The geometry package

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Abstract
This package provides an easy and flexible user interface to customize page layout. It implements auto-centering and auto-balancing mechanisms so that the users have only to give the least description for the page layout.

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1 Preface to Version 2
This new release contains three major changes:

- The geometry options using the keyval scheme can be set in the optional argument to the \usepackage command as well as in the (mandatory) argument of the \geometry macro. Therefore, you can go
  \usepackage[width=10cm, left=3cm]{geometry}
  \geometry{scale={0.7,0.8}, nohead}

- Multiple use of \geometry macro is allowed. In the previous version \geometry command initialized layout dimensions before reading its options. In this release, however, \geometry just appends its options to the previously specified ones. Therefore,
  \usepackage[width=10cm, left=5cm]{geometry}
  \geometry{left=5cm}
  \geometry{vscale=0.8, nohead}

is equivalent to
  \usepackage[width=10cm, left=5cm, vscale=0.8, nohead]{geometry}.
If you want to reset layout dimensions and modes, you can use ‘reset’ option.

- The shortened control sequences for \paperwidth and \paperheight, \w and \h respectively, were removed.
2 Introduction

To set dimensions for page layout in \LaTeX is not straightforward. You need to adjust several \LaTeX dimensions to place a text area where you want. If you want to center the text area in the paper you use, for example, you have to specify \LaTeX dimensions as follows:

\begin{verbatim}
\usepackage{calc}
\setlength\textwidth{8in}
\setlength\textheight{11in}
\setlength\oddsidemargin{\left(\textwidth-1in\right)/2 - 1in}
\setlength\topmargin{\left(\textheight-\headheight-\headsep-\footskip\right)/2 - 1in}.
\end{verbatim}

Without \texttt{calc} package, the above example would need more tedious settings. The \texttt{geometry} package provides an easy way to set page layout parameters. In this case, what you have to do is just

\begin{verbatim}
\usepackage[body={8in,11in}]{geometry}
\end{verbatim}

In addition to this centering problem, setting margins from each edge of the paper is also troublesome. However, with \texttt{geometry} package, you can go

\begin{verbatim}
\usepackage[margin=1.5in]{geometry}
\end{verbatim}

if you want to set each margin 1.5in from each edge of the paper. In both cases, the remnant dimensions to be specified will be automatically determined. The package will be also useful when you have to set page layout obeying the following strict instructions: for example,

*The total allowable width of the text area is 6.5 inches wide by 8.75 inches high. The first line on each page should begin 1.2 inches from the top edge of the page. The left margin should be 0.4 inch from the left edge.*

In this case, using \texttt{geometry} package you can go

\begin{verbatim}
\usepackage[body={6.5in,8.75in},
               top=1.2in, left=0.4in, nohead]{geometry}.
\end{verbatim}

Setting a text area on the paper in document preparation system has some analogy to placing a window on the background in the window system. The name ‘geometry’ comes from the \texttt{-geometry} option used for specifying a size and location of a window in X Window System.

3 Page Geometry

3.1 Layout Dimensions

To realize a straightforward setting for page layout, the following page structure is introduced: A paper contains a total body (printable area) and margins. The total body consists of a body (text area), a header, a footer and a marginal note which is optional. There are four margins: left-, right-, top- and bottom-margin.

- \texttt{paper} : total-body (printable area) and margins
- \texttt{total-body} : head, body (text area), foot and marginal notes (option)
- \texttt{margins} : left-, right-, top- and bottom-margin

Each margin is measured from the corresponding edge of a paper. For example, left-margin means a horizontal distance between the left edge of the paper and that of the total body. Therefore the left-margin and top-margin defined in the \texttt{geometry} package are different from the ordinary \LaTeX dimensions \texttt{\leftmargin} and \texttt{\topmargin}. The size of a body (text area) can be modified by \texttt{\textwidth} and \texttt{\textheight}.

The layout parts and the corresponding dimension names used in this package are listed in Table 1 and showed schematically in Figure 1. The dimensions for paper, total body and margins have the following relations.

\begin{align*}
\text{paperwidth} &= \text{left} + \text{width} + \text{right} \\
\text{paperheight} &= \text{top} + \text{height} + \text{bottom}
\end{align*}
Table 1: Page geometry parts and dimension names used in this package.

<table>
<thead>
<tr>
<th>Parts</th>
<th>Dimension names used in this package</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td>paper</td>
<td>paperwidth</td>
</tr>
<tr>
<td>total-body</td>
<td>width or totalwidth</td>
</tr>
<tr>
<td>body</td>
<td>textwidth</td>
</tr>
<tr>
<td>left margin</td>
<td>left or lmargin</td>
</tr>
<tr>
<td>right margin</td>
<td>right or rmargin</td>
</tr>
<tr>
<td>top margin</td>
<td>—</td>
</tr>
<tr>
<td>bottom margin</td>
<td>—</td>
</tr>
<tr>
<td>head</td>
<td>—</td>
</tr>
<tr>
<td>foot</td>
<td>—</td>
</tr>
<tr>
<td>marginal notes</td>
<td>marginparwidth and marginparsep</td>
</tr>
</tbody>
</table>

Figure 1: Dimension names for page geometry. If includemp is false (default), width = textwidth.

