**pseudo 1.2.3**.14

```
straight-
    forward
pseudocode
```

The `pseudo` package permits writing pseudocode without much fuss and with quite a bit of configurability. Its main environment combines aspects of `enumeration`, `tabbing` and `tabular` for nonintrusive line numbering, indentation and highlighting, and there is functionality for typesetting common syntactic elements such as keywords, identifiers and comments.

# The pseudo Package

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# Contents

# Chapter 1

# Introduction

The pseudo package lets you typeset pseudocode in a straightforward and not all too opinionated manner. You don't need to use separate commands for different constructs; the indentation level is controlled in a manner similar to in a `tabbing` environment:

1 **while** $a \neq b$
2 **if** $a > b$
3 $a = a - b$
4 **else** $b = b - a$
5 **return** $a$

```
\begin{pseudo}
    while $a \neq b$                          \\+
        if $a > b$                            \\+
            $a = a - b$                       \\-
        else $b = b - a$                      \\-
    return $a$
\end{pseudo}
```

If you prefer having **end** at the end of blocks, or you'd rather wrap them in C-style braces, you just put those in. Fonts, numbering, indentation levels, etc., may be configured. You import pseudo with:

`\usepackage[`⟨*options*⟩`]{pseudo}`

The only option usable here at the moment is `kw` (used in the example above), as the `\usepackage` command is a bit too eager in expanding its arguments, but there are several options that may be provided to the `\pseudoset` command, to configure things (see Sect. 4.2). For a more complete example, see Algorithm 1.1.

## Microtutorial: How to produce Algorithm 1.1

The pseudocode in Algorithm 1.1 is typeset in the same way as on on this page. The line numbers are styled using the `label` key, the vertical lines are produced by the `indent-mark` option, and the comments are just a separate column of

**Algorithm 1.1** Euclid's algorithm, EUCLID$(a, b)$

**Input:** Two positive integers, $a$ and $b$.

**Output:** The greatest common divisor of $a$ and $b$.

```
1 while a ≠ b                          If equal, both are gcd
2     if a > b                         Reduce max with multiple of min
3         a = a − b                    a is largest
4     else b = b − a                   b is largest
5 return a                             Both are gcd, so return one
```

The running time is quadratic in the number of bits in the input.

a `tabularx`, which is used instead of the built-in `tabular`, as explained in Sect. 5.4.* To get the surrounding ruled box, a tcolorbox is used, with the style `pseudo/ruled`. This has been set up with a predefined box environment, `algorithm`, which is defined in Chapter 3 (on page 23). The `\pr` command and its relatives (as well as most other functionality) are discussed in Chapter 2, with individual definitions given in Chapter 4.† The input and output descriptions are aligned using `\tab` from the tabto package (cf. Sect. 5.5).

```
% In document preamble:
% \usepackage{tabto}
% \TabPositions{1.5cm} % Adjust as needed!

\begin{algorithm}{Euclid's algorithm, \pr{Euclid}(a, b)}{euclid}

\textbf{Input:}  \tab Two positive integers, $a$ and $b$.

\textbf{Output:} \tab The greatest common divisor of $a$ and $b$.

\begin{pseudo}[label=\small\arabic*, indent-mark, fullwidth]
    while $a \neq b$      &  If equal, both are gcd           \\+
        if $a > b$        &  Reduce max with multiple of min  \\+
            $a = a - b$   &  $a$ is largest                   \\-
        else $b = b - a$  &  $b$ is largest                   \\-
    return $a$            &  Both are gcd, so return one
\end{pseudo}

The running time is quadratic in the number of bits in the input.

\end{algorithm}
```

* That is, the `fullwidth` style that is defined on page 61 is used in this example.
† The actual implementations, with explanations, are found in Chapter 6.

> With a different font, "**Output:**" may take up more space, and `\tabto` might just introduce a line break. If so, simply increase the argument to `\TabPositions`. To produce an indent right after a line break (`\\`)—e.g., if you want multiline input/output—use `\null\tab`.

## Alternatives

There are many ways of typesetting code and pseudocode in LaTeX, so if you're unhappy with pseudo, you have several alternatives to choose from. I wrote pseudo based on my needs and preferences, but yours may differ, of course. For example, I've built on tabular layouts to get (*i*) automatic width calculations; (*ii*) line/row highlighting; and (*iii*) easy embedding in tikz nodes and the like. I have also set things up inspired by existing mechanisms for numbering and indenting lines, and treat the pseudocode as a form of text, rather than as a form of markup in itself. The latter point means that I don't have separate commands for conditionals, loops, etc.

The basic style of pseudocode is inspired by the standard reference *Introduction to Algorithms* by Cormen et al. [1] (i.e., similar to that of newalg, clrscode and clrscode3e). Rather than locking down all aspects of pseudocode appearance, however, I've tried to make pseudo highly configurable, but if it's not flexible enough, or just not to your liking, you might want to have a look at the following packages:

> alg, algobox, algorithm2e, algorithmicx, algorithms, algpseudocodex, algxpar, clrscode, clrscode3e, clrscode4e, latex-pseudocode, newalg, program, pseudocode

There are also code-typesetting packages like listings and minted, of course.

## Using older TeX distributions

The imlementation of pseudo uses some functionality that isn't available in older TeX distributions, in particular, older versions of xparse and expl3. Some care has been taken to make the code backward compatible to the point where it works on TeX Live 2020, which is what is used (at the time of writing) on arXiv. If you run into issues somewhere else (e.g., when submitting to some publisher with a custom setup), feel free to file an issue, or even provide a pull request with a fix. One thing to look out for is that older versions of xparse parse arguments differently, so things like `\\[hl]` would work, but separating the arguments with spaces, as in `\\ [hl]` will *not* work, though this works with more recent versions (as seen from some of my examples, later).

> For more advice on working around an older distribution, see Sect. 5.9.

# Chapter 2

# Pseudocode

The main component of the pseudo package is the `pseudo` environment, which is, in a sense, a hybrid of `enumerate`, `tabular` and `tabbing`, in that it provides numbered lines, each placed in a tabular row (for ease of highlighting and automatic column width calculation), with functionality for increasing and decreasing indentation similar to the `tabbing` commands `\+` and `\-` (in pseudo, combined with the row separator `\\`). Here, once again, is Euclid's algorithm for finding the gcd of $a$ and $b$:

1 repeat the following while $a \neq b$
2 if $a > b$, let $a = a - b$
3 otherwise, let $b = b - a$

```
\begin{pseudo}
repeat the following while $a\neq b$            \\+
    if $a > b$, let $a = a - b$                 \\
    otherwise, let $b = b - a$
\end{pseudo}
```

There are also some styling commands for special elements of the pseudocode:

**while**, FALSE, *rank*, "Hello!", EUCLID$(a, b)$, *length*$(A)$, (*Important!*)

```
\kw{while},          % or \pseudokw    -- keywords
\cn{false},          % or \pseudocn    -- constants
\id{rank},           % or \pseudoid    -- identifiers
\st{Hello!},         % or \pseudost    -- strings
\pr{Euclid}(a, b),   % or \pseudopr    -- procedures
\fn{length}(A),      % or \pseudofn    -- functions
\ct{Important!}      % or \pseudoct    -- comments
```

The longer names (`\pseudokw`, `\pseudocn`, etc.) are always available; the more convenient short forms (`\kw`, `\cn`, etc.) are prone to name collisions, and are only defined if the names are not already in use when pseudo is imported.

Spacing is handled similarly to in LaTeX lists, with `\topsep` and `\parskip` added before and after, as well as `\partopsep` whenever the environment starts

a new paragraph. The left margin (how much the pseudocode is indented wrt. the surrounding text) is set by the `left-margin` key (initially `0pt`).

> If `pseudo` occurs in a box such as `fbox`, or a tikz node, this spacing is dropped. See also the `compact` key for overriding this behavior.

The `indent-length` option, which determines the length of each indentation step, is initially set via the secondary `indent-text` key, so that the any code after `\kw{else}` aligns with the indented text (a stylistic choice from clrscode3e):

1 **if** $x < y$
2 $\quad x = x + 1$
3 **else** $x = x - 1$

```
\begin{pseudo}
\kw{if} $x < y$                                    \\+
    $x = x + 1$                                    \\-
\kw{else} $x = x - 1$
\end{pseudo}
```

The indentation may also be configured with `indent-mark`, which inserts a mark at every indenation step:

1 while $x \leq n$
2 $\quad x = x + 1$
3 $\quad$ if $f(x) < y$
4 $\quad\quad x = x + 1$
5 $\quad$ print $x$
6 return $x$

```
\begin{pseudo}[indent-mark]
    while $x\leq n$                                \\+
        $x = x + 1$                                \\
        if $f(x) < y$                              \\+
            $x = x + 1$                            \\-
        print $x$                                  \\-
    return $x$
\end{pseudo}
```

The default is a vertical line, but anything else may be supplied as an argument. To avoid adding to the indentation, you can wrap this argument in `\rlap`.* The color may be modified using `indent-mark-color`:

* If your mark is very tall, and you don't wish it to increase the line height, you could also wrap it in `\smash`.

1 while $x \leq n$
2 ▷ $x = x + 1$
3 ▷ if $f(x) < y$
4 ▷ ▷ $x = x + 1$
5 ▷ print $x$
6 return $x$

```
\begin{pseudo}[
    indent-mark=\rlap{$\triangleright$}, indent-mark-color=teal]
    while $x\leq n$                                  \\+
        $x = x + 1$                                  \\
        if $f(x) < y$                                \\+
            $x = x + 1$                              \\-
        print $x$                                    \\-
    return $x$
\end{pseudo}
```

The default indent mark scales with the line height, which can be adjusted with `line-height` and `extra-space`, to avoid gaps in the vertical lines, and its width has no impact on the indentation. The width of the (default) mark can be set with `indent-mark-width`:*

1 the
2 lines
3 are
4 scaled

```
\begin{pseudo}[
    indent-mark, indent-mark-width=3pt, line-height=1.5]
    the                                              \\+
        lines                                        \\+[3ex]
            are                                      \\-
        scaled
\end{pseudo}
```

Note here how some extra space is specified using the optional argument `3ex` with `\\`. This is equivalent to explicitly setting the key `extra-space` (i.e., in this case, `\\+[extra-space=2ex]`).

If you want, you can certainly create shortcuts, e.g., with simple macro definitions like `\def\While{\kw{while}}`, or with declaration commands such as `\DeclarePseudoKeyword` or `\DeclarePseudoConstant`. Procedures and functions capture parenthesized arguments and set them in math mode; this carries over in shortcuts, so if you define `\Euclid` to mean `\pr{Euclid}`, then `\Euclid(a, b)` yields Euclid$(a, b)$.†

* You can also shift the default mark inward by setting `indent-mark-shift`.
† Note that `\Euclid (a, b)`, with a space before the parenthetical, yields Euclid (a, b).

These commands are not used in the internals of the package, so they may be freely redefined for different styling, such as `\let\id\textsf`. They generally do some extra work, though, such as wrapping the styled text in `\textnormal` to avoid having the styles blend, adding quotes (`\st`) and handling parenthesized arguments (`\pr`). To let you hook into their appearance without messing with their definitions, each command has a corresponding font command (`\kwfont`, `\cnfont`, `\idfont`, etc.), which you may redefine. These fonts may even be set using correspondingly named options, either with `\pseudoset` or via optional keyword arguments to the `pseudo` environment:*

Euclid's algorithm is initiated with the call $\mathsf{Euclid}(a, b)$.

```
\pseudoset{prfont=\textsf}
Euclid's algorithm is initiated with the call \pr{Euclid}(a, b).
```

You can also configure the quotes and comment markers:

1 **print** '*Hello, world!*' // Greeting

```
\pseudoset{
    st-left=‘, st-right=’, stfont=\textit,
    ct-left=\texttt{/\!/}\,, ct-right=, ctfont=
}
\begin{pseudo}
\kw{print} \st{Hello, world!} \quad \ct{Greeting}
\end{pseudo}
```

> Note that `\stfont` and friends may either be font-switching commands like `\itshape` or formatting commands like `\textit`, though the latter are generally preferable when available. They need not be restricted to actual fonts, but may include color commands, for example.

You can also set the font for the entire code lines, using the `font` option. The command you provide there should just switch the font (i.e., not take an argument to typeset); initially, `\kwfont` is such a command:

1 **while** $a \neq b$
2 **if** $a > b$
3 $a = a - b$
4 **else** $b = b - a$

* Because of LaTeX expansion behavior, they can *not* be set globally when importing pseudo.

```
\begin{pseudo}[font=\kwfont]
while $a \neq b$                                    \\+
    if $a > b$                                      \\+
        $a = a - b$                                 \\-
    else $b = b - a$
\end{pseudo}
```

Though not the default, this is in fact an intended configuration, to reduce the markup noise for pseudocode that consists primarily of keywords and mathematics. The setting `font = \kwfont` is also available by using the `kw` option (with no arguments), e.g., by importing the package with `\usepackage[kw]{pseudo}`. If you need to typeset normal text in your pseudocode after using `font`, you can use `\textnormal` or `\normalfont`, for which `pseudo` defines aliases `\tn` and `\nf`:

1 **for** each node $v \in V$
2 do something
3 **for** each edge $e \in E$
4 do something else

```
\begin{pseudo}[kw]
for \tn{each node} $v\in V$                         \\+
    \tn{do something}                               \\-
for \nf each edge $e \in E$                         \\+
    \nf do something else
\end{pseudo}
```

The row separator may have multiple pluses or (more commonly) multiple minuses appended, indicating multiple increments or decrements to the indentation level:

1 **for** $k = 1$ **to** $n$
2 **for** $i = 1$ **to** $n$
3 **for** $j = 1$ **to** $n$
4 $t_{ij} = t_{ij} \lor (t_{ik} \land t_{kj})$
5 **return** $t$

```
\begin{pseudo}[kw]
for $k = 1$ to $n$                                  \\+
for $i = 1$ to $n$                                  \\+
for $j = 1$ to $n$                                  \\+
$t_{ij} = t_{ij} \lor (t_{ik} \land t_{kj})$        \\---
return $t$
\end{pseudo}
```

The code is normally typeset in a two-column `tabular` (whose preamble, and thus number of columns, is configurable via the option `preamble`), but the first column is handled by an automatic `prefix` inserted before each line, containing

the numbering and column separator (`&`). You disable the prefix for the following line by using `\\*`. If you add the `&` manually, you get an (appropriately indented) unnumbered line:

1 this line has an automatic prefix
  this line does not
2  but this one does

```
\begin{pseudo}
  this line has an automatic prefix             \\+*&
  this line does not                            \\+
  but this one does
\end{pseudo}
```

The `\\*&` combo can also be used for manual line breaking in multiline pseudocode steps:

1 Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat.
2 At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor.

```
\begin{pseudo}[indent-mark]
Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam
nonumy \\*& eirmod tempor invidunt ut labore et dolore magna
aliquyam erat. \\+
At vero eos et accusam et justo duo dolores et ea rebum. Stet
clita \\*& kasd gubergren, no sea takimata sanctus est Lorem ipsum
dolor.
\end{pseudo}
```

> Automatic line wrapping is a bit trickier. See Sect. 5.12 for a discussion.

This star also works after `\begin{pseudo}`. Note that in order to prevent your code from ending up in the numbering column, you must insert a column separator manually. A version of the `\pr` command, called `\hd` (or `\pseudohd`, where `\hd` stands for *header*) instead wraps a procedure call in a `multicolumn`, so it can be used, for example, as an unnumbered header line:*

EUCLID$(a, b)$
1 **if** $b == 0$
2  **return** $a$
3 **else return** EUCLID$(b, a \bmod b)$

* See also `hd-space`, if you want some extra space after the header.

```
\begin{pseudo}[kw]*
\hd{Euclid}(a, b)                                   \\
if $b \== 0$                                        \\+
    return $a$                                      \\-
    else return \pr{Euclid}(b, a \bmod b)
\end{pseudo}
```

> The `\hd` command is less capable than `\pr` and `\fn` in its argument parsing: the parenthetical arguments are mandatory, and they are terminated at the first closing parenthesis, regardless of nesting. If you want to include parentheses in the arguments, you need to wrap them in braces, e.g., `\hd{Traverse}({G=(V, E), s})`.

Another style is to include the header as a statement, just as any other, perhaps with an introductory keyword. The following example, for example, is based on one in the algxpar documentation (using `pseudo*` to suppress line numbering, along with a couple of config keys):

**function** MAX$(a, b)$
  **if** $a > b$ **then**
    **return** $a$
  **else**
    **return** $b$
  **end if**
**end function**

```
\begin{pseudo*}[font=\bf, indent-length=1.5em]
function \pr{Max}(a, b)                             \\+
    if $a > b$ then                                 \\+
        return $a$                                  \\-
    else                                            \\+
        return $b$                                  \\-
    end if                                          \\-
end function
\end{pseudo*}
```

As can be seen in the earlier EUCLID example, `\==` (or `\eqs`) is a notational convenience defined by pseudo, along with interval dots `\..` (or `\dts`) and the alternative range operator `\rng`:

Do you prefer $A[1 \,..\, n]$ or $A[1 : n]$?

```
Do you prefer $A[1 \.. n]$ or $A[1 \rng n]$?
```

### Shortcuts for \rng

The `\..` command is actually implemented by hijacking the `\.` command, and isn't easily redefined directly. Instead, if you want `1\..n` to produce $1:n$, you can use the `dts-impl` key (i.e., `dts-impl = \rng`).

Another option is to introduce some other shortcut, such as `\:`, for example:

$A[1:n]$

```
\let\:\rng
$A[1\:n]$
```

Note that `\:` is an existing spacing command that produces a medium space. If `\:` is redefined, this spacing command is still available as `\>`. However, if you use packages that rely on `\:`, such a redefinition might cause trouble. One solution is to keep the redefinition local, e.g., using `\pseudoset{init = \let\:\rng}`.

Other special symbols may be found in other packages. For example, if you want to use $\coloneqq$ for assignment, you can use `\coloneqq` from mathtools (perhaps with `\let\gets\coloneqq`).*

As can be seen, one use of `\\*` is to get an unnumbered line, but you could also insert custom material in the first column. The lines are numbered by the counter `pseudoline`, so you could, for example, do:

A Look!
B We're using letters!

```
\begin{pseudo}*
\stepcounter{pseudoline}\Alph{pseudoline} & Look! \\*
\stepcounter{pseudoline}\Alph{pseudoline} & We're using letters!
\end{pseudo}
```

This is a bit cumbersome, so there are some shortcuts. First of all, rather than replacing the entire `prefix`, you can replace only a *part* of it, namely the `label`, retaining counter increments and column separators. You can set this key for each line individually with an optional argument to the row separator, i.e., `\\[label =` ⟨*commands*⟩`]`, or at some higher level. Within the `pseudo` environment, there is also a counter named `*` that is simply a local clone of `pseudoline`, letting you use starred versions of counter commands, similarly to how label definitions work in enumitem:†

1: Look!
2: We're using something custom!

* Tip: If you want to use a left-arrow for assignment, but think it's a bit large in Computer Modern or Latin Modern, you can use the old-arrows package, so `x \gets y` yields $x \leftarrow y$.

† Also like in enumitem, there's a `start` key for setting the first line number.

```
\pseudoset{label=\small\arabic*:}
\begin{pseudo}
Look! \\
We're using something custom! \label{custom-line}
\end{pseudo}
```

Note that if you refer to the labeled line with `\ref`, you'll just end up with 2, which is probably what you'd want in this case. If you want a custom reference format as well, you can set that with the `ref` key, in the same way as with `label`. If you use the key without arguments, it'll use the same format as the one provided to `label`:

(*i*) Look!
(*ii*) We're using Roman numerals!
(*iii*) And here's a reference to line (*ii*).

```
\pseudoset{label=(\textit{\roman*}), label-align=l, ref}
\begin{pseudo}
Look! \\
We're using Roman numerals! \label{roman-line} \\
And here's a reference to line \ref{roman-line}.
\end{pseudo}
```

The `label-align` key sets the alignment of the label column, and can be `l`, `r` or `c` (or really any other column type compatible with the `array` package; you could use a `p{...}` column to get fixed width, for example).

Highlighting can also be done in a similar manner, by, e.g., inserting a `\rowcolor` at the start of the first column. Rather than doing this manually, you could use the `bol` key, which inserts a command at the beginning of the line—or the `hl` key, which is equivalent to `bol-prepend = \pseudohl`:

I'm not highlighted
But I am!

```
\begin{pseudo*}
I'm not highlighted \\[hl]
But I am!
\end{pseudo*}
```

Initially, the `\pseudohl` command that is inserted is simply a `\rowcolor` that uses `hl-color`, but you're free to redefine this command to whatever you'd like.

In the previous example, there is no spacing to the sides of the table contents. This is normally what you'd want, for example, to keep the pseudocode aligned with the surrounding text. However, when using row highlighting (e.g., because you are stepping through the code in some presentation), that alignment may be less of an issue—and you'd rather widen the highlight a bit. The horizontal padding on each side is controlled by the `hpad` key.

> If you use `hl` without `hpad`, you'll get a warning. You can turn this warning off using `hl-warn` or by setting `hpad` to `0pt`.

You can either specify a length, or just turn on the default, by not supplying an argument. There's a similar option, `hsep`, which controls the separation between the two columns.

```
1  let's
2     use
3  some
4     padding!
```

```
\begin{pseudo}[hpad, hsep=1em, indent-length=1em]
    let's                                          \\+
        use                                        \\-
    some                                           \\+ [hl]
        padding!
\end{pseudo}
```

For ease of use with beamer, the various pseudo options support beamer overlay specifications. For example, using `hl<1>` means that the `hl` specification would only take effect on slide 1. If you use such an overlay specification on a key when *not* using beamer, the key is simply ignored.

What is more, the row separator *itself* takes an overlay specification as a shortcut for the one on `hl`, so `\\<1,2-4>` is equivalent to `\\[hl<1,2-4>]`.

> Actually, explicitly using `hl<1,2-4>` wouldn't work! The problem is that the key–value lists are split at commas before individual keys (including overlay specifications) are parsed. And unlike values, using braces to "protect" the keys isn't entirely straightforward. The solution is instead to use the key multiple times, as in `\\[hl<1>, hl<2-4>]`.

