The LuaTeX-ja package

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This documentation is far from complete. It may have many grammatical (and contextual) errors. Also, several parts (especially, Section 12) are written in Japanese only.

Part I

User's manual

1 Introduction

The LuaTeX-ja package is a macro package for typesetting high-quality Japanese documents when using LuaTeX.

1.1 Backgrounds

Traditionally, ASCII pTeX, an extension of TeX, and its derivatives are used to typeset Japanese documents in TeX. pTeX is an engine extension of TeX: so it can produce high-quality Japanese documents without using very complicated macros. But this point is a mixed blessing: pTeX is left behind from other extensions of TeX, especially ε-TeX and pdfTeX, and from changes about Japanese processing in computers (*e.g.*, the UTF-8 encoding).

Recently extensions of pTeX, namely upTeX (Unicode-implementation of pTeX) and ε-pTeX (merging of pTeX and ε-TeX extension), have developed to fill those gaps to some extent, but gaps still exist.

However, the appearance of LuaTeX changed the whole situation. With using Lua 'callbacks', users can customize the internal processing of LuaTeX. So there is no need to modify sources of engines to support Japanese typesetting: to do this, we only have to write Lua scripts for appropriate callbacks.

1.2 Major Changes from pTeX

The LuaTeX-ja package is under much influence of pTeX engine. The initial target of development was to implement features of pTeX. However, *LuaTeX-ja is not a just porting of pTeX; unnatural specifications/behaviors of pTeX were not adopted.*

The followings are major changes from pTeX:

- A Japanese font is a tuple of a 'real' font, a Japanese font metric (**JFM**, for short), and an optional string called 'variation'.
- In pTeX, a line break after Japanese character is ignored (and doesn't yield a space), since line breaks (in source files) are permitted almost everywhere in Japanese texts. However, LuaTeX-ja doesn't have this function completely, because of a specification of LuaTeX.
- The insertion process of glues/kerns between two Japanese characters and between a Japanese character and other characters (we refer these glues/kerns as **JAglue**) is rewritten from scratch.
  - As LuaTeX's internal character handling is 'node-based' (*e.g.*, `of{}fice` doesn't prevent ligatures), the insertion process of **JAglue** is now 'node-based'.
  - Furthermore, nodes between two characters which have no effects in line break (*e.g.*, `\special` node) and kerns from italic correction are ignored in the insertion process.
  - *Caution: due to above two points, many methods which did for the dividing the process of the insertion of **JAglue** in pTeX are not effective anymore.* In concrete terms, the following two methods are not effective anymore:

    `ちょ{}っと`　　`ちょ\/っと`

    If you want to do so, please put an empty hbox between it instead:

    `ちょ\hbox{}っと`
  - In the process, two Japanese fonts which only differ in their 'real' fonts are identified.
- At the present, vertical typesetting (*tategaki*), is not supported in LuaTeX-ja.

For detailed information, see Part III.

1.3 Notations

In this document, the following terms and notations are used:

- Characters are divided into two types:
  - **JAchar**: standing for Japanese characters such as Hiragana, Katakana, Kanji and other punctuation marks for Japanese.
  - **ALchar**: standing for all other characters like alphabets.

  We say 'alphabetic fonts' for fonts used in **ALchar**, and 'Japanese fonts' for fonts used in **JAchar**.
- A word in a sans-serif font (like prebreakpenalty) means an internal parameter for Japanese typesetting, and it is used as a key in `\ltjsetparameter` command.
- A word in typewriter font with underline (like `fontspec`) means a package or a class of LaTeX.
- The word 'primitive' is used not only for primitives in LuaTeX, but also for control sequences that defined in the core module of LuaTeX-ja.
- In this document, natural numbers start from 0.

1.4 About the project

Project Wiki Project Wiki is under construction.

