The savetrees package*

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1 Introduction

The goal of the savetrees package is to pack as much text as possible onto each page of a LaTeX document. Admittedly, this makes the document far less attractive. Nevertheless, savetrees provides a simple way to save paper when printing draft copies of a document. It can also be useful when trying to meet a tight page-length requirement. For example, consider the difference between

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and

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*This document corresponds to savetrees v2.1, dated 2013/04/09.

The former (default) layout looks nicer, but the latter consumes approximately 10% less space.

The easiest way to use savetrees is simply to place one of the following in your document's preable:

- `\usepackage[subtle]{savetrees}`
- `\usepackage[moderate]{savetrees}`
- `\usepackage[extreme]{savetrees}`

The first option, subtle, preserves all document layout and merely encourages LaTeX to try harder to pack text onto the page while introducing white space only when absolutely necessary. The second option, moderate, additionally reduces paragraph indentation, typesets lists and mathematical displays without indentation or surrounding vertical space, reduces interline spacing, and makes the font slightly narrower, if supported. The third option, extreme, which is in fact the default if no package options are specified, turns on all of the space-saving techniques in savetrees's repertoire, including using smaller title and section fonts, typesetting the bibliography with a smaller font and no inter-item spacing, and substantially reducing the page margins. For a demonstration of these package options, see the accompanying `st-sample2e.pdf` file, which presents Lamport's "An Example Document" typeset both normally and with each of savetrees's subtle, moderate, and extreme options.

The following section describes those and the rest of savetrees's space-saving capabilities in more detail.

2 Usage

Table 1 to Table 3 on pages 3–4 describe savetrees's main package options and summarize their implementation. Some package options merely load a package or redefine some variables. Others redefine entire environments to consume less space. A few resort to some underhanded TeX trickery to squeeze as much text as possible onto the page. See the annotated source code listing in Section 4 for the definitive description of the mechanics underlying the savetrees package.

Each of the options that appears in Table 1 through Table 3 can be set to either `tight` or `normal`. `tight`, the default, enables the space-saving technique while `normal` disables it. For example, specifying `\usepackage[title=normal]{savetrees}` instructs savetrees not to modify the font size and spacing used to typeset the document's title. The all option can be used to set all of savetrees's options en masse to either `tight` or `normal`. For example, if only a few space-saving techniques should be enabled, it may be more convenient to specify `all=normal` followed by a small list of options set to `tight` than to specify `normal` typesetting for a large set of options. The arguments passed to `\usepackage` are processed left-to-right.

Table 1: savetrees package options for enabling/disabling space-saving techniques (`subtle`)

Option	Space-saving technique	Implementation
paragraphs	Discourage TEX from allowing the last line of a paragraph to contain only a single word.	Reassign `\looseness`.
floats	Relax float placement (more floats per page, increased ability to share pages with text, etc.).	Reassign LATEX 2_ε float variables.
mathspacing	Reduce the amount of space within mathematical expressions.	Reassign `\thinmuskip`, `\medmuskip`, and `\thickmuskip`.
wordspacing	Reduce the amount of space between words.	Reassign `\fontdimen2`.
tracking	Reduce the amount of space between characters.	Pass options to the microtype package.

Table 2: savetrees package options for enabling/disabling space-saving techniques (`moderate`)

Option	Space-saving technique	Implementation
bibnotes	Ignore `NOTE` fields in the bibliography.	Pass information to `savetrees.bst`.
charwidths	Allow character glyphs to be drawn slightly narrower than normal.	Pass options to the microtype package.
mathdisplays	Reduce the amount of vertical space surrounding displayed mathematics.	Reassign `\abovedisplayskip`, `\belowdisplayskip`, `\abovedisplayshortskip`, and `\belowdisplayshortskip`.
leading	Reduce interline spacing.	Reassign `\baselinestretch`.
indent	Decrease paragraph indentation.	Reassign `\parindent`.
lists	Remove both indentation and inter-item spacing from the various list environments.	Redefine the `itemize`, `enumerate`, and `description` environments.

Table 3: savetrees package options for enabling/disabling space-saving techniques (`extreme`)

Option	Space-saving technique	Implementation
bibliography	Typeset the bibliography in a smaller font and with no inter-item spacing.	Redefine `thebibliography`.
title	Typeset the document title with smaller fonts and with less surrounding white space.	Redefine `\maketitle`.
sections	Typeset section titles with smaller fonts and with less surrounding white space.	Pass options to the titlesec package.
margins	Reduce the page margins.	Pass options to the geometry package.

As convenient shortcuts, the options in Table 1 can be enabled as a group by passing the subtle option to savetrees; the options in both Table 1 and Table 2 can be enabled as a group by passing the moderate option to savetrees; and all of the options in Table 1, Table 2, and Table 3 can be enabled as a group by passing the extreme option to savetrees.

The options in Table 1 through Table 3 are presented in roughly decreasing order of subtlety. If you find that savetrees's default options—or the subtle, moderate, and extreme meta-options—produce too hideous a result, try incrementally setting to `normal` the options from the bottom of the options list up, and see if doing so improves the document's appearance while still saving space over the non-savetrees version. That is, start by including `margins=normal` in the optional argument to `\usepackage`. Then add `sections=normal`, then `title=normal`, and so forth, rebuilding the document and examining the result each time. Alternatively, if you need to save just a small amount of space (e.g., if your document is just barely over a maximum page length), specify `all=normal` then incrementally add options from the top of the three tables downwards: `paragraphs=tight`, then `floats=tight`, then `mathspacing=tight`, and so forth. Appendix B presents examples of some of savetrees's space-saving features so you can decide for yourself which are worth the price paid in typesetting elegance.

Saving space in a document is always a balancing act between document aesthetics and the amount of space that can be saved. If you find that a particular space-saving option makes the document formatting just a little too ugly—or if you're willing to make it even uglier to save even more space—savetrees provides additional package options that let you adjust the aggressiveness of various space-saving techniques. Table 4 on the following page lists and describes these package options. As an example, LaTeX's normal line height is defined to have a value of 1.0. When savetrees is loaded with `leading=tight` (the default), Table 4

Table 4: savetrees package options for refining the way space is saved

Option	Description	Requires `tight`	Default
charwidthfraction	Fraction of normal character widths	charwidths	0.95
leadingfraction	Fraction of normal line height	leading	0.95
marginwidth	Width of the page margins	margins	1.5cm
parindent	Paragraph indentation	indent	1em
trackingfraction	Fraction of normal inter-character spacing	tracking	0.975
wordspacingfraction	Fraction of normal inter-word spacing	wordspacing	0.8

indicates that the line height is reduced to 95% of that. Additionally including `leadingfraction=0.98` on the `\usepackage` line increases the line height to 98% of LaTeX's default—still a space reduction but possibly a somewhat less overt one.

There are a few restrictions on the space-saving techniques that can be applied. The tracking option requires pdfLaTeX. The charwidths option requires either pdfLaTeX or LuaLaTeX. For both options, pdfLaTeX must be in PDF mode, not DVI mode. See the microtype documentation for additional (and possibly more up-to-date) information.

