

modernruler Package Documentation

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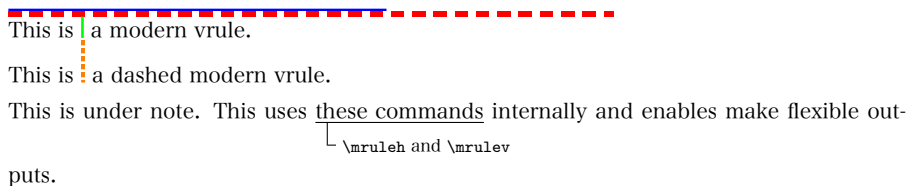
1 Outline

This package provides modern `hrule` (`\mruleth`), `vrule` (`\mruletv`), and `\undernote` internally uses the two commands.

Input

```
1 % normal rule
2 \mruleth[height=1pt, width=5cm, color=blue]
3
4 % dashed rule
5 \mruleth[height=2pt, width=8cm, color=red, dash=true, dash-len=5pt, gap-len=3
  pt]
6
7 % inline rule
8 This is \mruletv[height=\zw, depth=1.5\zw, width=1pt, color=green] a modern
  vrule.
9
10 % inline dashed rule
11 This is \mruletv[height=2\zw, width=1.5pt, color=orange, dash=true, dash-len
  =2pt, gap-len=1pt] a dashed modern vrule.
12
13 % undernote
14 This is under note. This uses \undernote{these commands}{\texttt{\
  textbackslash mruleh} and \texttt{\textbackslash mrulev}} internally and
  enables make flexible outputs.
```

Output



This is a modern vrule.

This is a dashed modern vrule.

This is under note. This uses these commands internally and enables make flexible outputs.

`\mruleh` and `\mrulev`

2 Acknowledgements / Credits

This package was inspired by discussions on TeX Forum concerning undernote-like constructions using rules.

An improved approach was later presented by Mr. Yusuke Terada, which clarified several implementation details.

The present package is a complete reimplementaion and extension, introducing a generalized rule-based engine, redesigned control flow, and additional features such as modern ruler integration and `tclobox`-based abstractions.

Any remaining errors or design decisions are entirely the responsibility of the author.

3 Note

This package only supports LuaLaTeX.

In this package, a unit `\zw` is used in many parts. It is Japanese standard unit, but it's not normal outside of Japan. When you encounter `\zw` in documentations, please understand it as `1em`. In detail, `\zw` and `1em` is different when you use Japanese characters. But only when you use alphabetic characters and numbers, the difference doesn't matter.

4 Installation

Input

```
1 \usepackage[<options>]{modernruler}
```

Detailed information regarding the options will be provided in a later section, specifically during the explanation of the `\undernote` command.

5 Commands

5.1 `\mruleth`, `\mruletv`

In the first place, `\mruleth` and `\mruletv` are extended `\hrule` and `\vrule`. You can use them like this:

Input

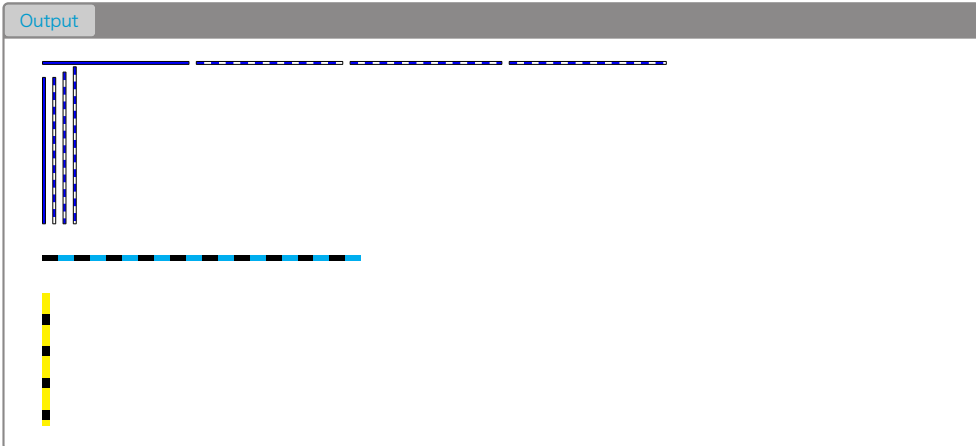
```
1 \mruleth[<keyvaloptions>]
2 \mruletv[<keyvaloptions>]
```

These commands share the same keys.

