and the symbol map

simplebnf provides a `::=`, `->`, and `:in:` for the rule relation between the left-hand side and the right-hand side. Each of them is mapped to a symbol in the `relation-sym-map` key-value list; By default, they are mapped to ::= (\ensuremath{\Coloneqq}), → (\ensuremath{\to}), and ∈ (\ensuremath{\in}), respectively.

To provide a custom relation symbol, provide the desired symbol and the mapping to the `relation-sym-map` key-value list and to the `relation`.

2.6 Or symbol

The default or symbol `or-sym` is `$|$`. Probably the most common use case for this option is to remove the or symbol altogether by setting it to `{}`.

2.7 Production separation

The default production separation `prod-sep` is `2pt`. This will add a vertical space between the productions.

2.8 Row separation

The default row separation `row-sep` is `0pt`. This will add a vertical space between the alternatives in the same production.

3 Caveats

The choices of delimiters and symbols should be carefully made, in order to avoid conflicts with the grammar of the target language and our meta-language, TeX.

Another subtlety to consider while customizing delimiters, is that certain delimiters not contain the others as a substring. For instance, as mentioned in , the single-line alternative delimiter must not contain the new-line alternative delimiter as a substring.

When using custom OpenType fonts with the `unicode-math` package in X⅁LATEX or LuaLATEX, beware of the fact that many fonts lack the `\Coloneqq` symbol, ::=. The easiest way to fix this is to actually use a font that provides the symbol, such as `Garamond-Math`, which comes with the TeXLive installation[4].

```
\setmathfont{Garamond-Math.otf}[
  Scale = MatchUppercase,
  range = {\Coloneq}
]
```

4 The deprecated `bnfgrammar` environment

Prior to version 1.0.0, the package provided a sole environment `bnfgrammar` for typesetting grammars. While it is still available, it is now deprecated and will be removed in a future release. Using it will result in a deprecation warning.

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[4] `\Coloneq` is not a typo of `\Coloneqq`.

To migrate to the new `bnf` environment, simply replace the `bnfgrammar` environment with `bnf`, and replace `\in` with `:in:` and `||` with `//`. While there will be some differences in the spacings and the font styles, it is an easy fix. See for more details.

Below is an example of using the deprecated `bnfgrammar` environment, left here for historical reasons.

```
\begin{bnfgrammar}          │
  a : Variables \in \textit{Vars}    │
  ;;                        │                Variables   a      ∈    Vars
  expr : Expressions ::=    │                Expressions  expr   ::=  expr + term
    expr + term             │                                    |    term
  | term                    │                            term   ::=  term * a | a
  ;;                        │
  term ::= term * a || a    │
\end{bnfgrammar}            │
```

Appendix

The following is the code used to typeset the metagrammar of the simplebnf DSL in the first page.

```
\begin{bnf}(
  prod-delim = ;;;,
  new-line-delim = !,
  single-line-delim = ?,
  comment = //,
  relation = {:::=|:in:},
  relation-sym-map =
    {
      {:::=} = $\Coloneqq$,
      {:in:} = $\in$,
    },
)[
  colspec = lrcll,
  column{2} = {mode=dmath},
  column{4} = {mode=text, font=\ttfamily},
]
  G // Gramar :::=
  ! $P$ // production
  ! $P \fatsemi {}$ // production w/ a trailing delimiter
  ! $P \fatsemi G$ // production sequence
;;;
  P // Production :::= $L \rightarrowtriangle R$
;;;
  L // LHS :::=
  ! $v$ // metavariable
  ! $v\!\fatslash\,c$ // annotated metavariable
;;;
  R // RHS :::=
  ! $\talloblong$ // delimiter
  ! $A \talloblong R$ // alternative sequence
;;;
  A // Alternative :::=
  ! $f$ // syntactic form
  ! $f\!\fatslash\,c$ // annotated syntactic form
```

```
;;;
  \fatsemi // Prod. delimiter :::=
  ! ;; // default symbol
  ! $\cdots$ // user-defined
;;;
  \rightarrowtriangle // Rule relation :::=
  ! ::= // $\Coloneqq$
  ! -> // $\to$
  ! \texttt{\char`\\in} // $\in$
  ! $\cdots$ // user-defined
;;;
  \fatslash // Annot. symbol :::=
  ! : // default symbol
  ! $\cdots$ // user-defined
;;;
  \talloblong // Alt. delimiter :::=
  ! | // new-line delimiter
  ! || // single-line delimiter
  ! $\cdots$ // user-defined
;;;
  v, f, c :in: \textsf{\TeX{} tl} // valid \TeX{} token lists
;;;
\end{bnf}
```