- `http://sourceforge.jp/projects/luatex-ja/wiki/FrontPage%28en%29` (English)
- `http://sourceforge.jp/projects/luatex-ja/wiki/FrontPage` (Japanese)
- `http://sourceforge.jp/projects/luatex-ja/wiki/FrontPage%28zh%29` (Chinese)

This project is hosted by SourceForge.JP.

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2 Getting Started

2.1 Installation

To install the LuaTEX-ja package, you will need:

- LuaTEX (version 0.65.0-beta or later) and its supporting packages.
  If you are using TEX Live 2011 or current W32TEX, you don't have to worry.
- The source archive of LuaTEX-ja, of course :)
- The `xunicode` package, which version is *just v0.981 (2011/09/09)*.
  If you have the `fontspec` package, this `xunicode` package must be exist. But be careful about the version; other versions may not work correctly with LuaTEX-ja.

The installation methods are as follows:

1. Download the source archive, by one of the following method. At the present, LuaTEX-ja has no *stable* release.
   - Copy the Git repository:

     ```
     $ git clone git://git.sourceforge.jp/gitroot/luatex-ja/luatexja.git
     ```

   - Download the `tar.gz` archive of HEAD in the `master` branch from

     http://git.sourceforge.jp/view?p=luatex-ja/luatexja.git;a=snapshot;h=HEAD;sf=tgz.

   - Now LuaTEX-ja is available from the following archive and distributions:
     - CTAN (in the `macros/luatex/generic/luatexja` directory)
     - MiKTEX (in `luatexja.tar.lzma`)
     - TEX Live (in `texmf-dist/tex/luatex/luatexja`)
     - W32TEX (in `luatexja.tar.xz`)

     These are based on the `master` branch.

   Note that the `master` branch, and hence the archive in CTAN, are not updated frequently; the forefront of development is not the `master` branch.
2. Extract the archive. You will see `src/` and several other sub-directories. But only the contents in `src/` are needed to work LuaTEX-ja.
3. Copy all the contents of `src/` into one of your `TEXMF` tree. `TEXMF/tex/luatex/luatexja/` is an example location. If you cloned entire Git repository, making a symbolic link of `src/` instead copying is also good.
4. If `mktexlsr` is needed to update the file name database, make it so.

2.2 Cautions

- The encoding of your source file must be UTF-8. No other encodings, such as EUC-JP or Shift-JIS, are not supported.

2.3 Using in plain TEX

To use LuaTEX-ja in plain TEX, simply put the following at the beginning of the document:

```
\input luatexja.sty
```

This does minimal settings (like `ptex.tex`) for typesetting Japanese documents:

- The following 6 Japanese fonts are preloaded:

classification	**font name**	**‘10 pt’**	**‘7 pt’**	**‘5 pt’**
mincho	Ryumin-Light	`\tenmin`	`\sevenmin`	`\fivemin`
gothic	GothicBBB-Medium	`\tengt`	`\sevengt`	`\fivegt`

  - It is widely accepted that the font ‘Ryumin-Light’ and ‘GothicBBB-Medium’ aren’t embedded into PDF files, and PDF reader substitute them by some external Japanese fonts (*e.g.*, Kozuka Mincho is used for Ryumin-Light in Adobe Reader). We adopt this custom to the default setting.
  - A character in an alphabetic font is generally smaller than a Japanese font in the same size. So actual size specification of these Japanese fonts is in fact smaller than that of alphabetic fonts, namely scaled by 0.962216.

- The amount of glue that are inserted between a **JAchar** and an **ALchar** (the parameter xkanjiskip) is set to

$$(0.25 \cdot 0.962216 \cdot 10\,\mathrm{pt})^{+1\,\mathrm{pt}}_{-1\,\mathrm{pt}} = 2.40554\,\mathrm{pt}^{+1\,\mathrm{pt}}_{-1\,\mathrm{pt}}.$$

2.4 Using in LaTeX

LaTeX 2ε Using in LaTeX 2ε is basically same. To set up the minimal environment for Japanese, you only have to load `luatexja.sty`:

```
\usepackage{luatexja}
```

It also does minimal settings (counterparts in pLaTeX are `plfonts.dtx` and `pldefs.ltx`):

- `JY3` is the font encoding for Japanese fonts (in horizontal direction).
  When vertical typesetting is supported by LuaTeX-ja in the future, `JT3` will be used for vertical fonts.