<table>
<thead>
<tr>
<th>Modes</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>nohead</td>
<td>sets headheight=0pt, headsep=0pt.</td>
</tr>
<tr>
<td>nofoot</td>
<td>sets footskip=0pt.</td>
</tr>
<tr>
<td>noheadfoot</td>
<td>equals nohead and nofoot</td>
</tr>
<tr>
<td>includemp</td>
<td>takes account of the dimensions for marginal notes when determining width: width := textwidth + marginparsep + marginparwidth</td>
</tr>
<tr>
<td>reversemp</td>
<td>makes the marginal notes appear in the left margin and sets includemp unless includemp=false exists. reversemp results in the same effect.</td>
</tr>
</tbody>
</table>

Table 2: Layout modes defined in this package and their effects.
The dimensions of the total body, width and height, are defined as follows:

\begin{align*}
\text{width} & := \text{textheight} + \text{headheight} + \text{headsep} + \text{footskip} + \text{marginparwidth} + \text{marginparsep} \\
\text{height} & := \text{textheight} + \text{headheight} + \text{headsep} + \text{footskip}
\end{align*}

Figure 2: Sample layouts of total body with different layout modes. (a) default, (b) includemp, (c) nohead, and (d) nohead and includemp. Marginal note can be changed its placement from the right-hand to the left-hand side of the total body by reversemp. If both twoside and includemp are effective, marginal note will appear on the left (odd pages) and the right (even pages) by turns. Note that marginal notes can be printed even by default or includemp=false, but then the width of total body will not include that of marginal notes.

3.2 Completion Algorithm

The automatic completion of layout dimension is a distinguishing feature of this package. Suppose that the paper size is pre-defined in Equation (1) or (2), if two dimensions out of three in the right-hand side of each equation are given, the remnant dimension will be determined automatically. In addition, even when only one of three is given, the rest of dimensions will be determined using auto-balancing or auto-centering scheme. The completion rules are shown in Table 3 and Equation (5). In Table 3, \( R_n \) (\( n=1, 2, 3 \)) are the remnant lengths which can be
Table 3: Dimension completion rules. The mark ‘*’ denotes the dimensions not specified. Each unspecified dimension will be given a proper value according to the completion rule. See text for explanation of other symbols.

determined by $A$, $B$ and $L$ ($\text{paperwidth}$ or $\text{paperheight}$) according the following relations.

\begin{align*}
R_1 &= L - 2A \quad \cdots \text{auto-balancing} \\
R_2 &= (L - A)/2 \quad \cdots \text{auto-centering} \\
R_3 &= L - A - B \quad \cdots \text{obvious completion}
\end{align*} \tag{5}

If none of three dimensions is specified in each direction, the default setting is used: $\ell$ and $m$ in horizontal direction are 80\% and 10\% of $\text{paperwidth}$ respectively, 90\% and 5\% of $\text{paperheight}$ vertically.

4 User Interface

4.1 General Features

The geometry options using the $\text{keyval}$ interface '{\texttt{\textbackslash key}=\texttt{\textbackslash value}}' can be set either in the optional argument to the $\texttt{\usepackage}$ command, or in the argument of the $\texttt{\geometry}$ macro. This macro, if necessary, should be placed in the preamble, i.e., before $\texttt{\begin{document}}$. In either case, the argument consists of a list of comma-separated keyval options. The main features of setting options are listed below.

- Multiple lines are allowed. (But blank lines are not allowed.)
- Any spaces between words are ignored.
- Options are basically order-independent.
  (There are some exceptions. See Section 6.2 for details.)

For example,

\begin{verbatim}
\usepackage[a5paper, hmargin = {3cm, 0.8in}, height = 10in]{geometry}
\end{verbatim}

is equivalent to

\begin{verbatim}
\usepackage[height=10in,a5paper,hmargin={3cm,0.8in}]{geometry}
\end{verbatim}

Note that the order of values in the sub-list (e.g., $\texttt{hmargin=(3cm,0.8in)}$) is significant. The above setting is equivalent to the followings:

\begin{verbatim}
\usepackage{geometry}
\geometry{height=10in,a5paper,hmargin={3cm,0.8in}}
\end{verbatim}
or

\begin{verbatim}
\usepackage[a5paper]{geometry}
\geometry{hmargin={3cm,0.8in},height=8in}
\geometry{height=10in}.
\end{verbatim}

Thus, multiple use of $\texttt{\geometry}$ just appends options.

The geometry package supports the $\texttt{calc}$ package\textsuperscript{1}. For example,

\begin{verbatim}
\usepackage{calc}
\usepackage[textheight=20\baselineskip+10pt]{geometry}
\end{verbatim}

\textsuperscript{1}CTAN/macro\slash latex\slash contrib\slash support\slash calc
4.2 Option Types

There are five types of options:

1. **Boolean type**
   
   Takes a boolean value (true or false). If no value, true is set for default.
   
   \( \langle \text{key} \rangle = \text{true} \mid \text{false} \).
   
   Examples: verbose=true, nohead, twoside=false.
   
   Paper name is the exception. The preferred paper name should be set with no values. Whatever value is given, it is ignored. For instance, a4paper=XXX is equivalent to a4paper.

2. **Single-valued type**
   
   Takes a mandatory value.
   
   \( \langle \text{key} \rangle = \langle \text{value} \rangle \).
   
   Examples: width=8in, left=1.25in, footskip=1cm, height=.86\paperheight.

3. **Two-valued type**
   
   Takes a pair of comma-separated values in braces. The two values can be shortened to one value if they are identical.
   
   \( \langle \text{key} \rangle = \{ \langle \text{value1} \rangle, \langle \text{value2} \rangle \} \).
   
   \( \langle \text{key} \rangle = \langle \text{value} \rangle \) is equivalent to \( \langle \text{key} \rangle = \{ \langle \text{value} \rangle, \langle \text{value} \rangle \} \).
   
   Examples: hmargin={1.5in,1in}, scale=0.8, body={7in,10in}.