3 Abbreviating bibliographic information

One of the advantages of a tool like BibTeX is that the bibliographic database can—and should—contain complete bibliographic information for each reference while style files determine the subset of that information that is actually typeset. Hence, to help further reduce a document's length, the savetrees package additionally provides a BibTeX style file, `savetrees.bst`, which exhibits the following salient differences from `plain.bst`:

- Abbreviations are used wherever possible:

chapter	$\Longrightarrow$	chap.
edition	$\Longrightarrow$	ed.
editor *or* editors	$\Longrightarrow$	ed. *or* eds.
January, February, ...	$\Longrightarrow$	Jan., Feb., ...
page *or* pages	$\Longrightarrow$	p. *or* pp.
Technical Report	$\Longrightarrow$	Tech. Rep.

- At most two authors are listed. The remainder are replaced by "et al."
- Authors' names are abbreviated to their initials plus surname (e.g., "S. D. Pakin").

In addition, `savetrees.bst` does not normally typeset `NOTE` fields, although it can be instructed to do so by passing `savetrees` the `bibnotes=normal` package option.

To use `savetrees.bst`, simply replace your document's existing `\bibliographystyle` line with "`\bibliographystyle{savetrees}`". Then, to give `savetrees.bst`—or *any* BibTeX style file—maximum flexibility, you should obey the following rules when writing your `.bib` file:

1. Use the three-letter month macros defined by virtually all BibTeX style files instead of spelling out month names explicitly:

   Good: `MONTH = sep,`
   Can be typeset as "September", "Sept.", "SEP", "Septiembre", etc.
   Bad: `MONTH = {September},`
   Can be typeset only as "September".

2. Include authors' full names (or as much of each name as is available); let BibTeX abbreviate as necessary:

   Good: `AUTHOR = {Rufus Xavier Sarsaparilla},`
   Can be typeset either in full or abbreviated to "Rufus X. Sarsaparilla", "R. X. Sarsaparilla", etc.
   Bad: `AUTHOR = {R. X. Sarsaparilla},`
   Can be typeset only as "R. X. Sarsaparilla" and can't be expanded to the full name.

3. Include the names of *all* authors; let BibTeX decide where to truncate the list:

   Good: `AUTHOR = {Rufus Xavier Sarsaparilla and Rafaella Gabriela Sarsaparilla and Albert Andreas Armadillo},`
   All authors can be named, or the list can be truncated at any point with "et al.", "and others", or whatever.
   Bad: `AUTHOR = {Rufus Xavier Sarsaparilla and others},`
   At most one author can be named, but "and others" can still be replaced by "et al." or a different phrase, and the author's name can still be abbreviated, as discussed in the previous rule.
   Worse: `AUTHOR = {{Rufus Xavier Sarsaparilla, et al.}},`
   Can be typeset only precisely as "Rufus Xavier Sarsaparilla, et al."

The savetrees BibTeX style utilizes the same fields as the standard BibTeX styles (`plain`, `alpha`, `abbrv`, `unsrt`, etc.), with the exception that the `NOTE` field is suppressed unless the `bibnotes=normal` package option is provided.

As of version 2.0 of savetrees, `savetrees.bib` can be used independently of `savetrees.sty`.

4 Implementation of `savetrees.sty`

This section presents the complete, commented source code for the savetrees package. Although reading this section—and the subsequent implementation sections—is not necessary for understanding how to use savetrees, it may be a useful teaching instrument for LaTeX newcomers who want to learn more about fine-tuning document formatting.

1 ⟨*package⟩

4.1 Default values

savetrees attempts to provide a reasonable balance between aesthetics and the amount of space saved in a document. However, savetrees does enable the document author to adjust a number of parameters to bias savetrees's behavior towards either reduced document length or prettier output. This section defines the default values for various package parameters.

`\st@margin@width` When `margins=tight`, `\st@margin@width` specifies how wide the page margins should be. The default, 1.5 cm, is extremely small, but it can sure save a lot of space on the page.

```
2 \newcommand*{\st@margin@width}{1.5cm}
```

`\st@parindent` The standard LaTeX classes (`article`, `report`, and `book`) define paragraph indentation as follows. If `twocolumn` is in effect, `\parindent` is set to 1 em. Otherwise, if the base font size is 10 pt., `\parindent` is set to 15 pt.; if the base font size is 11 pt., `\parindent` is set to 17 pt.; and if the base font size is 12 pt., `\parindent` is set to 1.5 em. When `indent=tight`, savetrees uses a default of 1 em—approximately a third of the no-savetrees value—regardless of font size.

```
3 \newcommand*{\st@parindent}{1em}
```

`\st@baselinestretch` Depending on font size, the standard LaTeX classes (`article`, `report`, and `book`) use 2–2.6 pt. lead (inter-line spacing), or approximately 20% of font size. Specifically, they typeset body text at 10/12, 11/13.6, or 12/14.5. When `leading=tight`, savetrees reduces the line spacing to 95% of normal or an average of about 0.67 pt. less lead than LaTeX's defaults: 10/11.4, 11/12.92, or 12/13.78. 95% gives very good compression but still prevents descenders from running into successive ascenders.

```
4 \newcommand*{\st@baselinestretch}{0.95}
```

\st@char@shrink When `charwidths=tight`, savetrees disables font expansion but enables font compaction. The default contraction of 5% (50/1000) of normal character widths is largely undetectable to the casual observer but can save a great deal of space over the course of a long document.

```
\newcommand*{\st@char@shrink}{50}
```

\st@cspace@shrink savetrees reduces tracking (inter-character spacing) when `tracking=tight`. By default, tracking is set to -2.5% (-25/1000) of an em width. When decreased much more than that, characters begin to overlap and become hard to read.

```
\newcommand*{\st@cspace@shrink}{-25}
```

\st@wspace@factor savetrees reduces inter-word spacing when `wordspacing=tight`. By default, inter-word spacing is set to 80% of normal. If decreased much beyond that, words start to run together and become hard to read.

```
\newcommand*{\st@wspace@factor}{0.8}
```

4.2 Option processing

4.2.1 Enabling/disabling space-saving techniques

By default, savetrees tries to make documents extremely dense. However, this also makes them rather ugly. The package options defined below let the author specify which space-saving routines are unacceptably grotesque and should not be utilized.

savetrees uses the xkeyval package to parse its package options.

```
\RequirePackage{xkeyval}
```

\st@more@packages \st@RequirePackage As we process the package options we may encounter additional packages that we need to load. Rather than load them eagerly, which may lead to the same package problematically being loaded twice with different options, we merely construct a list of required packages. Then, as savetrees's last action before finishing, it loads all of the pending packages. `\st@RequirePackage` takes the same arguments as `\RequirePackage` but simply adds the package name to the `\st@more@packages` list and instructs LaTeX 2$_\varepsilon$ to eventually pass the given arguments, if any, to the package.

```
\def\st@more@packages{}

\newcommand*{\st@RequirePackage}[2][]{%
  \PassOptionsToPackage{#1}{#2}%
  \@cons\st@more@packages{{#2}}%
}

\AtEndOfPackage{%
  \let\@elt=\RequirePackage
  \st@more@packages
  \let\@elt=\relax
}
```

\st@define@option
\st@arg
\st@arg@num

savetrees accepts a large number of package options, each of which can be set to `tight` (the default) to enable a feature or `normal` to disable it. As the definitions of these options are fairly repetitive, we define a helper macro to assist with the processing.

```
\newcommand*{\st@define@option}[1]{%
  \expandafter\newif\csname if@st@tight@#1\endcsname
  \csname @st@tight@#1true\endcsname
  \define@choicekey{savetrees}{#1}[\st@arg\st@arg@num]{tight,normal}[tight]{%
    \ifnum\st@arg@num=0
      \csname @st@tight@#1true\endcsname
    \else
        \csname @st@tight@#1false\endcsname
    \fi
  }%
  \DeclareOptionX{#1}[tight]{\csname KV@savetrees@#1\endcsname{##1}}%
}
```

Using the preceding macro we define one conditional and one package option for each trick in savetrees's book. When *true* (caused by passing `tight` to the package option), the conditional enables the corresponding space compression; when *false*, (caused by passing `normal` to the package option), savetrees leaves alone that aspect of the formatting.