Key	Type	Default	Description
width	dim	0pt	Width of the rule
height	dim	0pt	Height above the baseline
depth	dim	0pt	Depth below the baseline
color	tl	black	Color of the rule
gap-color	tl	white	Color of the gap segments
dash	bool	false	Enables dashed line if true
dash-len	dim	3pt	Length of the dash segment
gap-len	dim	2.5pt	Length of the gap between dashes

The outputs are as follows:

```
Input
1 \fboxsep=0pt\fboxrule=.1pt%
2
3 % horizontal rule
4 \fbox{\mruleth[height=1pt, width=55pt, color=blue]}
5 \fbox{\mruleth[height=1pt, width=55pt, color=blue, dash=true]}
6 \fbox{\mruleth[height=1pt, width=57pt, color=blue, dash=true]}
7 \fbox{\mruleth[height=1pt, width=59pt, color=blue, dash=true]}
8
9 % vertical rule
10 \fbox{\mruletv[width=1pt, height=55pt, color=blue]}
11 \fbox{\mruletv[width=1pt, height=55pt, color=blue, dash=true]}
12 \fbox{\mruletv[width=1pt, height=57pt, color=blue, dash=true]}
13 \fbox{\mruletv[width=1pt, height=59pt, color=blue, dash=true]}\bigskip
14
15 % Horizontal: Alternating Black and Cyan segments
16 \mruleth[width=120pt, height=2pt, dash=true, dash-len=6pt, gap-len=6pt, color
    =black, gap-color=cyan]\bigskip
17
18 % Vertical: Warning Pattern (Yellow and Black)
19 \mruletv[width=3pt, height=50pt, dash=true, dash-len=8pt, gap-len=4pt, color=
    yellow, gap-color=black]
```



5.2 \undernote

This commands provides underlined annotation. There is some optional parameters which adjust the position of the annotation text.

└ Like this.

```

Input
1 % grammar
2 \undernote<star option>[<number of lines to shift the note downward>]{<the
target phrase>}{<annotation>}[<style>]
3
4 % example
5 In this single paragraph, we deliberately place many annotated terms to
6 stress-test the undernote mechanism, starting with a
7 \undernote{concept}{A brief explanation of the main concept}
8 that appears early in the line, followed closely by another\
9 \undernote{idea}{A slightly longer explanatory note that is expected to
10 interact with nearby notes} to encourage horizontal overlap detection.
11 As the sentence continues, we insert a fixed-level annotation such as
12 \undernote[2]{method}{This note is forced onto the second vertical level}
13 to verify that manual level assignment overrides automatic stacking,
14 and later a short
15 \undernote{term}{Short note}
16 next to a much longer
17 \undernote*{expression}{This is a considerably longer explanatory note

```

```

18 designed to increase the occupied width and push subsequent notes
19 downward in the vertical stacking algorithm}.
20 Near the end of the paragraph, we add one more fixed example,
21 \undernote[3]{result}{A third-level note used to confirm deep stacking},
22 followed immediately by an automatic one,
23 \undernote*{observation}{This final note should be placed at a safe
24 vertical distance determined by the collision analysis performed
25 during the previous compilation run}.

```

Output

In this single paragraph, we deliberately place many annotated terms to stress-test the undernote mechanism, starting with a concept that appears early in the line, followed

└ A brief explanation of the main concept

closely by another idea to encourage horizontal overlap detection. As the sentence continues, we insert a

└ A slightly longer explanatory note that is expected to interact with nearby notes

fixed-level annotation such as method to verify that manual level assignment overrides

└ This note is forced onto the second vertical level

automatic stacking, and later a short term next to a much longer expression. Near the

└ Short note

└ This is a considerably longer explanatory note designed to increase the occupied width and push subsequent notes downward in the vertical stacking algorithm

end of the paragraph, we add one more fixed example, result, followed immediately by an

└ A third-level note used to confirm deep stacking

automatic one, observation.

└ This final note should be placed at a safe vertical distance determined by the collision analysis performed during the previous compilation run

As the example above shows, the star option puts the annotation text in a parabox. So when you include a long description in the fourth argument of the `\undernote`, the option is the best way to avoid overflow.

Regarding the second argument, “number of lines to shift the note downward” is always determined automatically if you don’t specify it. I recommend using this option only when annotations are too close to each other.

Of course, this package provides some package options for adjustments.

Key	Type	Default	Description
notesize	tl	<code>\footnotesize</code>	Font size of the note text
notepos	dim	3mm	Minimum vertical length of the line to the note
noteshift	dim	4mm	Vertical shift amount per level for overlapping notes
noterulethickness	dim	.4pt	Thickness of the rule used in the note
noterulehshift	dim	1.5mm	Horizontal offset of the vertical line from the underline start
noterulehsize	dim	1.5mm	Length of the horizontal line extending to the note
notesep	dim	2em	Minimum horizontal distance to prevent note overlap
noteoverhang	dim	3em	Extension length of the note parbox (starred version)
parstyle	int	0	Border style (0: none, 1: solid, 2: dashed)