4. **Three-valued type**
   
   Takes three mandatory, comma-separated values in braces.
   
   \( \langle \text{key} \rangle = \{ \langle \text{value1} \rangle, \langle \text{value2} \rangle, \langle \text{value3} \rangle \} \)
   
   Each value must be a dimension or null. When you give an empty value or ‘*’, it means null and leaves the appropriate value to the auto-calculation mechanism. One needs to specify at least one dimension, typically two dimensions. You can set nulls for all the values, but it makes no sense. Examples:
   
   hdivide={2cm,*1cm}, vdivide={3cm,19cm, }, divide={1in,*1in}.

5 Option List

5.1 Boolean Options

Boolean options are also called ‘modes’. One can change various modes for page geometry.

The boolean options are listed below.

- **verbose**
  - Typeouts warnings and a list of resulted page parameters.
- **landscape**
  - Switches the paper orientation to landscape mode.
- **portrait**
  - Switches the paper orientation to portrait mode. This is equivalent to landscape=false.
- **twoside**
  - Switches on two-sided printing. In this mode, specified left and right margins are switched over in each odd-numbered page.
- **includemp**
  - Takes account of spaces for margin notes (marginparwidth and marginparsep) when adjusting horizontal partition.
- **reversemp**
  - Reverse marginpar makes the marginal notes appear in the left margin and sets includemp=true unless includemp=false has been set explicitly.
- **nohead**
  - Eliminates spaces for the head of page, which is equivalent to \headheight=0pt and \headsep=0pt.
- **nofoot**
  - Eliminates spaces for the foot of page, which is equivalent to \footskip=0pt.
- **noheadfoot**
  - Eliminates spaces for the head and foot of page, which is equivalent to nohead and nofoot, i.e., \headheight=0pt, \headsep=0pt and \footskip=0pt.
dvips writes the paper size in the PostScript output with the \special macro. If you use dvips as a DVI-to-PS driver, this option is very useful. For example, to print a document with \geometry{a3paper,landscape} on A3 paper in landscape mode, you don’t need options “-t a3 -t landscape” to dvips. This option is ineffective and forced false if pdftex is true.

pdftex sets \pdfoutput=1 and sets \pdfpagewidth and \pdfpageheight properly in the \begin{document} if pdflatex command is used for typeset. When you use latex command with pdftex=true, this option is ineffective and forced to be false. If \pdfoutput=1 is already specified, this option is initialized to be true. You can set pdftex=false explicitly to output DVI, not PDF, when pdflatex is used. This option has priority over dvips.

a0paper, a1paper, a2paper, a3paper, a4paper, a5paper, a6paper
b0paper, b1paper, b2paper, b3paper, b4paper, b5paper, b6paper

letterpaper, executivepaper, legalpaper

specifies paper name. They must be used with no values. Note that whatever value (even false) is given to this option, the value will be ignored and the paper name is used. For example, the followings have the same effect: a5paper, a5paper=true, a5paper=false and a5paper=XXX.

reset initializes modes and layout dimensions to their defaults. Note that this option is ineffective against paper size (ex., a4paper) and lengths for header, footer and marginal notes (ex., head, footskip, marginparwidth and so on). reset=false has no effect and cannot cancel the previous reset(true) if any.

Some of the above options may be given as document class options. For example, you can set \documentclass[a4paper,landscape]{article}, then a4paper and landscape are processed in the geometry package as well. Some options may be implicitly given by \ExecuteOptions in a document class. The standard book document class has twoside. So when you have \documentclass{book}, then geometry can find twoside without any explicit setting for twoside.

5.2 Single-Valued Options

The single-valued options with a mandatory value are listed below.

paper | papernamesspecifies a paper name. The available paper names are defined in the geometry package. paper=(paper name). For example paper=a4paper, which is equivalent to just a4paper (see above).

paperwidth width of the paper. paperwidth=(paper width).

paperheight height of the paper. paperheight=(paper height).

width | totalwidth width of the total body. width=(width) or totalwidth=(width). This dimension should not be confused with textwidth. Generally, width ≥ textwidth because width includes the width of marginal notes when includemp or dimensions for marginal notes is set. If textwidth and width are specified at the same time, width is ignored.

height | totalheight height of the total body (including header and footer). height=(height) or totalheight=(height). If both textheight and height are specified, height will be ignored.

left | lmargin left margin of the total body. In other words, the distance between the left edge of the paper and that of the total body. left= (left margin).

right | rmargin right margin of the total body. right= (right margin).

top | tmargin top margin of the total body. top= (top margin).

bottom | bmargin bottom margin of the total body. bottom= (bottom margin).

hscale ratio of width of the total body to \paperwidth. hscale=(h-ratio). hscale=0.8 is equivalent to width=0.8\paperwidth.
Figure 3: twosideshift option.

vscale ratio of height of the total body to \paperheight. vscale=\textit{v-ratio}. vscale=0.9 is equivalent to height=0.9/paperheight.
textwidth modifies \textwidth, width of text (body). textwidth=\textit{width}.
textheight modifies \textheight, height of text (body). textheight=\textit{height}.
marginparwidth \marginpar modifies \marginparwidth, width of the marginal notes. When this option is set, includemp is also set true automatically. marginparwidth=\textit{length}.
marginparsep modifies \marginparsep, separation between body and marginal notes. includemp is also set true automatically. marginparsep=\textit{length}.
headheight | head modifies \headheight, height of header. headheight=\textit{length} or head=\textit{length}.
headsep modifies \headsep, separation between header and text (body). headsep=\textit{length}.
footskip | foot modifies \footskip, distance separation between baseline of last line of text and baseline of footer. footskip=\textit{length} or foot=\textit{length}.
hoffset modifies \hoffset. hoffset=\textit{length}.
voffset modifies \voffset. voffset=\textit{length}.
twosideshift specifies extra space which is added to left-margin of odd-numbered pages and subtracted from that of even-numbered pages. twoside mode is also set. twosideshift=\textit{length}. The default is 20pt. See Figure 3.
mag sets magnification value \textit{\mag} and automatically modifies \hoffset and \voffset according to the magnification. mag=\textit{magnification}. Note that \textit{magnification} should be an integer value with 1000 as a normal size. For example, mag=1414 with a4paper provides an enlarged print fitting in a3paper, which is 1.414 (=\sqrt{2}) times larger than a4paper. Font enlargement needs extra disk space.