\if@st@tight@sections
\@st@tight@sectionstrue
\@st@tight@sectionsfalse
\KV@savetrees@sections

The sections package option enables or disables savetrees's modifications to section titles by setting `\@st@tight@sectionstrue` or `\@st@tight@sectionsfalse`, respectively.

```
\st@define@option{sections}
```

\if@st@tight@margins
\@st@tight@marginstrue
\@st@tight@marginsfalse
\KV@savetrees@margins

The margins package option enables or disables savetrees's modifications to page margins by setting `\@st@tight@marginstrue` or `\@st@tight@marginsfalse`, respectively.

```
\st@define@option{margins}
```

\if@st@tight@lists
\@st@tight@liststrue
\@st@tight@listsfalse
\KV@savetrees@lists

The lists package option enables or disables savetrees's modifications to the various list environments by setting `\@st@tight@liststrue` or `\@st@tight@listsfalse`, respectively.

```
\st@define@option{lists}
```

\if@st@tight@floats
\@st@tight@floatstrue
\@st@tight@floatsfalse
\KV@savetrees@floats

The floats package option enables or disables savetrees's modifications to LaTeX's float-placement parameters by setting `\@st@tight@floatstrue` or `\@st@tight@floatsfalse`, respectively.

```
\st@define@option{floats}
```

\if@st@tight@indent
\@st@tight@indenttrue
\@st@tight@indentfalse
\KV@savetrees@indent

The indent package option enables or disables savetrees's modifications to paragraph indentation by setting `\@st@tight@indenttrue` or `\@st@tight@indentfalse`, respectively.

```
\st@define@option{indent}
```

\if@st@tight@title
\@st@tight@titletrue
\@st@tight@titlefalse
\KV@savetrees@title

The title package option enables or disables savetrees's modifications to title formatting by setting \@st@tight@titletrue or \@st@tight@titlefalse, respectively.

```
\st@define@option{title}
```

\if@st@tight@leading
\@st@tight@leadingtrue
\@st@tight@leadingfalse
\KV@savetrees@leading

The leading package option enables or disables savetrees's modifications to interline spacing by setting \@st@tight@leadingtrue or \@st@tight@leadingfalse, respectively. This interline spacing is known as "leading" because of the additional strips of lead placed between lines in the days of metal type.

```
\st@define@option{leading}
```

\if@st@tight@paragraphs
\@st@tight@paragraphstrue
\@st@tight@paragraphsfalse
\KV@savetrees@paragraphs

The paragraphs package option enables or disables savetrees's modifications to TEX's paragraph looseness (i.e., the number of lines by which TEX is instructed to shrink each paragraph) by setting \@st@tight@paragraphstrue or \@st@tight@paragraphsfalse, respectively.

```
\st@define@option{paragraphs}
```

\if@st@tight@charwidths
\@st@tight@charwidthstrue
\@st@tight@charwidthsfalse
\KV@savetrees@charwidths

The charwidths package option enables or disables savetrees's modifications to character width by setting \@st@tight@charwidthstrue or \@st@tight@charwidthsfalse, respectively.

```
\st@define@option{charwidths}
```

\if@st@tight@tracking
\@st@tight@trackingtrue
\@st@tight@trackingfalse
\KV@savetrees@tracking

The tracking package option enables or disables savetrees's modifications to tracking (spacing between letters) by setting \@st@tight@trackingtrue or \@st@tight@trackingfalse, respectively.

```
\st@define@option{tracking}
```

\if@st@tight@wordspacing
\@st@tight@wordspacingtrue
\@st@tight@wordspacingfalse
\KV@savetrees@wordspacing

The wordspacing package option enables or disables savetrees's modifications to inter-word spacing by setting \@st@tight@wordspacingtrue or \@st@tight@wordspacingfalse, respectively.

```
\st@define@option{wordspacing}
```

\if@st@tight@bibliography
\@st@tight@bibliographytrue
\@st@tight@bibliographyfalse
\KV@savetrees@bibliography

The bibliography package option enables or disables savetrees's modifications to bibliography formatting by setting \@st@tight@bibliographytrue or \@st@tight@bibliographyfalse, respectively.

```
\st@define@option{bibliography}
```

\if@st@tight@bibnotes
\@st@tight@bibnotestrue
\@st@tight@bibnotesfalse
\KV@savetrees@bibnotes

The bibnotes package option conditionally excludes or includes NOTE fields when using savetrees.bst by setting \@st@tight@bibnotestrue or \@st@tight@bibnotesfalse, respectively.

```
\st@define@option{bibnotes}
```

\if@st@tight@mathspacing
\@st@tight@mathspacingtrue
\@st@tight@mathspacingfalse
\KV@savetrees@mathspacing

The mathspacing package option enables or disables savetrees's modifications to horizontal spacing within mathematical expressions by setting \@st@tight@mathspacingtrue or \@st@tight@mathspacingfalse, respectively.

```
\st@define@option{mathspacing}
```

\if@st@tight@mathdisplays
\@st@tight@mathdisplaystrue
\@st@tight@mathdisplaysfalse
\KV@savetrees@mathdisplays

The mathdisplays package option enables or disables savetrees's modifications to vertical spacing surrounding mathematical displays by setting \@st@tight@mathdisplaystrue or \@st@tight@mathdisplaysfalse, respectively.

```
\st@define@option{mathdisplays}
```

4.2.2 Meta options

savetrees provides a large number of package options, which might be overwhelming for a casual user. Here, we define a few "meta options" that set multiple, related, package options en masse.

\KV@savetrees@all
\st@arg
\st@arg@num

Define an all meta-option that can be used to enable or disable all of savetrees's space-saving features at once.

```
\define@choicekey{savetrees}{all}[\st@arg\st@arg@num]{tight,normal}[tight]{%
  \ifnum\st@arg@num=0
    \@st@tight@sectionstrue
    \@st@tight@marginstrue
    \@st@tight@liststrue
    \@st@tight@floatstrue
    \@st@tight@indenttrue
    \@st@tight@titletrue
    \@st@tight@leadingtrue
    \@st@tight@paragraphstrue
    \@st@tight@charwidthstrue
    \@st@tight@trackingtrue
    \@st@tight@wordspacingtrue
    \@st@tight@bibliographytrue
    \@st@tight@bibnotestrue
    \@st@tight@mathspacingtrue
    \@st@tight@mathdisplaystrue
  \else
    \@st@tight@sectionsfalse
    \@st@tight@marginsfalse
    \@st@tight@listsfalse
    \@st@tight@floatsfalse
    \@st@tight@indentfalse
    \@st@tight@titlefalse
    \@st@tight@leadingfalse
    \@st@tight@paragraphsfalse
    \@st@tight@charwidthsfalse
    \@st@tight@trackingfalse
    \@st@tight@wordspacingfalse
    \@st@tight@bibliographyfalse
    \@st@tight@bibnotesfalse
    \@st@tight@mathspacingfalse
    \@st@tight@mathdisplaysfalse
  \fi
}
```

```
\DeclareOptionX{all}[tight]{\KV@savetrees@all{#1}}
```