- Two font families `mc` and `gt` are defined:

classification	**family**	`\mdseries`	`\bfseries`	**scale**
mincho	`mc`	Ryumin-Light	GothicBBB-Medium	0.962216
gothic	`gt`	GothicBBB-Medium	GothicBBB-Medium	0.962216

  Remark that the bold series in both family are same as the medium series of *gothic* family. This is a convention in pLaTeX. This is a trace that there were only 2 fonts (these are Ryumin-Light and GothicBBB-Medium) in early years of DTP.

- Japanese characters in math mode are typeset by the font family `mc`.

However, above settings are not sufficient for Japanese-based documents. To typeset Japanese-based documents, you are better to use class files other than `article.cls`, `book.cls`, and so on. At the present, we have the counterparts of `jclasses` (standard classes in pLaTeX) and `jsclasses` (classes by Haruhiko Okumura), namely, `ltjclasses` and `ltjsclasses`.

3 Changing Fonts

3.1 plain TeX and LaTeX 2ε

Remark: Japanese Characters in Math Mode Since pTeX supports Japanese characters in math mode, there are sources like the following:

```
$f_{高温}$~($f_{\text{high temperature}}$).
\[ y=(x-1)^2+2\quad よって\quad y>0 \]
$5\in 素:=\{\,p\in\mathbb N:\text{$p$ is a prime}\,\}$.
```

$f_{高温}$ ($f_{\text{high temperature}}$).

$$y=(x-1)^2+2\quad よって\quad y>0$$

$5\in 素:=\{\,p\in\mathbb N:\text{$p$ is a prime}\,\}$.

We (the project members of LuaTEX-ja) think that using Japanese characters in math mode are allowed if and only if these are used as identifiers. In this point of view,

- The lines 1 and 2 above are not correct, since '高温' in above is used as a textual label, and 'よって' is used as a conjunction.
- However, the line 3 is correct, since '素' is used as an identifier.

Hence, in our opinion, the above input should be corrected as:

```
$f_{\text{高温}}$~%
($f_{\text{high temperature}}$).
\[ y=(x-1)^2+2\quad
  \mathrel{\text{よって}}\quad y>0 \]
$5\in 素:=\{\,p\in\mathbb N:\text{$p$ is a prime}\,\}$.
```

$f_{\text{高温}}$ ($f_{\text{high temperature}}$).

$$y=(x-1)^2+2 \quad \mathrel{\text{よって}} \quad y>0$$

$5\in 素:=\{\,p\in\mathbb{N}:p\text{ is a prime}\,\}$.

We also believe that using Japanese characters as identifiers is rare, hence we don't describe how to change Japanese fonts in math mode in this chapter. For the method, please see Subsection 5.4.

plain TEX To change Japanese fonts in plain TEX, you must use the primitive `\jfont`. So please see Subsection 5.1.

LATEX 2ε (NFSS2) For LATEX 2ε, LuaTEX-ja adopted most of the font selection system of pLATEX 2ε (in `plfonts.dtx`).