5.3 Two-Valued Options

The following list shows keys taking two values in braces or one value for short.
papersize width and height of the paper. papersize=\{\textit{width},\textit{height}\} or papersize=\textit{length}.
total width and height of the total body. total=\{\textit{width},\textit{height}\} or total=\textit{length}.
body | text textwidth and textheight of the body of page. body=\{\textit{width},\textit{height}\} or body=\textit{length}.
scale  ratio of the total body length to the paper’s. 
scale={⟨h-ratio⟩,⟨v-ratio⟩} or scale=⟨ratio⟩.

hmargin  left and right margin.  
hmargin={⟨left margin⟩,⟨right margin⟩} or hmargin=⟨length⟩.

vmargin  top and bottom margin. 
vmargin={⟨top margin⟩,⟨bottom margin⟩} or vmargin=⟨length⟩.

margin  margin=⟨A,B⟩ is equivalent to hmargin=⟨A,B⟩ and vmargin=⟨A,B⟩. 
margin=A  is automatically expanded to hmargin=A  and vmargin=A.

offset horizontal and vertical offset. 
offset={⟨hoffset⟩,⟨voffset⟩} or offset=⟨length⟩.

5.4 Three-Valued Options
The keys taking three comma-separated values in braces are listed below.

hdivide  horizontal partitions (left,width,right). 
  hdivide={⟨left margin⟩,⟨width⟩,⟨right margin⟩}.
Note that you should not specify all of the three parameters. The best way of using this option is to specify two of three and leave the rest with null(nothing) or ‘*’. For example, when you set hdivide={2cm,15cm, }, the margin from the rightside edge of page will be determined calculating paperwidth-2cm-15cm.

vdivide  vertical partitions (top,height,bottom). 
vdivide={⟨top margin⟩,⟨height⟩,⟨bottom margin⟩}.

divide  divide=⟨A,B,C⟩ is interpreted as hdivide=⟨A,B,C⟩ and vdivide=⟨A,B,C⟩.

6 Relations Between Options
6.1 Option Priority

\[ \text{low} \rightarrow \text{high} \quad \text{priority} \]

- \{hscale\} < \{width\} < \{textwidth\},
- \{vscale\},
- \{head(height)\} < \{nohead\},
- \{headsep\} < \{nofoot\},
- \{foot(skip)\} < \{noheadfoot\},

- dvips < pdftex.

For example,

\usepackage[hscale=0.8, textwidth=7in, width=18cm]{geometry}

is the same as

\usepackage[textwidth=7in]{geometry}.

6.2 Order Dependence
The options defined in the geometry package are basically order-independent, but there are some exceptions. When redundant, overlap specification is given, the last setting is adopted. For example,

verbose=true, verbose=false

obviously results in verbose=false. If you set

hmargin={3cm,2cm}, left=1cm

the left-margin is overwritten by left=1cm. As a result, it is equivalent to hmargin={1cm,2cm}.

The reset option initializes all the modes and settings for page layout. If you set
then \texttt{landscape}, \texttt{margins}=1cm and \texttt{nohead} are ignored and \texttt{head}=20pt is set. Note that \texttt{reset} can’t initialize paper size (\texttt{a4paper} in this case).

### 6.3 \texttt{dvips} and \texttt{pdftex}

The options \texttt{dvips} and \texttt{pdftex} are provided for driver support. They may be used for other packages that support them. In the \texttt{geometry} package, the \texttt{pdftex} option has priority over \texttt{dvips}. The table below shows relations between the typeset command, \texttt{pdfoutput} and effective values for each driver option.

<table>
<thead>
<tr>
<th>command</th>
<th>pdfoutput</th>
<th>dvips</th>
</tr>
</thead>
<tbody>
<tr>
<td>latex</td>
<td>false</td>
<td>any</td>
</tr>
<tr>
<td>pdflatex</td>
<td>true</td>
<td>false</td>
</tr>
<tr>
<td></td>
<td>false</td>
<td>any</td>
</tr>
</tbody>
</table>

where ‘\texttt{any}’ means that one can choose \texttt{true} or \texttt{false}. When \texttt{pdflatex} command is used for typeset, the default value of the \texttt{pdftex} option is dependent upon the value of \texttt{pdfoutput}: \texttt{true} if \texttt{pdfoutput}=1, and \texttt{false} otherwise.

### 7 Default Settings

#### 7.1 Default Option

The default option is

\[ \texttt{scale} = \{0.8, 0.9\}. \]

Other layout parameters, such as paper size, orientation and lengths for header and footer, are set as defined in the documentclass you use. If you just go \texttt{\usepackage[geometry]} in the preamble, the package will set the default layout. Additional options will overwrite the layout dimensions. For example,

\[ \texttt{\usepackage[\texttt{margins}=2cm ]{geometry}} \]

will overwrite horizontal dimensions, but use the default for vertical layout.