\KV@savetrees@subtle The subtle package option turns off all of savetrees's space-saving tricks except those that preserve document layout: margins, indentation, font heights, vertical spacing surrounding titles, lists, displays, etc.

```
\define@key{savetrees}{subtle}{%
  \setkeys{savetrees}{%
    all=normal,
    paragraphs=tight,
    floats=tight,
    mathspacing=tight,
    wordspacing=tight,
    tracking=tight
  }%
}
\DeclareOptionX{subtle}{\KV@savetrees@subtle}
```

\KV@savetrees@moderate The moderate package option includes everything covered by subtle but additionally makes the font narrower, removes vertical white space around lists and displays, cuts back on indentation, reduces interline spacing, and drops `NOTE` fields from the bibliography,

```
\define@key{savetrees}{moderate}{%
  \setkeys{savetrees}{%
    subtle=yes,
    charwidths=tight,
    mathdisplays=tight,
    lists=tight,
    indent=tight,
    leading=tight,
    bibnotes=tight
  }%
}
\DeclareOptionX{moderate}{\KV@savetrees@moderate}
```

\KV@savetrees@extreme The extreme package option is simply a synonym for `all=tight`.

```
\DeclareOptionX{extreme}{%
  \setkeys{savetrees}{all=tight}%
}
```

4.2.3 Parameter tuning

While savetrees tries to use reasonable defaults for the numerical values used by its space-saving techniques, many of these parameters can be modified conveniently via package options:

The marginwidth option specifies the width of the page margins when `margins=tight`.

```
\DeclareOptionX{marginwidth}{\gdef\st@margin@width{#1}}
```

The parindent option specifies the paragraph indent when `indent=tight`.

```
\DeclareOptionX{parindent}{\gdef\st@parindent{#1}}
```

The leadingfraction option specifies the fraction by which to multiply the line spacing when `leading=tight`.

```
\DeclareOptionX{leadingfraction}{\gdef\st@baselinestretch{#1}}
```

The charwidthfraction option specifies the fraction by which to multiply character-glyph widths when `charwidths=tight`. Because the microtype package takes a per mill width contraction we have to do some arithmetic to produce `\st@char@shrink`.

```
\DeclareOptionX{charwidthfraction}{%
  \@tempdima=#1pt
  \multiply\@tempdima by -1000
  \advance\@tempdima by 1000pt
  \divide\@tempdima by 65536
  \@tempcnta=\@tempdima
  \xdef\st@char@shrink{\the\@tempcnta}%
}
```

The trackingfraction option specifies the fraction by which to multiply character spacing when `tracking=tight`. Because the microtype package takes a per mill width expansion we have to do some arithmetic to produce `\st@cspace@shrink`.

```
\DeclareOptionX{trackingfraction}{%
  \@tempdima=#1pt
  \advance\@tempdima by -1pt
  \multiply\@tempdima by 1000
  \divide\@tempdima by 65536
  \@tempcnta=\@tempdima
  \xdef\st@cspace@shrink{\the\@tempcnta}%
}
```

The wordspacingfraction option specifies the fraction by which to multiply inter-word spacing when `wordspacing=tight`.

```
\DeclareOptionX{wordspacingfraction}{\gdef\st@wspace@factor{#1}}
```

4.2.4 Obsolete options

savetrees used to name all of its options `normal`⟨*something*⟩. None of these took arguments so the only usage model was for savetrees to turn all space-saving techniques on by default and let the user selectively disable them. Starting with version 2.0, savetrees package options take the form ⟨*something*⟩[`=tight`] or ⟨*something*⟩`=normal`, which gives a document author the ability to enable or disable options as desired. To move authors to the new set of parameters, we define all of the old options as error-generating calls.

`\st@mark@as@obsolete` We define a helper macro that processes the given option by issuing an error message that instructs the document author to use a different option instead.

```
\newcommand*{\st@mark@as@obsolete}[2]{%
  \define@key{savetrees}{#1}[tight]{%
```

```
    \PackageError{savetrees}{Package option `#1' is no longer supported}{%
      Rather than `#1', please specify `#2=normal'.\MessageBreak
      Instead of enabling all features by default and letting the\MessageBreak
      user selectively disable them, savetrees now provides the\MessageBreak
      ability to turn features on or off as desired, including all\MessageBreak
      features en masse.}%
```

Out of the goodness of our heart, we automatically convert the obsolete option to a new option and evaluate that.

```
    \csname @st@tight@#2false\endcsname
  }%
  \DeclareOptionX{#1}[tight]{\csname KV@savetrees@#1\endcsname{##1}}%
}
```

We now invoke `\st@mark@as@obsolete` once for each obsolete savetrees option,

```
\st@mark@as@obsolete{normalsections}{sections}
\st@mark@as@obsolete{normalmargins}{margins}
\st@mark@as@obsolete{normallists}{lists}
\st@mark@as@obsolete{normalfloats}{floats}
\st@mark@as@obsolete{normalindent}{indent}
\st@mark@as@obsolete{normaltitle}{title}
\st@mark@as@obsolete{normalleading}{leading}
\st@mark@as@obsolete{normallooseness}{paragraphs}
\st@mark@as@obsolete{normalcharwidths}{charwidths}
\st@mark@as@obsolete{normalbib}{bibliography}
\st@mark@as@obsolete{normalbibnotes}{bibnotes}
```

At long last, we can process all of the options defined in Section Section 4.2.

```
\ProcessOptionsX\relax
```

4.3 Section titles

The LaTeX default is to typeset section titles in a large font and with significant surrounding white space. We use the titlesec package to typeset section titles in the same font size as the body text and to leave only a single blank line above and below them.

```
\if@st@tight@sections
  \st@RequirePackage[tiny,compact]{titlesec}
\fi
```

4.4 Page margins

The typesetting wisdom of the ages says that the human eye is most comfortable reading approximately 60 characters per line of text, and this is what LaTeX's default margins aim to achieve. Of course, narrower margins mean fewer pages, and that's what savetrees is striving for.

We use the geometry package to narrow our page margins unless the author wants to keep LaTeX's original ones. Note that we accept geometry's default of zero space allocated to marginal notes.

```
\if@st@tight@margins
  \st@RequirePackage[lmargin=\st@margin@width,
                     rmargin=\st@margin@width,
                     tmargin=\st@margin@width,
                     bmargin=\st@margin@width,
                     includefoot,
                     footskip=2ex]{geometry}
\fi
```

4.5 List spacing

We try to save space in itemized lists, enumerated lists, and description lists by reducing indentation and by eliminating pre-list and inter-item spacing altogether.

```
\if@st@tight@lists
```

The calc package helps simplify our list redefinitions.

```
  \st@RequirePackage{calc}
```

`itemize` Except where indicated, the following code was taken directly from LaTeX 2$_\varepsilon$'s definition of the `itemize` environment, in `ltlists.dtx`:

```
  \def\itemize{%
    \ifnum \@itemdepth >\thr@@\@toodeep\else
      \advance\@itemdepth\@ne
      \edef\@itemitem{labelitem\romannumeral\the\@itemdepth}%
      \expandafter
      \list
        \csname\@itemitem\endcsname
        {\def\makelabel##1{\hss\llap{##1}}%
```

The following lines have been modified from the original.

```
         \settowidth{\leftmargin}{\csname\@itemitem\endcsname}%
         \addtolength{\leftmargin}{\labelsep * \@itemdepth}%
         \setlength{\partopsep}{0pt plus 4pt}%
         \setlength{\topsep}{0pt plus 4pt}%
         \setlength{\itemsep}{0pt}%
         \setlength{\parsep}{0pt}%
         \setlength{\listparindent}{\st@parindent}%
```