Just like with the optional arguments, space before the overlay specification is ignored, so you're free to put the specification in front of the line in question:

```
1  Go to line 3        1  Go to line 3        1  Go to line 3        1  Go to line 3
2  Go to line 4        2  Go to line 4        2  Go to line 4        2  Go to line 4
3  Go to line 2        3  Go to line 2        3  Go to line 2        3  Go to line 2
4  Go to line 1        4  Go to line 1        4  Go to line 1        4  Go to line 1
```

```
% In a beamer presentation
\begin{pseudo}[hpad]
    <1>  Go to line 3                          \\
    <3>  Go to line 4                          \\
    <2>  Go to line 2                          \\
    <4>  Go to line 1                          \\
\end{pseudo}
```

You might have expected these overlay specifications to indicate *visibility*, as they do for the `\item` command in `\enumerate`, for example. However, in stepwise animations, highlighting patterns (showing which line is currently executed, for example) tend to be more complex than, say, a gradual uncovering—and therefore in greater need of abbreviation.

To control visibility, you could, for example, add `\pause` at the end of each line, before the row separator. You can also do this using the `eol` key, either per line or at the top level, with `eol = \pause`. There is even the shortcut key `pause` for this specific purpose (equivalent to `eol-append = \pause`):

| | | | |
|---|---|---|---|
| 1 Eeny | 1 Eeny | 1 Eeny | 1 Eeny |
| 2 Meeny | 2 Meeny | 2 Meeny | 2 Meeny |
| 3 Miny | 3 Miny | 3 Miny | 3 Miny |
| 4 Moe | 4 Moe | 4 Moe | 4 Moe |

```
% In a beamer presentation
\setbeamercovered{transparent}
\begin{pseudo}[pause]
    Eeny                                    \\
    Meeny                                   \\
    Miny                                    \\
    Moe                                     \\
\end{pseudo}
```

The `eol` value is only inserted wherever `\\` starts a new line (i.e., not at the end of the environment), so in this case only three `\pause` commands are inserted.

> The last `\\` looks for an immediately following `\end{pseudo}`, after skipping any non-paragraph whitespace, so if you insert anything between the the `\\` and `\end{pseudo}`, even if it's just an empty line (i.e., a `\par`), you'll end up with an extra (empty) line in the result. Note, however, that the last `\\` is entirely optional!

The previously discussed configuration keys are described in more detail in Chapter 4. You can create your own presets or *styles* using `\pseudodefinestyle`. This command takes two arguments; the first is the name of a key, and the second is a key–value list, as you would have supplied it to `\pseudoset`. This is exactly how the `starred` style is defined (see page 99), clearing the prefix and reducing the preamble to a single column. This style is what's used in the starred, unnumbered version of the `pseudo` environment:

**while** $a \neq b$
    **if** $a > b$
        $a = a - b$
    **else** $b = b - a$
**return** $a$

```
\begin{pseudo*}
    while $a \neq b$                        \\+
        if $a > b$                          \\+
            $a = a - b$                     \\-
        else $b = b - a$                    \\-
    return $a$
\end{pseudo*}
```

# Chapter 3

# Boxes and floats

There are (at least) two different ways of viewing a block of pseudocode: as an inline element, like equations, or as a float, like figures and tables. For example, Cormen et al. [1] place their pseudocode inline, and refer to the algorithms by name (e.g., "Dijkstra"), while Williamson and Shmoys [5] place them in floats, and refer to them by number (e.g., "Algorithm 3.1").*

Just using the `pseudo` environment is sufficient for typesetting pseudocode as part of the body text. If you wish to place your pseudocode in a float, you can easily use a package such as float.† You could also use the float environments supplied with packages such as algorithms, algorithmicx and algorithm2e.

> The definition of `\==` doesn't properly carry over into floats. It's properly redefined inside `pseudo`, so you probably won't notice, but if you wish to use the symbol outside the `pseudo` environment, but in a float (e.g., inside `\caption`), you'll need to either call `\RestorePseudoEq` to re-establish pseudo's redefinition of `\=` or simply use `\eqs` instead of `\==`.

**The short story**

First import tcolorbox, with libraries `skins` and `theorems` (see nearby sidebar), and then put the following in your preamble:

```
\newtcbtheorem{algorithm}{Algorithm}{pseudo/ruled, float}{alg}
```

You now have an `algorithm` float with the `pseudo/ruled` style. The environment takes two arguments: the title and a label name, which can be left empty.

* A third option that is sometimes used is to use a theorem-like environment for your algorithms. There are many packages to help with this; just search CTAN for "theorem".

† Or you could do a quick CTAN search for "float", or take a look at the recommendations related to the float package, which will give you many options, with varying functionality.

### Importing tcolorbox

For performance reasons, pseudo does *not* automatically import tcolorbox; if you want to use the box functionality, you will need to import it yourself:

```
\usepackage{pseudo}
% ...
\usepackage{tcolorbox}           % possibly with options
\tcbuselibrary{skins,theorems}   % remember these
```

It does not matter whether you import tcolorbox before or after pseudo, but make sure you also import the two libraries `skins` and `theorems`, as in the example above.

The pseudo package does provide some specialized setup, however, using tcolorbox. This also lets you typeset non-float pseudocode with a colored background, for example, like Cormen et al. do in the most recent version of their textbook [2]. The styles defined by pseudo are versions of the commonly used *boxed* and *ruled* styles, as found in, e.g., float, as well as the *boxruled* and *tworuled* styles found in algorithm2e. In addition, there's a *filled* style, with a colored background. If you wish to customize and extend the box style, `pseudo/boxruled` is probably the best starting point, as the other styles disable the default frame drawing.

The ruled style is one of the more common ones in use in publications. This is a style originally used for (non-floating) tables in *Concrete Mathematics* [3]. Rather than reproducing the look of those tables directly, pseudo aims to match the style of booktabs, with spacing and line thicknesses taken from its constants such as `\aboverulesep`, `\heavyrulewidth`, etc. (with defaults provided if booktabs has not been imported).* The `pseudo/booktabs` style uses the same pattern of thin and thick lines as booktabs tables, while `pseudo/ruled` uses a thin line at the bottom, as in the *Concrete Mathematics* style.

The pseudo box styles can be used used directly to style `tcolorbox` environments, possiby with additional tcolorbox options for customization:

BORŮVKA$(V, E, w, T)$
1 **while** $E$ is not empty
2  **for** each $u \in V$
3  add light $uv \in E$ to $T$
4  **for** each $e \in T$
5  contract $e$

* In booktabs, the contents between the top rules make up the header row, whereas in the *Concrete Mathematics* style, it's the caption.

```
% In document preamble:
% \usepackage[cmyk]{xcolor}
% Partial clrscode4e.sty emulation:
\definecolor{lighttan}{cmyk}{0,0.05,0.17,0}
\pseudoset{label=\small\arabic*, hd-space}

\begin{tcolorbox}[pseudo/filled, colback=lighttan]
    \begin{pseudo}*
        \hd{Bor\r{u}vka}(V, E, w, T)            \\
        \kw{while} $E$ is not empty             \\+
            \kw{for} each $u\in V$              \\+
                add light $uv \in E$ to $T$     \\-
            \kw{for} each $e \in T$             \\+
                contract $e$
    \end{pseudo}
\end{tcolorbox}
```

Beyond the boxes themselves, you can customize the pseudocode inside them (separately from pseudocode elsewhere) by defining the `in-float` style with `\pseudodefinestyle`.

You can also create new environments with `\newtcolorbox`,* but the most common use-case will probably be to define a (possibly floating) theorem-style environment, using `\newtcbtheorem` (probably in the preamble):

```
\newtcbtheorem{algorithm}{Algorithm}{pseudo/ruled}{alg}
```

Here `algorithm` is the name we've chosen for our new environment, `Algorithm` is the label to be used when numbering (i.e., "Algorithm 1", etc.), `pseudo/ruled` is the ruled box style, and `alg` is is a prefix that will be used in automatically labeling our boxes.

If you want a *floating* box (like figures and tables, for example), simply add the key `float` alongside the box style, such as:

```
\newtcbtheorem{algorithm}{Algorithm}{pseudo/ruled, float}{alg}
```

Other tcolorbox styling options may be inserted in the same place. One can also supply some *init options* as a first argument, for configuring the automatic numbering. For example, if we want our algorithms to be numbered within sections, and we wish to provide cleveref with the appropriate names, we could define the environment like this:†

* See the tcolorbox documentation for details and alternatives.

† If you use the `crefname` option, you should make sure to place your `\newtcbtheorem` command in the preamble, and not in the document body, for the naming to take effect.

```
\newtcbtheorem[
        number within = chapter,
        crefname = {Algorithm}{algorithms}
    ]%
    {algorithm}{Algorithm}{pseudo/ruled, float}{alg}
```

Once our environment has been defined with `\newtcbtheorem`, it can be used as follows (here with floating turned off locally):

**Algorithm 3.1** Sort an array $A$ of $n$ elements.

```
1 i = 1
2 while i < n
3     if i == 1 or A[i − 1] ≤ A[i]
4         i = i + 1
5     else swap A[i − 1] and A[i]
6         i = i − 1
```

```
\begin{algorithm}{Sort an array $A$ of $n$ elements.}{gnome}
\begin{pseudo}
    $i = 1$                                     \\
    while $i < n$                               \\+
        if \nf $i\== 1$ or $A[i-1] \leq A[i]$   \\+
            $i = i + 1$                         \\-
        else \nf swap $A[i-1]$ and $A[i]$       \\+
            $i = i - 1$
\end{pseudo}
\end{algorithm}
```

The first argument is the title, or "caption", and the second argument (`gnome`) is the *marker*, which is combined with the prefix (in our case, `alg`) to create the label, `alg:gnome`, which can be used with `\ref` or (using cleveref) `\cref`, etc.:*

Algorithm 3.1 is the well-known *gnome sort*, by Sarbazi-Azad and Grune.

```
\Cref{alg:gnome} is the well-known \emph{gnome sort}, by
Sarbazi-Azad and Grune.
```

Algorithms 3.2 to 3.6 are typeset with the remaining box styles.

* The separator (`:`) can be configured; see the tcolorbox docs.

**Algorithm 3.2** `pseudo/booktabs`

```
1  i = 1
2  while i < n
3        if i == 1 or A[i − 1] ≤ A[i]
4              i = i + 1
5        else swap A[i − 1] and A[i]
6              i = i − 1
```

**Algorithm 3.3** `pseudo/boxed`

```
1  i = 1
2  while i < n
3        if i == 1 or A[i − 1] ≤ A[i]
4              i = i + 1
5        else swap A[i − 1] and A[i]
6              i = i − 1
```

**Algorithm 3.4** `pseudo/boxruled`

```
1  i = 1
2  while i < n
3        if i == 1 or A[i − 1] ≤ A[i]
4              i = i + 1
5        else swap A[i − 1] and A[i]
6              i = i − 1
```

**Algorithm 3.5** `pseudo/tworuled`

```
1  i = 1
2  while i < n
3        if i == 1 or A[i − 1] ≤ A[i]
4              i = i + 1
5        else swap A[i − 1] and A[i]
6              i = i − 1
```

**Algorithm 3.6** `pseudo/filled`

```
1  i = 1
2  while i < n
3        if i == 1 or A[i − 1] ≤ A[i]
4              i = i + 1
5        else swap A[i − 1] and A[i]
6              i = i − 1
```

Unnumbered boxes may be constructed with `\newtcolorbox`, using the same styles. These boxes, by default, have no title part—only the main body, containing the pseudocode itself:

SUM$(a, b)$
1 **if** $b == 0$
2 **return** $a$
3 **return** SUM$(a, b - 1) + 1$

```
\newtcolorbox{pseudobox}{pseudo/filled}

\begin{pseudobox}
\begin{pseudo}*
    \hd{Sum}(a, b)                              \\
    if $b \== 0$                                \\+
        return $a$                              \\-
    return $\pr{Sum}(a, b - 1) + 1$
\end{pseudo}
\end{pseudobox}
```

It is possible to add titles using the `title` key, but then the definition must be expanded slightly, to permit arguments, e.g.:

```
\newtcolorbox{pseudobox}[1][]{pseudo/filled, #1}
```

Here we've added a single argument (`[1]`), with an empty default (`[]`), and this is spliced into the box options at the end. Now we may configure each box individually, as we please:

SUM$(a, b)$

1 **if** $b == 0$
2 **return** $a$
3 **return** SUM$(a, b - 1) + 1$

```
\begin{pseudobox}[title={\pr{Sum}(a, b)}]
\begin{pseudo}
    if $b \== 0$                                \\+
        return $a$                              \\-
    return $\pr{Sum}(a, b - 1) + 1$
\end{pseudo}
\end{pseudobox}
```

Colors (e.g., `colback`, `colbacktitle` or `colframe`), fonts (e.g., `fonttitle`), line thicknesses (`boxrule` or `titlerule`), punctuation (`separator sign` and `terminator sign`) etc., may also be configured, either for all the boxes of this type (directly in the call to `\newtcolorbox`) or for any individual box, as with the `title` key in the previous example. The style that is closest to a plain, default `tcolorbox` is `pseudo/boxruled`, which may be a good starting-point for this kind of configuration. However, if you just wish to add some minor tweaks to one of the existing `pseudo` styles (e.g., changing the colors of `pseudo/filled`),

starting with that style may be easier. (For some hints on configuring the boxes, see Sect. 5.14.)

The contents of one of these boxes need not be restricted to pseudocode—the spacing is set up to handle plain text as well. For example, you may want to specify inputs and outputs.* (If you want to align such specification, as in Algorithm 1.1 on page 6, you can use the tabto package; see Sect. 5.5.)

**Algorithm 3.7** Gnome sort

**Input:** An array $A$ of length $n$.

**Output:** $A$, sorted in nondescending order.

```
1  i = 1
2  while i < n
3      if i == 1 or A[i − 1] ≤ A[i]
4          i = i + 1
5      else swap A[i − 1] and A[i]
6          i = i − 1
```

The running time of the algorithm is quadratic.

```
\begin{algorithm}{Gnome sort}{} % environment defined earlier

\textbf{Input:} An array $A$ of length $n$.

\textbf{Output:} $A$, sorted in nondescending order.

\begin{pseudo}
    $i = 1$                                     \\
    while $i < n$                               \\+
        if \nf $i \== 1$ or $A[i-1] \leq A[i]$  \\+
            $i = i + 1$                         \\-
        else \nf swap $A[i-1]$ and $A[i]$       \\+
            $i = i - 1$
\end{pseudo}

The running time of the algorithm is quadratic.

\end{algorithm}
```

* Common alternatives to “Input/Output” are “Require/Ensure” and “Data/Result”.

**Why only styles?**

Currently, pseudo defines only tcolorbox *styles*, and not any actual boxes or theorem-style environments. While this may change in the future, it has a couple of advantages. First, the style definitions aren't dependent on tcolorbox being imported, making it entirely optional. Second, when defining the box or theorem environment, you can easily configure the counter style, counter level, etc., through the normal tcolorbox mechanisms. Similar customization mechanisms would have to be defined, anyway, and there is no real point in aliasing them, rather than simply using the originals.

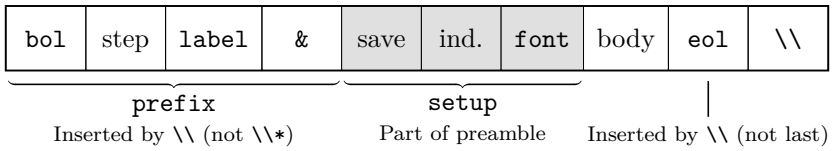
# Chapter 4

# Reference

This section gives an overview of all the moving parts of the package. A *default* value is one used implicitly if the key is specified with no explicit value given, while an *initial* value is one provided to the key at the point where pseudo is imported. Several commands (such as, e.g., `\pseudoprefix`) may be modified using corresponding keys (e.g., `prefix`). When the behavior of such commands is described, the description references their initial behavior.

## 4.1 Line structure

Each line of a `pseudo` environment is (initially) structured as follows:




The components in the `prefix` are populated by the `\\` command (or the beginning of the environment), the ones in the `setup` by the `preamble`, and the actual body is supplied by the user, inside the environment, terminated by the row separator `\\` (which then goes on to populate the next row, and so on). The `eol` part is also inserted by `\\`, except if it's used after the last line (where it doesn't really do anything).* The following describes the default behavior, which can be modified substantially by setting the appropriate options (e.g., `prefix` and `setup`).

`bol` This field is inserted by `\\` (and `\begin{pseudo}`) at the beginning of the following line, using the `\pseudobol` command. Because it's a the very beginning of the tabular row, it may be used for things like `\rowcolor` when highlighting lines (as with the `hl` key).

step This refers to a call to `\stepcounter*` (where `*` is an alias for `pseudoline`), getting the counter ready for the label itself. Note that this does *not* use `\refstepcounter`, so at this point the counter has not been saved yet (and so you should not use `\label` to refer to it at this point).

* Thus, `eol` acts more as a line *separator* than a line *terminator*.

`label` This is where the numbering label is inserted, using `\pseudolabel`; initially, this inserts `\arabic*`.

`&` At the end of the prefix is the column separator, closing the label column and beginning the code line column.

save Now that we're in the column where the user will normally insert text and code, we save `pseudoline` so it may be used with `\label` and `\ref`, etc. This is done using `\pseudosavelabel`, which first *decrements* the counter (to undo the increment before the label) and then calls `\refstepcounter`.

ind. Inserts the appropriate amount of indentation (with an indent step length set by `indent-length` or `indent-text` and the indentation level set by `+/-` flags or `indent-level`), using `\pseudoindent`.

`font` Inserts the base font, using `\pseudofont`.

body This is where the manually written body of the code line appears.

`eol` Inserted by the terminating `\\` (using `\pseudoeol`), unless we're at the end of the environment. Useful, e.g., for taking actions such as a beamer `\pause` (cf., `pause`) between the lines.*

`\\` The row/line separator. Ends one line (inserting `eol`) and begins another (inserting `prefix`). As in tabulars in general, this command is also permitted after the final line of the environment, but there it does no real work (i.e., it does not insert `eol` and does not start a new line).

## 4.2 Command and key reference

In addition to descriptions of the various commands and options/keys (in alphabetical order), you'll find definitions of a couple of counters here (`*` and `pseudoline`).

`*`

This counter is a duplicate of `pseudoline`, available inside `pseudo`. It makes it possible to simplify calls such as `\arabic{pseudoline}` to starred forms such as `\arabic*`, like in enumitem. These short forms are available (and intended) for use in `label` and `ref`.

`\..`

This is a shortcut that hijacks the normal `\.` accent command, so that if it is called with `.` as an argument, the result is `\dts` (or, rather, the fully prefixed `\pseudodts`). In other words, the command `\..` is really the call `\.{.}`. For any other arguments, the original `\.` is used, so while `$1\..n$` produces $1 \mathinner{..} n$, `\.o` still yields ȯ.

Because `\..` isn't an ordinary macro, it cannot be overridden by a simple `\let` statement. Instead, the part that produces the actual output may be overridden by using the `dts-impl` key. For example, if you'd like to use the `\..` shortcut, but prefer to use `\dots` or `\rng` as your range operator, you could achieve that as follows:

* If the same action must be taken after the last line, you can simply insert it there manually.

$1 \dots n$
$1 : n$

```
\pseudoset{dts-impl=\dots}
$1\..n$

\pseudoset{dts-impl=\rng}
$1\..n$
```

`\==`

This is a shortcut that hijacks the normal `\=` accent command, so that if it is called with `=` as an argument, the result is `\eqs` (or, rather, the fully prefixed `\pseudoeqs`). In other words, the command `\==` is really the call `\={=}`. For any other arguments, the original `\=` is used, so while `$x\==y$` produces $x == y$, `\=o` still yields $\bar{o}$.

In some contexts, this may not work because `\=` has reverted to its original meaning (as is currently the case if you try to use it within a custom float, as in Chapter 3, or a standard one such as `figure`). In this case, you can restore the `pseudo` meaning (and the `\==` shortcut) by using `\RestorePseudoEq`. In some cases, you may want to just use `\eqs` instead.

Because `\==` isn't an ordinary macro, it cannot be overridden by a simple `\let` statement. Instead, the part that produces the actual output may be overridden by using the `eqs-impl` key. For example, if you'd like to use the `\==` shortcut, but prefer to use `\equiv` as your range operator, you could achieve that as follows:

$1 \equiv n$

```
\pseudoset{eqs-impl=\equiv}
$1\==n$
```

`\\ + - * <`*overlay specification*`> [`*line options*`]`

This row separator is the workhorse of the `pseudo` package. Just as in a `tabular` environment, it signals the end of a line. It is optional after the list line, where it doesn't do any work. The command may be followed by a series of one or more plus (`+`) signs, each of which will increment the indentation level before starting a new line; similarly, it may be followed by one or more minus (`-`) signs, each of which will decrement the indentation level. Normally, the command will insert a `prefix` at the beginning of the new line; if the star (`*`) flag is used, this prefix is not inserted.

The optional overlay specifications refer to the `hl` key, so `\\<3>` is equivalent to `\\[hl<3>]`. This applies to the following line, as do other options set explicitly as optional arguments. Note that options are set locally, *before* the new line (and a new scope) is started, so unless they are handled specifically (in order to carry over), they will have no effect. Thus, even though all options are available here, not all make sense. (Consult individual option keys for intended use.)

The pluses and minuses are conceptually part of the command name, and there should be no whitespace before the star (`*`). You are, however, free to insert whitespace before the overlay specification and the line options. This means that you may, for example, place the overlay specification at the beginning of the following line in the source.

The `\\` command is special in that it also permits a keyless value to be used among its option; this will then be taken to implicitly use the key `extra-space`, which adds extra vertical space below as part of the line break. This means you can supply a length argument in the same way as with the ordinary `\\` command:

1 no extra space after this line
2 but there's extra space after this line

3 so this line is a bit lonely

```
\begin{pseudo}
    no extra space after this line              \\
    but there's extra space after this line     \\[2ex]
    so this line is a bit lonely
\end{pseudo}
```

`\arabic*`

See `*`.