- Two control sequences `\mcdefault` and `\gtdefault` are used to specify the default font families for *mincho* and *gothic*, respectively. Default values: `mc` for `\mcdefault` and `gt` for `\gtdefault`.
- Commands `\fontfamily`, `\fontseries`, `\fontshape` and `\selectfont` can be used to change attributes of Japanese fonts.

	encoding	**family**	**series**	**shape**	**selection**
alphabetic fonts	`\romanencoding`	`\romanfamily`	`\romanseries`	`\romanshape`	`\useroman`
Japanese fonts	`\kanjiencoding`	`\kanjifamily`	`\kanjiseries`	`\kanjishape`	`\usekanji`
both	—	–	`\fontseries`	`\fontshape`	—
auto select	`\fontencoding`	`\fontfamily`	—	—	`\usefont`

  `\fontencoding{<encoding>}` changes the encoding of alphabetic fonts or Japanese fonts depending on the argument. For example, `\fontencoding{JY3}` changes the encoding of Japanese fonts to `JY3` and `\fontencoding{T1}` changes the encoding of alphabetic fonts to `T1`. `\fontfamily` also changes the family of Japanese fonts, alphabetic fonts, *or both*. For detail, see Subsection 8.1.
- For defining a Japanese font family, use `\DeclareKanjiFamily` instead of `\DeclareFontFamily`. However, in the present implementation, using `\DeclareFontFamily` doesn't cause any problem.

3.2 fontspec

To coexist with the `fontspec` package, it is needed to load `luatexja-fontspec` package in the preamble. This additional package automatically loads `luatexja` and `fontspec` package, if needed.

In `luatexja-fontspec` package, the following 7 commands are defined as counterparts of original commands in the `fontspec` package:

Japanese fonts	`\jfontspec`	`\setmainjfont`	`\setsansjfont`	`\newjfontfamily`
alphabetic fonts	`\fontspec`	`\setmainfont`	`\setsansfont`	`\newfontfamily`
Japanese fonts	`\newjfontface`	`\defaultjfontfeatures`	`\addjfontfeatures`	
alphabetic fonts	`\newfontface`	`\defaultfontfeatures`	`\addfontfeatures`	

```
\fontspec[Numbers=OldStyle]{TeX Gyre Termes}
\jfontspec{IPAexMincho}
JIS~X~0213:2004→辻

\addjfontfeatures{CJKShape=JIS1990}
JIS~X~0208:1990→辻
```

JIS X 0213:2004 →辻
JIS X 0208:1990 →辻

Note that there is no command named `\setmonojfont`, since it is popular for Japanese fonts that nearly all Japanese glyphs have same widths. Also note that the kerning feature is set off by default in these 7 commands, since this feature and **JAglue** will clash (see 5.1).

3.3 プリセット設定

よく使われている和文フォント設定を一行で指定できるようにしたのが luatexja-preset パッケージである．このパッケージは，otf パッケージの一部機能と八登崇之氏による PXchfon パッケージの一部機能とを合わせたような格好をおり，内部で luatexja-fontspec を読み込んでいる．

一般的なオプション

`deluxe` 明朝体2ウェイト・ゴシック体3ウェイトと，丸ゴシック体 (`\mgfamily`) を使用可能とする．ゴシック体は細字・太字・極太の3ウェイトがあるが，極太ゴシック体はファミリの切り替え (`\gtebfamily`) で実現している．fontspec では通常 (`\mdseries`) と太字 (`\bfseries`) しか扱えないためにこのような中途半端な実装になっている．

`expert` 横組専用仮名を用いる．また，`\rubyfamily` でルビ用仮名が使用可能となる．

`bold` 明朝の太字をゴシック体の太字とする．

`90jis` 出来る限り 90JIS の字形を使う．

`jis2004` 出来る限り JIS2004 の字形を使う．

`jis` 用いる JFM を `jfm-jis.lua` とする．このオプションがない時は LuaTeX-ja 標準の `jfm-ujis.lua` が用いられる．

小塚フォント　まず，小塚フォントを用いる設定を述べる．単ウェイト時のゴシック体は小塚ゴシック R では細いように感じるので，小塚ゴシックに変更している．さらに，丸ゴシック体はないので便宜上小塚ゴシック H で代用している．