#### 7.2 Configuration File

You can set up a configuration file to make default options. To do this, produce a file \texttt{geometry.cfg} containing an \texttt{\ExecuteOptions} macro, for example,

\[ \texttt{\ExecuteOptions{\texttt{a4paper,\texttt{dvips}}}} \]

and install it somewhere \TeX{} can find it.

### 8 Examples

- Set the width of the total body to be 70\% that of the paper. The total body is then centered horizontally. The following settings (each line) result in the same effect.

  - \texttt{hscale}=0.7,
  - \texttt{width}=0.7\texttt{\paperwidth},
  - \texttt{hdivide}={*,0.7\texttt{\paperwidth},*},
  - \texttt{hmargin}=0.15\texttt{\paperwidth},
  - \texttt{left}=0.15\texttt{\paperwidth},
  - \texttt{left} = .15\texttt{\paperwidth}, \texttt{right} = 0.15\texttt{\paperwidth},
  - \texttt{rmargin}= .15\texttt{\paperwidth}.

  For vertical layout, in this case, the default is used: \texttt{vscale}=0.9.

- Set the height of the total body to be 10in, the bottom-margin 3cm, and the width default. Then the top-margin will be calculated in the package.
- height=10in,bottom=2cm,
- bmargin = 2cm ,totalheight= 10in,
- vdivide = { *, 10in ,2cm },
and so on.

- Set the left-, right-, and top-margin 3cm, 2cm and 2.5in respectively. The page header is not used. The body is 40 lines of text in height.

- left=3cm,right=2cm, nohead,
  top=2.5in, textheight=40\baselineskip,
- hmargin={3cm, 2cm}, head=0pt, headsep=0pt
tmargin=2.5in, textheight=40\baselineskip,
and so on.

- Modify the width of marginal notes to 3cm and include marginal notes when adjusting horizontal partition

  marginpar=3cm,
  marginparwidth=3cm.
In this case, includemp is not necessary because it is set automatically when dimension(s) for marginal note are specified.

- marginpar=3cm, reversemp
makes the marginal notes appear in the left margin.

- Use A5 paper in landscape mode and a full scale of the paper as the body.

  a5paper, landscape, scale=1.0 , noheadfoot.
  landscape = TRUE, paper=a5paper, noheadfoot,
  total=\{\paperwidth,\paperheight\},
and so on.

- Get PDF output using pdflatex command for typeset.

  \% pdflatex foo
with
  \documentclass[pdftex]{article}
  \usepackage{geometry}
or
  \documentclass{article}
  \usepackage[pdftex]{geometry}

  is equivalent to

  \% pdflatex \'\pdoutput=1 \input{foo}'
with
  \documentclass{article}
  \usepackage{geometry}.

- Enlarge A4 print to A3 with fonts and spaces also enlarged.

  a4paper, mag=1414.
To enlarge B5 to B3, go

  b5paper, mag=2000.

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James Killfiger, and Jean-Marc Lasgouttes for their pointing out bugs and suggesting improvements. I would like to also thank Frank Bennett for many helpful comments.
10 The Code

This package requires David Carlisle’s keyval package.

\RequirePackage{keyval}

Internal switches are declared here.

\newif\ifGeom@verbose
\newif\ifGeom@landscape
\newif\ifGeom@nohead
\newif\ifGeom@nofoot
\newif\ifGeom@includemp
\newif\ifGeom@passincmp
\newif\ifGeom@hbody
\newif\ifGeom@vbody
\newif\ifGeom@dvips
\newif\ifGeom@pdftex
\newif\ifGeom@dvips

Counters for horizontal and vertical partitioning patterns.

\newcount\geom@cnth
\newcount\geom@cntv

Macor for printing warning messages.

\def\geom@warning#1{\ifGeom@verbose\PackageWarningNoLine{geometry}{#1}\fi}

The default values for the horizontal and vertical scale, and twosideshift are defined.

\def\Geom@Dhscale{0.8}
\def\Geom@Dvscale{0.9}
\def\Geom@Dtwosideshift{20pt}

The macro for initializing modes and flags is defined here. This macro is called when geometry package is loaded and when reset option is specified.

\def\geom@init{\Geom@hbodyfalse\Geom@vbodyfalse
\let\Geom@width\undefined\let\Geom@height\undefined
\let\Geom@textwidth\undefined\let\Geom@textheight\undefined
\let\Geom@hscale\undefined\let\Geom@vscale\undefined
\let\Geom@lmargin\undefined\let\Geom@rmargin\undefined
\let\Geom@tmargin\undefined\let\Geom@bmargin\undefined
\def\Geom@twosideshift{\Geom@Dtwosideshift}\Geom@verbosefalse
\Geom@landscapefalse\Geom@noheadfalse\Geom@nofootfalse
\Geom@includempfalse\Geom@passincmpfalse\Geom@dvipsfalse
\geom@initpdftex}

This macro initializes Geom@pdftex switch, which appears in \geom@init macro.

\def\geom@initpdftex{%
\ifx\undefined\pdfpagewidth
\Geom@pdftexfalse
\else
\ifnum\pdfoutput=1\relax\Geom@pdftextrue\else\Geom@pdftexfalse\fi
\fi}

Macro for setting boolean options.