`begin-tabular` = ⟨*commands*⟩ (no default)

The actual command for beginning the `tabular` or `tabular`-like environment used by `pseudo`. Normally not needed, as the `tabular` behavior may be modified by other keys, but could be used to use some other tabular environment, e.g., from packages such as tabularx or longtable. Rather than `\begin{tabularx}` and `\end{tabularx}`, the command versions `\tabularx` and `\endtabularx` should be used. Commands such as `\pseudopos` and `\pseudopreamble` may be used as part of the setup:

```
\pseudoset{
    begin-tabular =
        \tabularx{\linewidth}[\pseudopos]{\pseudopreamble},
    end-tabular = \endtabularx
}
```

`bol` = ⟨*commands*⟩ (no default, initially empty)

Used to set `\pseudobol`, which is inserted at the beginning of each line. See also `bol-append` and `bol-prepend`.

`bol-append` = ⟨*commands*⟩ (no default)

Locally appends ⟨*commands*⟩ to `bol`.

**bol-prepend** = ⟨*commands*⟩ (no default)

Similar to `bol-append`, except that ⟨*commands*⟩ are added to the *beginning* of `bol`.

**\cn**{⟨*name*⟩}

Indicates a constant (such as TRUE or NIL). First wraps the argument in `\textnormal` and then uses `\cnfont`. See also `\DeclarePseudoConstant`. This is a convenience for typesetting constants, and you may freely redefine it to whatever you prefer. If some package defines `\cn` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\pseudocn`. To get the shorter version, simply use `\let\cn\pseudocn`, possibly as part of the `init` hook.

**cnfont** = ⟨*command*⟩ (no default, initially `\textsc`)

Used to set `\cnfont`, which is used as part of `\cn`. May be set to take a single argument or none. Not restricted to actual font commands; you may also mix in `\textcolor` or the like.

**\cnfont**

The command set by the `cnfont` option. Used as part of `\cn`.

**compact** = ⟨*boolean*⟩ (default `true`, initially `false`)

The pseudo environment emulates the built-in LaTeX lists when it comes to spacing above and below, in normal text. If the environment is part of an ongoing paragraph, paragraphs will be inserted above and below, along with whitespace specified by `topsep` (and `\parskip`). If the environment begins a paragraph of its own, additional whitespace is added, as specified by `partopsep`. It is also possible to specify space to insert to the left of the environment, using `left-margin`.

However, these spacing commands don't work well inside `\mbox`, `\fbox`, etc. To avoid getting into trouble, pseudo determines that the environment should be *compact*, and drop this surrounding space, if we're in inner horizontal mode at the beginning of the environment. This will also turn off setting `\prevdepth` (cf. `prevdepth`).

```
1  if we're in a node
2      there's no added space
```

```
% In document preamble:
% \usepackage{tikz}
\begin{tikzpicture}
    \draw (0,0) node [draw] {%
        \begin{pseudo}
            if we're in a node \\+
                there's no added space
        \end{pseudo}};
\end{tikzpicture}
```

This may not be enough, however. For example, if you're using standalone to produce individual pseudocode images, this compactness may not

be triggered automatically. In such cases, you can override the behavior using the `compact` key, manually specifying whether you want the pseudocode to be compact or not.

`\ct{`⟨*text*⟩`}`

Indicates that ⟨*text*⟩ is a comment, (*typeset like this*). You can customize the comment appearance using `ctfont`, `ct-left` and `ct-right`:

1 $y = 1$
2 $x = 2$ /* this is a comment */
3 $z = 345$ /* this is another comment */

```
\pseudoset{
    ctfont=\color{black!75},
    ct-left=\unskip\qquad\texttt{/* },
    ct-right=\texttt{ */}
}
\begin{pseudo}
    $y=1$ \\
    $x=2$ \ct{this is a comment} \\
    $z=345$ \ct{this is another comment}
\end{pseudo}
```

An alternative to using `\ct` is to simply set comments in a separate column, as demonstrated in Sect. 5.4. Or even without a separate column, if you use a `tabularx` as described there, and set the tabular width explicitly, you could insert an `\hfill` into `ct-right` and get all end-markers aligned at the right-hand side:

1 $x = 1$
2 $y = 2$ /* this is a comment */
3 $z = 345$ /* this is another comment */

Or if you'd rather have the comments right-aligned (like you can in, e.g., algorithm2e), you could use insert the `\hfill` at the beginning of the `ct-left`:

1 $x = 1$
2 $y = 2$ /* this is a comment */
3 $z = 345$ /* this is another comment */

`ct-left` = ⟨*text*⟩ (no default, initially `()`)

Text or commands inserted at the start of a comment, when using `\ct`.

`ct-right` = ⟨*text*⟩ (no default, initially `))`)

Text or commands inserted at the end of a comment, when using `\ct`.

`ctfont` (no default, initially `\textit`)

The font of the main text of a comment, when using `\ct`.

\ctfont

The command set by the `ctfont` option. Used as part of `\ct`.

\DeclarePseudoComment{⟨*shortcut*⟩}{⟨*comment*⟩}

Used to declare a macro that expands to a comment. For example:

$x = y$ (*Important!*)

```
\DeclarePseudoComment \Imp {Important!}
$x = y$ \qquad \Imp
```

See also `\ct`. (Note that `\pseudoct` is used internally here.)

\DeclarePseudoConstant{⟨*shortcut*⟩}{⟨*constant*⟩}

Used to declare a macro that expands to a constant. For example:

FALSE

```
\DeclarePseudoConstant \False {false}
\False
```

See also `\cn`. (Note that `\pseudocn` is used internally here.)

\DeclarePseudoFunction{⟨*shortcut*⟩}{⟨*function*⟩}

Used to declare a macro that expands to a function. For example:

*length*$(A)$ or *length*$[A]$

```
\DeclarePseudoFunction \Ln {length}
\Ln(A) or \Ln[A]
```

See also `\fn`. (Note that `\pseudofn` is used internally here.)

\DeclarePseudoIdentifier{⟨*shortcut*⟩}{⟨*identifier*⟩}

Used to declare a macro that expands to a identifier. For example:

*rank*

```
\DeclarePseudoIdentifier \Rank {rank}
\Rank
```

See also `\id`. (Note that `\pseudoid` is used internally here.)

\DeclarePseudoKeyword{⟨*shortcut*⟩}{⟨*keyword*⟩}

Used to declare a macro that expands to a keyword. For example:

**while**

```
\DeclarePseudoKeyword \While {while}
\While
```

See also `\kw`. (Note that `\pseudokw` is used internally here.)

`\DeclarePseudoNormal{`⟨*shortcut*⟩`}{`⟨*text*⟩`}`

Used to declare a macro that expands to normal text. For example:

**if** $x$ == NIL
halt with an error message

```
\DeclarePseudoNormal \Error {halt with an error message}
\begin{pseudo*}[kw]
    if $x \== \cn{nil}$ \\+
        \Error
\end{pseudo*}
```

See also `\tn`. (Note that `\pseudotn` is used internally here.)

`\DeclarePseudoProcedure{`⟨*shortcut*⟩`}{`⟨*procedure*⟩`}`

Used to declare a macro that expands to a procedure. For example:

EUCLID$(a, b)$

```
\DeclarePseudoProcedure \Euclid {Euclid}
\Euclid(a, b)
```

See also `\pr`. (Note that `\pseudopr` is used internally here.)

`\DeclarePseudoString{`⟨*shortcut*⟩`}{`⟨*string*⟩`}`

Used to declare a macro that expands to a string. For example:

"Hello!"

```
\DeclarePseudoString \Hello {Hello!}
\Hello
```

See also `\st`. (Note that `\pseudost` is used internally here.)

`dim`

Dims the following line. Equivalent to:

```
\pseudodefinestyle{dim}{
    bol-append   = \color{\pseudodimcolor},
    setup-append = \color{\pseudodimcolor}
}
```

May be used to dim out inactive or currently less relevant lines (possibly using overlays; see page 18).

GNOME-SORT($A$)
1 $i = 1$
2 **while** $i \leq length[A]$
3 **if** $i == 1$ **or** $A[i] \geq A[i-1]$
4 $i = i + 1$
5 **else** swap $A[i]$ and $A[i-1]$
6 $i = i - 1$

```
\begin{pseudo}[kw, dim-color=black!25]*
\hd{Gnome-Sort}(A)                                  \\
[dim]  $i = 1$                                      \\
[dim]  while $i \leq \fn{length}[A]$                \\+
           if $i \== 1$ or $A[i] \geq A[i-1]$       \\+
               $i = i + 1$                          \\-
[dim]      else \nf swap $A[i]$ and $A[i-1]$        \\+
[dim]           $i = i - 1$
\end{pseudo}
```

See also `bol-append`, `setup-append` and `dim-color`.

`dim-color` = ⟨*color*⟩ (no default, initially `\pseudohlcolor`)

Sets the color used by `dim` (available as `\pseudodimcolor`). The initial value is the one set by `hl-color`.

`\dts`

A two-dot ellipsis, for use in the Wirth interval notation $1\,..\,n$, typeset as Graham, Knuth, and Patashnik did in *Concrete Mathematics* [3]. Its definition is the same as in `gkpmac`. Also accessible via the `\..` shortcut (which calls the fully prefixed command `\pseudodts`). See also `\rng`.

If some package defines `\dts` before `pseudo` is loaded, `pseudo` will not overwrite it. The command will still be available, as `\pseudodts`. To get the shorter version, simply use `\let\dts\pseudodts`, possibly as part of the `init` hook.

`dts-impl` = ⟨*code*⟩ (no default, initially `\pseudodts`)

The code used internally by the `\..` command, to produce the actual output. The initial value is the fully prefixed version of the `\dts` command.

`end-tabular` (no default, initially `\end{tabular}`)

The actual command for ending the `tabular` or `tabular`-like environment used by `pseudo`. (See `begin-tabular`.)

`eol` = ⟨*commands*⟩ (no default, initially empty)

Sets `\pseudoeol`, which is inserted at the end of all but the last line by `\\`. See also `eol-append` and `eol-prepend`.

`eol-append` = ⟨*commands*⟩ (no default)

Locally appends ⟨*commands*⟩ to `eol`.

`eol-prepend` = ⟨*commands*⟩ (no default)

Similar to `eol-append`, except that ⟨*commands*⟩ are added to the *beginning* of `eol`.

`\eqs`

Two equality signs typeset together as a binary relation, as in $x == y$ (as opposed to the wider $x == y$, resulting from `$x == y$`). It emulates the stix symbol `\eqeq`, but for use with Computer Modern (the default LaTeX font) or Latin Modern (available via the lmodern package). It should work just fine with other fonts. Also accessible via the `\==` shortcut (which calls the fully prefixed command `\pseudoeqs`), and configurable via `eqs-pad`, `eqs-scale` and `eqs-sep`.

If some package defines `\eqs` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\pseudoeqs`. To get the shorter version, simply use `\let\eqs\pseudoeqs`, possibly as part of the `init` hook.

`eqs-impl` = ⟨*code*⟩ (no default, initially `\pseudoeqs`)

The code used internally by the `\==` command, to produce the actual output. The initial value is the fully prefixed version of the `\eqs` command.

`eqs-pad` = ⟨*muskip*⟩ (no default, initially `0.28mu`)

The amount of space inserted on each side of `\eqs`.

`eqs-scale` = ⟨*number*⟩ (no default, initially `0.6785`)

The amount of horizontal scaling applied to the `=` signs in `\eqs`.

`eqs-sep` = ⟨*muskip*⟩ (no default, initially `0.63mu`)

The amount of space inserted between the two `=` signs in `\eqs`.

`in-float` (pseudo style)

This is a style, defined using `\pseudodefinestyle`, that is applied to the contents of every `tcolorbox` styled using the `pseudo/` styles, such as `pseudo/boxed`, `pseudo/ruled`, etc. (Despite the name, it is not limited to boxes defined with the `float` key.) The style is initially empty, and acts as a hook for user customization (similar to `pseudo/init`, but specifically for pseudo configuration):

**not modified**

modified

```
\pseudodefinestyle{in-float}{kwfont = \sffamily}
\kw{not modified}
\begin{tcolorbox}[pseudo/filled]
    \kw{modified}
\end{tcolorbox}
```

**extra-space** = ⟨*length*⟩ (no default, initially `0pt`)

Additional space to be added by `\\`, below the baseline of the current row. For example:

1 a

2 b

3 c

```
\begin{pseudo}[indent-mark, extra-space=2ex]
    a                                                \\+
        b                                            \\+
            c
\end{pseudo}
```

Note the difference from `line-height`: Here the space is added below, just like with the *normal* `\\` command, when its optional argument is used, whereas with `line-height` the height and depth of the line are both scaled. Also, unlike with `line-height`, with `extra-space`, nothing is added to the last line unless it actually ends with a `\\` command.

The most likely use-case for this command is to add space after specific lines, rather than for *every* line, as in the previous example. For example:

1 one group that is
2 logically connected

3 another group that is
4 separate from the first

```
\begin{pseudo}
    one group that is           \\
    logically connected         \\ [extra-space=1.5ex]
    another group that is       \\
    separate from the first
\end{pseudo}
```

In fact, `extra-space` is so closely tied to `\\`, that you can supply a keyless value as one of its options, and `extra-space` will be *assumed*. So, for example, in the previous example, you could simply have used `\\[1.5ex]`.

If you want spacing only after the heading (created with `\hd`), you can set that using the `hd-space` key.

`\fn{`⟨*name*⟩`}(`⟨*arguments*⟩`)`

Indicates a function name, such as *length*, and is initially more or less an alias for `\id`. The optional arguments (given in parentheses) are typeset in math mode, so `\fn{length}(A)` yields *length*$(A)$. Sometimes square brackets are used with functions that are meant to indicate array lookups or some property access or the like. This works in the same manner, so

`\fn{length}[A]` yields *length*[*A*]. This behavior of picking up arguments carries over if you define a shortcut, of course:

We're not in math mode, but the argument of *length*[*A*] is.

```
\def\Ln{\fn{length}}
We're not in math mode, but the argument of \Ln[A] is.
```

See also `\DeclarePseudoFunction`. This is a convenience for typesetting function names, and you may freely redefine it to whatever you prefer. If some package defines `\fn` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\pseudofn`. To get the shorter version, simply use `\let\fn\pseudofn`, possibly as part of the `init` hook.

`fnfont` = ⟨*font*⟩ (no default, initially `\idfont`)

Used to set `\fnfont`, which is used as part of `\fn`. May be set to take a single argument or none. Not restricted to actual font commands; you may also mix in `\textcolor` or the like.

`\fnfont`

The command set by the `fnfont` option. Used as part of `\fn`.

`font` = ⟨*command*⟩ (no default, initially `\normalfont`)

Sets the base font used in the code lines. Initially, this is just `\normalfont`, but the `kw` switch is a convenient way to set it to the keyword font `\kwfont`. This is presumed to be a common case, under the assumption that most of the pseudocode will consist of either keywords or mathematics. If you'd rather explicitly mark up your keywords, leaving `font` as it is, you could use `\kw` (or `\DeclarePseudoKeyword` for common cases):

**while** pigs don't fly
    keep waiting

```
\begin{pseudo*}
\kw{while} pigs don't fly                    \\+
    keep waiting
\end{pseudo*}
```

`\hd{`⟨*name*⟩`}(`⟨*arguments*⟩`)`

Typesets a procedure signature, like `\pr`, but is intended for use as a *header* for a procedure, rather than a procedure call. The difference is that `\hd` wraps its contents in a `\multicolumn`, spanning two columns (i.e., both the label column and the main code column, but not any additional columns added using `preamble` or `begin-tabular`), using the preamble set with `hd-preamble`. For this to work, you need to use the star flag (`*`) to suppress the automatic insertion of the `prefix`:

ALGORITHM$(x, y, z)$
1 setup
2 **while** condition
3 iterative step
4 **return** result

```
\begin{pseudo}*
    \hd{Algorithm}(x, y, z)                    \\
    setup                                      \\
    \kw{while} condition                       \\+
        iterative step                         \\-
    \kw{return} result
\end{pseudo}
```

The `hd-space` key can be used to configure `\hd` so it sets the `extra-space` key. Note that the signature arguments are mandatory; in order to function properly, `\hd` must be *expandable*, and therefore cannot end with an optional argument, the way `\pr` does. Also, it is not able to determine nesting levels of parentheses, so the arguments are terminated upon encountering the first closing parentheses. If you want to use parentheses in the arguments themselves, you must wrap them in braces, or thing will get wonky:

FOO$(G = (V, E)$ , w, s)
FOO$(G = (V, E), w, s)$
1 lorem ipsum dolor sit amet, consetetur

```
\begin{pseudo}*
\hd{Foo}(G=(V, E), w, s)                       \\*
\hd{Foo}({G=(V, E), w, s})                     \\
lorem ipsum dolor sit amet, consetetur
\end{pseudo}
```

If some package defines `\hd` before `pseudo` is loaded, `pseudo` will not overwrite it. The command will still be available, as `\pseudohd`. To get the shorter version, simply use `\let\hd\pseudohd`, possibly as part of the `init` hook.

`hd-preamble` = ⟨*columns*⟩ (no default)

Sets the preamble used by `\hd`. The result is available as the column type with name `\pseudohdpreamble`. (Note that this is the literal column name, and not a macro containing the name. See `preamble` for more information.) Initially, a single left-aligned column with `\pseudohpad` on either side (see page 89). If you introduce more columns in `preamble`, you might want to increase the number of columns in `hd-preamble` as well, or at least remove the right-hand `\pseudohpad`.

`hd-space` = ⟨*length*⟩ (default `0.41386ex`, initial value `0pt`)

The value `extra-space` is set to (before any value set manually as part of `\\`) after the use of `\hd`. This is useful if one wants some extra space only

after the header. The default is based on clrscode4e,* and, so getting spacing header spacing similar to that package requires only `\pseudoset{hd-space}`. (See, e.g., the example on page 22.)

`hl` (takes no value)

Prepends `\pseudohl` to `bol`. Normally used with beamer (see page 18). Note that if if `hpad` is set, a warning will be emitted (unless this is overridden by `hl-warn`).

`hl-color` = ⟨*color*⟩ (no default, initially `black!12`)

Sets the color used by `\pseudohl` (available as `\pseudohlcolor`).

`hl-warn` = ⟨*warn*⟩ (default `true`, initial value `true`)

Permits turns off (by setting `hl-warn` to `false`) the warning that is normally emitted if you use `hl` without having used `hpad`.

`hpad` = ⟨*length*⟩ (default `0.3em`, initially `0em`)

Horizontal padding on either side of the pseudocode. Useful, among other things when highlighting lines, to have some of the highlighting (i.e., row color) protrude beyond the text. This key also sets `hl-warn` to `false`.

`hsep` = ⟨*length*⟩ (no default, initially `0.75em`)

The space between the line labels and the code lines, i.e., between the two columns of numbered `pseudo` environments.

`\id{`⟨*name*⟩`}`

Indicates an identifier, and is simply an alias for `\textit` wrapped in `\textnormal`. See also `\DeclarePseudoIdentifier`. This is a convenience for typesetting identifiers, and you may freely redefine it to whatever you prefer. If some package defines `\id` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\pseudoid`. To get the shorter version, simply use `\let\id\pseudoid`, possibly as part of the `init` hook.

It might seem more natural to use `\mathit` (without `\tn`), but that may not give the desired results. First of all, special characters will not behave as if they're parts of a name:

*foo* − *bar* : *baz*

```
$\mathit{foo-bar:baz}$
```

This may be remedied, e.g., by using the (internal) command `\newmcodes@` from amsopn, but the kerning, spacing and font application in the result still leaves something to be desired:

*foo-bar*: *baz*

```
$\mathit{\newmcodes@ foo-bar:baz}$
```

* And older versions, for that matter.

Compare this to a simple `\textit`:

*foo-bar:baz*

```
$\textit{foo-bar:baz}$
```

The decision to use `\textit` means that you can't use, say, subscripts or the like as parts of an identifier, or mix in greek letters or other mathematical symbols. Though you can still easily typeset things like *foo-α*, you'll have to mix in the math mode more explicitly (in this case, `$\id{foo-$\alpha$}$`). If some package defines `\id` before `pseudo` is loaded, `pseudo` will not overwrite it. The command will still be available, as `\pseudoid`. To get the shorter version, simply use `\let\id\pseudoid`, possibly as part of the `init` hook.

`idfont` = ⟨*font*⟩ (no default, initially `\textit`)

Used to set `\idfont`, which is used as part of `\id`. May be set to take a single argument or none. Not restricted to actual font commands; you may also mix in `\textcolor` or the like.

`\idfont`

The command set by the `idfont` option. Used as part of `\id`.

`indent-length` = ⟨*length*⟩ (no default, initially empty)

How large each indentation step is. If this key is not specified, `indent-text` is used to calculate one the indent length instead.

`indent-level` = ⟨*level*⟩ (no default, initially `0`)

Sets the current indentation level. This is most usefully set on `pseudo` environment, in concert with `start`:*

1 this is
2 the first part

This is some text interrupting the code.

3 this is the
4 second part

* The `\strut` here is just to even out spacing above and below the text, which doesn't have fixed-height lines like the pseudocode.

```
\begin{pseudo}
    this is                                          \\+
    the first part
\end{pseudo}

\medskip \strut
This is some text interrupting the code.
\medskip

\begin{pseudo}[start=3, indent-level=1]
    this is the                                      \\-
    second part
\end{pseudo}
```

`indent-mark` = ⟨*mark*⟩ (default vertical line, initially empty)

A mark used to indicate the start of each step of indentation.* Any horizontal space taken up by this mark is added to the indentation; to prevent this, wrap the mark in `\rlap` (and, if necessary, in `\smash`, to handle *vertical* space). The following example uses `indent-mark=\rlap{$\cdot$}`:

```
1 repeat n − 1 times
2 ·   for each edge uv
3 ·   ·   update estimate for v via u
4 for each edge uv
5 ·   if estimate for v improves via u
6 ·   ·   return FALSE
7 return TRUE
```

By default, the indent mark is a vertical line that scales with the line height, so each indented block is indicated by a single unbroken vertical line. It also "undoes" its own width, so it doesn't impact the indentation. The following example uses the `indent-mark` key with no argument:

```
1 repeat n − 1 times
2 |   for each edge uv
3 |   |   update estimate for v via u
4 for each edge uv
5 |   if estimate for v improves via u
6 |   |   return FALSE
7 return TRUE
```

This default mark may be configured by using the keys `indent-mark-color`, `indent-mark-width` and `indent-mark-shift`.