	`kozuka4`	`kozuka6`	`kozuka6n`
明朝体細字	小塚明朝 Pro R	小塚明朝 ProVI R	小塚明朝 Pr6N R
明朝体太字	小塚明朝 Pro B	小塚明朝 ProVI B	小塚明朝 Pr6N B
ゴシック体細字			
単ウェイト時	小塚ゴシック Pro M	小塚ゴシック ProVI M	小塚ゴシック Pr6N M
多ウェイト時	小塚ゴシック Pro R	小塚ゴシック ProVI R	小塚ゴシック Pr6N R
ゴシック体太字	小塚ゴシック Pro B	小塚ゴシック ProVI B	小塚ゴシック Pr6N B
ゴシック体極太	小塚ゴシック Pro H	小塚ゴシック ProVI H	小塚ゴシック Pr6N H
(丸ゴシック体)	小塚ゴシック Pro H	小塚ゴシック ProVI H	小塚ゴシック Pr6N H

モリサワ・ヒラギノ　モリサワ・ヒラギノ用の設定はそのようなことは行っていない．まずヒラギノフォントから：

	`hiragino`	`hiraginon`
明朝体細字	ヒラギノ明朝体 Pro W3	ヒラギノ明朝体 Pr6N W3
明朝体太字	ヒラギノ明朝体 Pro W6	ヒラギノ明朝体 Pr6N W6
ゴシック体細字	ヒラギノ角ゴ Pro W3	ヒラギノ角ゴ ProN W3
ゴシック体太字	ヒラギノ角ゴ Pro W6	ヒラギノ角ゴ ProN W6
ゴシック体極太	ヒラギノ角ゴ Std W8	ヒラギノ角ゴ StdN W8
丸ゴシック体	ヒラギノ丸ゴ Pro W4	ヒラギノ丸ゴ ProN W4

次はモリサワフォントを用いる設定である：

	`morisawa4`	`morisawa6n`
明朝体細字	リュウミンPro L-KL	リュウミンPr6N L-KL
明朝体太字	太ミンA101 Pro Bold	太ミンA101 Pr6N Bold
ゴシック体細字	中ゴシックBBB Pro Med	中ゴシックBBB Pr6N Med
ゴシック体太字	太ゴB101 Pro Bold	太ゴB101 Pr6N Bold
ゴシック体極太	見出ゴPro MB31	見出ゴPr6N MB31
丸ゴシック体	じゅんPro 101	じゅんPr6N 101

単ウェイト用設定　次に，単ウェイト用の設定を述べる．この4設定では「細字」「太字」の区別はない．また，丸ゴシック体はゴシック体と同じフォントを用いる．

	`noembed`	`ipa`	`ipaex`	`ms`
明朝体	Ryumin-Light（非埋込）	IPA明朝	IPAex明朝	MS明朝
ゴシック体	GothicBBB-Medium（非埋込）	IPAゴシック	IPAexゴシック	MSゴシック

HGフォントの利用　すぐ前に書いた単ウェイト用設定を，Microsoft Office等に付属するHGフォントを使って多ウェイト化した設定もある．

	`ipa-dx`	`ipaex-dx`	`ms-dx`
明朝体細字	IPA明朝	IPAex明朝	MS明朝
明朝体太字	HG明朝E		
ゴシック体細字			
単ウェイト時	IPAゴシック	IPAexゴシック	MSゴシック
`jis2004`指定時	IPAゴシック	IPAexゴシック	MSゴシック
それ以外の時	HGゴシックM		
ゴシック体太字	HGゴシックE		
ゴシック体極太	HG創英角ゴシックUB		
丸ゴシック体	HG丸ゴシック体PRO		

なお，HG明朝E・HGゴシックE・HG創英角ゴシックUB・HG丸ゴシック体PROの4つについては，内部で

標準　フォント名（`HGMinchoE`など）

`90jis`指定時　ファイル名 (`hgrme.ttc`, `hgrge.ttc`, `hgrsgu.ttc`, `hgrsmp.ttf`)

`jis2004`指定時　ファイル名 (`hgrme04.ttc`, `hgrge04.ttc`, `hgrsgu04.ttc`, `hgrsmp04.ttf`)