That's it for the modifications. We can now finish up the redefinition of `itemize`.

```
        }%
    \fi}
```

`enumerate` Except where indicated, the following code was taken directly from LaTeX 2$_\varepsilon$'s definition of the `enumerate` environment, in `ltlists.dtx`:

```
  \def\enumerate{%
    \ifnum \@enumdepth >\thr@@\@toodeep\else
      \advance\@enumdepth\@ne
      \edef\@enumctr{enum\romannumeral\the\@enumdepth}%
        \expandafter
        \list
```

```
          \csname label\@enumctr\endcsname
          {\usecounter\@enumctr\def\makelabel##1{\hss\llap{##1}}%
```

The following lines have been modified from the original.

```
           \settowidth{\leftmargin}{\csname label\@enumctr\endcsname}%
           \addtolength{\leftmargin}{\labelsep * \@enumdepth}%
           \setlength{\partopsep}{0pt plus 4pt}%
           \setlength{\topsep}{0pt plus 4pt}%
           \setlength{\itemsep}{0pt}%
           \setlength{\parsep}{0pt}%
           \setlength{\listparindent}{\st@parindent}%
```

That's it for the modifications. We can now finish up the redefinition of `enumerate`.

```
          }
    \fi}
```

`description` The `description` environment is a bit simpler than the `itemize` and `enumerate` environments; it's a direct application of `list`. All we need to do is reduce the left margin from the `list` default of 2 em to a slightly denser 1 pc.

```
\renewenvironment{description}{%
  \begin{list}{}{\setlength{\leftmargin}{1pc}%
                 \setlength{\itemindent}{-\leftmargin}%
                 \setlength{\partopsep}{0pt plus 4pt}%
                 \setlength{\topsep}{0pt plus 4pt}%
                 \setlength{\itemsep}{0pt}%
                 \setlength{\parsep}{0pt}%
                 \setlength{\labelwidth}{0pt}%
                 \setlength{\listparindent}{\st@parindent}%
                 \let\makelabel\descriptionlabel}%
}{%
  \end{list}
}
\fi
```

4.6 Float placement

`\topfraction` `\bottomfraction` `\textfraction` `\floatpagefraction` `\dbltopfraction` `\dblfloatpagefraction` LaTeX normally doesn't try very hard to pack floats onto a page. The following parameter changes attempt to reduce the number of float pages (and hence, total pages).

```
\if@st@tight@floats
  \renewcommand{\topfraction}{0.85}
  \renewcommand{\bottomfraction}{0.85}
  \renewcommand{\textfraction}{0.1}
  \renewcommand{\floatpagefraction}{0.85}
  \renewcommand{\dbltopfraction}{0.85}
  \renewcommand{\dblfloatpagefraction}{.85}
  \setcounter{topnumber}{25}
  \setcounter{bottomnumber}{25}
  \setcounter{totalnumber}{25}
  \setcounter{dbltopnumber}{25}
```

```
\fi
```

4.7 Paragraph indentation

LaTeX normally provides approximately 1.5 em of indentation at the start of each paragraph. We can save a little space by slightly reducing the indentation amount.

```
\if@st@tight@indent
  \setlength{\parindent}{\st@parindent}
\fi
```

4.8 Document title formatting

By default, the document title is typeset in the `\LARGE` font size, and the author list and date are typeset `\large`. We redefine `\@maketitle` to typeset the title `\large` and everything else in the body font. In addition, we remove the extra white space above the title and lessen the white space below the title.

```
\if@st@tight@title
```

`\@maketitle` The following was taken largely from `classes.dtx`, but modified as specified above.

```
  \def\@maketitle{%
    \newpage
    \null
    \begin{center}%
      \let \footnote \thanks
      {\large \textbf{\@title}\par}
      \vskip 0.5\baselineskip
      \begin{tabular}[t]{c}%
        \@author
      \end{tabular}\par
      \vskip 0.5\baselineskip
      \@date
    \end{center}%
    \par
    \vskip \baselineskip
  }
\fi
```

4.9 Interline spacing

`\baselinestretch` A document's page count can be reduced quite significantly by reducing the amount of white space between successive lines of text so that's exactly what we do below.

```
\if@st@tight@leading
  \renewcommand{\baselinestretch}{\st@baselinestretch}
\fi
```

4.10 Paragraph looseness

Some paragraphs end with a lone word on the last line. If we can discourage such typesetting we can gain an extra line. The underlying mechanism we use is TEX's `\looseness` primitive, which encourages TEX to expand the current paragraph by a given number of lines. However, `\looseness` can be set to a negative number, which encourages TEX to shrink the current paragraph by a given number of lines. For this technique to work, the paragraph must be relatively long so TEX has enough shrinkable white space to work with.

Unfortunately, `\looseness` applies only to the current paragraph. We therefore use `\everypar` to inject `\looseness=-1` into every paragraph. However, the approach is not quite so simple as the `\looseness=-1` is not injected into list environments. We therefore use some tricky code due to Donald Arseneau to make the effect of `\looseness=-1` as global as possible:

```
\if@st@tight@paragraphs
  \let\markeverypar\everypar
  \newtoks\everypar
  \everypar\markeverypar
  \markeverypar{\the\everypar\looseness=-1\relax}
\fi
```

Even when `\everypar` is used in the ordinary fashion it is likely to conflict with various LATEX packages. Because the preceding code is a particularly tricky redefinition of `\everypar` it's likely that many documents will need to disable paragraph looseness by providing the `paragraphs=normal` option to savetrees.

4.11 Font width

The microtype package provides LATEX support for the font-expansion feature supported by pdfTEX and luaTEX. Font expansion is intended to improve text "color"—the even balance between ink and absence of ink on a page—by subtly expanding or narrowing character widths instead of by adding or removing white space. savetrees hijacks this feature as a space-saving mechanisms by specifying a maximum expansion of 0% of a character's natural width but a maximum contraction of greater than 0%.

```
\if@st@tight@charwidths
  \st@RequirePackage[stretch=0,shrink=\st@char@shrink]{microtype}
\fi
```

4.12 Inter-character spacing

The microtype package provides LATEX support for pdfTEX's tracking feature. Rather than using tracking with a light touch and just in certain contexts (e.g., small caps), we instruct microtype to track somewhat aggressively, shaving off a few percent of an em width between *every* pair of characters.

```
\if@st@tight@tracking
  \st@RequirePackage[letterspace=\st@cspace@shrink,tracking=all]{microtype}
```

```
\fi
```

4.13 Inter-word spacing

Any font used by TEX is required to have at least seven `\fontdimen` parameters. `\fontdimen2` represents the base inter-word spacing. (`\fontdimen3` and `\fontdimen4` represent, respectively, the amount by which inter-word spacing can stretch or shrink; savetrees does not currently alter those.) Here, we hook into LATEX 2_ε's font-loading mechanism. Whenever a new font is loaded, we specify that the inter-word spacing for that font should be reduced.

```
\if@st@tight@wordspacing
  \g@addto@macro\define@newfont{%
    \fontdimen2\font@name=\st@wspace@factor\fontdimen2\font@name
  }%
```

We also reduce the inter-word spacing for whatever font is currently loaded.

```
  \fontdimen2\font@name=\st@wspace@factor\fontdimen2\font@name
\fi
```