`indent-mark-color` = ⟨*color*⟩ (no default, initially `lightgray`)

Sets the color to be used by the default `indent-mark`. See `indent-mark-shift` for an example.

* Similar to `c:indentLine_char` in the vim plugin indentLine.

`indent-mark-shift` = ⟨*length*⟩ (default `.6em`, initial value `0pt`)

Sets the horizontal shift (from the actual start of an indent step) at which to render the default `indent-mark`. The following example uses the default value, and sets `indent-mark-width` to `.4pt` and `indent-mark-color` to `black`, to approximate the look of the indent mark in algorithm2e.

```
1 repeat n − 1 times
2 │   for each edge uv
3 │   │   update estimate for v via u
4 for each edge uv
5 │   if estimate for v improves via u
6 │   │   return FALSE
7 return TRUE
```

`indent-mark-width` = ⟨*width*⟩ (no default, initially `.6pt`)

Sets the width of the default `indent-mark`. See `indent-mark-shift` for an example. The default value of `.6pt` corresponds to the tikz line width `semithick`.

`indent-text` = ⟨*text*⟩ (no default, initially `\pseudofont\kw{else}\␣`)

The size of each indentation step is set to the width of the ⟨*text*⟩. The default is set up so that code following on the same line as **else** will be properly aligned, as in:

```
if condition
    something
else something else
```

If you're not going to put code on the same line as **else**, for example, you might want a different indentation size. To set it to some specific length, you could use the `indent-length` key.

`init` = ⟨*commands*⟩ (no default, initially empty)

Used to set the initialization hook, which is inserted at the beginning of the `pseudo` environment (right before the actual tabular environment begins, as defined by `begin-tabular`). See also `init-append` and `init-prepend`.

`init-append` = ⟨*commands*⟩ (no default)

Locally appends ⟨*commands*⟩ to `init`.

`init-prepend` = ⟨*commands*⟩ (no default)

Similar to `init-append`, except that ⟨*commands*⟩ are added to the *beginning* of `init`.

`kw` (takes no value)

Sets `font` to `\kwfont`.

`\kw{`⟨*name*⟩`}`

Indicates a keyword. First wraps the argument in `\textnormal` and then adds `\kwfont`. See also `\DeclarePseudoKeyword`. This is a convenience

for typesetting keywords, and you may freely redefine it to whatever you prefer. If some package defines `\kw` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\pseudokw`. To get the shorter version, simply use `\let\kw\pseudokw`, possibly as part of the `init` hook.

`kwfont` = ⟨*font*⟩ (no default, initially `\fontseries{b}\selectfont`)

Used to set `\kwfont`, which is used as part of `\kw`. May be set to take a single argument or none. Not restricted to actual font commands; you may also mix in `\textcolor` or the like. Note, however, that with the `kw` switch, you set `font = \kwfont`, which is then applied as a font-switching command for each entire line, taking no argument. If you provide an command requiring an argument, the `\kw` command will still work, but the `kw` switch won't:

foo bar

vs.

foo bar

```
\pseudoset{kw}
\begin{pseudo*}[kwfont=\textsf]    % breaks kw option
    foo \kw{bar}
\end{pseudo*}
vs.\
\begin{pseudo*}[kwfont=\sffamily]  % works with kw option
    foo \kw{bar}
\end{pseudo*}
```

The initial value isn't *quite* as straightforward as indicated, however. For more info, see `\kwfont`.

`\kwfont`

The command set by the `kwfont` option. Used as part of `\kw`. Its initial definition is *essentially* `\fontseries{b}\selectfont`, except the first time it's called (normally when evaluating the initial value of `indent-text`), it also runs a check to see if the font selection *worked*, as in some cases (such as in a default beamer presentation), the non-extended bold may not be available. In that case, it defaults to an extended bold (`\bfseries`) instead. At this point, the command is redefined to `\fontseries{b}\selectfont` or `\bfseries`, as appropriate (i.e., without this check). So, while `\kw{hello}` produces the non-extended **hello** in a default LaTeX document, it yields the extended **hello** in a default beamer presentation. Perhaps more clearly, this is the result in plain LaTeX (using lmodern):

**while**
**while**
**while**

```
\textbf{while}\\                    % Extended
\kw{while}\\                        % Keyword
{\fontseries{b}\selectfont while} % Non-extended
```

The same code results in the the following in beamer:

**while**
**while**
**while**

You'll also get a font warning,* though only once, as it's suppressed after the first occurrence, so the fact that the font selection doesn't work on the last line isn't reported.

> The current implementation of `\kwfont` actually *piggybacks* on this warning to determine if the non-extended bold is available. This means that if you've tried (and failed) to use `\fontseries{b}` *before* the fist use of `\kwfont`, the fallback (i.e., extended bold) won't be triggered.

Note that `indent-text` (which will tend to be the first occurrence use of `\kwfont`) won't be evaluated (to determine `indent-length`) until you actually start a `pseudo` environment, so if you're *aware* that you don't have non-extended bold available, and you set `kwfont = \bfseries`, for example, there will be no attempt to use the non-extended version, and you won't get the font warning that the default implementation produces in that case.

`label` = ⟨*commands*⟩ (no default, initially `\arabic*`)

Used to format the line label/number. For example, to emulate clrscode4e rather than clrscode3e, you'd use `label = \small\arabic*`. You can also add punctuation or the like, as in enumitem:

1: **print** "Hello, label!"
2: **goto** 1

```
\pseudoset{kw, label=\footnotesize\arabic*:}

\begin{pseudo}
print \st{Hello, label!} \label{li:label}       \\
goto \tn{\ref{li:label}}
\end{pseudo}
```

> Make sure to use `\label` in the actual code line, as here, and not in the number cell (which is generally not explicitly written, anyway).

* Of course, if you use a different font or theme, e.g., with the beamer command `\usefonttheme{serif}`, you may not have any issues to begin with.

As can be seen from the example, `\ref` is unaffected by `label`, and in many cases that's what you want—as apposed to, say, "**goto** 1:". In some cases, however (especially when using one of the other formatting commands, such as `\alph` or `\roman`), you *do* want the reference format to reflect the original, or be similar in some way. To do that, you use the `ref` key.

`label-align` = ⟨*column*⟩ (no default, initially `r`)

Used to specify the alignment of the `label` of each line. Whatever is provided is stored as a column type (named `\pseudolabelalign`), which is a part of the default `preamble`. In other words, beyond the basic `l` and `r` (for left- and right-justified), you can supply anything that would be valid as part of the preamble (possibly using functionality from the `array` package). If you want to get creative here, though, it might be easier to get the results you want by specifying your own `preamble` in full.

`left-margin` = ⟨*length*⟩ (no default, initially `0pt`)

Sets the left margin of the `pseudo` environment, i.e., how far it is indented wrt. the surrounding text:

Lorem ipsum dolor sit amet:

1 consetetur sadipscing elitr
2 sed diam nonumy eirmod tempor

Invidunt ut labore et dolore magna.

```
Lorem ipsum dolor sit amet:

\begin{pseudo}[left-margin=1.25em]
consetetur sadipscing elitr \\
sed diam nonumy eirmod tempor
\end{pseudo}

Invidunt ut labore et dolore magna.
```

To have the environment indented as (the beginning of) any normal paragraph, you could use `left-margin = \parindent`. Note that `left-margin`, as well as the spacing above and below the `pseudo` environment, is turned off inside `\mbox` and the like:

I'm a livin' in a box
I'm a livin' in a cardboard box

```
\pseudoset{left-margin=1cm} % Won't affect box contents
\fbox{\begin{pseudo*}
I'm a livin' in a box \\
I'm a livin' in a cardboard box
\end{pseudo*}}
```

As opposed to with `topsep` and `partopsep`, we are *not* working with one of the built-in list spacing commands; `\leftmargin` has no effect on this key (which is why the hyphenated naming style of other keys such as `label-align` or `indent-text` is also adopted for `left-margin`). See also `compact`.

`line-height` = ⟨*factor*⟩ (no default, initially `1`)

The ⟨*factor*⟩ with which to multiply the ordinary line height. For simple, sparse pseudocode, the oridnary line height works well, but if your code gets too crowded with text and notation, you may wish to increase `line-height`. To emulate, e.g., the `\jot` set by `amsmath` (which is `0.25\baselineskip`), you could use `1.25`, though even `1.1` should help in many cases.

`\nf`

Switch to the normal font (i.e., without bold or italics, etc.). If some package defines `\nf` before `pseudo` is loaded, `pseudo` will not overwrite it. The command will still be available, as `\normalfont`. To get the shorter version, simply use `\let\nf\normalfont`, possibly as part of the `init` hook. See also `\tn`.

`partopsep` = ⟨*length*⟩ (no default, initially `\partopsep`)

Sets a `pseudo`-local copy of `\partopsep` for use in vertical spacing above and below the `pseudo` environment. See also `compact`.

`pause` (takes no value)

Equivalent to `eol-append = \pause` (see Chapter 2).

`pos` = ⟨*depth*⟩ (no default, initially `t`)

Specifies the vertical position of the `pseudo` environment, i.e., whether it should be vertically aligned on the top (`t`) or bottom (`b`) row, or be vertically centered (no value). This is equivalent to the (optional) `pos` argument to `tabular`, and is in fact supplied to the internal `tabular` environment. The initial value is `t`, which makes sure the spacing above is consistent, regardless of the depth of the previous line. Here are two examples, set side by side:

$x$ $f(x)$

1 foo 1 frozz
2 bar 2 bozz

The `pseudo` environments are properly aligned. If, instead, we set `pos = {}`, they will not be, because $f(x)$ has more depth than $x$:*

$x$ $f(x)$

1 foo 1 frozz
2 bar 2 bozz

If `compact` is set to `true`, `pos` is automatically emptied like this—a behavior which can, of course, be overridden:

* This was the behavior in older versions of `pseudo`.

Lorem $\begin{matrix}\text{foo}\\ \text{bar}\end{matrix}$ ipsum $\begin{matrix}\text{foo}\\ \text{bar}\end{matrix}$ dolor $\begin{matrix}\text{foo}\\ \text{bar}\end{matrix}$.

```
Lorem
\begin{pseudo*}[compact]
    foo \\ bar
\end{pseudo*}
ipsum
\begin{pseudo*}[compact, pos=b]
    foo \\ bar
\end{pseudo*}
dolor
\begin{pseudo*}[compact, pos=t]
    foo \\ bar
\end{pseudo*}.
```

`\pr{`⟨*name*⟩`}(`⟨*arguments*⟩`)`

Indicates a procedure name, such as QUICKSORT, and is initially more or less an alias for `\cn`. The optional arguments (in parentheses) are typeset in math mode, so `\pr{Quicksort}(A,p,r)` yields QUICKSORT$(A, p, r)$. See also `\DeclarePseudoProcedure`. This is a convenience for typesetting procedure names, and you may freely redefine it to whatever you prefer. If some package defines `\pr` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\pseudopr`. To get the shorter version, simply use `\let\pr\pseudopr`, possibly as part of the `init` hook.

`preamble` = ⟨*columns*⟩ (no default)

Sets the preamble to be used by the internal `tabular`. The result is available as the column type with name `\pseudopreamble`. (Note that this is the literal column name, and not a macro containing the name. Initially, pseudo uses a `tabular` as redefined by the array, which prevents the expansion of whatever is provided as its preamble, and so we supply the preamble in the form of a single "column" instead.) For the default value, see the actual implementation on page 89 as well as the explanation in Sect. 4.1.

`prefix` = ⟨*commands*⟩ (no default)

This is the text inserted at the beginning of the following line by `\\` (and by `\begin{pseudo}`), unless you use the star (`*`) flag. Unless modified, it inserts the code necessary to label the line and to move into the second column, where the actual code is inserted by the user. For the default value, see the actual implementation on page 89 as well as the explanation in Sect. 4.1.

`prevdepth` = ⟨*depth*⟩ (no default, initially `.3\baselineskip`)

This value is used to properly adjust the vertical distance to any following text, by setting `\prevdepth` to ⟨*depth*⟩, unless `compact` is set to `true`. In general, it should not be necessary to change its value.*

* In previous versions, `\prevdepth` was not set. To get the old behavior, set `prevdepth = 0pt`.

**prfont** = ⟨*font*⟩ (no default, initially `\cnfont`)

Used to set `\prfont`, which is used as part of `\pr`. May be set to take a single argument or none. Not restricted to actual font commands; you may also mix in `\textcolor` or the like.

`\prfont`

The command set by the `prfont` option. Used as part of `\pr`.

`\begin{pseudo}`[⟨*options*⟩] * <⟨*overlay specification*⟩> [⟨*line options*⟩]
⟨*pseudocode*⟩
`\end{pseudo}`

The actual environment in which the pseudocode is typeset. The ⟨*options*⟩ are local to the environment, while the ⟨*line options*⟩ are local to the following line (in the same manner as those set in `\\`; i.e., only some will actually have any effect). The star (`*`) and ⟨*overlay specification*⟩ act just like those on `\\`. Note that if you wish to specify ⟨*line options*⟩ without the star or the ⟨*overlay specification*⟩, you need to supply at least an empty pair of brackets for the global options:

1 First line
2 Second line

vs.

1 First line
2 Second line

```
\pseudoset{hpad} % because we're using hl
\begin{pseudo}[][hl]
First line \\
Second line
\end{pseudo}
vs.\
\begin{pseudo}[hl]
First line \\
Second line
\end{pseudo}
```

There are no `+`/`-` flags here, unlike for `\\`; if needed, you can use `indent-level`.

`\begin{pseudo*}`[⟨*options*⟩] * <⟨*overlay specification*⟩> [⟨*line options*⟩]
⟨*pseudocode*⟩
`\end{pseudo*}`

An unnumbered version of the `pseudo` environment. Equivalent to `pseudo`, but with the `starred` style applied (see page 99). Unless this style is altered, this means that the label column is removed from the preamble, and the prefix is reduced to only `bol`.

**pseudo/boxed** (tcolorbox style)

A style defined for use with tcolorbox (i.e., not with `\pseudoset`).

A simple, manually numbered example:

**Algorithm 1** HELLO($x$)

1 **print** "Hello," $x$

```
\begin{tcolorbox}[pseudo/boxed,
    title={Algorithm 1\enskip \pr{Hello}(x)}]
    \begin{pseudo}
        \kw{print} \st{Hello,} $x$
    \end{pseudo}
\end{tcolorbox}
```

To create a floating box, use the tcolorbox key `\float`. In general, it is probably better to create such boxes with `\newtcbtheorem`. For more information on using tcolorbox styles, see Chapter 3.

`pseudo/booktabs` (tcolorbox style)

A style defined for use with tcolorbox (i.e., not with `\pseudoset`). A simple example:

**Algorithm 1** HELLO($x$)

1 **print** "Hello," $x$

See the `pseudo/boxed` reference entry and Chapter 3 for more information.

`pseudo/boxruled` (tcolorbox style)

A style defined for use with tcolorbox (i.e., not with `\pseudoset`). A simple example:

**Algorithm 1** HELLO($x$)

1 **print** "Hello," $x$

See the `pseudo/boxed` reference entry and Chapter 3 for more information.

`pseudo/filled` (tcolorbox style)

A style defined for use with tcolorbox (i.e., not with `\pseudoset`). A simple example:

**Algorithm 1** HELLO($x$)

1 **print** "Hello," $x$

See the `pseudo/boxed` reference entry and Chapter 3 for more information.

`pseudo/init` = ⟨*commands*⟩ (tcolorbox hook)

Can be used to define the contents of a hook that is inserted before the contents of a tcolorbox box styled with one of the `pseudo/` styles, such as `pseudo/boxruled`, etc. It is used as part of the tcolorbox configuration, and

is *not* set using `\pseudoset`. Useful, e.g., for setting `\parskip` or tabstops (with the tabto package).

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna.

At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

```
\begin{tcolorbox}[pseudo/boxed, pseudo/init=\parskip 2ex]
Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed
diam nonumy eirmod tempor invidunt ut labore et dolore magna.

At vero eos et accusam et justo duo dolores et ea rebum. Stet
clita kasd gubergren, no sea takimata sanctus est Lorem ipsum
dolor sit amet.
\end{tcolorbox}
```

`pseudo/ruled` (tcolorbox style)

A style defined for use with tcolorbox (i.e., not with `\pseudoset`). A simple example:

**Algorithm 1** HELLO($x$)

1 **print** "Hello," $x$

See the `pseudo/boxed` reference entry and Chapter 3 for more information.

`pseudo/tworuled` (tcolorbox style)

A style defined for use with tcolorbox (i.e., not with `\pseudoset`). A simple example:

**Algorithm 1** HELLO($x$)

1 **print** "Hello," $x$

See the `pseudo/boxed` reference entry and Chapter 3 for more information.

`\pseudobol`

The command set by the `bol` option. Used as part of `\pseudoprefix`.

`\pseudodefinestyle{`⟨*name*⟩`}{`⟨*options*⟩`}`

Used to define "styles" or meta-keys, i.e., shortcuts for setting several keys to given values (used, e.g., to define `starred`). The ⟨*name*⟩ is simply the name of the new meta-key, and the ⟨*options*⟩ are just what you'd provide to, e.g., `\pseudoset`.

`\pseudoeol`

The command set by the `eol` option. Used as part of `\\`. It is inserted between lines, but not after the last one.

`\pseudofont`

The command set by the `font` option. Used as part of `\pseudosetup`. It is used to set up the font for each pseudocode line. (See also `kw`.)

`\pseudohl`

This is the command inserted as `bol` by the `hl` switch. Initially, it's just a `\rowcolor` using the color set by `hl-color`, but you could redefine it to whatever you wish.

`\pseudohpad`

Used on the left- and right-hand sides of `preamble`. Conceptually, it inserts the horizontal space specified by `hpad`. To play nice with `\rowcolor`, however, it is not used in a `@{...}` column; rather, it's placed in `>{...}` and `<{...}` modifiers, and the actual space inserted has `\tabcolsep` subtracted.

`\pseudoindent`

The command set by the `indent-length` and `indent-mark` options. Used in `\pseudosetup`. More precisely, `indent-length` is stored textually, and is converted to the length `\pseudoindentlength` when entering a `pseudo` environment (so that units like `em` and `ex` adapt to the current font). If no `indent-mark` is set, the `\pseudoindent` command then inserts a horizontal space of length `\pseudoindentlength` × *current indent level*. Otherwise, one `indent-mark` and a horizontal space of length `\pseudoindentlength` is inserted for each level of indentation up to the current indentation level. (This horizontal space is measured from the left edge of the `indent-mark`.)

`\pseudolabel`

The command set by the `label` option. Used as part of `\pseudoprefix`.

`pseudoline`

Counter for pseudocode lines. See also `*`.

`\pseudopos`

The command set by the `pos` option. Used as part of the initial value of `begin-tabular`.

`\pseudopreamble`

The command set by the `preamble` option. Used as part of the initial value of `begin-tabular`.

`\pseudoprefix`

The command set by the `prefix` option. Used as part of `\\`.

`\pseudosavelabel`

Used as part of `\pseudosetup` to save the `pseudoline` counter for use in `\label` and `\ref`. The `pseudoline` counter is *incremented* as part of the `\pseudolabel` command, but that's done using a plain `\stepcounter`, as any use of `\label` will presumably be placed in the pseudocode line (i.e., the next column). To save the value there, `\pseudosavelabel` first *decrements* the counter, and then uses `\refstepcounter`.

`\pseudoset{`⟨*options*⟩`}`

Used to set the configuration keys of the pseudo package (using l3keys with `pseudo` as the module). These may also be set as optional arguments to the `pseudo` and `pseudo*` environments. For example, if you'd like to switch to `\rm` as your base font, you could use `\pseudoset{font = \rm}`.

`\pseudosetup`

The command set by the `setup` option. Used as part of the `preamble`.

*Not to be confused with* `\pseudoset`.

`ref` = ⟨*commands*⟩ (initially empty, default `\pseudolabel`)

Shortcut for setting the `\thepseudoline` command. If used without arguments, it will use the value supplied to `label`.

(A) print "Hello, ref!"
(B) goto 4.2

```
\pseudoset {
    label = (\textsc{\alph*}),
    ref   = \Alph*,
    hsep  = .5em
}

\begin{pseudo}
print \st{Hello, ref!} \label{li:ref} \\
goto \tn{\ref{li:ref}}
\end{pseudo}
```

`\RestorePseudoBackslash`

Command similar to the `\arraybackslash` of the array package. Switches the definition of `\\` to the one used by pseudo. Useful if you've used some code that modifies `\\` for its own purposes (such as `\raggedleft` or the like).

`\RestorePseudoEq`

Similar to `\RestorePseudoBackslash`. Switches the definition of `\=` to the one used by pseudo. Useful if `\=` reverts to its original definition in some context (see `\==`).

`\rng`

Used to typeset a range, slice or subarray, or simply to indicate the indices of an array, similar to `\dts`, but using a colon rather than two dots placed horizontally. Uses the same spacing as `\dts`, as opposed to a plain `:`, which adds more space (more suitable, for example, to set-builder notation).

Compare $A[1:n]$ to $A[1:n]$.

```
Compare $A[1\rng n]$ to $A[1:n]$.
```

If some package defines `\rng` before `pseudo` is loaded, `pseudo` will not overwrite it. The command will still be available, as `\pseudorng`. To get the shorter version, simply use `\let\rng\pseudorng`, possibly as part of the `init` hook.

`setup` = ⟨*commands*⟩ (no default)

The setup part of each pseudocode line: Save the line counter (using the `\pseudosavelabel` command), insert the proper indentation (with `\pseudoindent`) and switch to the correct font (`\pseudofont`).

Rather than setting `setup` directly, you may wish to add commands using `setup-append` or `setup-prepend`.