When you want to change some settings in the middle of the document, you can use the following commands:

Key (Command)	Type	Default	Description
<code>\SetUNoteSize</code>	tl	<code>\footnotesize</code>	Sets the font size of the note
<code>\SetUNoteRuleThickness</code>	dim	.4pt	Sets the thickness of the note rules
<code>\SetUNoteRuleHShift</code>	dim	1.5mm	Sets the horizontal offset of the vertical rule
<code>\SetUNoteRuleHSize</code>	dim	1.5mm	Sets the length of the horizontal rule
<code>\SetUNotePos</code>	dim	3mm	Sets the minimum vertical line length
<code>\SetUNoteShift</code>	dim	4mm	Sets the vertical shift amount per level
<code>\SetUNoteSep</code>	dim	2em	Sets the minimum horizontal separation between notes
<code>\SetUNoteOverHang</code>	dim	3em	Sets the overhang length for parbox notes
<code>\SetUNoteParstyle</code>	int	0	Updates the border style and drawing logic

6 License

Released under the MIT License.

7 Version History

- v1.0.0 — Initial public release.
- v1.1.0 — Add a fallback for `\zw` and `\tjgetparameter`.

8 Source Code


```

\NeedsTeXFormat{LaTeX2e}
\ProvidesPackage{modernruler}[2025/01/06, Version 1.1.0]

%% parameters
\unless\ifdefined\zw
  \newdimen\zw
  \zw=1em
\fi
\unless\ifdefined\ltjgetparameter
  \newcommand{\ltjgetparameter}[1]{4}
\fi

%% basic settings
\RequirePackage{kvoptions}
\RequirePackage{varwidth}
\RequirePackage[most]{tcolorbox}

%% kv (undernoteの方)
\SetupKeyvalOptions{
  family=undernote,%
  prefix=undernote%
}
\DeclareStringOption[\footnotesize]{notesize}
\DeclareStringOption[3mm]{notepos}
\DeclareStringOption[4mm]{noteshift}
\DeclareStringOption[.4pt]{noterulethickness}
\DeclareStringOption[1.5mm]{noterulehshift}
\DeclareStringOption[1.5mm]{noterulehsize}
\DeclareStringOption[2em]{notesep}
\DeclareStringOption[3em]{noteoverhang}
\DeclareStringOption[0]{parstyle}
\ProcessKeyvalOptions*

\def\notesize@internal@undernote{\undernote@notesize}
  %%% 注釈部分の文字サイズ
\def\notepos@internal@undernote{\undernote@notepos}
  %%% 注釈へと伸ばす縦線の長さの最小値
\def\noteshift@internal@undernote{\undernote@noteshift}
  %%% 注釈を下にずらす場合の1段階分の移動量
\def\noterulethickness@internal@undernote{\undernote@noterulethickness}
  %%% \note で用いる罫線の太さ
\def\noterulehshift@internal@undernote{\undernote@noterulehshift}
  %%% 注釈へと伸ばす縦線の位置（注釈をつける語句につけた下線の左端から
  %%% \noterulehshift@internal@undernote だけ右にずれた位置に縦線を置く）
\def\noterulehsize@internal@undernote{\undernote@noterulehsize}
  %%% 注釈へと伸ばす横線の長さ
\def\notesep@internal@undernote{\undernote@notesep}
  %%% 前にある注釈が次の注釈の縦線から \notesep@internal@undernote 以内に近づくようなら、
  %%% 前にある注釈を下にずらす（「2em」のように文字サイズに依存する
  %%% 指定をした場合は、 \notesize@internal@undernote（の、現在使用中のフォント）における値）

```

```

\def\noteoverhang@internal@undernote{\undernote@noteoverhang}
%%% parbox に入れるタイプ（スターをつけた時）
%%% どの程度後ろに注釈部分を張り出させるか
\def\noteparstyle@internal@undernote{\undernote@parstyle}
%%% 注釈部分を
%%% 1 と 2 以外：囲みなし 1: 実線で囲う 2: 点線で囲う

% command
\NewDocumentCommand{\SetUNoteSize}{0{\footnotesize}}{%
  \def\notesize@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteRuleThickness}{0{.4pt}}{%
  \def\noterulethickness@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteRuleHShift}{0{1.5mm}}{%
  \def\noterulehshift@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteRuleHSize}{0{1.5mm}}{%
  \def\noterulehsize@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNotePos}{0{3mm}}{%
  \def\notepos@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteShift}{0{4mm}}{%
  \def\noteshift@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteSep}{0{2em}}{%
  \def\notesep@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteOverHang}{0{3em}}{%
  \def\noteoverhang@internal@undernote{#1}%
}
\NewDocumentCommand{\SetUNoteParstyle}{0{0}}{%
  \ifnum#1=1%
    \let\wrap@undernote\wrap@undernote@styleA%
    \let\wrap@undernote@par\wrap@undernote@par@styleA%
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
      undernote@textlen@tempo]}%
    \def\vlines@undernote@par{%
      \mruletv[height=\dimen0, width=\noterulethickness@internal@undernote, depth=0pt]%
      \mruleth[height=\noterulethickness@internal@undernote, width=\
        noterulehsize@internal@undernote, depth=0pt]%
    }%
  \else\ifnum#1=2
    \let\wrap@undernote\wrap@undernote@styleB%
    \let\wrap@undernote@par\wrap@undernote@par@styleB%
    \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
      undernote@textlen@tempo, dash=true]}%
    \def\vlines@undernote@par{%