\def\geom@setbool#1#2{%
\csname #2\ifx\relax#1\relax true\else#1\fi\endcsname}
\geom@checkbool Macro used in \geom@showparams to print ‘true’ or nothing.
\def\geom@checkbool{\csname ifGeom@\endcsname \space
\else\fi

\geom@detiv This macro determines the fourth length(#4) from #1(paperwidth or paperheight), #2 and #3. It is used in \geom@detall macro.
\def\geom@detiv{\setlength{\@tempdima}{\nameuse{paper#1}}\setlength{\@tempdimb}{\nameuse{Geom@#2}}\addtolength{\@tempdima}{-\@tempdimb}\setlength{\@tempdimb}{\nameuse{Geom@#3}}\addtolength{\@tempdima}{-\@tempdimb}\ifdim{\@tempdima}<\z@\geom@warning{‘#4’ results in NEGATIVE (\the\@tempdima).}\else% \spaces Parameters of ‘#2’ and ‘#3’ should be shortened\fi\expandafter\edef\csname Geom@#4\endcsname{\the\@tempdima}\fi

\geom@detiiandiii This macro determines #2 and #3 from #1. The first argument can be width or height, which is expanded into dimensions of paper and total body. It is used in \geom@detall macro.
\def\geom@detiiandiii#1#2#3{% determine #2 and #3.\setlength\@tempdima{\nameuse{paper#1}}\setlength\@tempdimb{\nameuse{Geom@#1}}\addtolength\@tempdima{-\@tempdimb}\divide\@tempdima\tw@\ifdim\@tempdima<\z@\geom@warning{‘#2’ and ‘#3’ result in NEGATIVE (\the\@tempdima).}\else% \spaces Parameter for ‘#1’ should be shortened\fi\expandafter\edef\csname Geom@#2\endcsname{\the\@tempdima}\expandafter\edef\csname Geom@#3\endcsname{\the\@tempdima}\fi

\geom@detall This macro determines partition of each direction. The first argument is h or v.
\def\geom@detall#1#2#3#4{% \@tempcnta\z@\if#1h% \if\undefined\Geom@lmargin\else\advance\@tempcnta4\relax\fi\if\Geom@hbody\advance\@tempcnta2\relax\fi\if\undefined\Geom@rmargin\else\advance\@tempcnta1\relax\fi\geom@cnth\@tempcnta\else% \if\undefined\Geom@tmargin\else\advance\@tempcnta4\relax\fi\if\Geom@vbody\advance\@tempcnta2\relax\fi\if\undefined\Geom@bmargin\else\advance\@tempcnta1\relax\fi\geom@cntv\@tempcnta\fi% 0:(*,*,*)\if#1h% \edef\Geom@width{\Geom@Dhscale\paperwidth}\
\else% \edef\Geom@height{\Geom@Dvscale\paperheight}\fi% 1:(*,*,S) goto (5)\geom@warning{‘#3’ was forced to equal ‘#4’}\expandafter\edef\csname Geom@#3\endcsname{\nameuse{Geom@#4}}% \geom@detiv{#2}{#3}{#4}{#2}\or% 2:(*,S,*) goto (5)\geom@warning{‘#4’ was forced to equal ‘#3’}\expandafter\edef\csname Geom@#4\endcsname{\nameuse{Geom@#3}}% \geom@detiv{#2}{#3}{#4}{#2}\or% 3:(S,*,S) goto (5)\geom@warning{Redundant specification in ‘#1’-direction.}
\geom@clean Macro for setting unspecified dimensions to be \undefined. This is used by \geometry macros.
\def\geom@clean{\ifnum\geom@cnth<4\let\Geom@lmargin\undefined\fi\ifodd\geom@cnth\else\let\Geom@rmargin\undefined\fi\ifnum\geom@cntv<4\let\Geom@tmargin\undefined\fi\ifodd\geom@cntv\else\let\Geom@bmargin\undefined\fi\if\Geom@hbody\else\let\Geom@hscale\undefined\let\Geom@width\undefined\let\Geom@textwidth\undefined\fi\if\Geom@vbody\else\let\Geom@vscale\undefined\let\Geom@height\undefined\let\Geom@textheight\undefined\fi}\
\geom@parse@divide Macro for parsing \((h,v)\)divide options.
\def\geom@parse@divide#1#2#3#4{\def\Geom@star{*}\@tempcnta\z@\@for\Geom@tmp:=#1\do{\KV@@sp@def\expandafter\Geom@frag\expandafter{\Geom@tmp}\\edef\Geom@value{\Geom@frag}\\ifcase\@tempcnta\relax% cnta == 0\\edef\Geom@key{#2}\\or \edef\Geom@key{#3}\\else \edef\Geom@key{#4}\\fi\@nameuse{Geom@set\Geom@key false}\\ifx\empty\Geom@value\else\\ifx\Geom@star\Geom@value\\setkeys{Geom}{\Geom@key=\Geom@value}\\fi\fi\advance\@tempcnta\@ne}\\ifnum\@tempcnta=\@ne\\setkeys{Geom}{#2=\Geom@value}\\setkeys{Geom}{#3=\Geom@value}\\fi}\
\geom@magtooffset This macro is used to determine offsets when \texttt{mag} option is specified.
\def\geom@magtooffset#1{\@tempdima=#1sp\@tempdimb=1in\divide\@tempdimb\@tempdima\multiply\@tempdimb\@m\addtolength{\hoffset}{1in}\addtolength{\voffset}{1in}\addtolength{\hoffset}{-\@tempdimb}\addtolength{\voffset}{-\@tempdimb}}
Various paper size are defined here.

\begin{verbatim}
\def\geom@setpaper(#1,#2){\setlength\paperwidth{#1} \setlength\paperheight{#2}}
\end{verbatim}

The option keys are defined below.