`setup-append` = ⟨*commands*⟩ (no default)

Locally appends ⟨*commands*⟩ to `setup`.

`setup-prepend` = ⟨*commands*⟩ (no default)

Similar to `setup-append`, except that ⟨*commands*⟩ are added to the *beginning* of `setup`.

`\st{`⟨*string*⟩`}`

Typesets ⟨*string*⟩ with added quotes using `\stfont`. (The entire thing is wrapped in `\textnormal`.) For example, `print \st{42}` yields:

print “42”

See also `\DeclarePseudoString`. This is a convenience for typesetting strings, and you may freely redefine it to whatever you prefer. If some package defines `\st` before `pseudo` is loaded, `pseudo` will not overwrite it. The command will still be available, as `\pseudost`. To get the shorter version, simply use `\let\st\pseudost`, possibly as part of the `init` hook.

`st-left` = ⟨*text*⟩ (no default, initially ‘‘)

Text or commands inserted at the start of a string, when using `\st`.

`st-right` = ⟨*text*⟩ (no default, initially ’’)

Text or commands inserted at the end of a string, when using `\st`.

`starred` (takes no value)

The style (defined by `\pseudodefinestyle`) used by the `pseudo*` environment. You may modify this (again using `\pseudodefinestyle`) if you wish.

`start` = ⟨*number*⟩ (no default, initially `1`)

Sets the starting line number:

10 Maybe we’re continuing from some earlier code?
11 Anyway, let’s keep going!

```
\begin{pseudo}[start=10]
Maybe we’re continuing from some earlier code?  \\
Anyway, let’s keep going!
\end{pseudo}
```

See also `indent-level`.

**stfont**

Used to set `\stfont`, which is used as part of `\st`. May be set to take a single argument or none. Not restricted to actual font commands; you may also mix in `\textcolor` or the like.

**\stfont**

The command set by the `stfont` option. Used as part of `\st`.

**\tn**`{`⟨*text*⟩`}`

An alias for `\textnormal`, to break out of the font set using the `font` key, for inserting ordinary prose between the keywords. For example, to get the result "**for** every node $v \in V$", one might write:

```
for \tn{every node} $v\in V$
```

This is equivalent to using `\textnormal{every node}`. If some package defines `\tn` before pseudo is loaded, pseudo will not overwrite it. The command will still be available, as `\textnormal`. To get the shorter version, simply use `\let\tn\textnormal`, possibly as part of the `init` hook.

**topsep** = ⟨*length*⟩ (no default, initially `\topsep`)

Sets a pseudo-local copy of `\topsep` for use in vertical spacing above and below the `pseudo` environment. See also `compact`.

**unknown**

Unknown keys are checked for beamer overlay specifications. That is, if an unknown key has the form

⟨*name*⟩`<`⟨*overlay specification*⟩`>` = ⟨*value*⟩

then it does not trigger an error, but, if beamer is used, is rewritten to:

`\only<`⟨*overlay specification*⟩`>{\pseudoset{`⟨*name*⟩ = ⟨*value*⟩`}}`

If beamer is *not* used, the key is simply ignored.

> Currently, using commas in the ⟨*overlay specification*⟩ doesn't work. As a workaround, you can use the key multiple times. That is, rather than `dim<1,3>`, use `dim<1>, dim<3>`.

If an unknown key does *not* take the form of a key with an overlay specification, a second special case is also handled: If we're processing arguments for `\\`, and the key does not have an associated (non-blank) value, we treat the key instead as a *value*, whose implicit key is `extra-space`. This means that you can specify extra space in the ordinary way, with `\\[1.5ex]`, etc.

### Unknown Keys and Defaults

Because of current limitations on how keys are handled, unknown keys cannot have defaults, and so there is no way to insert a marker for when no value is provided, which could be used to determine whether to use `\pseudoset{`⟨*name*⟩ `=` ⟨*value*⟩`}` or simply `\pseudoset{`⟨*name*⟩`}`. Instead, if an empty value is provided to the unknown key, that is treated in the same way as when the key is used without a value, resulting in `\pseudoset{`⟨*name*⟩`}` rather than `\pseudoset{`⟨*name*⟩ `=}`.

# Chapter 5

# But how do I . . .

Some functionality is not built in, but is still fairly easy to achieve. Some streamlining may be added in future versions.

## 5.1 . . . prevent paragraph indentation after `pseudo`?

If you want to keep the pseudocode as part of a surrounding paragraph, you could have it not start its own, i.e., not have an empty line before it. This will reduce the amount of spacing as well; if you'd rather have that reduced, you could simply drop the empty line *after* the environment:

```
Text before

\begin{pseudo}
    pseudocode
\end{pseudo}
%
Text after
```

The effect would then be the following:

1 pseudocode

No indentation here, and normal spacing. If, however, you wish to suppress indentation after *all* instances of `pseudo`, you could use the noindentafter package, as follows:

```
\usepackage{noindentafter}
\NoIndentAfterEnv{pseudo}
\NoIndentAfterEnv{pseudo*}
```

If you wish to override this, and indent a given paragraph after all, you can simply use the `\indent` command.

## 5.2 . . . get log-like functions?

There's no built-in command for math-roman function names, as used in log and sin, etc. (other than just setting `fnfont`, if you want it everywhere). If you wish to define your own, you could use `\operatorname` or `\DeclareMathOperator`. For example:

1 **if** my-func $x$ == 1
2 $y$ = my-func$(z + 1)$

```
% In document preamble:
% \usepackage{amsmath}
% \DeclareMathOperator{\MyFunc}{my-func}
\begin{pseudo}[kw]
if $\MyFunc x \== 1$ \\+
    $y = \MyFunc(z + 1)$
\end{pseudo}
```

The spacing is then correct whether you enclose the arguments in parentheses or not.

## 5.3 . . . unbold punctuation?

If you use the `kw` key, all pseudocode not in math mode will end up using the keyword font (`\kwfont`), which initially is bold. Though some *do* typeset, e.g., grouping braces in boldface, you might not want to do that; the same goes for, say, line-terminating semicolons. The `theoremfont` option of, e.g., `newtx` does something similar (for italics), but uses a custom font for that. Packages like `emrac` rely on straightforward textual substitution, replacing certain characters with marked-up ones, but the way things are set up at the moment, our font command won't have access to the entire line when it's executed.

If you're adventurous, it's not hard (using the `xparse` argument type `u`) to make a version that *does* gobble up the entire line, up to and including `\\` (and you could then use the regular expression functionality from `expl3`, presumably also reinserting `\\`). A simpler solution is to just use `\DeclarePseudoNormal`. Here's an example based on pseudocode from Knuth [4]:

**procedure** *printstatistics*;
**begin integer** $j$;
    *write*("Closed sets for rank", $r$, ":");
    $j := L[h]$;
    **while** $j \neq h$ **do**
        **begin** *writeon*($S[j]$); $j := L[j]$ **end**;
**end**;

```
% In document preamble:
% \usepackage{mathtools}
\let\gets\coloneqq

\pseudoset{kw, indent-length=2em, line-height=1.1}

\DeclarePseudoNormal \; ;

\begin{pseudo*}
procedure \id{printstatistics}\;                                  \\
begin integer $j$\;                                               \\+
    \fn{write}(\st{Closed sets for rank}, r, \st{:})\;            \\
    $j \gets L[h]$\;                                              \\
    while $j \neq h$ do                                           \\+
        begin \fn{writeon}(S[j])\; $j\gets L[j]$ end\;            \\--
end\;
\end{pseudo*}
```

If you'd really like to avoid the extra backslashes, you could make the relevant punctuation active (though that's probably a bit risky; make sure to only do it locally, at the very least):

**begin integer** $j$;

```
\DeclarePseudoNormal \semi ;

\catcode`\;=\active
\let;\semi

\begin{pseudo*}[kw]
    begin integer $j$; % Look! The semicolon isn't bold!
\end{pseudo*}
```

## 5.4 ... use tabularx?

You can use other tabular packages such as tabularx via `begin-tabular` and `end-tabular`. Let's say, for example, that you wish to extend the `pseudo` environment to fill out the entire line, and set up a new column for comments. You could achieve that as follows:*

| | |
|---|---|
| COUNTING-SORT$(A, k)$ | Find positions by counting |
| 1 $C =$ an array of $k$ zeros | Element frequencies |
| 2 **for** $i = 1$ **to** $A.length$ | Count all elements |
| 3 ... | Etc. |

* For an explanation of the use of `[t]`, see the documentation of the `pos` option.

```
\pseudodefinestyle{fullwidth}{
    begin-tabular =
    \tabularx{\linewidth}[t]{@{}
        r                                       % Labels
        >{\pseudosetup}                         % Indent, font, ...
        X                                       % Code (flexible)
        >{\leavevmode\small\color{gray}}        % Comment styling
        p{0.5\linewidth}                        % Comments (fixed)
        @{}},
    end-tabular = \endtabularx,
    setup-append = \RestorePseudoEq
}
\begin{pseudo}[kw, fullwidth, line-height=1.1]*
    \hd{Counting-Sort}(A, k) & Find positions by counting \\
    $C = \tn{an array of $k$ zeros}$ & Element frequencies \\
    for $i = 1$ to $A.\id{length}$ & Count all elements \\+
    $\dots$ & Etc.
\end{pseudo}
```

Note that using the `\color` command in a `>{...}` modifier with a `p` column places the text in a new paragraph, on the next line; you'll need to insert `\leavevmode` or the like to prevent that. This is true also of normal `tabular` environments. Also note that `tabularx` environments with `X` columns don't interact nicely with `\=`; so if you wish to use `\==`, you can reassert the definition by adding `>{\RestorePseudoEq}` before each column.*

See the tabularx documentation (page 4) for an explanation of why we can't use `\begin{tabularx}` and `\end{tabularx}`. Also, because tabularx passes its contents as the argument to a macro, the parsing pseudo uses to determine if `\\` is at the end of the last line doesn't work; if you add `\\` at the end here, you'll introduce an empty line.

For simplicity, I've used `@{}` to remove space on either side. For `hpad` to work, you should use `>{\pseudohpad}` and `<{\pseudohpad}` instead, as in the standard `preamble` (see page 89). To keep things configurable, you might also want to use `\pseudolabelalign`, rather than `r`.

## 5.5 . . . get tab stops?

Some packages, such as clrscode3e, use an actual `tabbing` environment internally. While this may be a bit brittle (e.g., creating problems if you wish to insert your pseudocode into a tikz node—one of the goals of pseudo), it does mean that you can use the tabbing command `\>` manually, to align various construct.

If all your tabbing is done *before* the text on a given code line, you can achieve this in pseudo as well, by using the `+` and `-` modifiers. (For example, the tab stops in clrscode3e are set at fixed intervals, just like in pseudo.) But what if you'd like to align something that comes later, such as comments after code

* You can also, of course, just use `\eqs` instead.

lines? You can't simply use `\hspace`, of course, unless the code lines themselves have exactly the same length.

One solution is to use an additional column, as discussed in Sect. 5.4, but you could also make creative use of the `\rlap` command, which prevents its contents from taking up horizontal space:*

This is some text And here is some more

```
\noindent\rlap{This is some text}%
And here is some more
```

By using `\rlap` on the code lines in question, you can insert `\hspace` that begins at the beginning of the code line (here with an example convenience command defined using xparse):

1 $x = 42$ (*first comment*)
2 $y = \sin x$ (*second comment*)

```
\NewDocumentCommand \C { +u{/* } +u{ */} } {%
    \rlap{#1}\hspace{3cm}\ct{#2}\\%
}
\begin{pseudo}
\C $x = 42$      /* first comment */
\C $y = \sin x$  /* second comment */
\end{pseudo}
```

See also the discussion of the `\ct` command for ideas on typesetting comments. If you wish to align things across different indentation levels, you'll have to add or subtract multiples of `\pseudoindentlength` (see `\pseudoindent`).

Another option for aligning comments or the like is to use a custom `\tabular` or `\tabular`-like environment, where the aligned material is placed in a column of its own. This is the technique used in Algorithm 3.1, for example. For more on this approach, see Sect. 5.4.

If you want alignment or tabbing *outside* the `pseudo` environment, for example, to align the input and output descriptions inside a `tcolorbox` (cf. Chapter 3), an excellent alternative is the tabto package. You could also use other constructs, such as a `tabular`, `tabbing` or `description`. An advantage of the tabto solution is that you retain the paragraph spacing set up by the tcolorbox styles defined by pseudo.

You can simply define the tab stops globally, using `\TabPositions` in your preamble, or you can do it as part of the box setup, e.g.,. using `pseudo/init` when defining your tcolorbox environment with `\newtcbtheorem` (or, as in the following simplified example, just supply it directly as an option to the box environment).

If you'd rather not separate the elements of, say, your input description by paragraphs, you could of course use line breaks (`\\`); however, `\tab` won't work

* Note that `\rlap` doesn't start a new paragraph, which is why I use `\noindent`, here. You could replace `\noindent\rlap{...}` with `\makebox[0pt][l]{...}`. This isn't an issue in `pseudo` code lines, however.

on its own at the beginning of the next line. To fix this, simply add `\null` before it (i.e., use `\null\tab`).

**Data** A graph $G = (V, E)$ with weight function $w : E \to \mathbf{R}$
A start node $s \in V$
**Require** No negative cycle in $G$ is reachable from $s$
**Result** An array $d$ of distances from $s$
1 . . .

```
% In document preamble:
% \usepackage{tabto}
\begin{tcolorbox}[pseudo/filled,
    pseudo/init = {\TabPositions{1.5cm}}]

\textbf{Data}
    \tab A graph $G=(V,E)$ with weight function $w:E\to\mathbf{R}$

    \tab A start node $s\in V$

\textbf{Require}
    \tab No negative cycle in $G$ is reachable from $s$

\textbf{Result}
    \tab An array $d$ of distances from $s$

\begin{pseudo}
\dots
\end{pseudo}
\end{tcolorbox}
```

## 5.6 . . . use horizontal lines?

Many opt for a table-like appearance when typesetting algorithms, with horizontal lines above and below, and generally a header row on top. While this may be part of a surrounding floating environment (see Chapter 3), you may also wish to include such lines in your actual pseudocode. In this case, you can simply use existing `tabular`-based tools such as booktabs, making sure to suppress the `pseudo prefix` using the star flag (`*`):

BORŮVKA$(G, w)$

1 **while** $E(G)$ is not empty
2 **for** each $u \in V(G)$
3 add light $uv \in E(G)$ to $T$
4 **for** each $e \in T$
5 contract $e$

```
% In document preamble:
% \usepackage{booktabs}
\begin{pseudo}*
\toprule

    \hd{Bor\r{u}vka}(G, w)                          \\
                                                    %
[bol=\midrule]

    \kw{while} $E(G)$ is not empty                  \\+
        \kw{for} each $u\in V(G)$                   \\+
            add light $uv \in E(G)$ to $T$          \\-
        \kw{for} each $e \in T$                     \\+
            contract $e$                            \\*

\bottomrule
\end{pseudo}
```

Rather than `\\[bol=\midrule]`, you could also have used `\\*`, followed by `\midrule\pseudoprefix`. (Note that the paragraph break between `\\` and its argument has been commented out.)

## 5.7 . . . handle object attributes?

In the clrscode3e package, you'll find an assortment of commands for handling object attributes such as *A.length*. The manual says (here with emulated kerning of the dot operator):

> You might think you could typeset *A.length* by `$A.\id{length}$`, but that would produce *A.length*, which has not quite enough space after the dot. (page 3)

However, this is a font issue, more than anything. If, for example, if you want Times New Roman (like Cormen et al.) and use mathptm, you at times run into the problem described; with newtx it's less pronounced. With other fonts (e.g., fourier, mathpple, or newtxmath with libertine), or even without any font packages (or possibly using lmodern), the kerning works just fine.

In general, then, I suggest you try to use `$A.\id{length}$` and the like, and see if the result is satisfactory:

*v.prev.next* = *v.next*

```
$v.\id{prev}.\id{next} = v.\id{next}$
```

If you *do* need to adjust the kerning (with `\mkern` commands or perhaps using microtype), you may of course do so, but pseudo does not (at present) include any special attribute lookup commands that do it for you.

## 5.8 . . . indicate blocks with braces or the like?

Some packages (such as algorithm2e) have support for using vertical lines to indicate the block structure; pseudocode uses large braces. In pseudo, there is support for using an `indent-mark`, for which the default is a semithick, gray vertical line (see page 10). However, by using tikz, you could draw all kinds of indentation decorations.

You could, for example, add a `node` at the start of each code line, containing an `\@arstrut`, the (array) strut used to indicate the extent of a tabular row:

```
% \usepackage{xparse,tikz}
% \usetikzlibrary{decorations.pathreplacing,calligraphy}
\makeatletter
\NewDocumentCommand \pseudoanchor { m } {%
    \tikz[baseline, overlay, remember picture]
        \node[anchor=base, inner sep=0] (#1) {\@arstrut};%
    \ignorespaces
}
\makeatother
```

You can then use the resulting nodes to draw braces or lines or whatever. First some example setup:

```
\pseudoset{
    kw,
    indent-length = 3.5em,
    setup-append = {\pseudoanchor{L-\arabic*}}
}
\tikzset{
    braces/.style =
    {thick, decoration = {calligraphic brace, raise=.2em}},
    label/.style =
    {midway, left=3em, anchor=west, font=\strut\kwfont}
}
```

You would then get something like the following:

1 **if** $x < y$
2
3 **then** $\begin{cases} x = y \\ y = 0 \end{cases}$

```
\begin{pseudo}
if $x < y$                                          \\+
    $x = y$                                         \\
    $y = 0$
\end{pseudo}
\tikz[overlay, remember picture, braces] {
    \draw[decorate] (L-3.south) -- (L-2.north) node[label] {then};
}
```

If multiple blocks are closed at the same time, the bottom coordinates could be things like `(L-2.north |- L-3.south)` instead. To adjust the end points, you could also use things like `($(L-3.south)+(0,.2em)$)`.

The actual drawing of the brace (or line or whatever) isn't automated here, of course. This could be done by some hook triggered by the `-` flags in `\\`. If it turns out there's a demand for something like that, I might add it in a future version.

## 5.9 ... use pseudo with older TEX distributions?

As mentioned in the introduction, I've tried to make pseudo work with at least *somewhat* outdated TEX distributions. In these cases, the package itself won't be available as part of the distribution, of course, but you can simply download the file `pseudo.sty` and place it in the directory where you're compiling your document (or anywhere else where your LATEX executable can find it).

However, there may be cases where this just doesn't work, such as when submitting to a publisher with a really old setup.* In that case, the simplest solution is probably to use the standalone package to produce individual PDFs of your algorithms, and then to include those in your document. Then you can submit the PDFs rather than the LATEX, so that the pseudocode need not be compiled on the old system. Each algorithm could go in a file like this:

```
\documentclass{standalone}
\usepackage{pseudo}
\begin{document}
\begin{pseudo}
    ...
\end{pseudo}
\end{document}
```

Let's say this is compiled to `algo1.pdf`. You then include this file:

* If possible, though, feel free to file an issue or provide a pull request to address the issue.

```
\documentclass{article}
\usepackage{graphicx} % For \includegraphics
...
\begin{document}
... sanctus est Lorem ipsum dolor sit amet:

\medskip\noindent
\includegraphics{algo1.pdf}

\smallskip
Lorem ipsum dolor sit amet, consetetur sadipscing ...
\end{document}
```

Of course, you can adjust the spacing (e.g., using `\vspace` or the like) to your liking. Using this method, you can can achieve results essentially identical to if you compiled the pseudocode directly as part of the document. Of course, you won't have access to other functionality (such as `\DeclarePseudoIdentifier` or the like) for use in the main tex, but most of that should be possible to emulate by hand (possibly peeking at the implementation in Chapter 6).

## 5.10 . . . use a header with no arguments?

Normally, `\hd` has a mandatory set of arguments; at the very least, you'll need to supply the parentheses:

No-Arguments()
1 . . . but still with parentheses

```
\begin{pseudo}*
\hd{No-Arguments}() \\
\dots\ but still with parentheses
\end{pseudo}
```

This is because `\hd` has to be fully expandable to be able to insert the requisite `\multicolumn`, and then it cannot have any (final) optional arguments. If you'd like, though, you can just use `\multicolumn` yourself (see also `hd-preamble`):

No-Arguments
1 . . . and no parentheses!

```
\begin{pseudo}*
\multicolumn{2}{\pseudohdpreamble}
{\pr{No-Arguments}} \\
\dots\ and no parentheses!
\end{pseudo}
```

## 5.11 . . . place algorithm boxes side by side?

In the simplest case, maybe you just want to place two of them side by side in the text (i.e., not as floats). Let's say you've defined an environment as follows:

```
\newtcbtheorem{procedure}{Procedure}{pseudo/filled}{}
```

Two of these cannot directly be placed side by side, because each will insert paragraph breaks and spacing before and after itself. However, this code can be disabled by using the tcolorbox keys `before` and `after` (along with `width`, to make sure there's room). If we also want the boxes to have the same height, we can use the key `equal height group` (with some arbitrary name):

**Procedure 1**

1 Foo
2 Bar
3 Baz

**Procedure 2**

1 Frozz
2 Bozz

```
\begin{procedure}[after={}, width=.49\linewidth,
    equal height group=A]{}{}
\begin{pseudo}
Foo \\ Bar \\ Baz
\end{pseudo}
\end{procedure}
\hfill
\begin{procedure}[before={}, width=.49\linewidth,
    equal height group=A]{}{}
\begin{pseudo}
Frozz \\ Bozz
\end{pseudo}
\end{procedure}
```

If the boxes are floats (i.e., either defined or used with the tcolorbox key `float`, you can still use the `equal height group` key. This is useful, for example, in a twocolumn layout, if the boxes are at the top (or bottom), one in each column.