4.14 Bibliography formatting

There are two ways we save space when typesetting bibliographies. First, we omit blank linkes between entries. And second, we typeset the entire bibliography—excluding the section title—with `\small`.

```
\if@st@tight@bibliography
```

`thebibliography` The following was taken largely from `classes.dtx`; see that file for additional documentation. savetrees's modifications are indicated below.

```
  \renewenvironment{thebibliography}[1]{%
```

In the `article` document class, a bibliography is a *section* called "`\refname`". In the `report` and `book` document classes, a bibliography is a *chapter* called "`\bibname`". In `classes.dtx`, the correct code is extracted by DocStrip. Here, we have to use an `\ifx` primitive to select the appropriate title and formatting.

```
    \@ifundefined{chapter}{%
      \section*{\refname
        \@mkboth{\MakeUppercase\refname}{\MakeUppercase\refname}}%
    }{%
      \chapter*{\bibname
        \@mkboth{\MakeUppercase\bibname}{\MakeUppercase\bibname}}%
    }%
```

Back to the original code...

```
    \list{\@biblabel{\@arabic\c@enumiv}}%
         {\settowidth\labelwidth{\@biblabel{#1}}%
          \leftmargin\labelwidth
          \advance\leftmargin\labelsep
```

We eliminate the space between paragraphs, and we set the space between items to only 1 pt. We could have set this to 0 pt., but the extra space helps keep the citation numbers' brackets from getting too close to each other, vertically.

```
            \setlength{\parsep}{0pt}%
            \setlength{\itemsep}{1pt}%
```

Back to the original code...

```
            \@openbib@code
            \usecounter{enumiv}%
            \let\p@enumiv\@empty
            \renewcommand\theenumiv{\@arabic\c@enumiv}}%
```

Although we kept the section title in its original size, we typeset the rest of the bibliography a little bit smaller.

```
      \small
```

We finish up using the original code.

```
      \sloppy
      \clubpenalty4000
      \@clubpenalty \clubpenalty
      \widowpenalty4000%
      \sfcode`\.\@m
  }{%
    \def\@noitemerr
         {\@latex@warning{Empty `thebibliography' environment}}%
    \endlist
  }
\fi
```

4.15 Bibliographic notes

`\savetreesbibnote` The bibliographies output by the `savetrees.bst` BibTeX style (presented in Section 5) surround all `NOTE` fields with a call to the `\savetreesbibnote` macro. As a result, this macro must be defined for `savetrees.bst` to work. By default, `\savetreesbibnote` is defined to do nothing. Howevever, setting `bibnotes=normal` indicates that `\savetreesbibnote` should instead output its argument as is.

```
\if@st@tight@bibnotes
```

To supppress a `NOTE` field, we also have to gobble the period following the note. Otherwise, the bibliography will show two periods surrounding an empty note.

```
  \newcommand{\savetreesbibnote}[1]{\@gobble}
\else
  \newcommand{\savetreesbibnote}[1]{#1}
\fi
```

4.16 Mathematical expressions

By default, mathematical expressions contain substantial white space around operators, relations, etc. Here, we shave approximately three math units off each

of `\thinmuskip`, `\medmuskip`, and `\thickmuskip`. This needs to happen after the `\begin{document}` so that the new values don't get overwritten.

```
\if@st@tight@mathspacing
  \AtBeginDocument{%
    \thinmuskip=0mu plus 3mu
    \medmuskip=1mu plus 4mu
    \thickmuskip=2mu plus 5mu
  }
\fi
```

4.17 Displayed mathematics

Displayed mathematical expressions are normally offset from the surrounding text with vertical white space. Here, we set the amount of vertical white space to zero. This needs to happen after the `\begin{document}` so that the new values don't get overwritten.

```
\if@st@tight@mathdisplays
  \AtBeginDocument{%
    \abovedisplayskip=0pt plus 3pt
    \belowdisplayskip=0pt plus 3pt
    \abovedisplayshortskip=0pt plus 3pt
    \belowdisplayshortskip=0pt plus 3pt
  }
\fi
```

⟨/package⟩

5 Implementation of `savetrees.bst`

In addition to a LaTeX 2ε style, the savetrees package also includes a BibTeX style, `savetrees.bst`. `savetrees.bst` was generated with the help of Patrick W. Daly's custom-bib package. The following options were provided to `merlin.mbs`:

```
lang, nm-init, ed-au, nmdash, nmlm, x2, m2, isbn,
issn, pp, ed, abr, ednx, xedn, jabr, nfss
```

Because `savetrees.bst` is a generated file—and can be regenerated using the options listed above—it is unnecessary to list the complete source code in this document. Rather, only the hand-modified parts are presented below.

⟨*bibstyle⟩

⋮

(443 lines of code omitted)

⋮

`format.note` is the first of two functions modified by hand. The modification involves placing the entire note field within `\savetreesbibnote{...}`. This enables `savetrees.sty` to selectively define `\savetreesbibnote` to either output its argument as is or discard it (and the subsequent period). See Section 4.15 for `savetrees.sty`'s definition of `\savetreesbibnote`.

```
FUNCTION {format.note}
{
 note empty$
    { "" }
    { "\savetreesbibnote{"
      note #1 #1 substring$
      duplicate$ "{" =
        'skip$
        { output.state mid.sentence =
          { "l" }
          { "u" }
        if$
        change.case$
        }
      if$
      note #2 global.max$ substring$ *
      "}" * *
    }
  if$
}
```

⋮

(914 lines of code omitted)

⋮

`begin.bib` is the second of two functions modified by hand. The modification is to have the function write some additional code to the `.bbl` file to define `\savetreesbibnote` as the identity function if that macro is not already defined.

```
FUNCTION {begin.bib}
{ preamble$ empty$
    'skip$
    { preamble$ write$ newline$ }
  if$
  "\begin{thebibliography}{"  longest.label  * "}" *
  write$ newline$
  "\providecommand*{\selectlanguage}[1]{\relax}%"
  write$ newline$
  "\providecommand*{\savetreesbibnote}[1]{#1}%"
  write$ newline$
}
```

⋮

(13 lines of code omitted)

⋮

352 ⟨/bibstyle⟩

A Average character widths of common fonts

Question: What's the narrowest font?

Answer: It depends upon how you measure. Table 5 shows, for various 10 pt. fonts, the width in points of 1000 lowercase letters with relative frequencies chosen to match "typical" English text. There are 130 e's, 93 t's, 78 n's, 77 r's, and so forth down the frequency distribution. According to the table, Times is statistically likely to be the best typeface for maximizing the amount of text on the page. However, Times may not be the narrowest for *your* document; you'll have to experiment and see.

Typeface	Package	Avg. width (pt.)
Times	mathptmx	4.26901
Computer Modern	(default)	4.62675
Charter	charter	4.6762
Helvetica	helvet	4.70108
Palatino	mathpazo	4.79744
Utopia	utopia	4.92876
New Century Schoolbook	newcent	4.98047
Avant Garde	avant	5.22113
Bookman	bookman	5.23056
Courier	courier	6

Table 5: Common fonts sorted by increasing width

Although savetrees does not automatically change the document font it does specify that character glyphs may be typeset narrower than normal (cf. the charwidth option). Note, however, that savetrees unfortunately has no control over precisely which lines of text are typeset with narrow characters. This narrowing technique works only with pdfLaTeX, so that program should be used if possible to maximize the space-saving achievable with savetrees.