- `paper` takes paper name as its value. Available paper names are listed below.

\begin{verbatim}
\define@key{Geom}{paper}{\setkeys{Geom}{#1}}
\end{verbatim}

- Thirteen standard paper names are available.

\begin{verbatim}
\define@key{Geom}{a0paper}{\def\Geom@paper{a0paper}}
\define@key{Geom}{a1paper}{\def\Geom@paper{a1paper}}
\define@key{Geom}{a2paper}{\def\Geom@paper{a2paper}}
\define@key{Geom}{a3paper}{\def\Geom@paper{a3paper}}
\define@key{Geom}{a4paper}{\def\Geom@paper{a4paper}}
\define@key{Geom}{a5paper}{\def\Geom@paper{a5paper}}
\define@key{Geom}{a6paper}{\def\Geom@paper{a6paper}}
\define@key{Geom}{b0paper}{\def\Geom@paper{b0paper}}
\define@key{Geom}{b1paper}{\def\Geom@paper{b1paper}}
\define@key{Geom}{b2paper}{\def\Geom@paper{b2paper}}
\define@key{Geom}{b3paper}{\def\Geom@paper{b3paper}}
\define@key{Geom}{b4paper}{\def\Geom@paper{b4paper}}
\define@key{Geom}{b5paper}{\def\Geom@paper{b5paper}}
\define@key{Geom}{b6paper}{\def\Geom@paper{b6paper}}
\define@key{Geom}{letterpaper}{\def\Geom@paper{letterpaper}}
\define@key{Geom}{legalpaper}{\def\Geom@paper{legalpaper}}
\define@key{Geom}{executivepaper}{\def\Geom@paper{executivepaper}}
\end{verbatim}

- `papersize` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{papersize}{\geom@branch{#1}{paperwidth}{paperheight}}
\end{verbatim}

- `paperwidth` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{paperwidth}{\setlength\paperwidth{#1} \let\Geom@paper\undefined}
\end{verbatim}

- `paperheight` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{paperheight}{\setlength\paperheight{#1} \let\Geom@paper\undefined}
\end{verbatim}

- `total` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{total}{\geom@branch{#1}{width}{height}}
\end{verbatim}

- `body` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{body}{\geom@branch{#1}{textwidth}{textheight}}
\end{verbatim}

- `scale` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{scale}{\geom@branch{#1}{hscale}{vscale}}
\end{verbatim}

- `hscale` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{hscale}{\let\Geom@paper\undefined \Geom@hbodytrue \edef\Geom@hscale{#1}}
\end{verbatim}

- `vscale` is a key that takes a single value.

\begin{verbatim}
\define@key{Geom}{vscale}{\let\Geom@paper\undefined \Geom@vbodytrue \edef\Geom@vscale{#1}}
\end{verbatim}
Provide useful ways to partition each direction of paper.

`divide`

Provide useful ways to partition each direction of paper.

`hdivide`

Provide useful ways to partition each direction of paper.

`vdivide`

Provide useful ways to partition each direction of paper.

`offset`

Provide useful ways to partition each direction of paper.

`headheight`

Provide useful ways to partition each direction of paper.

`headsep`

Provide useful ways to partition each direction of paper.

`footskip`

Provide useful ways to partition each direction of paper.

`marginparwidth`

Provide useful ways to partition each direction of paper.

`marginparsep`

Provide useful ways to partition each direction of paper.

`verbose`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`reset`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`includemp`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`reversemp`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`reversemarginpar`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`twoside`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`nohead`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`nofoot`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`landscape`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`portrait`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`dvips`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.

`pdftex`

Note that `reset` executes `\geom@init` and sets `oneside`: `\twosidefalse` and `@mparswitchfalse`.
\define@key{Geom}{dvips}[true]{\lowercase{\geom@setbool{#1}}}{Geom@dvips}
\define@key{Geom}{pdftex}[true]{\lowercase{\geom@setbool{#1}}}{Geom@pdftex}

\makeatletter
\newcommand{\mag}{\magtooffset{#1}\mag#1}
\makeatother

\geom@process
\makeatletter
\ifx\undefined\Geom@paper\else\@nameuse{Geom@\Geom@paper}\fi
\ifGeom@landscape
\setlength\@tempdima{\paperwidth}\%\setlength\paperwidth{\paperheight}\%\setlength\paperheight{\@tempdima}\%
\fi
\ifGeom@nohead
\setlength\headheight{0pt}\%
\setlength\headsep{0pt}\%
\fi
\ifGeom@nofoot
\setlength\footskip{0pt}\%
\fi
\ifGeom@hbody
\ifx\undefined\Geom@width\else
\setlength\@tempdima{\Geom@width}\%
\fi
\fi
\ifGeom@vbody
\ifx\undefined\Geom@height\else
\setlength\@tempdima{\Geom@height}\%
\fi
\fi
\makeatother

`mag' Provides an interface to \mag with offset auto-justification.
\providecommand{\mag}{\magtooffset{#1}\mag#1}

The key aliases are defined.

`papername'  
`totalwidth'  
`totalheight'  
`text'  
`left'  
`right'  
`top'  
`bottom'  
`head'  
`foot'  
`marginpar'  

The main macro processing specified layout dimensions is defined.