```

```

\mruletv[height=\dimen@, width=\noterulethickness@internal@undernote, depth=Opt ,dash=
true]%
\mruleth[height=\noterulethickness@internal@undernote, width=\
noterulehsz@internal@undernote, depth=Opt, dash=true]%
}%
\else
\let\wrap@undernote\wrap@undernote@styleC%
\let\wrap@undernote@par\wrap@undernote@par@styleC%
\def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
undernote@textlen@tempo]}%
\def\vlines@undernote@par{%
\mruletv[height=\dimen@, width=\noterulethickness@internal@undernote, depth=Opt]%
\mruleth[height=\noterulethickness@internal@undernote, width=\
noterulehsz@internal@undernote, depth=Opt]%
}%
\fi\fi
}
%%
%% modern rule commands
\ExplSyntaxOn

% 変数の宣言
\dim_new:N \l_mrule_width_dim
\dim_new:N \l_mrule_height_dim
\dim_new:N \l_mrule_depth_dim
\dim_new:N \l_mrule_dash_len_dim
\dim_new:N \l_mrule_gap_len_dim
\dim_new:N \l_mrule_total_width_dim
\tl_new:N \l_mrule_color_tl
\bool_new:N \l_mrule_dash_bool
\tl_new:N \l_mrule_leader_cmd_tl
\dim_new:N \l__mrule_tmp_remaining_dim

% キーの定義
\keys_define:nn { modernrule }
{
width .dim_set:N = \l_mrule_width_dim,
height .dim_set:N = \l_mrule_height_dim,
depth .dim_set:N = \l_mrule_depth_dim,
color .tl_set:N = \l_mrule_color_tl,
dash .bool_set:N = \l_mrule_dash_bool,
dash-len .dim_set:N = \l_mrule_dash_len_dim,
gap-len .dim_set:N = \l_mrule_gap_len_dim,
gap-color .tl_set:N = \l_mrule_gap_color_tl,

% デフォルト値
width .initial:n = Opt,
height .initial:n = Opt,
depth .initial:n = Opt,

```

```

color .initial:n = black,
dash .initial:n = false,
dash-len .initial:n = 3pt,
gap-len .initial:n = 2.5pt,
gap-color .initial:n = white,
}

% 水平方向：2色点線
\NewDocumentCommand{\mruleth}{0{}}
{
  \group_begin:
  \keys_set:nn { modernrule } { #1 }
  \ifvmode \nointerlineskip \fi

  \bool_if:NTF \l_mrule_dash_bool
  {
    % dash=true: 2色交互の点線描画
    \hbox_to_wd:nn { \l_mrule_width_dim }
    {
      \dim_set:Nn \l_mrule_tmp_remaining_dim { \l_mrule_width_dim }
      \dim_while_do:nNnn { \l_mrule_tmp_remaining_dim } > { Opt }
      {
        \dim_compare:nNnTF { \l_mrule_tmp_remaining_dim } > { \l_mrule_dash_len_dim }
        {
          % メイン色
          {\color{\l_mrule_color_t1} \vrule width \l_mrule_dash_len_dim height \
            l_mrule_height_dim depth \l_mrule_depth_dim}
          \dim_sub:Nn \l_mrule_tmp_remaining_dim { \l_mrule_dash_len_dim }

          % ギャップ色
          \dim_compare:nNnTF { \l_mrule_tmp_remaining_dim } > { \l_mrule_gap_len_dim }
          {
            {\color{\l_mrule_gap_color_t1} \vrule width \l_mrule_gap_len_dim height \
              l_mrule_height_dim depth \l_mrule_depth_dim}
            \dim_sub:Nn \l_mrule_tmp_remaining_dim { \l_mrule_gap_len_dim }
          }
          {
            {\color{\l_mrule_gap_color_t1} \vrule width \l_mrule_tmp_remaining_dim
              height \l_mrule_height_dim depth \l_mrule_depth_dim}
            \dim_set:Nn \l_mrule_tmp_remaining_dim { Opt }
          }
        }
      }
      {
        {\color{\l_mrule_color_t1} \vrule width \l_mrule_tmp_remaining_dim height \
          l_mrule_height_dim depth \l_mrule_depth_dim}
        \dim_set:Nn \l_mrule_tmp_remaining_dim { Opt }
      }
    }
  }
  \hss
}