B Gallery of space-saving techniques

Figure 1 through Figure 7 on pages 24–27 provide examples of some of the ways that savetrees saves space when typesetting text. Each figure showcases a single space-saving technique in isolation. The default pararameters are used for each technique. Table 4 on page 5 documents the package options that can be used to

refine these parameters either to save more space or to make the typesetting less offensive.

Figure 1 shows how setting `lists=tight` saves space by reducing the white space above, below, and within list environments (in this case, the `itemize` environment). Figure 2 shows how setting `mathspacing=tight` saves space by typesetting mathematical expressions denser. Figure 3 shows how setting `mathdisplays=tight` removes the space around mathematical displays (e.g., `\[...\]` or `\begin{equation}...\end{equation}`). Figure 4 shows how setting `wordspacing=tight` saves space by typesetting words closer together. Figure 5 shows how setting `tracking=tight` saves space by typesetting the characters within a word closer together. Figure 6 shows how setting `charwidths=tight` saves space by narrowing the individual character glyphs without affecting the font's point size (height) or amount of white space. Finally, Figure 7 shows how setting `leading=tight` saves space by removing white space between adjacent lines of text. Again, these techniques are shown with their default parameters, which can be adjusted if desired.

While Figure 1 through Figure 7 each illustrate a single space-saving technique, Figure 8 on page 28 demonstrates that when multiple techniques are used in combination, the benefits are essentially additive.

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

- curabitur
- tellus
- nulla

Quisque feugiat lacinia mauris ut tincidunt.

(a) `lists=normal`

Lorem ipsum dolor sit amet, consectetur adipiscing elit.
- curabitur
- tellus
- nulla

Quisque feugiat lacinia mauris ut tincidunt.

(b) `lists=tight`

Figure 1: Effect of the `lists` option

Lorem ipsum dolor sit amet, consectetur adipiscing elit $\mathcal{H} = T + V$ quisque feugiat $T = \frac{p^2}{2m}$ lacinia mauris $V = V(q)$ ut tincidunt. Etiam ligula dolor $\mathcal{H} = \sum_i \dot{q}_i \frac{\partial \mathcal{L}}{\partial \dot{q}_i} - \mathcal{L} = \sum_i \dot{q}_i p_i - \mathcal{L}$ eget nulla.

(a) `mathspacing=normal`

Lorem ipsum dolor sit amet, consectetur adipiscing elit $\mathcal{H}=T+V$ quisque feugiat $T=\frac{p^2}{2m}$ lacinia mauris $V=V(q)$ ut tincidunt. Etiam ligula dolor $\mathcal{H}=\sum_i \dot{q}_i \frac{\partial \mathcal{L}}{\partial \dot{q}_i} - \mathcal{L} = \sum_i \dot{q}_i p_i - \mathcal{L}$ eget nulla.

(b) `mathspacing=tight`

Figure 2: Effect of the `mathspacing` option

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam dapibus

$$\mathrm{d}\mathcal{L} = \sum_i \left(\frac{\partial \mathcal{L}}{\partial q_i} \mathrm{d}q_i + p_i \mathrm{d}\dot{q}_i \right) + \frac{\partial \mathcal{L}}{\partial t} \mathrm{d}t$$

tempus dolor ac dignissim. Etiam ligula dolor, varius at rutrum.

(a) `mathdisplays=normal`

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam dapibus

$$\mathrm{d}\mathcal{L} = \sum_i \left(\frac{\partial \mathcal{L}}{\partial q_i} \mathrm{d}q_i + p_i \mathrm{d}\dot{q}_i \right) + \frac{\partial \mathcal{L}}{\partial t} \mathrm{d}t$$

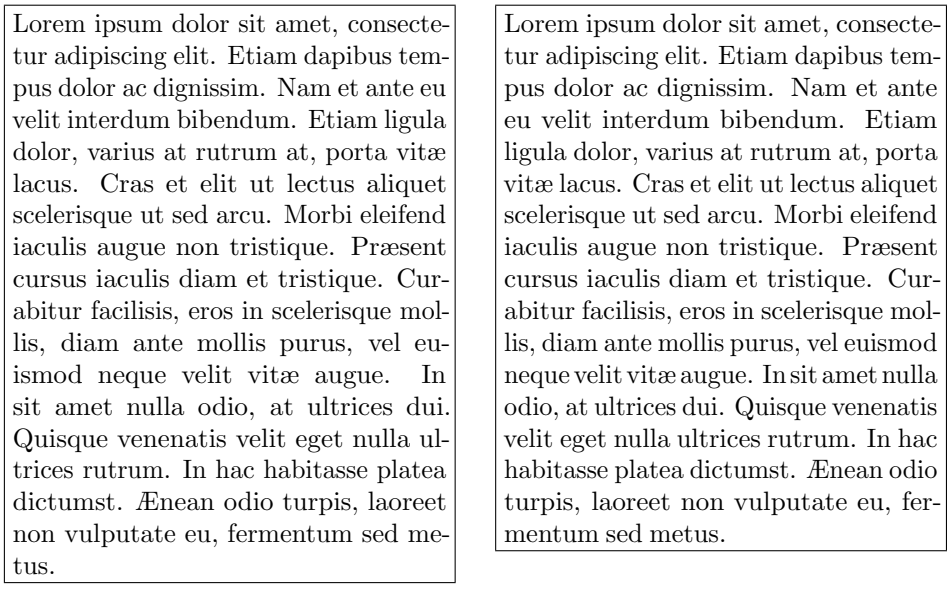
tempus dolor ac dignissim. Etiam ligula dolor, varius at rutrum.