として指定を行っているので注意すること．

3.4 `\CID`, `\UTF` and macros in `otf` package

Under pLaTeX, `otf` package (developed by Shuzaburo Saito) is used for typesetting characters which is in Adobe-Japan1-6 CID but not in JIS X 0208. Since this package is widely used, LuaTeX-ja supports some of functions in `otf` package. If you want to use these functions, load `luatexja-otf` package.

```
森\UTF{9DD7}外と内田百\UTF{9592}とが\UTF{9AD
    9}島屋に行く。

\CID{7652}飾区の\CID{13706}野家，
葛飾区の吉野家
```

森鷗外と内田百閒とが髙島屋に行く。
葛飾区の吉野家，葛飾区の吉野家

4 Changing Parameters

There are many parameters in LuaTeX-ja. And due to the behavior of LuaTeX, most of them are not stored as internal register of TeX, but as an original storage system in LuaTeX-ja. Hence, to assign or acquire those parameters, you have to use commands `\ltjsetparameter` and `\ltjgetparameter`.

4.1 Editing the range of JAchars

To edit the range of **JAchar**s, you have to assign a non-zero natural number which is less than 217 to the character range first. This can be done by using `\ltjdefcharrange` primitive. For example, the next line assigns whole characters in Supplementary Ideographic Plane and the character '漢' to the range number 100.

```
\ltjdefcharrange{100}{"10000-"1FFFF,`漢}
```

This assignment of numbers to ranges are always global, so you should not do this in the middle of a document.

If some character has been belonged to some non-zero numbered range, this will be overwritten by the new setting. For example, whole SIP belong to the range 4 in the default setting of LuaTeX-ja, and if you specify the above line, then SIP will belong to the range 100 and be removed from the range 4.

After assigning numbers to ranges, the jacharrange parameter can be used to customize which character range will be treated as ranges of **JAchar**s, as the following line (this is just the default setting of LuaTeX-ja):

```
\ltjsetparameter{jacharrange={-1, +2, +3, -4, -5, +6, +7, +8}}
```

The argument to jacharrange parameter is a list of integer. Negative integer $-n$ in the list means that 'the characters that belong to range n are treated as **ALchar**', and positive integer $+n$ means that 'the characters that belong to range n are treated as **JAchar**'.

Default Setting LuaTeX-ja predefines eight character ranges for convenience. They are determined from the following data:

- Blocks in Unicode 6.0.
- The `Adobe-Japan1-UCS2` mapping between a CID Adobe-Japan1-6 and Unicode.
- The `PXbase` bundle for upTeX by Takayuki Yato.

Now we describe these eight ranges. The alphabet 'J' or 'A' after the number shows whether characters in the range is treated as **JAchar**s or not by default. These settings are similar to the `prefercjk` settings defined in `PXbase` bundle.

Range 8$^{\mathbf{J}}$ Symbols in the intersection of the upper half of ISO 8859-1 (Latin-1 Supplement) and JIS X 0208 (a basic character set for Japanese). This character range consists of the following characters:

- § (`U+00A7`, Section Sign)
- ¨ (`U+00A8`, Diaeresis)
- ° (`U+00B0`, Degree sign)
- ± (`U+00B1`, Plus-minus sign)
- ´ (`U+00B4`, Spacing acute)
- ¶ (`U+00B6`, Paragraph sign)
- × (`U+00D7`, Multiplication sign)
- ÷ (`U+00F7`, Division Sign)

Range 1$^{\mathbf{A}}$ Latin characters that some of them are included in Adobe-Japan1-6. This range consist of the following Unicode ranges, *except characters in the range 8 above*:

- `U+0080`–`U+00FF`: Latin-1 Supplement
- `U+0100`–`U+017F`: Latin Extended-A
- `U+0180`–`U+024F`: Latin Extended-B
- `U+0250`–`U+02AF`: IPA Extensions
- `U+02B0`–`U+02FF`: Spacing Modifier Letters
- `U+0300`–`U+036F`: Combining Diacritical Marks
- `U+1E00`–`U+1EFF`: Latin Extended Additional

Table 1. Unicode blocks in predefined character range 3.