Finally, if your boxes are floats in general, you're using a single-column layout, and you want two boxes to float *together*, side by side (e.g., because the pseudocode itself takes up little horizontal space), you can use the first technique (setting `width`, `before` and `after`) along with the tcolorbox key `nofloat`, and then place the boxes inside some other float (such as a normal LaTeX `figure`, or a custom one using the float package):

```
\begin{figure}
\begin{procedure}[nofloat, after={}, width=.49\linewidth,
    equal height group=A]{}{}
\begin{pseudo}
    % ...
\end{pseudo}
\end{procedure}
\hfill
\begin{procedure}[nofloat, after={}, width=.49\linewidth,
    equal height group=A]{}{}
\begin{pseudo}
    % ...
\end{pseudo}
\end{procedure}
\end{figure}
```

## 5.12 . . . have steps span multiple lines?

First of all, you can do this by just breaking your lines manually, keeping any additional lines belonging to the same step unnumbered, by using the starred version of `\\` and skipping the number column with `&`, adding unnumbered lines:

1 This step is broken . . .
. . . into multiple lines
2 This one is not

```
\begin{pseudo}[line-height=1.1]
  This step is broken\,\dots                    \\*&
  \dots\,into multiple lines                    \\
  This one is not
\end{pseudo}
```

If you want the line breaking to be automated, *and you don't need indentation*, you can use a `p` column, specified in `preamble` (perhaps defining a style using `\pseudodefinestyle`), adapted from the default, as in the following.

> The default is found on p. 89. However, in the source code there, whitespace is insignificant. In writing your own preamble, you should avoid spurious whitespace inside `>{...}` and `<{...}`.

1 Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat.

2 At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

```
\begin{pseudo}[preamble = {
        >{\pseudohpad} \pseudolabelalign
        >{\pseudosetup} p{11.7cm} <{\pseudohpad}
    },
    setup-append = \raggedright\RestorePseudoBackslash,
    line-height = 1.5]
Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam
nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam
erat. \\
At vero eos et accusam et justo duo dolores et ea rebum. Stet
clita kasd gubergren, no sea takimata sanctus est Lorem ipsum
dolor sit amet.
\end{pseudo}
```

In addition to introducing the `p` column, I've added `\raggedright` to the setup (using `setup-append`, with `\RestorePseudoBackslash` to restore `\\`, because `\raggedright` redefines it).

One disadvantage of the `p` column is that you need to know its exact width. A better solution is probably to replace the default `tabular` with a `tabularx`, as discussed in Sect. 5.4, and use an `X` column, i.e.:*

```
    begin-tabular = \tabularx{\linewidth}[t]{
        >{\pseudohpad} \pseudolabelalign
        >{\pseudosetup} X <{\pseudohpad}
    },
    end-tabular = \endtabularx,
    setup-append = \RestorePseudoEq,
```

The main problem with this setup is that the automatic line wrapping doesn't take indentation into account, i.e., only the first line is indented! While there are ways of dealing with this,† the simplest solution (at least for now) is probably to break lines manually, using `\\*&`.

## 5.13 . . . get the old spacing?

The current version of the `pseudo` environment ensures the spacing above and below is adjusted, so the baselines of the previous and following lines are positioned equally, regardless of their depths or heights. If you'd rather have the old behavior (which, frankly, was really a bug), you can get that as follows:

```
\pseudoset{pos = {}, prevdepth = 0pt}
```

* For an explanation of the use of `[t]`, see the documentation of the `pos` option.
† Cf. `https://github.com/mlhetland/pseudo.sty/issues/16`.

## 5.14 ...configure my `tcolorbox`es?

If you use the pseudo styles for `tcolorbox`es (see Chapter 3), you might still wish to do some tweaking, or even redefine most of the styling. This is done using the tcolorbox configuration system, not that of pseudo, so it's worth consulting the tcolorbox documentation (and, perhaps, the source of the pseudo box styles, in Sect. 6.9). In the following, I go through some examples of things you might want to adjust. First, let's define a rather unstyled environment which we can modify locally.

```
\newtcbtheorem{example}{Example}{}{}
```

> If you want the styling to apply to the environment in general, simply insert it as the third argument. See the tcolorbox documentation for more about `\newtcbtheorem`.

**A different separator.** By default, the pseudo box styles use an `\enskip` to separate the label part from the description, but you might want to use something else, such as a colon or a period. You can get this by using the `separator sign` key:

**Example 1:** ...

...

```
\begin{example}[pseudo/ruled, separator sign = :]{\dots}{}
    \dots
\end{example}
```

**A different parskip.** You might want more or less spacing between the paragraphs of any plain text outside your pseudocode. You do this by setting `\parskip`, which is normally set as part of the `before upper` key in the `pseudo/` styles (see p. 101). Rather than overwrite the `before upper` code, you can use the hook `pseudo/init` (set as part of the tcolorbox configuration, not using `\pseudoset`):

**Example 2** ...

The parskip

is bigger!

```
\begin{example}[pseudo/boxed,
    pseudo/init = \parskip\baselineskip]{\dots}{}
    The parskip

    is bigger!
\end{example}
```

> It is possible to use the tcolorbox key `before upper app` (together with the tcolorbox library `hooks`) instead of `pseudo/init`. However, the compatibility code (Sect. 6.11) appends some spacing to this setup hook, and this may be messed up by inserting more code after it. In this case, `pseudo/init` is safer.

You *could* set `\topsep` and `\partopsep` in the same manner, but unless you want to change the settings for lists (such as `itemize` and `enumerate`), you could also just set those for pseudocode specifically, using the pseudo keys `topsep` and `partopsep`, perhaps as part of the `in-float` style.

**Different line widths.** If you start with `pseudo/boxruled`, this is easy enough—you can just use the standard tcolorbox keys to adjust the line widths.

**Example 3** ...

Now *that's* a *box*!

```
\begin{example}[pseudo/boxruled,
    boxrule = 4pt, titlerule = 2pt]{\dots}{}
    Now \emph{that's} a \emph{box}!
\end{example}
```

The problem with the other ruled or boxed styles is that they use the `empty` skin, which removes the box drawing.

> The reason they don't just set the appropriate line widths to zero is that this generally still results in visible hairlines in many PDF viewers.

They then instead rely on various `borderline` commands. These are cumulative, so if you want to replace some of them, you first need to clear the deck with `no borderline`, and then re-do them all. For example, maybe you want a version of `pseudo/tworuled` with light rules:

**Example 4** ...

...

```
\begin{example}[pseudo/tworuled,
    no borderline,
    toprule = \lightrulewidth,
    bottomrule = \lightrulewidth,
    borderline horizontal =
    {\lightrulewidth}{0pt}{black}]{\dots}{}
\dots
\end{example}
```

Note that even though the box rules aren't *drawn*, they can still be used for spacing—which the borderlines don't handle. In `pseudo/tworuled`, `toprule` and `bottomrule` are set to `\heavyrulewidth`, so since we're replacing the horizontal borderlines with lighter ones, we need adjust these as well. (If you do something similar with `pseudo/ruled`, the width of the title rule can still be changed by using the `titlerule` key, as in the previous example.)

**Different colors.** Again, customizing `pseudo/boxruled` is easy enough; you can set the line colors using the `colframe`, and the fill colors using `colback` and `colbacktitle`. The latter two keys also work well with the `pseudo/filled` style (as shown in the example on page 22). To modify the line colors in the other styles, you'll need borderline commands, again (though with separate styling for the title rule). For example:

**Example 5** . . .

. . .

```
\begin{example}[pseudo/booktabs,
    no borderline,
    titlerule style = lightgray,
    borderline horizontal = {\heavyrulewidth}{0pt}{gray}]{\dots}{}
\dots
\end{example}
```

If you want to style the top and bottom line separately, just use `borderline north` and `borderline south` separately, rather than the collective `borderline horizontal`.

# Chapter 6

# Implementation

**Note:** In the following, `_@@` and `@@` represent an internal prefix (`__pseudo`), the same way they do with l3docstrip.

First, we just define some metadata:

```
\def \pseudoversion  {1.2.3}
\def \pseudorevision {.14}
\def \pseudodate     {2024/02/03}
```

The pseudo package is implemented using experimental LaTeX 3, so we start by importing expl3:

```
\RequirePackage{expl3}
```

Then we're ready start the package:

```
\ProvidesExplPackage
    {pseudo}
    {\pseudodate}
    {\pseudoversion\pseudorevision}
    {Straightforward pseudocode}
```

Tools for defining user commands:

```
\RequirePackage{xparse}
```

For defining tcolorbox styles, without importing tcolorbox:

```
\RequirePackage{pgfkeys}
```

The `pseudo` environment is built upon tabular functionality, and we're using some extensions:

```
\RequirePackage{array, xcolor, colortbl}
```

Though *most* keys aren't available as `\usepackage` arguments, we still use the mechanism:

```
\RequirePackage{l3keys2e}
```

Inside the `pseudo` environment, `*` is an alias for `pseudoline`. To perform the proper aliasing, we use aliascnt:

```
\RequirePackage{aliascnt}
```

As part of the initial setup, we also record whether we're part of a beamer presentation; this will affect the overlay functionality:

```
\bool_new:N \c_@@_beamer_bool
\@ifclassloaded{beamer}
    {\bool_set_true:N  \c_@@_beamer_bool}
    {\bool_set_false:N \c_@@_beamer_bool}
```

We're now ready to begin the actual implementation.

## 6.1 Variable declarations

Many variables are created as needed by various `set` commands, but some are declared initially. First, we create a plain-vanilla LaTeX counter for the line number, as well as an outer one for the environment, the latter just to avoid duplicate labels:

```
\newcounter{pseudoenv}
\newcounter{pseudoline}[pseudoenv]
```

Eventually, we'll be saving the line counter so that `\label` commands will work, but we'll only do so if the counter has *changed* (again, to avoid duplicate labels). To determine whether, in fact, it has, we keep the previous one we saved:

```
\int_new:N \g_@@_last_saved_line_int
```

Normally a counter is just saved when it's incremented (with `\refstepcounter`), but in our case, we want to increment and typeset it based on a (potentially) user-configured `label`, and then actually save it and make it the target of `\label` commands in a *different scope* (i.e., the next cell in the tabular row).

The indent size is set through the configuration key `indent-length` (or indirectly through `indent-text`), while the current indent level is manipulated by `\\`; their product determines the actual length by which the current line is indented. The initial indent level may be set using `indent-level`.

```
\dim_new:N \pseudoindentlength
\int_new:N \g_@@_indent_level_int
\int_new:N \l_@@_initial_indent_level_int
```

When handling unknown keys, we have special-casing of `\\`, so we need to know if that's the command we're in:

```
\bool_new:N \l_@@_in_eol_bool
```

We'll also create a couple of globals, to help us get some key-setting results out of the group surrounding the code handling unknown keys:

```
\tl_new:N \g_@@_extra_space_temp_tl
\tl_new:N \g_@@_key_setting_code_temp_tl
```

## 6.2 Utilities

**Variants.** First, let's just generate a couple of expansion variants we'll need of some standard commands. (I'm using the `\q_no_value` machinery rather than `\c_novalue_tl` for compatibility with older TEX distributions.)

```
\cs_generate_variant:Nn \quark_if_no_value:nTF    { VTF    }
\cs_generate_variant:Nn \tl_if_novalue:nTF        { VTF    }
```

**Defining columns.** The `preamble` is is configurable, but the array package makes sure it doesn't expand any part of its preamble. One way of inserting a dynamically generated one is to simply define it all as a single column type. To avoid getting an error when overwriting this definition through the configuration, we'll also need to be able to *un*-define column types:

```
\cs_new:Npn \@@_undef_col:n #1 {
    \tl_set_eq:cN { NC@find@ \token_to_str:N #1 } \scan_stop:
}
```

Note that the implementation specifically targets the array package. The following command then will either define or *re*-define a column type:

```
\cs_new:Npn \@@_def_col:nn #1 #2 {
    \@@_undef_col:n { #1 }
    \newcolumntype  { #1 } { #2 }
}
```

**Defining commands.** This command creates a new command with a `pseudo` prefix, and defines the prefixless version as well, *if the name is available* (i.e., undefined):

```
\cs_new:Npn \@@_meta_new_cmd:NNnn #1 #2 #3 #4 {
    \tl_set:Nn \l_tmpa_tl {pseudo \cs_to_str:N #2}
    \exp_args:Nc
        #1 \l_tmpa_tl #3 {#4}
    \cs_if_free:NT #2 {\cs_gset_eq:Nc #2 \l_tmpa_tl}
}

\cs_new:Npn \@@_new_cmd:Nnn #1 #2 #3 {
    \@@_meta_new_cmd:NNnn
    \NewDocumentCommand #1 {{#2}} {
```

```
        #3
    }
}

\cs_new:Npn \@@_new_ecmd:Nnn #1 #2 #3 {
    \@@_meta_new_cmd:NNnn
    % \NewExpandableDocumentCommand #1 {{#2}} {
    % Replaced for compatibility:
    \def #1 {#2} {
        #3
    }
}
```

This is for defining commands that declare styled shortcuts:

```
\cs_new:Npn \@@_new_dec:nn #1 #2 {
    \tl_set:Nn \l_tmpa_tl { DeclarePseudo #1 }
    \exp_args:Nc
    \DeclareDocumentCommand \l_tmpa_tl { mm } {
        \DeclareDocumentCommand ##1 { } {
            \use:c { #2 } { ##2 }
        }
    }
}
```

You use this with a capitalized name for the kind of thing you're declaring, and the name of the style command to use. For example,

```
\@@_new_dec:nn{Keyword}{kw}
```

will create the command `\DeclarePseudoKeyword`, which takes a csname and a word, and binds the csname as a shortcut for the word, properly styled as a keyword.

**Argument parsing.** In processing the multiple `+` and `-` arguments to `\\`, we'll gobble up one character at a time, each time performing some action. We also supply code to be performed once we're done.

```
\cs_new:Npn \@@_per_char:nnn #1 #2 #3 {
    \peek_charcode_remove:NTF { #1 } {
        #2 % body
        \@@_per_char:nnn{#1}{#2}{#3}
    } {
        #3 % tail
    }
}
```

**Indentation.** The indent size (i.e., the length of a single step of indentation) is either set directly through `indent-length`, or indirectly through `indent-text`. The latter is there the default is provided, but `indent-text` is only used if there is no `indent-length`.

```
\cs_new:Npn \@@_set_indent_length: {

    \quark_if_no_value:VTF \l_@@_indent_length_tl {
        \hbox_set:Nn \l_tmpa_box { \l_@@_indent_text_tl }
        \dim_set:Nn \pseudoindentlength { \box_wd:N \l_tmpa_box }
    } {
        \dim_set:Nn \pseudoindentlength \l_@@_indent_length_tl
    }

}
```

Note that the configured indent length is stored in a `tl`, which is expanded in the `pseudo` environment.

The indent size is subsequently used by the indent command, which takes the number of indentation steps as its only argument. If no `indent-mark` is set, it just inserts an appropriate horizontal space. Otherwise, it iterates over the indent levels, inserting one indent marker for each level. Note that to avoid affecting the indent, the `indent-mark` should have no width (i.e., it should "undo" the width of any text it contains, using `\rlap`, a negative `\hspace` or the like).

```
\cs_new:Npn \@@_indent:N #1 {
    \tl_if_novalue:VTF \l_@@_indent_mark_tl {
        \skip_horizontal:n{ \pseudoindentlength * #1 }
    } {
        \group_begin:
        \color{\l_@@_indent_color_tl}
        \int_step_inline:nn { \g_@@_indent_level_int } {
            \l_@@_indent_mark_tl
            \skip_horizontal:n{ \pseudoindentlength }
        }
        \group_end:
    }
    \ignorespaces
}
```

**Counter copying.** Inside the `pseudo` environment, we want `*` to be a duplicate of `pseudoline`, for convenience. This requires a bit of work. We use the aliascnt package to deal with much of the book-keeping, but in order for `\newaliascnt` to work whenever a counter already exists, we need to undefine it first. (Here we're relying on the internal LaTeX convention of using `c@` as a prefix to counter names.)

```
\cs_new:Npn \@@_drop_ctr:n #1 {
    \cs_undefine:c { c@ #1 }
}

\cs_new:Npn \@@_copy_ctr:nn #1 #2 {
    \@@_drop_ctr:n { #1 }
    \newaliascnt   { #1 } { #2 }
}
```

```
\cs_new:Npn \@@_star_setup: {

    \cs_if_exist:cT { c@ * } {
        \@@_copy_ctr:nn { @@_orig_* } { * }
    }
    \@@_copy_ctr:nn { * } { pseudoline }

    \group_insert_after:N \@@_star_reset:

}

\cs_new:Npn \@@_star_reset: {
    \cs_if_exist:cT { c@ @@_orig_* } {
        \@@_copy_ctr:nn { * } { @@_orig_* }
        \cs_undefine:c { c@ @@_orig_* }
    }
}
```

**Label saving.** In the body of each line, we make sure to save the counter, so it's available for the `\label` command. We've aready incremented `pseudoline` with `\stepcounter` in the label, so we first need to decrement it before we again increment it, this time with `\refstepcounter`. However, we only do so if the counter actually *was* incremented, i.e., if it's different from the last one we saved.

```
\cs_new:Npn \@@_save_label: {

    \int_set:Nn \l_tmpa_int {\arabic{pseudoline}}

    \int_compare:nF {\l_tmpa_int = \g_@@_last_saved_line_int} {
        \addtocounter{pseudoline}{-1}
        \refstepcounter{pseudoline}
        \int_gset_eq:NN \g_@@_last_saved_line_int \l_tmpa_int
    }

}

\DeclareDocumentCommand \pseudosavelabel { } {
    \@@_save_label:
}
```

**Saving and restoring.** In general, we could just use local variables and trust the scope mechanism, but if we use global assignments inside the scope (e.g., because of where in a tabular we must assign things and use them), the original meaning *won't* be restored. Of course, this should *not* be used if assignments are local, as it will globally set the original name to the meaning it had when we entered the scope.

In saving a macro, we also supply a name for the original, which may then be used to refer to it until it's restored.

```
\cs_new:Npn \@@_cs_gsave_as:NN #1 #2 {
    \cs_gset_eq:NN #2 #1
    \group_insert_after:N \cs_gset_eq:NN
```

```
    \group_insert_after:N #1
    \group_insert_after:N #2
}
```

**Skipping paragraphs.** Ignoring space is easy enough, but skipping `\par` tokens takes a bit more work. We'll be using this as part of the end-of-line handling, when we're checking if the next "real" token is `\end`. The argument is the code to execute after skipping (and removing) whitespace and `\par` tokens.

```
\cs_new:Npn \@@_skip_pars:n #1 {
    \peek_meaning_remove_ignore_spaces:NTF \par {
        \@@_skip_pars:n { #1 }
    } {
        #1
    }
}
```

## 6.3 Styles

The first text styling commands are only straight-up shortcuts for normal font commands:

```
\@@_new_cmd:Nnn \nf {   } { \normalfont          }
\@@_new_cmd:Nnn \tn { m } { \textnormal { #1 }   }
\@@_new_cmd:Nnn \kw { m } { \textnormal {\kwfont { #1 } } }
\@@_new_cmd:Nnn \cn { m } { \textnormal {\cnfont { #1 } } }
\@@_new_cmd:Nnn \id { m } { \textnormal {\idfont { #1 } } }
```

> As a side-effect, we've now also defined `\pseudonf` and `\pseudotn`, which we don't really need, as we might as well use `\normalfont` and `\textnormal` directly.

While we're at it, we'll define the initial value for `\kwfont`, which is generally non-extended bold, if that's available, but extended bold otherwise:

```
\cs_new:Npn \@@_b_or_bx: {

    % Note: We're relying on the warning text in \@defaultsubs
    % being defined by \selectfont if the desired font isn't
    % found. This won't happen, however, if the same
    % \curr@fontshape combination has been attempted before
    % (cf. source2e.pdf page 179).

    \group_begin:

    \cs_if_exist:NT \@defaultsubs {
        \@@_cs_gsave_as:NN \@defaultsubs \@@_defaultsubs
        \cs_gset_eq:NN \@defaultsubs \relax
    }
```

```
        % This is what we'd like:
        \cs_gset:Nn \@@_b_or_bx: { \fontseries{b}\selectfont }

        % Try it:
        \@@_b_or_bx:

        % Fallback, if that failed:
        \cs_if_exist:NT \@defaultsubs {
            \cs_gset_eq:NN \@@_b_or_bx: \bfseries
        }

        \group_end:

        % Make sure the new version is used:
        \@@_b_or_bx:

    }
```

Note that the command redefines itself after the first use, so as not to execute the check every time.