```

```

}
{
  \hbox_to_wd:nn { \l_mruler_width_dim } {{
    \color{\l_mruler_color_tl}
    \vrule width \l_mruler_width_dim height \l_mruler_height_dim depth \l_mruler_depth_dim
  }}
}

\ifvmode \nointerlineskip \fi
\group_end:
}

% 垂直方向：2色点線
\NewDocumentCommand{\mruletv}{0{}}
{
  \group_begin:
  \keys_set:nn { modernrule } { #1 }

  \bool_if:NTF \l_mruler_dash_bool
  {
    % dash=true: 2色交互の垂直点線
    \dim_set:Nn \l_mruler_tmp_remaining_dim { \l_mruler_height_dim }
    \vbox:n
    {
      \dim_while_do:nNnn { \l_mruler_tmp_remaining_dim } > { Opt }
      {
        \dim_compare:nNnTF { \l_mruler_tmp_remaining_dim } > { \l_mruler_dash_len_dim }
        {
          % メイン色
          {\color{\l_mruler_color_tl} \hrule width \l_mruler_width_dim height \
            \l_mruler_dash_len_dim}
          \dim_sub:Nn \l_mruler_tmp_remaining_dim { \l_mruler_dash_len_dim }

          % ギャップ色
          \dim_compare:nNnTF { \l_mruler_tmp_remaining_dim } > { \l_mruler_gap_len_dim }
          {
            {\color{\l_mruler_gap_color_tl} \hrule width \l_mruler_width_dim height \
              \l_mruler_gap_len_dim}
            \dim_sub:Nn \l_mruler_tmp_remaining_dim { \l_mruler_gap_len_dim }
          }
          {
            {\color{\l_mruler_gap_color_tl} \hrule width \l_mruler_width_dim height \
              \l_mruler_tmp_remaining_dim}
            \dim_set:Nn \l_mruler_tmp_remaining_dim { Opt }
          }
        }
      }
      {
        {\color{\l_mruler_color_tl} \hrule width \l_mruler_width_dim height \
          \l_mruler_tmp_remaining_dim}
        \dim_set:Nn \l_mruler_tmp_remaining_dim { Opt }
      }
    }
  }
}

```

```

    }
  }
}
{
  \vbox:n { {\color{\l_mrule_color_t1} \hrule width \l_mrule_width_dim height \
    l_mrule_height_dim} }
}
\group_end:
}
\ExplSyntaxOff
%%

\DeclareTotalTCBox{\FramedBox@undernote}{ 0{} +m }{%
  on line,arc=0pt,
  sharp corners,boxsep=0mm,
  left=.3mm,right=.3mm,top=0.3mm,bottom=0.3mm,
  colback=white,colframe=white,
  enhanced,before={\hspace*{- .1722\zw}},
  borderline={\noterulethickness@internal@undernote}{0mm}{solid},
  #1
}{#2}
\DeclareTotalTCBox{\DashedBox@undernote}{ 0{} +m }{%
  on line,arc=0pt,
  sharp corners,boxsep=0mm,
  left=.3mm,right=.3mm,top=0.3mm,bottom=0.3mm,
  colback=white,colframe=white,
  enhanced,before={\hspace*{- .1722\zw}},
  borderline={\noterulethickness@internal@undernote}{0mm}{dashed},
  #1
}{#2}
\DeclareTotalTCBox{\NoframeBox@undernote}{ 0{} +m }{%
  on line,arc=0pt,
  sharp corners,boxsep=0mm,
  left=.3mm,right=.3mm,top=0.3mm,bottom=0.3mm,
  colback=white,colframe=white,
  enhanced,before={\hspace*{- .1722\zw}},
  #1
}{#2}

\newlength{\undernote@textlen@tempo}

\NewDocumentCommand{\wrap@undernote@par@styleA}{ +m }{%
  {%
    \FramedBox@undernote{%
      \parbox[t]{\dimexpr\undernote@textlen@tempo - \noterulehsiz@internal@undernote - \
        noterulehshift@internal@undernote + \noteoverhang@internal@undernote\relax}%
      {\setlength{\baselineskip}{.2153\zw}#1}}%
    }}
\NewDocumentCommand{\wrap@undernote@par@styleB}{ +m }{%