`geom@process' 
\providecommand{\geom@process}{
\def\geom@process{
\ifx\undefined\Geom@paper\else\@nameuse{Geom@\Geom@paper}\fi
\ifGeom@landscape
\setlength\@tempdima{\paperwidth}\%\setlength\paperwidth{\paperheight}\%\setlength\paperheight{\@tempdima}\%
\fi
\ifGeom@nohead
\setlength\headheight{0pt}\%
\setlength\headsep{0pt}\%
\fi
\ifGeom@nofoot
\setlength\footskip{0pt}\%
\fi
\ifGeom@hbody
\ifx\undefined\Geom@width\else
\setlength\@tempdima{\Geom@width}\%
\fi
\fi
\ifGeom@vbody
\ifx\undefined\Geom@height\else
\setlength\@tempdima{\Geom@height}\%
\fi
\fi
\makeatletter
\ifx\undefined\Geom@width\else
\edef\Geom@width{\the\@tempdima}\%
\fi
\makeatother
\ifx\undefined\Geom@textwidth\else
\addtolength\@tempdima{\marginparwidth}\%
\edef\Geom@width{\the\@tempdima}\%
\fi
\edef\Geom@width{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@height\else
\edef\Geom@height{\the\@tempdima}\%
\fi
\edef\Geom@height{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@textwidth\else
\addtolength\@tempdima{\marginparwidth}\%
\addtolength\@tempdima{\marginparsep}\%
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\fi
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@height\else
\edef\Geom@height{\the\@tempdima}\%
\fi
\edef\Geom@height{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@textwidth\else
\addtolength\@tempdima{\headheight}\%
\addtolength\@tempdima{\headsep}\%
\addtolength\@tempdima{\footskip}\%
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\fi
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@textwidth\else
\addtolength\@tempdima{\footskip}\%
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\fi
\ifx\undefined\Geom@height\else
\edef\Geom@height{\the\@tempdima}\%
\fi
\edef\Geom@height{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@textwidth\else
\addtolength\@tempdima{\footskip}\%
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\fi
\ifx\undefined\Geom@height\else
\edef\Geom@height{\the\@tempdima}\%
\fi
\edef\Geom@height{\the\@tempdima}\%
\fi
\ifx\undefined\Geom@textwidth\else
\addtolength\@tempdima{\footskip}\%
\edef\Geom@width{\the\@tempdima}\%
\edef\Geom@height{\the\@tempdima}\%
\fi
\fi
\ifx\undefined\Geom@height\else
\edef\Geom@height{\the\@tempdima}\%
\fi
\edef\Geom@height{\the\@tempdima}\%
\fi
The macro for typeout of geometry status and \LaTeX\ layout dimensions.

\def\geom@showparams{%
\typeout{----------------------- Geometry parameters^^J%
mode: %
\ifx\undefined\Geom@paper\else
\Geom@paper\space
\fi%\geom@checkbool{landscape}%
\geom@checkbool{nohead}%
\geom@checkbool{nofoot}%
\geom@checkbool{includemp}%
\if@reversemargin reversemp\space\fi%
\if@twoside twoside\space\fi%
\geom@checkbool{dvips}^^J%
\geom@checkbool{pdftex}^^J%
h-parts: \Geom@lmargin, \Geom@width, \Geom@rmargin%}
\def\geom@showparams{%
\typeout{----------------------- Page layout dimensions^^J%
\string\paperwidth\space\the\paperwidth^^J%
\string\paperheight\space\the\paperheight^^J%

Paper size is initialized only once here.

\let\Geom@paper\undefined
\geom@setkey\ExecuteOptions is replaced with \geom@setkey to make it possible to deal with `key=value` as its argument.
\def\geom@setkey\setkeys{Geom}
\let\geom@origExecuteOptions\ExecuteOptions
\let\ExecuteOptions\geom@setkey
\geom@init is executed. Note that \@twoside and \@mparswitch are not changed.
\geom@init
A local configuration file may define more options. To set A4 paper as default, geometry.cfg needs to contain \ExecuteOptions{a4paper}.
\InputIfFileExists{geometry.cfg}{}{}
The original definition for \ExecuteOptions macro is restored.
\let\ExecuteOptions\geom@origExecuteOptions
\ProcessOptionsWithKV This macros can process package options using `key=value` scheme. The code was borrowed from the hyperref package written by Sebastian Rahtz.
\def\ProcessOptionsWithKV#1{%\let\@tempa\@empty\@for\CurrentOption:\@classoptionslist\do{%\@ifundefined{KV@#1@\CurrentOption}%{}{\edef\@tempa{\@tempa,\CurrentOption,}}}%\edef\@tempa{\noexpand\setkeys{#1}{\@tempa\@ptionlist{\@currname.\@currext}}}%\@tempa\AtEndOfPackage{\let\@unprocessedoptions\relax}}
The optional arguments to \usepackage and \documentclass macros are processed here.
\ProcessOptionsWithKV(Geom)
Actual setting and calculation of layout dimensions are here.
\geom@process
The verbose, pdftex and dvips options are checked in \AtBeginDocument.
\AtBeginDocument{%\ifx\undefined\pdfpagewidth % latex command is used.\Geom@pdftexfalse % else % pdflatex command is used
\ifGeom@pdftex\Geom@dvipsfalse\fi
\fi
\ifGeom@dvips
\AtBeginDvi\special{\papersize=\the\paperwidth,\the\paperheight}%%
\fi
\ifGeom@pdftex
\pdfoutput=1\relax
}
if verbose, the page geometry parameters and options are displayed.

\ifGeom@verbose
\geom@showparams
\fi}

\geometry The user-interface macro \texttt{\geometry} is defined, which sets unspecified dimensions to be \texttt{\undefined} by \texttt{\geom@clean}, appends specified options to themselves, and determines layout dimensions by \texttt{\geom@process}.

\def\geometry#1{\% \geom@clean \setkeys{Geom}{#1}\% \geom@process}

\% Uncomment and edit the line below to set default options.
\%\texttt{\ExecuteOptions{a4paper,dvips}}

\%\texttt{\ExecuteOptions{a4paper,dvips}}