The `\pr` command is also a font shortcut, but in addition takes optional parenthesis-delimited arguments, which are set in math mode. To avoid erroneousy slurping up following parentheticals, there should be no space separating the command and its optional argument. With current versions of xparse, this can be achieved with the `!` argument type, but for compatibility with older TEX distributions, I'll deal with it "manually".

```
\cs_new:Npn \@@_fmt_pr:n #1 {
    \textnormal{\prfont{ #1 }}
}

\NewDocumentCommand \@@_parse_paren_args { +d() } {
    \IfNoValueF { #1 } {
        \ensuremath{ ( #1 ) }
    }
}

\NewDocumentCommand \@@_parse_bracket_or_paren_args { +o } {
    \IfNoValueTF { #1 } {
        \@@_parse_paren_args
    } {
        \ensuremath{ [ #1 ] }
    }
}

\@@_new_cmd:Nnn \pr { m } {
    \@@_fmt_pr:n { #1 }
    \peek_catcode:NTF { ~ } { } {
        \@@_parse_paren_args
    }
}
```

The `\fn` command is similar, but alternatively permits arguments in square brackets.

```
\cs_new:Npn \@@_fmt_fn:n #1 {
    \textnormal{\fnfont{ #1 }}
}
\@@_new_cmd:Nnn \fn { m } {
    \@@_fmt_fn:n { #1 }
    \peek_catcode:NTF { ~ } { } {
        \@@_parse_bracket_or_paren_args
    }
}
```

The `\hd` command is similar to `\pr` command, except that it spans two columns (effectively ignoring the labeling column). Because it needs to be expandable in order to insert the multicolumn, the final, parenthesis-enclosed argument can not be optional (unlike for `\pr`). Note also that `\hd` sets `extra-space` (or the underlying `tl`) based on `hd-space`.

```
% \@@_new_ecmd:Nnn \hd { m +r() } {
% Now uses \def syntax:
\@@_new_ecmd:Nnn \hd { #1 ( #2 ) } {
    \multicolumn{2}
        {\pseudohdpreamble}
        {\@@_fmt_pr:n{#1}\ensuremath{(#2)}}
        \tl_set_eq:NN \l_@@_extra_space_tl \l_@@_hd_space_tl
}
```

Finally, `\st` and `\ct` add quotes and comment delimiters, respectively, to the typeset string, keeping it all in `\textnormal`:

```
\@@_new_cmd:Nnn \st { +m } {
    \textnormal {
    \l_@@_st_left_tl {\stfont{#1}} \l_@@_st_right_tl }
}
\@@_new_cmd:Nnn \ct { +m } {
    \textnormal {
    \l_@@_ct_left_tl {\ctfont{#1}} \l_@@_ct_right_tl }
}
```

Beyond text styling, we also have styling for entire rows, i.e., highlighting:

```
% \NewExpandableDocumentCommand \pseudohl { } {
% For backward compatibility:
\def \pseudohl {
    \rowcolor{\pseudohlcolor}
}
```

**Declarations.** To declare shortcuts using the various styles, commands à la `DeclareMathOperator` and `DeclareDocumentCommand` are provided:

```
\@@_new_dec:nn { Comment    } { ct }
\@@_new_dec:nn { Constant   } { cn }
\@@_new_dec:nn { Function   } { fn }
\@@_new_dec:nn { Identifier } { id }
```

```
\@@_new_dec:nn { Keyword    } { kw }
\@@_new_dec:nn { Normal     } { tn }
\@@_new_dec:nn { Procedure  } { pr }
\@@_new_dec:nn { String     } { st }
```

## 6.4 Notation

Here we'll define a couple of symbols that are useful for pseudocode but that are not necessarily entirely standard mathematical notation. First, the double equals sign, ubiquitous in modern programming languages, and useful if `=` is used for assignment. The horizontal scaling of the equals signs, as well as the space between them and the padding on both sides may be adjusted by using the keys `eqs-scale`, `eqs-sep` and `eqs-pad`. Initially, these are set to emulate the `\eqeq` symbol from stix when used with Computer Modern, Latin Modern or the like (though the command works just fine with other fonts as well).

```
\@@_new_cmd:Nnn \eqs { } {
    \group_begin:
    \muskip_set:Nn \l_tmpa_muskip \l_@@_eqs_pad_tl
    \muskip_set:Nn \l_tmpb_muskip \l_@@_eqs_sep_tl
    \hbox_set:Nn   \l_tmpa_box {\(=\)}
    \box_scale:Nnn \l_tmpa_box {\l_@@_eqs_scale_fp}{1}
    \mathrel{
        \tex_mskip:D     \l_tmpa_muskip
        \box_use:N       \l_tmpa_box
        \tex_mskip:D     \l_tmpb_muskip
        % \box_use_drop:N  \l_tmpa_box
        % Replaced for compatibility
        \box             \l_tmpa_box
        \tex_mskip:D     \l_tmpa_muskip
    }
    \group_end:
}
```

For convenience and source-code clarity, the following shortcut (i.e., `\==`) is defined (hijacking the `\=` accent command):

```
\cs_gset_eq:NN \c_@@_orig_eq_cs \=

\DeclareDocumentCommand \= { m } {
    \tl_if_eq:nnTF { #1 } { = } {
        \l_@@_eqs_impl_tl
    } {
        \c_@@_orig_eq_cs{#1}
    }
}

\cs_gset_eq:NN \@@_eq: \= % Stored for \RestorePseudoEq
```

Similarly, there's the Pascal two-dot interval notation, whose implementation mirrors Knuth's `\dts` command from Concrete Mathematics (see gkpmac.tex), with the addition of `\nolinebreak`, taken from clrscode4e.

```
\@@_new_cmd:Nnn \dts { } {
    \nolinebreak
    \mathinner {
        \ldotp
        \ldotp
    }
    \nolinebreak
}
```

There's a shortcut (`\..`) defined for this as well (this time hijacking `\.`):

```
\cs_gset_eq:NN \c_@@_dot_cs \.

\DeclareDocumentCommand \. { m } {
    \tl_if_eq:nnTF { #1 } { . } {
        \l_@@_dts_impl_tl
    } {
        \c_@@_dot_cs { #1 }
    }
}
```

Finally, we define a different syntax for numeric ranges like these (or *slices* or *subarrays*). This command is based on the `\subarr` command of clrscode4e.

```
\@@_new_cmd:Nnn \rng { } {
    \nolinebreak
    \mathinner { : }
    \nolinebreak
}
```

## 6.5 Options

Much of the behavior of pseudo may be configured through various options, and these are defined below. You provide these either through `\pseudoset` or (where applicable) as optional arguments to `\\` or the `pseudo` environment itself.

The `\usepackage` options (handled by l3keys2e) are subject to full expansion, an so many options simply won't work. In order to make the `kw` option as easily available as possible, however, we permit it here, by way of a `bool` that triggers the *actual* key later on:

```
\keys_define:nn { pseudo/package } {
    kw              .bool_gset:N    = \g_@@_kw_bool,
    kw              .default:n      = true
}
\ProcessKeysOptions{ pseudo/package }
```

We now define the actual keys used by `\pseudoset`. Note that `hpad` and `hsep` do *not* use `.dim_set:N`. This is because the `dim` would then be interpreted at the point where it's *set*, and not where it's *used*. If we use units like `em` and `ex`, which depend on the font and font size, the spacing would not be updated if

we change these things between setting `hpad` and `hsep` and actually typesetting the pseudocode.

```
\keys_define:nn { pseudo } {

    init            .tl_set:N       = \l_@@_init_tl,
    init-append     .code:n         = {
        \tl_put_right:Nn \l_@@_init_tl {#1}
    },
    init-prepend    .code:n         = {
        \tl_put_left:Nn \l_@@_init_tl {#1}
    },

    font            .tl_set:N       = \pseudofont,
    font            .initial:n      = \normalfont,

    hpad            .meta:n         = {
        hpad-val = { #1 },
        hl-warn = false,
    },
    hpad            .default:n      = 0.3em,

    % For internal use:
    hpad-val        .tl_set:N       = \l_@@_hpad_tl,
    hpad-val        .initial:n      = 0.0em,

    hsep            .tl_set:N       = \l_@@_hsep_tl,
    hsep            .initial:n      = .75em,

    left-margin     .tl_set:N       = \l_@@_left_margin_tl,
    left-margin     .initial:n      = 0pt,

    label           .tl_set:N       = \l_@@_label_tl,
    label           .initial:n      = \arabic*,

    label-align     .code:n         =
        \@@_def_col:nn{ \pseudolabelalign }{#1},
    label-align     .initial:n      = r,

    ref             .tl_set:N       = \thepseudoline,
    ref             .default:n      = \l_@@_label_tl,

    indent-length   .tl_set:N       = \l_@@_indent_length_tl,
    indent-length   .initial:V      = \q_no_value,

    indent-text     .tl_set:N       = \l_@@_indent_text_tl,
    indent-text     .initial:n      = { \pseudofont\kw{else}\ },

    indent-mark     .tl_set:N       = \l_@@_indent_mark_tl,
    indent-mark     .initial:x      = \c_novalue_tl,
```

The default `indent-mark` is a vertical rule with width set by `indent-mark-width`, followed by a negative horizontal space of the same magnitude.

```
indent-mark     .default:n      =
    \skip_horizontal:n { \l_@@_indent_mark_shift_tl }
    \tex_vrule:D width \l_@@_indent_mark_wd_tl
    \skip_horizontal:n {
        -\l_@@_indent_mark_wd_tl
        -\l_@@_indent_mark_shift_tl
    },

indent-mark-width .tl_set:N     = \l_@@_indent_mark_wd_tl,
indent-mark-width .initial:n    = \c_@@_semithick_dim,

indent-mark-shift .tl_set:N     = \l_@@_indent_mark_shift_tl,
indent-mark-shift .initial:n    = 0pt,
indent-mark-shift .default:n    = .5em,

indent-mark-color .tl_set:N     = \l_@@_indent_color_tl,
indent-mark-color .initial:n    = lightgray,

indent-level    .int_set:N      =
\l_@@_initial_indent_level_int,

kwfont          .tl_set:N       = \kwfont,
kwfont          .initial:n      = \@@_b_or_bx:,

kw              .meta:n         = { font = \kwfont },
kw              .value_forbidden:n = true,

hl-warn         .bool_set:N     = \l_@@_hl_warn_bool,
hl-warn         .initial:n      = true,
hl-warn         .default:n      = true,

% For internal use:
hl-warn-code    .code:n         = {
    \bool_if:nT \l_@@_hl_warn_bool {
        \msg_warning:nn { pseudo } { hl-without-hpad }
    }
},

hl              .meta:n         = {
    hl-warn-code,
    bol-prepend = \pseudohl
},
hl              .value_forbidden:n = true,

bol             .tl_set:N       = \l_@@_bol_tl,
bol-append      .code:n         = {
    \tl_put_right:Nn \l_@@_bol_tl {#1}
},
bol-prepend     .code:n         = {
    \tl_put_left:Nn \l_@@_bol_tl {#1}
},

eol             .tl_set:N       = \l_@@_eol_tl,
eol-append      .code:n         = {
```

```
    \tl_put_right:Nn \l_@@_eol_tl {#1}
},
eol-prepend     .code:n         = {
    \tl_put_left:Nn \l_@@_eol_tl {#1}
},

% Defined differently in beamer -- see below
pause           .meta:n         = ,
pause           .value_forbidden:n = true,

cnfont          .tl_set:N       = \cnfont,
cnfont          .initial:n      = \textsc,

idfont          .tl_set:N       = \idfont,
idfont          .initial:n      = \textit,

stfont          .tl_set:N       = \stfont,
stfont          .initial:n      = \textnormal,

st-left         .tl_set:N       = \l_@@_st_left_tl,
st-left         .initial:n      = ‘‘,

st-right        .tl_set:N       = \l_@@_st_right_tl,
st-right        .initial:n      = ’’,

prfont          .tl_set:N       = \prfont,
prfont          .initial:n      = \cnfont,

fnfont          .tl_set:N       = \fnfont,
fnfont          .initial:n      = \idfont,

ctfont          .tl_set:N       = \ctfont,
ctfont          .initial:n      = \textit,

ct-left         .tl_set:N       = \l_@@_ct_left_tl,
ct-left         .initial:n      = (,

ct-right        .tl_set:N       = \l_@@_ct_right_tl,
ct-right        .initial:n      = ),

hl-color        .tl_set:N       = \pseudohlcolor,
hl-color        .initial:n      = black!12,

dim-color       .tl_set:N       = \pseudodimcolor,
dim-color       .initial:n      = \pseudohlcolor,

dim             .meta:n         = {
    bol-append   = \color{\pseudodimcolor},
    setup-append = \color{\pseudodimcolor}
},

line-height     .tl_set:N       = \l_@@_line_height_tl,
line-height     .initial:n      = 1,
```

```
extra-space     .tl_set:N       = \l_@@_extra_space_tl,
extra-space     .initial:n      = 0pt,

hd-space        .tl_set:N       = \l_@@_hd_space_tl,
hd-space        .initial:n      = 0pt,
```

The default value here emulates the spacing used in clrscode4e, though with a different mechanism:*

```
hd-space        .default:n      = 0.41386ex,

start           .tl_set:N       = \l_@@_start_tl,
start           .initial:n      = 1,
```

**Line structure.** The preamble for the internal `tabular` is defined as a single column type, to make it easier to apply it despite the array protections against expansion.

```
preamble        .code:n         =
    \@@_def_col:nn{ \pseudopreamble }{#1},
```

The preamble is laid out as described in Chapter 4:

```
preamble        .initial:n      = {
    >{ \pseudohpad }
    \pseudolabelalign
    >{ \pseudosetup }
    l
    <{ \pseudohpad }
},
setup           .tl_set:N       = \l_@@_setup_tl,
setup           .initial:n      = {
    \pseudoindent \pseudofont \pseudosavelabel
},

setup-append    .code:n         = {
    \tl_put_right:Nn \l_@@_setup_tl {#1}
},
setup-prepend   .code:n         = {
    \tl_put_left:Nn \l_@@_setup_tl {#1}
},
```

The preamble used for multicolumns is treated similarly:

```
hd-preamble     .code:n         =
    \@@_def_col:nn{ \pseudohdpreamble }{#1},
hd-preamble     .initial:n      = {
    >{ \pseudohpad } l <{ \pseudohpad }
},
```

The prefix is inserted by the row separator command.

* They insert `\rule[-1.25ex]{0pt}{0pt}` as part of the header.

```
prefix          .tl_set:N       = \pseudoprefix,
prefix          .initial:n      = {
    \pseudobol \stepcounter* \pseudolabel &
},
```

**Tabular setup.** The beginning and end of the tabular environment, as well as some positioning and spacing.

```
pos             .tl_set:N       = \pseudopos,
pos             .initial:n      = t,

prevdepth       .tl_set:N       = \l_@@_prevdepth_tl,
prevdepth       .initial:n      = .3 \baselineskip,

begin-tabular   .tl_set:N       = \l_@@_begin_tabular_tl,
begin-tabular   .initial:n      =
    \begin{tabular}[\pseudopos]{\pseudopreamble},

end-tabular     .tl_set:N       = \l_@@_end_tabular_tl,
end-tabular     .initial:n      = \end{tabular},
```

**List-like spacing.** Space above and below is handled similarly to in the built-in LaTeX lists, with the option of locally overriding `\topsep` and `\partopsep`, with `compact` used to control the presence of this spacing (overriding the ordinary automatic choice based on the current mode).

```
topsep          .tl_set:N       = \l_@@_topsep_tl,
topsep          .initial:n      = { \topsep },

partopsep       .tl_set:N       = \l_@@_partopsep_tl,
partopsep       .initial:n      = { \partopsep },

compact         .meta:n         = {
    compact-val  = { #1 },
    compact-def  = true,
    compact-code = { #1 },
},
compact         .default:n      = true,

% For internal use:
compact-val     .bool_set:N     = \l_@@_compact_bool,
compact-def     .bool_set:N     = \l_@@_compact_def_bool,
compact-code    .code:n         = {
    \bool_if:nT { \l_@@_compact_bool } {
        \tl_clear:N \pseudopos
    }
},
```

**Notation.** The commands `\==` and `\..` normally produce .. and ==, via `\eqs` and `\dts` (in their fully prefixed versions, `\pseudoeqs` and `\pseudodts`). Because of the implementation of these commands, you can't simply replace their implementation directly with `\def` or `\let`. Instead, you can use these keys to replace the necessary internal code.

```
    eqs-impl        .tl_set:N       = \l_@@_eqs_impl_tl,
    eqs-impl        .initial:n      = { \pseudoeqs },

    dts-impl        .tl_set:N       = \l_@@_dts_impl_tl,
    dts-impl        .initial:n      = { \pseudodts },
```

**Details.** Finally, some tweakable parameters.

```
    eqs-scale       .fp_set:N       = \l_@@_eqs_scale_fp,
    eqs-scale       .initial:n      = 0.6785,

    eqs-sep         .tl_set:N       = \l_@@_eqs_sep_tl,
    eqs-sep         .initial:n      = 0.63mu,

    eqs-pad         .tl_set:N       = \l_@@_eqs_pad_tl,
    eqs-pad         .initial:n      = 0.28mu,

}
```

Now that we've defined the real `kw` key, we reexamine the placeholder handled by l3keys2e:

```
\bool_if:NT \g_@@_kw_bool {
    \keys_set:nn { pseudo } { kw }
}
```

**Beamer overlays.** We redefine the `pause` key if we're using beamer:

```
\bool_if:NT \c_@@_beamer_bool {
    \keys_define:nn { pseudo } {
        pause .meta:n = { eol-append = \pause }
    }
}
```

There's also the mechanism for handling overlay specifications on keys. Here we handle unknown keys by checking if they end with an overlay specification, and if they do, and we're in beamer, we extract it. Outside beamer, keys with overlays are simply ignored.

Note that because unknown keys currently can't have a default (which we could, in this case, use for some kind of marker, indicating no value was supplied), the only solution is to treat an empty value the same way as no value, in this case. This means that `foo<1>` and `foo<1>={}` are equivalent, and both will trigger the default of `foo`, even though the latter of the two really shouldn't.*

```
\cs_new:Npn \@@_keys_set_overlay:nnn #1 #2 #3 {
    \bool_if:NT \c_@@_beamer_bool {
        \tl_if_novalue:nF { #1 } {
            \only<#1>{ \keys_set:nn { #2 } { #3 } }
        }
    }
```

* See `https://github.com/latex3/latex3/issues/67`.

```
}

\msg_new:nnn { pseudo } { unknown-key } {
    Unknown~key~'#1'~ignored.
}

\tl_new:N \l_@@_overlay_tl

\keys_define:nn { pseudo } {
    unknown .code:n = {

        \group_begin:

        \int_zero:N \l_tmpa_int
        \int_zero:N \l_tmpb_int

        \tl_clear:N \l_tmpa_tl
        \tl_clear:N \l_tmpb_tl

        % We'll modify this globally, remporarily, and put it back
        % into the local variable just outside this group.
        \tl_gset_eq:NN \g_@@_extra_space_temp_tl
                       \l_@@_extra_space_tl

        \tl_map_inline:Nn \l_keys_key_tl {

            \tl_if_eq:nnTF { ##1 } { < } {

                \int_incr:N \l_tmpa_int
                \int_compare:nF { \l_tmpb_int == 0 } {
                    % We already found '>'!
                    % Increment again to prevent match:
                    \int_incr:N \l_tmpa_int
                }

                \tl_set_eq:NN \l_tmpb_tl \l_tmpa_tl
                \tl_clear:N \l_tmpa_tl

            } {

            \tl_if_eq:nnTF { ##1 } { > } {

                \int_incr:N \l_tmpb_int

                \tl_set_eq:NN \l_@@_overlay_tl \l_tmpa_tl
                \tl_clear:N \l_tmpa_tl

            } {

                \tl_put_right:Nn \l_tmpa_tl { ##1 }

            } }

        }
```

```
% A single '<' and a final, single '>'?
\bool_if:nTF {
    \int_compare_p:n { \l_tmpa_int == \l_tmpb_int == 1 }
    &&
    \tl_if_empty_p:N \l_tmpa_tl
} {
```

We've matched a key with an overlay specification. If it's got a (non-blank) value, we include that in the key-setting code we're building in `\l_tmpb_tl`, and then we set the key, with the appropriate overlay specification.

```
    \tl_if_blank:nF{ #1 } {
        \tl_put_right:Nn \l_tmpb_tl {= #1}
    }
```

Rather than setting the keys here, inside a group, we put the code into a variable that we'll expand outside the group, later:

```
    \tl_set:Nn \l_tmpa_tl {
        \@@_keys_set_overlay:nnn
    }
    \tl_put_right:Nx \l_tmpa_tl { { \l_@@_overlay_tl } }
    \tl_put_right:Nn \l_tmpa_tl { { pseudo           } }
    \tl_put_right:Nx \l_tmpa_tl { { \l_tmpb_tl       } }
} {
```

We have *not* matched an overlay specification, so we just have an unknown key. However, we have another special case to consider: If we're processing arguments to `\\`, we also permit a keyless value to be used to specify extra space (normally done using `extra-space`). If the unknown key doesn't have an attached (non-blank) value, we treat the key itself as a value, and use it as extra space. If this, too, fails, we emit an error message. Note that we'll also make sure the variable with the key-setting code is empty.

```
    \tl_clear:N \l_tmpa_tl
    \bool_if:nTF {
        \bool_lazy_and_p:nn
            { \l_@@_in_eol_bool       }
            { \tl_if_blank_p:n { #1 } }
    } {
        \tl_gset_rescan:Nno
            \g_@@_extra_space_temp_tl { }
            { \l_keys_key_str  }
    } {
        \msg_error:nnx
            { pseudo } { unknown-key }
            { \l_keys_path_str }
    }
}

\tl_gset_eq:NN \g_@@_key_setting_code_temp_tl \l_tmpa_tl
```

```
            \group_end:

            % Make sure extra space and key-setting carry over outside
            % the group:
            \tl_set_eq:NN \l_@@_extra_space_tl
        \g_@@_extra_space_temp_tl
            \tl_use:N \g_@@_key_setting_code_temp_tl

        }

    }
```

**Option processing.** To let the user work with the options (other than when they're available as optional arguments to other commands), we supply a command for setting them.

```
\cs_new:Npn \@@_set:n #1 { \keys_set:nn { pseudo } { #1 } }
```

## 6.6 The row separator

Much of the work of the `pseudo` environment is performed by the row separator, that is, the `\\` command; whatever part of the line structure (see Chapter 4) that's not in the `preamble` must be handled by `\\`. For example, this is where the `prefix` gets inserted. One reason for this is that there is no straightforward way to insert the column separator (`&`) from the `preamble` itself; and if you want to prevent the column separator insertion because you need to to some custom work in the first column, you'll probably want to suppress other parts of the `prefix` as well, so they might as well be collected in one place.

Beyond inserting material such as `\tabularnewline`s and `prefix` contents, `\\` is also an entrypoint for local customization, i.e., modifying the indentation level and setting any locally meaningful keys.