`U+2000–U+206F`	General Punctuation	`U+2070–U+209F`	Superscripts and Subscripts
`U+20A0–U+20CF`	Currency Symbols	`U+20D0–U+20FF`	Comb. Diacritical Marks for Symbols
`U+2100–U+214F`	Letterlike Symbols	`U+2150–U+218F`	Number Forms
`U+2190–U+21FF`	Arrows	`U+2200–U+22FF`	Mathematical Operators
`U+2300–U+23FF`	Miscellaneous Technical	`U+2400–U+243F`	Control Pictures
`U+2500–U+257F`	Box Drawing	`U+2580–U+259F`	Block Elements
`U+25A0–U+25FF`	Geometric Shapes	`U+2600–U+26FF`	Miscellaneous Symbols
`U+2700–U+27BF`	Dingbats	`U+2900–U+297F`	Supplemental Arrows-B
`U+2980–U+29FF`	Misc. Mathematical Symbols-B	`U+2B00–U+2BFF`	Miscellaneous Symbols and Arrows
`U+E000–U+F8FF`	Private Use Area		

Table 2. Unicode blocks in predefined character range 6.

`U+2460–U+24FF`	Enclosed Alphanumerics	`U+2E80–U+2EFF`	CJK Radicals Supplement
`U+3000–U+303F`	CJK Symbols and Punctuation	`U+3040–U+309F`	Hiragana
`U+30A0–U+30FF`	Katakana	`U+3190–U+319F`	Kanbun
`U+31F0–U+31FF`	Katakana Phonetic Extensions	`U+3200–U+32FF`	Enclosed CJK Letters and Months
`U+3300–U+33FF`	CJK Compatibility	`U+3400–U+4DBF`	CJK Unified Ideographs Extension A
`U+4E00–U+9FFF`	CJK Unified Ideographs	`U+F900–U+FAFF`	CJK Compatibility Ideographs
`U+FE10–U+FE1F`	Vertical Forms	`U+FE30–U+FE4F`	CJK Compatibility Forms
`U+FE50–U+FE6F`	Small Form Variants	`U+20000–U+2FFFF`	(Supplementary Ideographic Plane)

Table 3. Unicode blocks in predefined character range 7.

`U+1100–U+11FF`	Hangul Jamo	`U+2F00–U+2FDF`	Kangxi Radicals
`U+2FF0–U+2FFF`	Ideographic Description Characters	`U+3100–U+312F`	Bopomofo
`U+3130–U+318F`	Hangul Compatibility Jamo	`U+31A0–U+31BF`	Bopomofo Extended
`U+31C0–U+31EF`	CJK Strokes	`U+A000–U+A48F`	Yi Syllables
`U+A490–U+A4CF`	Yi Radicals	`U+A830–U+A83F`	Common Indic Number Forms
`U+AC00–U+D7AF`	Hangul Syllables	`U+D7B0–U+D7FF`	Hangul Jamo Extended-B

Range 2$^{\mathrm{J}}$ Greek and Cyrillic letters. JIS X 0208 (hence most of Japanese fonts) has some of these characters.

- `U+0370–U+03FF`: Greek and Coptic
- `U+0400–U+04FF`: Cyrillic
- `U+1F00–U+1FFF`: Greek Extended

Range 3$^{\mathrm{J}}$ Punctuations and Miscellaneous symbols. The block list is indicated in Table 1.