```

```

{%
  \DashedBox@undernote{%
    \parbox[t]{\dimexpr\undernote@textlen@tempo - \noterulehsz@internal@undernote - \
      noterulehshift@internal@undernote + \noteoverhang@internal@undernote\relax}%
    {\setlength{\baselineskip}{.2153\zw}#1}}%
  }}
\NewDocumentCommand{\wrap@undernote@par@styleC}{ +m }{%
  {%
    \NoframeBox@undernote{%
      \parbox[t]{\dimexpr\undernote@textlen@tempo - \noterulehsz@internal@undernote - \
        noterulehshift@internal@undernote + \noteoverhang@internal@undernote\relax}%
      {\setlength{\baselineskip}{.2153\zw}#1}}%
    }}
\NewDocumentCommand{\wrap@undernote@styleA}{ +m }{{\FramedBox@undernote{#1}}}
\NewDocumentCommand{\wrap@undernote@styleB}{ +m }{{\DashedBox@undernote{#1}}}
\NewDocumentCommand{\wrap@undernote@styleC}{ +m }{{\NoframeBox@undernote{#1}}}
\NewDocumentCommand{\wrap@undernote}{ +m }{{#1}}
\NewDocumentCommand{\wrap@undernote@par}{ +m }{{\wrap@undernote@styleC{#1}}}
\ifnum\noteparstyle@internal@undernote=1
  \let\wrap@undernote\wrap@undernote@styleA
  \let\wrap@undernote@par\wrap@undernote@par@styleA
  \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
    undernote@textlen@tempo]}%
  \def\vlines@undernote@par{%
    \mruletv[height=\dimen@, width=\noterulethickness@internal@undernote, depth=0pt]%
    \mruleth[height=\noterulethickness@internal@undernote, width=\
      noterulehsz@internal@undernote, depth=0pt]%
  }
\else\ifnum\noteparstyle@internal@undernote=2
  \let\wrap@undernote\wrap@undernote@styleB
  \let\wrap@undernote@par\wrap@undernote@par@styleB
  \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
    undernote@textlen@tempo, dash=true]}%
  \def\vlines@undernote@par{%
    \mruletv[height=\dimen@, width=\noterulethickness@internal@undernote, depth=0pt ,dash=
      true]%
    \mruleth[height=\noterulethickness@internal@undernote, width=\
      noterulehsz@internal@undernote, depth=0pt, dash=true]%
  }
\else
  \let\wrap@undernote\wrap@undernote@styleC
  \let\wrap@undernote@par\wrap@undernote@par@styleC
  \def\hline@undernote@par{\mruleth[height=\noterulethickness@internal@undernote, width=\
    undernote@textlen@tempo]}%
  \def\vlines@undernote@par{%
    \mruletv[height=\dimen@, width=\noterulethickness@internal@undernote, depth=0pt]%
    \mruleth[height=\noterulethickness@internal@undernote, width=\
      noterulehsz@internal@undernote, depth=0pt]%
  }
}
\fi\fi

```

```

\newbox\@undernote@maintext
\newbox\@undernote@subtext
\newcounter{undernote@id} \setcounter{undernote@id}{0}
\DeclareDocumentCommand{\undernote}{ s O{ } m +m O{ } }{%
  %% #1 (star) 注釈をparboxに包む
  %% #2 (optinal): 注釈を下にずらす「行数」(与えない場合自動設定)
  %% #3: 注釈をつける語句
  %% #4: 注釈
  %% #5: どういう線にするか
  \def\key@undernote@ruler{#5}%
  \settoheight{\undernote@textlen@tempo}{#3}%
  \begingroup%
  \stepcounter{undernote@id}%
  \ifmmode%
    \@note@save@conters%
    \savepos%
    \expandafter\@math@undernote%
  \else%
    \leavevmode%
    \savepos%
    \expandafter\@text@undernote%
  \fi%
  {#2}{#3}{%
    \ifnum\ltjgetparameter{direction}=4%
      \begin{varwidth}[t]{\maxdimen}%
        \IfBooleanTF{#1}{\wrap@undernote@par{#4}}{\wrap@undernote{#4}}%
      \end{varwidth}%
    \else%
      \raisebox{.38\zw}{%
        \begin{varwidth}[t]{\maxdimen}%
          \IfBooleanTF{#1}{\wrap@undernote@par{#4}}{\wrap@undernote{#4}}%
        \end{varwidth}%
      }%
    \fi%
  }%
}
\endgroup}

% 名称カウンタ
\def\@note@save@conters{%
  \begingroup
  \def\@elt@udnote##1{%
    \expandafter\ifx\csname c@##1\endcsname\c@page\else
      \csname c@##1\endcsname\the\csname c@##1\endcsname\relax
    \fi}%
  \edef\@tempa{\cl@ckpt}%
  \expandafter\endgroup
  \expandafter\def\expandafter\@note@restore@counters\expandafter{\@tempa}}

% 数式モードの場合への対応