(b) `mathdisplays=tight`

Figure 3: Effect of the `mathdisplays` option

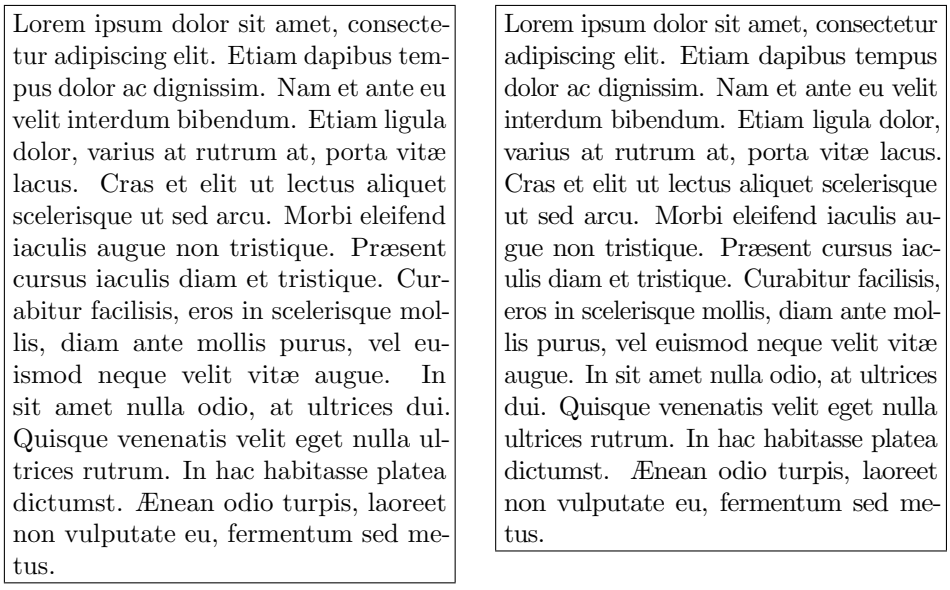
Change History

v1.0
General: Initial version 1
v1.1
`thebibliography`: Modified to test for `\chapter`, not `\bibname`. . 19
v1.2
General: Added support for reducing paragraph looseness 18
Made the top margin consistent with the other margins and allocated space for the footer . . . 14
`thebibliography`: Modified to use the more robust `\@ifundefined` macro to test for the existence of `\chapter` 19
v1.2a
General: Appended `\relax` to `\looseness=-1` to avoid discarding any leading digits appearing in a paragraph 18
v1.3
General: Added support for narrowing font widths 18
v2.0
General: Added package options for altering various formatting parameters 12
Added support for reducing intercharacter spacing 18
Added support for reducing interword spacing 19
Made `savetrees.bib` work independently of `savetrees.sty` by having it define `\savetreesbibnote` if not already defined 22
Removed the awkward-to-use `makethin` script now that the microtype package can shrink character widths more automatically 7
v2.1
General: Added support for removing vertical space around displayed mathematics 21
Added support for squeezing space out of mathematical expressions 21
Introduced the subtle, moderate, and extreme package options . 12
`description`: Reduced vertical space before and within the list 16
`enumerate`: Reduced vertical space before the list 16
`itemize`: Reduced vertical space before the list 15



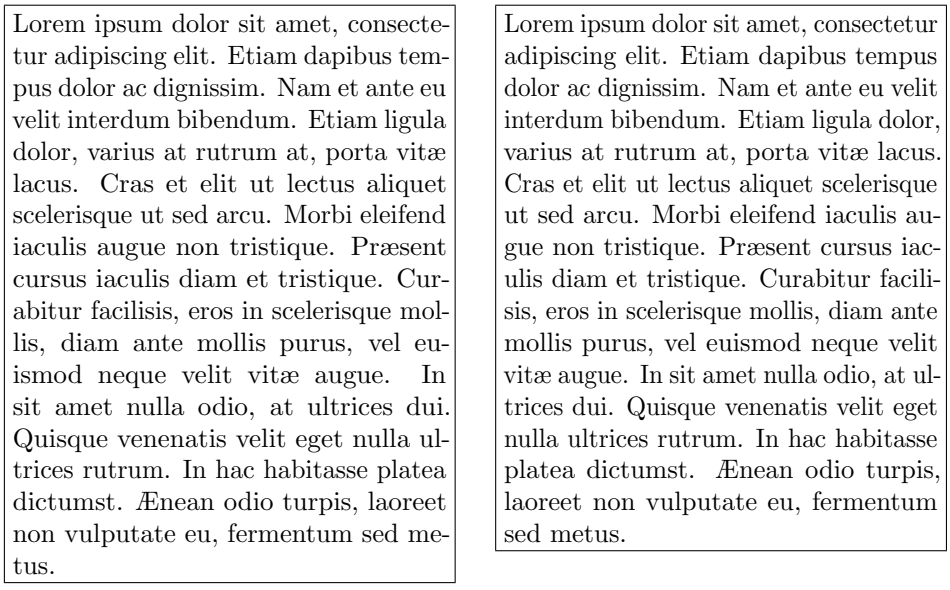
(a) `wordspacing=normal` (b) `wordspacing=tight`

Figure 4: Effect of the `wordspacing` option



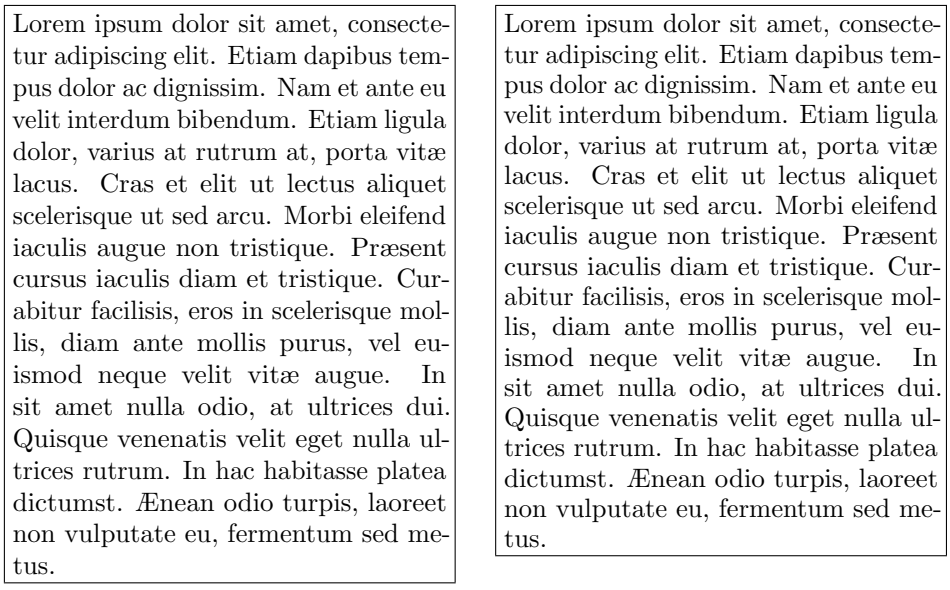
(a) `tracking=normal` (b) `tracking=tight`

Figure 5: Effect of the `tracking` option



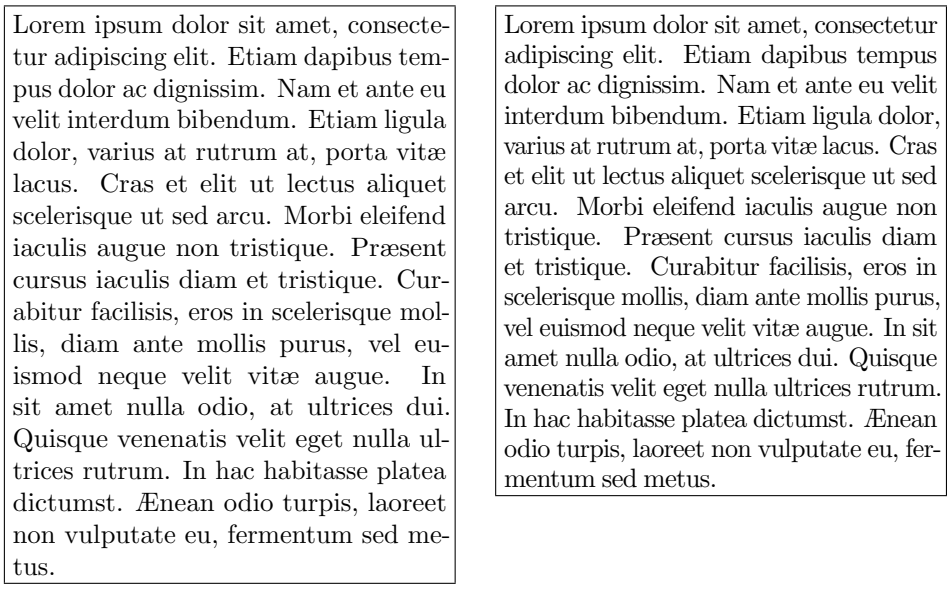
(a) `charwidths=normal` (b) `charwidths=tight`

Figure 6: Effect of the `charwidths` option



(a) `leading=normal` (b) `leading=tight`

Figure 7: Effect of the `leading` option



(a) `all=normal`

(b) `wordspacing=tight, tracking=tight, charwidths=tight, leading=tight`

Figure 8: Combined effect of using multiple options

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

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