**Indentation utilities.** First we have some functions for modifying the indentation level—essentially just incrementing, decrementing and setting it to zero.

```
\cs_new:Npn \@@_inc_indent: {
    \int_gincr:N \g_@@_indent_level_int
}

\cs_new:Npn \@@_dec_indent: {
```

If the user happens to dedent too much, we might as well be a bit forgiving, and clamp the indent level to non-negative values:

```
    % Not using \c_zero_int for compatibility
    \int_compare:nNnT \g_@@_indent_level_int > 0 {
        \int_gdecr:N \g_@@_indent_level_int
    }
}
```

**The actual row separator.** The command consists of a few interacting macros. The implementation of `\\` is `\@@_eol:`, but that is just a thin wrapper that counts pluses and minuses, before handing the control over to `\@@_eol_tail`. This is where the remaining argument parsing takes place, and the `\tabularnewline` is inserted, after which control is passed to `\@@_bol:` in order to begin a new line—unless we're at the end of the environment.

```
\cs_new:Npn \@@_eol_handle_args:nnn #1 #2 #3 {
    % Make extra-space default key for keyless value:
    \bool_set_true:N \l_@@_in_eol_bool
    \@@_keys_set_overlay:nnn { #2 } { pseudo } { hl }
    \keys_set:nn { pseudo } { #3 }
```

The variables underlying the keys (`\l_@@_label_tl`, etc.) are kept local, so they'll be restored after the environment, but in order to carry over to the next line and its preamble, we need to perform some global assignments here.

```
    \tl_gset_eq:NN \pseudolabel   \l_@@_label_tl
    \tl_gset_eq:NN \pseudobol     \l_@@_bol_tl
    \tl_gset_eq:NN \pseudoeol     \l_@@_eol_tl
    \tl_gset_eq:NN \pseudosetup   \l_@@_setup_tl
```

If starred, clear out the prefix:

```
    \IfBooleanTF { #1 } {
        \tl_gclear:N \g_@@_cur_prefix_tl
    } {
        \tl_gset_eq:NN \g_@@_cur_prefix_tl \pseudoprefix
    }
}
\NewDocumentCommand \@@_eol_tail { s d<> +O{ } } {
    \@@_eol_handle_args:nnn{#1}{#2}{#3}
```

A new line is begun only if we're not at the end of the (or, at least of *some*) environment. (We could have put the `\tabularnewline` outside, but then we'd have a conditional at the beginning of the next line, which would mess up `\bottomrule` or the like. We need to keep `\@@_bol:` alone at the start of the line.) We call `\tabularnewline` either way, in particular for it to use any extra space provided to `extra-space`.

It seems providing a zero-length extra space in `\tabularnewline` can cause trouble,* so we treat that as a special case.

```
    \dim_compare:nNnTF \l_@@_extra_space_tl = { 0pt } {
        \tl_set_eq:NN \l_tmpa_tl \tabularnewline
    } {
        \tl_set:Nx \l_tmpa_tl {
            \exp_not:N \tabularnewline [ \l_@@_extra_space_tl ]
        }
    }
    \@@_skip_pars:n {
```

* Cf. `https://github.com/mlhetland/pseudo.sty/issues/21`

```
            \peek_meaning_ignore_spaces:NTF \end {
                \l_tmpa_tl
            } {
                \pseudoeol
                \l_tmpa_tl
                \@@_bol:
            }
        }
    }
```

And here is the actual `\@@_eol:` command:

```
\cs_new:Npn \@@_eol: {

    \@@_per_char:nnn { + } {
        \@@_inc_indent:
    } {
    \@@_per_char:nnn { - } {
        \@@_dec_indent:
    } {
        \@@_eol_tail
    } }

}
```

The `\@@_bol:` command (currently) just inserts the `prefix`:

```
\cs_new:Npn \@@_bol: {
    \g_@@_cur_prefix_tl
}
```

## 6.7 Various user commands

A few user-level wrappers around internal commands. First, a couple primarily for use in the `preamble`, together with `\pseudosavelabel` and `\pseudofont`:

```
\NewDocumentCommand \pseudohpad { } {
    \skip_horizontal:n { \l_@@_hpad_tl - \tabcolsep }
}
\NewDocumentCommand \pseudoindent { } {
    \@@_indent:N { \g_@@_indent_level_int }
}
```

The `\RestorePseudoBackslash` command simply redefines the row separator, and is used at the start of the `pseudo` environment. It may be useful for the user if some other construct redefines `\\` as well. (This is similar to the `\arraycr` command of the array package.)

```
\NewDocumentCommand \RestorePseudoBackslash { } {
    \cs_gset_eq:NN \\ \@@_eol:
```

```
}
```

We also have a command for restoring our definition of `\=` if it has been overwritten:

```
\NewDocumentCommand \RestorePseudoEq { } {
    \cs_gset_eq:NN \= \@@_eq:
}
```

Finally, two utilities for working with options. The first (`\pseudoset`) directly sets a collection of keys, while the second (`\pseudodefinestyle`) defines a new key which can be used as a shortcut for setting multiple keys at some later point:

```
\NewDocumentCommand \pseudoset { +m }
    { \@@_set:n { #1 } }

\NewDocumentCommand \pseudodefinestyle { m +m } {
    \keys_define:nn { pseudo } {
        #1 .meta:n = {
            #2
        }
    }
}
```

## 6.8 The pseudo environment

While this is the main attraction, it's essentially just an augmented `tabular` environment, which does a bit of setup initially, using the various macros already described.

```
\NewDocumentEnvironment { pseudo } { +o s d<> +O{ } } {

    \group_begin:

    \@@_cs_gsave_as:NN \\ \c_@@_saved_cr_cs
    \@@_cs_gsave_as:NN \= \c_@@_saved_eq_cs

    % \RestorePseudoBackslash is inside the tabular
    \RestorePseudoEq

    \int_set:Nn \g_@@_last_saved_line_int {\arabic{pseudoline}}
    \@@_star_setup:

    \IfNoValueF { #1 } {
        \pseudoset { #1 }
    }
    \@@_set_indent_length:

    % If not manually set as compact/noncompact,
    % set automatically:
    \bool_if:NF \l_@@_compact_def_bool {
```

```
        \bool_set:Nn \l_@@_compact_bool {
            \mode_if_horizontal_p: && \mode_if_inner_p:
        }
    }

    \bool_if:nF { \l_@@_compact_bool } {

        \skip_set:Nn \l_tmpa_skip {
            \l_@@_topsep_tl
        }
        \mode_if_vertical:TF {
            \skip_add:Nn \l_tmpa_skip { \l_@@_partopsep_tl }
        } {
            \unskip \par
        }

        \addvspace { \l_tmpa_skip }

        \noindent
        \skip_horizontal:n{ \dim_eval:n { \l_@@_left_margin_tl } }

    }

    \dim_set:Nn   \tabcolsep    { \l_@@_hsep_tl / 2 }
    \tl_set_eq:NN \arraystretch \l_@@_line_height_tl

    \stepcounter{pseudoenv}
    \setcounter{pseudoline}{\l_@@_start_tl}
    \addtocounter{pseudoline}{-1}
```

Before starting the actual tabular environment, we insert any user-configured initialization.

```
    \tl_use:N \l_@@_init_tl
    \tl_use:N \l_@@_begin_tabular_tl
```

We use `\noalign` to be able to place these definitions inside the tabular, without messing up `\multicolumn` or `\hline` or the like. It's not really supposed to be used in expl3; the alternative would be to create an extra dummy line, like:

```
\skip_vertical:n{ -\dim_eval:n{ \box_ht:N \@arstrutbox +
                                \box_dp:N \@arstrutbox } }
\tabularnewline
```

This would give us a fresh start, without moving vertically. It's probably more hacky than just using `\noalign` here, though, so ...

```
    \tex_noalign:D {
```

We keep the `\\`-definition inside the `tabular`, to override the redefinition placed there by array, without patching any internals:

```
            \RestorePseudoBackslash
```

In a `tabularx`, for example, the body is executed multiple times, so we must make sure that any resets that are performed—such as setting the initial indentation level—are performed each time:

```
            \int_gset_eq:NN \g_@@_indent_level_int
                            \l_@@_initial_indent_level_int
```

Finally, we handle the line arguments, just like with the row separator:

```
            \@@_eol_handle_args:nnn{#2}{#3}{#4}
        }
```

Definitions and setup are done, we've left the `\noalign`, and we can start the line:

```
        \@@_bol:

    } {

        \tl_use:N \l_@@_end_tabular_tl
```

We'll only adjust spacing here if we're not `compact`. Otherwise, we'll just end the current group:

```
        \bool_if:nTF { \l_@@_compact_bool } {

            \group_end:

        } {

            \mode_if_vertical:F {
                \unskip \par
                \group_insert_after:N \@endparenv
            }

            \addvspace{ \l_tmpa_skip }
```

To ensure any local changes to `prevdepth` are used, we expand its local value before setting csprevdepth *outside* the group.*

```
            \exp_args:NNNV
                \group_end:
                \dim_set:Nn \prevdepth \l_@@_prevdepth_tl

        }

    }
```

The starred version of the environment is just a wrapper that uses the custom (and overridable) `starred` style:

* See, e.g., `https://tex.stackexchange.com/questions/56294`.

```
\pseudodefinestyle{ starred }{
    preamble = {
        >{\pseudohpad\pseudoindent\pseudofont}
        l
        <{\pseudohpad}
    },
    prefix = {\pseudobol},
}

\NewDocumentEnvironment { pseudo* } { +O{} } {
    \begin{pseudo}[starred, #1]
    % \begin{pseudo} will "eat" any remaining arguments to pseudo*
} {
    \end{pseudo}
}
```

## 6.9 Boxes and floats

Some spacing and width values are taken from booktabs, to partly emulate its table appearance. If booktabs is not loaded, we'll just define these constants ourselves; if booktabs is loaded later, it will blithely overwrite these.

```
\@ifpackageloaded { booktabs } { } {
    \dim_const:Nn \aboverulesep       { .40ex }
    \dim_const:Nn \belowrulesep       { .65ex }
    \dim_const:Nn \heavyrulewidth     { .08em }
    \dim_const:Nn \lightrulewidth     { .05em }
}
```

We also define some line widths based on those used by tikz.

```
\dim_const:Nn \c_@@_very_thin_dim     { 0.2pt }
\dim_const:Nn \c_@@_thin_dim          { 0.4pt }
\dim_const:Nn \c_@@_semithick_dim     { 0.6pt }
```

We'll be adjusting the spacing after the contents based on the value of `\prevdepth`. If `\prevdepth` is negative, this is suppressed. Otherwise, we add vertical space to the `\prevdepth`, to take us to (at least) `.3\baselineskip`. Since the mechanism is the same for the title and the body, we define a macro:

```
\cs_new:Npn \@@_prevdepth_adjustment: {
    \par % Ensure vertical mode
    \dim_compare:nNnF \prevdepth < \c_zero_dim {
        \dim_compare:nNnT \prevdepth < { .3 \baselineskip } {
            \skip_vertical:n { .3 \baselineskip - \prevdepth }
            \skip_vertical:N \c_zero_dim % Hide previous skip
        }
    }
}
```

To permit the styling specifically of `pseudo` environments inside our boxes, we define and use a pseudo style, and a hook (token list) that may overridden by the user:

```
\pseudodefinestyle { in-float } {
    % Initially empty
}
\tl_new:N \l_@@_float_init_tl
```

We now define some tcolorbox box styles. Rather than importing tcolorbox, we just use its key management mechanism, pgfkeys, with the appropriate namespace.

```
\pgfqkeys { /tcb/pseudo } {
```

We begin by defining our hook `pseudo/init`.

```
    init/.code = {
        \tl_set:Nn \l_@@_float_init_tl { #1 }
    },
```

The first box style (`pseudo/boxruled`) is the basis for the others.

```
boxruled/.style = {
```

By default, our boxes aren't floats, but if the `float` style is used, we'll want to have the placement configured. The tcolorbox default is `htb`, but we're emulating normal floats, so we'll use the normal LaTeX default:

```
    floatplacement = tbp,
```

Before the contents (which uses the upper part of the box), we adjust some distances, and set `\prevdepth`, for consistent vertical spacing of the first line. These settings may be overridden using `before upper app`, which appends code to `before upper`. For example, one could change the `\topsep` by using `before upper app = {\topsep10pt}`.*

```
    before~upper = {
        \dim_set:Nn \parskip    { .3 \baselineskip }
        \dim_set:Nn \topsep     { .2 \baselineskip }
        \dim_set:Nn \partopsep  { 0pt              }
        \dim_set:Nn \prevdepth  { .3 \baselineskip }
        \RestorePseudoEq            % Broken in floats
        \pseudoset { in-float }     % User hook (style)
        \l_@@_float_init_tl         % User hook (code)
    },
```

At the end of the contents, we add some spacing, again for consistent vertical alignment.

* While you might want to modify `\parskip`, `\topsep` or `\partopsep`, there's probably no need to change `\prevdepth`.

```
after~upper = \@@_prevdepth_adjustment:,
```

Now we add spacing before and after the box, when it's not used with the `float` key. We just mirror the spacing of the `pseudo` environment (except without the support for `partopsep`).

```
beforeafter~skip~balanced = \l_@@_topsep_tl,
```

Now we set up basic spacing for the contents. The spacing above and below the title is the same as for the top row of a booktabs tabular. For the "body" of the box (and the left/right), we add some extra space.

```
boxsep              = 0pt,
toptitle            =   \belowrulesep,
bottomtitle         =   \aboverulesep,
top                 = 2 \belowrulesep,
bottom              = 2 \aboverulesep,
left                = 2 \belowrulesep,
right               = 2 \belowrulesep,
```

The title has a separate part called the *description* (in tcolorbox theorem terms). We give the title one font (bold), and then reset that to `\normalfont` when we get to the description.

```
fonttitle           = \bfseries,
description~font    = \normalfont,
```

The spacing above and below the title is adjusted as for the body. We want to separate the initial part of the title (e.g., "Algorithm 3.2") from the description by an `\enskip` (`.5em` horizontal space). However, a single normal space is hard-coded into tcolorbox, so we'll subtract the width of that. (We make sure to do this with `\normalfont`, to not get the units warped by an extended bold, for example.)

```
before~title        =
    \dim_set:Nn \prevdepth  { .3 \baselineskip },
after~title         = \@@_prevdepth_adjustment:,
separator~sign      = {
    \normalfont
    \skip_horizontal:n { .5em - \fontdimen2\font\space }
},
```

Finally, some basic styling.

```
sharp~corners,
colback             = white,
colbacktitle        = white,
coltitle            = black,
colframe            = black,
boxrule             = \c_@@_thin_dim,
titlerule           = \c_@@_very_thin_dim,
```

```
},
```

The remaining box styles are based on `boxruled`, but rely on other skins (`empty` and `tile`), which remove the default frame drawing, as some of the frame are removed. (It would be possible to simply set the relevant widths to zero, but this tends to leave perceptible hairlines in most PDF viewers—probably because the fram is drawn by *filling* rather than *drawing*.)

```
ruled/.style = {
    pseudo/boxruled,
    empty,
```

Even though we've removed the default frame, we do want some rules. First the various rule thicknesses (and some horizontal spacing) are set. The ones that are missing have their thicknesses set to zero, for spacing/positioning purposes. The titlerule is drawn normally, but for the top and bottom rules, we need to use the `borderline` mechanism.

```
    boxrule             = 0pt,
    toprule             = \heavyrulewidth,
    titlerule           = \lightrulewidth,
    bottomrule          = \heavyrulewidth,
    left                = 0pt,
    right               = 0pt,
    titlerule~style     = draw,
    borderline~north    = {\heavyrulewidth}{0pt}{black},
    borderline~south    = {\lightrulewidth}{0pt}{black},
},
```

The `booktabs` is a variation of `ruled`, where the bottom rule is also thick, to match the style of `booktabs` tables.

```
booktabs/.style = {
    pseudo/ruled,
    no~borderline,
    bottomrule          = \heavyrulewidth,
    borderline~horizontal = {\heavyrulewidth}{0pt}{black}
},
```

The `boxed` style is similar, with the titlerule removed, and with the borderline drawn on all sides. Finally, we want to "simulate" the title just being the first paragraph of the contents, so we set the space above the title *almost* equal to the space used elsewhere above the content, zero out the spacing after the title, and make the top spacing equal to the the normal `\parskip` (which we set to `.3\baselineskip` in `before upper`).

```
boxed/.style = {
    pseudo/boxruled,
    empty,
    titlerule           = 0pt,
    borderline          = {\c_@@_thin_dim}{0pt}{black},
```

```
    toptitle            = 1.5 \belowrulesep,
    bottomtitle         = 0pt,
    top                 = 0.3 \baselineskip,
},
```

The `tworuled` style is based on `boxed` (including the spacing adjustment between title and body), but removes the previously drawn borderlines, adjusts the thicknesses, and draws new horizontal lines.

```
tworuled/.style = {
    pseudo/boxed,
    no~borderline,
    left                = 0pt,
    right               = 0pt,
    boxrule             = 0pt,
    toprule             = \heavyrulewidth,
    bottomrule          = \heavyrulewidth,
    borderline~horizontal = {\heavyrulewidth}{0pt}{black},
},
```

Finally, the `filled` style uses the `tile` skin, which has no frame, and is designed for filling. In addition to the colors, there's a slight spacing adjustment.* Since we have no border, we increase the spacing a bit (though not at the top, to prevent a "top-heavy" look, especially when dropping the title).

```
filled/.style = {
    pseudo/boxruled,
    tile,
    colback             = \pseudohlcolor,   % black!12
    colbacktitle        = lightgray,        % black!25
    bottom              = 2 \aboverulesep + \c_@@_thin_dim,
    left                = 2 \belowrulesep + \c_@@_thin_dim,
    right               = 2 \belowrulesep + \c_@@_thin_dim,
}
```

And that ends the tcolorbox definitions:

```
} % \pgfqkeys
```

## 6.10 Deprecations and warnings

Some commands are no longer intended for use, but are included for backward compatibility. These will issue a deprecation warning when used.

```
\msg_new:nnn { pseudo } { useinstead } {
    The~#1 command~(used~\msg_line_context:)~is~deprecated;~
    use~#2 instead.
}
```

* The `tile` skin also sets things like `sharp corners` and `fonttitle`, so some of what we inherit from `boxruled` is a bit redundant, here.

```
\cs_new:Npn \@@_use_instead:nn #1 #2 {
    \msg_warning:nnnn { pseudo } { useinstead } { #1 } { #2 }
    % \tl_gset_eq:NN #1 #2
}

\NewDocumentCommand \pseudoslash { } {
    \@@_use_instead:nn \pseudoslash \RestorePseudoBackslash
    \RestorePseudoBackslash
}

\NewDocumentCommand \pseudoeq { } {
    \@@_use_instead:nn \pseudoeq \RestorePseudoEq
    \RestorePseudoEq
}
```

Finally, we define a warning to issue if `hl` is used without `hpad`.

```
\msg_new:nnn { pseudo } { hl-without-hpad } {
    hl~used~without~hpad~\msg_line_context:.
}
```

## 6.11 Compatibility

If the box and float functionality is used with a version of tcolorbox prior to 4.40 (e.g., on `https://arxiv.org`, at the time of writing), the `beforeafter skip balanced` option won't be defined

```
\pgfkeysifdefined { /tcb/beforeafter~skip~balanced/.@cmd } { } {
```

To handle this, at least for the time being, pseudo implements a fallback version of this option.

```
\pgfqkeys { /tcb } {
    before~skip~balanced/.style = { before = {
        \int_compare:nNnF { \lastnodetype } = { -1 } {
            \par
            \mode_if_vertical:T {
                \@@_if_minipage:
                    \dim_compare:nNnTF \parskip > \c_zero_dim {
                        \addvspace{ -\parskip }
                    }
                \else:
                    \bool_lazy_or:nnTF {
                        \dim_compare_p:nNn
                            \prevdepth < \c_zero_dim
                    } {
                        \dim_compare_p:nNn
                            \prevdepth > { .3 \baselineskip }
                    } {
                        \addvspace { \skip_eval:n {
```

```
                            #1 - \parskip
                        } }
                    } {
                        \addvspace { \skip_eval:n {
                            #1 + .3 \baselineskip
                            - \prevdepth - \parskip
                        } }
                    }
                \fi:
                \nointerlineskip
            }
        }
        \dim_set_eq:NN \lineskip \c_zero_dim
        \noindent
    } },
    after~skip~balanced/.style = { after = {
        \par
        \mode_if_vertical:T {
            \dim_set:Nn \prevdepth { .3\baselineskip }
            \addvspace { \skip_eval:n { #1 - \parskip } }
        }
    } },
    beforeafter~skip~balanced/.style = {
        before~skip~balanced = { #1 },
        after~skip~balanced  = { #1 }
    }
}
```

We need to know if the box is in a `minipage`, and this is normally detected as part of `\tcb@apply@box@options`. We override that macro (if tcolorbox has been loaded by the time we reach the end of the preamble) to insert the approproate definition.

```
\RequirePackage{etoolbox}

\AtEndPreamble {
    \@ifpackageloaded { tcolorbox } {
        \tl_set_eq:NN \@@_orig_tcbopt \tcb@apply@box@options
        \def \tcb@apply@box@options #1 {
            \@@_orig_tcbopt { #1 }
            \tl_set_eq:NN \@@_if_minipage: \if@minipage
        }
    } { }
}
```

End of `\pgfkeysifdefined`:

```
}
```

In older version of tcolorbox, we end up with extra space at the top of the box contents. The simple solution here it so simply add `-\parskip` of vertical space. This doesn't really do much harm, but it is redundant with newer versions, and it does interfere with the use of `before upper app`, for example. Therefore, we

only add this spacing in older versions (for simplicity, just going with 4.x and older). We do this at the end of the preamble, and only if tcolorbox has actually been loaded at that point.

```
\AtEndPreamble {
    \@ifpackageloaded { tcolorbox } {

        \cs_new:Npn \@@_vmaj:n #1 { \@@_vmaj_aux:w #1 \q_stop }
        \cs_new:Npn \@@_vmaj_aux:w #1 . #2 \q_stop { #1 }

        \tl_set:Nx \l_tmpa_tl {
            \exp_args:No \@@_vmaj:n \tcb@version
        }

        \int_compare:nNnT \l_tmpa_tl < 5 {

            \tcbuselibrary { hooks }
            \tcbset {
                pseudo/boxruled/.append~style = {
                    before~upper~app = \vspace { -\parskip }
                }
            }

        }

    }

}
```

# Bibliography


[1] T. H. Cormen et al. *Introduction to Algorithms*. 3rd ed. MIT Press, 2009.

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[3] R. L. Graham, D. E. Knuth, and O. Patashnik. *Concrete Mathematics: A Foundation for Computer Science*. Addison-Wesley Professional, 1994.

[4] D. E. Knuth. "Random Matroids". *Discrete Mathematics* 12.4 (1975), pp. 341–358.

[5] D. P. Williamson and D. B. Shmoys. *The Design of Approximation Algorithms*. Cambridge University Press, 2011.