```



```

\def\@math@undernote#1#2#3{%
  \mathchoice
    {\@note@restore@counters\@text@undernote{#1}{\m@th$\displaystyle #2$\{#3}\}}%
    {\@note@restore@counters\@text@undernote{#1}{\m@th$\textstyle #2$\{#3}\}}%
    {\@note@restore@counters\@text@undernote{#1}{\m@th$\scriptstyle #2$\{#3}\}}%
    {\@note@restore@counters\@text@undernote{#1}{\m@th$\scriptscriptstyle #2$\{#3}\}}%

% 注釈の内部実装
\long\def\@text@undernote#1#2#3{%
  \hbox{%
    \def\@UNDATA@vsize{#1}% \undernoteの第2引数
    \ifx\@UNDATA@vsize\@empty%
      % 指定なしパターン
      % \undernoteの第2引数が空かそうでないか
      \expandafter\ifx\csname @UNDATAS@\the\c@undernote@id\endcsname\relax%
        % 1回目のコンパイルではまだ空
        % →\relaxと比較してスルー
        \def\@UNDATA@vsize{1}%
      \else%
        % 2回目のコンパイルでは自動設定されている
        % →\@UNDATAS@12のようなデータを\@UNDATA@vsizeに格納
        \edef\@UNDATA@vsize{\csname @UNDATAS@\the\c@undernote@id\endcsname}%
      \fi%
    \fi%
    \setbox\@undernote@maintext\hbox{#2\vphantom{}}}% \undernoteの第3引数
    \setbox\@undernote@subtext\hbox{\notesize\internal@undernote #3}% \undernoteの第4引数
    \vtop{%
      \box\@undernote@maintext%
      \begingroup%
        \notesize\internal@undernote%
        \if@filesw% .auxへの書き出しokかどうか
          \dimen@wd\@undernote@subtext%
          \advance\dimen@notesep\internal@undernote\relax%
            % 注釈の長さ、sepの長さを足す
            % 水平方向にどれだけスペースをとっているか
          \edef\@tempa{%
            \write\@auxout{% .auxへの書き出し
              \string\undernotedata@internal{\the\c@undernote@id}%
                {\noexpand\the\lastxpos}{\noexpand\the\lastypos}%
                {\number\dimen@}{\number\ht\@undernote@subtext}{\number\dp\
                  @undernote@subtext}%
                {\noexpand\the\c@page}% これで.auxに
                  % \undernotedata@internal{<id>}{<xpos>}{<ypos>}{<width of
                    the note>}}%
                  % {<height of the note>}{<depth of the note>}{<page>}
                  % が書き込まれる
            }%
          }%
        \@tempa%
      \else%

```

```

    \write16{}% 書き出し不可の場合、何もしない
  \fi%
\endgroup%
\hline\undernote@par% アンダーライン
\hbox{\notesize@internal@undernote%
  % サイズ指定
  \hskip\noterulehshift@internal@undernote%
  % 横に少しずらす
  \count@\@UNDATA@vsize\relax \advance\count@\m@ne%
  % \count@ = 現在の段 - 1
  \dimen@\noteshift@internal@undernote\relax \multiply\dimen@\count%
  % \count@*\dimen@ i.e.
  % ノートの縦幅だけ下へ
  \advance\dimen@\notepos@internal@undernote\relax%
  % 縦線の長さの分さらに下へ
  \vlines@undernote@par%
  % 縦線を出力
  \hbox to \z@ {\lower.38\zw%
    % 注釈テキストを.38\zw下へ
    \box\@undernote@subtext\hss%
    % 注釈配置
  }%
}%
\skip .3\dimexpr\f@size pt\relax%
}%
}%
}

\newcount\@UNDATA@min
\newcount\@UNDATA@max
\global\@UNDATA@max -\@M
\global\let\@UNDATA@idlist\@empty
\let\@UNDATA@elt\relax
\def\undernotedata@internal#1#2#3#4#5#6#7{%% #1: id, #2: xpos, #3: ypos, #4: width of the
note,
%% #5: height of the note, #6: depth of the note, #7:
page
\@ifundefined{\@UNDATA@#1}%
{\@tempcnta\@UNDATA@max \advance\@tempcnta\@ne%
% 連番チェック
\ifnum\@tempcnta=#1\relax%
\global\@UNDATA@max\@tempcnta%
\else%
\ifnum\@UNDATA@max<\z@\else %
% 最初はmaxが-10000なので
% 必ずこの分岐に入り
% idlistが作られる
\edef\@UNDATA@idlist{\@UNDATA@idlist\@UNDATA@elt{\the\@UNDATA@min}{\the\@UNDATA@max
}}%
% 1回目では\relaxが入ってるので

```

```

% 残って2回目へ
\fi%
\global\@UNDATA@min=#1\relax%
\global\@UNDATA@max\@UNDATA@min%
\fi}%
{\gdef\@multiplelabels{\@latex@warning@no@line{There were multiply-defined labels}}%
\@latex@warning@no@line{Note ID `#1' multiply appeared}%
}%
\global\@namedef{\@UNDATA@#1}{#2}{#3}{#4}{#5}{#6}{#7}}%
% データを.aux用に格納
}

\def\@undernotedata#1#2#3#4#5#6#7{%
\def\@tempa{#2}{#3}{#4}{#5}{#6}{#7}}%
\expandafter\ifx\csname @UNDATA@#1\endcsname\@tempa\else \@tempswatru \fi%
}

\def\checkundernotedata{%
\ifnum\@UNDATA@max<\z@else%
\edef\@UNDATA@idlist{\@UNDATA@idlist\@UNDATA@elt{\the\@UNDATA@min}{\the\@UNDATA@max}}%
\begingroup%
\let\@UNDATA@elt\@check@undernotedata%
\@UNDATA@idlist%
\endgroup%
\fi%
}

\def\@check@undernotedata#1#2{%
\def\@currpage{-10000}%
\@tempcnta\z@ \@tempcntb\z@%
\@tempdima-\p@ \@tempdimb-\p@%
\let\@linelist\@empty%
\let\@elt@udnote\relax%
\count@#1\relax %
\advance\count@\m@ne%
\@whilenum\count@<#2\do{%
\advance\count@\@ne%
\@check@undernotedata@split\count@%
\def\@tempz{T}%
\ifnum\@currpage=\@thispage\relax%
\ifdim\@thisy sp<\@tempdima \def\@tempz{F}\fi%
\ifdim\@thisy sp>\@tempdimb \def\@tempz{F}\fi%
\else%
\def\@tempz{F}%
\fi%
\if T\@tempz\relax%
\@tempcntb\count@%
\else%
\ifnum\@tempcnta>\z@%
\edef\@linelist{\@linelist\@elt@udnote{\the\@tempcnta}{\the\@tempcntb}}%

```

```

\fi%
\@tempcnta\count@ \@tempcntb\count%
\let\@currpage\@thispage%
\@tempdima\@thisy sp\relax%
\@tempdimb\@tempdima%
\advance\@tempdima -\@UNDATA@yfuzz\relax%
\advance\@tempdimb \@UNDATA@yfuzz\relax%
\fi}%
\edef\@linelist{\@linelist\@elt@udnote{\the\@tempcnta}{\the\@tempcntb}}%
\let\@elt@udnote\@check@undernotedata@elt%
\@linelist%
}

\def\@UNDATA@yfuzz{3\p@}

\def\@check@undernotedata@split#1{%
\expandafter\expandafter\expandafter\@check@undernotedata@split%
\csname @UNDATA@\number#1\endcsname 000000\@nnil%
}

\def\@check@undernotedata@split@#1#2#3#4#5#6#7\@nnil{%
\def\@thisx{#1}%
\def\@thisy{#2}%
\def\@thiswd{#3}%
\def\@thisht{#4}%
\def\@thisdp{#5}%
\def\@thispage{#6}%
}

\def\@check@undernotedata@elt#1#2{%
\count@#2\relax%
\advance\count@\@ne%
\@whilenum\count@>#1\do{%
\advance\count@\m@ne%
\@check@undernotedata@split\count%
\dimen@\@thisx sp\relax%
\advance\dimen@\@thiswd sp\relax%
\advance\dimen@\noterulehsizel@internal@undernote\relax%
\advance\dimen@\p@%
\let\@currht\@thisht%
\@tempcntb\@ne%
\@tempcnta\count%
\@whilenum\@tempcnta<#2\do{%
\advance\@tempcnta\@ne%
\@check@undernotedata@split\@tempcnta%
\ifdim\@thisx sp<\dimen@%
\@tempdima\noteshiftl@internal@undernote\relax%
\@tempdimb\@thisdp sp\relax%
\advance\@tempdimb\@currht sp\relax%
\advance\@tempdimb\lineskip%

```

```

        \divide\@tempdimb\@tempdima%
        \count\tw@\@tempdimb%
        \advance\count\tw@ \@ne%
        \advance\count\tw@\@nameuse{@UNDATAS@the\@tempcnta}\relax%
        \ifnum\@tempcntb<\count\tw@ \@tempcntb\count\tw@ \fi%
    \fi%
}%
\expandafter\xdef\csname @UNDATAS@the\count@\endcsname{\the\@tempcntb}%
}%
}

\AtEndDocument{%
    \if@filesw%
        \write\@auxout{\string\checkundernotedata}%
        \let\checkundernotedata\relax%
        \def\undernotedata@internal{\@undernotedata}%
    \fi%
}

\endinput

```