Range 4$^{\mathrm{A}}$ Characters usually not in Japanese fonts. This range consists of almost all Unicode blocks which are not in other predefined ranges. Hence, instead of showing the block list, we put the definition of this range itself:

```
\ltjdefcharrange{4}{%
  "500-"10FF, "1200-"1DFF, "2440-"245F, "27C0-"28FF, "2A00-"2AFF,
 "2C00-"2E7F, "4DC0-"4DFF, "A4D0-"A82F, "A840-"ABFF, "FB50-"FE0F,
 "FE20-"FE2F, "FE70-"FEFF, "FB00-"FB4F, "10000-"1FFFF} % non-Japanese
```

Range 5$^{\mathrm{A}}$ Surrogates and Supplementary Private Use Areas.

Range 6$^{\mathrm{J}}$ Characters used in Japanese. The block list is indicated in Table 2.

Range 7$^{\mathrm{J}}$ Characters used in CJK languages, but not included in Adobe-Japan1-6. The block list is indicated in Table 3.

4.2 kanjiskip and xkanjiskip

JAglue is divided into the following three categories:

- Glues/kerns specified in JFM. If `\inhibitglue` is issued around a Japanese character, this glue will not be inserted at the place.
- The default glue which inserted between two **JAchar**s (kanjiskip).
- The default glue which inserted between a **JAchar** and an **ALchar** (xkanjiskip).

The value (a skip) of kanjiskip or xkanjiskip can be changed as the following.

```
\ltjsetparameter{kanjiskip={0pt plus 0.4pt minus 0.4pt},
                 xkanjiskip={0.25\zw plus 1pt minus 1pt}}
```

It may occur that JFM contains the data of 'ideal width of kanjiskip' and/or 'ideal width of xkanjiskip'. To use these data from JFM, set the value of kanjiskip or xkanjiskip to `\maxdimen`.

4.3 Insertion Setting of xkanjiskip

It is not desirable that xkanjiskip is inserted into every boundary between **JAchar**s and **ALchar**s. For example, xkanjiskip should not be inserted after opening parenthesis (*e.g.*, compare '(あ' and '(あ'). LuaTEX-ja can control whether xkanjiskip can be inserted before/after a character, by changing jaxspmode for **JAchar**s and alxspmode parameters **ALchar**s respectively.

```
1 \ltjsetparameter{jaxspmode={`あ,preonly},
     alxspmode={`\!,postonly}}
2 pあ q い!う
```

p あq い! う

The second argument `preonly` means 'the insertion of xkanjiskip is allowed before this character, but not after'. the other possible values are `postonly`, `allow` and `inhibit`.

jaxspmode and alxspmode use a same table to store the parameters on the current version. Therefore, line 1 in the code above can be rewritten as follows:

```
\ltjsetparameter{alxspmode={`あ,preonly}, jaxspmode={`\!,postonly}}
```

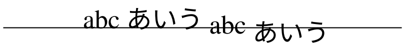
One can use also numbers to specify these two parameters (see Subsection 6.2).

If you want to enable/disable all insertions of kanjiskip and xkanjiskip, set autospacing and autoxspacing parameters to `true`/`false`, respectively.

4.4 Shifting Baseline

To make a match between a Japanese font and an alphabetic font, sometimes shifting of the baseline of one of the pair is needed. In pTEX, this is achieved by setting `\ybaselineshift` to a non-zero length (the baseline of alphabetic fonts is shifted below). However, for documents whose main language is not Japanese, it is good to shift the baseline of Japanese fonts, but not that of alphabetic fonts. Because of this, LuaTEX-ja can independently set the shifting amount of the baseline of alphabetic fonts (yalbaselineshift parameter) and that of Japanese fonts (yjabaselineshift parameter).

```
\vrule width 150pt height 0.4pt depth 0pt\
     hskip-120pt
\ltjsetparameter{yjabaselineshift=0pt,
     yalbaselineshift=0pt}abcあいう
\ltjsetparameter{yjabaselineshift=5pt,
     yalbaselineshift=2pt}abcあいう
```



Here the horizontal line in above is the baseline of a line.

There is an interesting side-effect: characters in different size can be vertically aligned center in a line, by setting two parameters appropriately. The following is an example (beware the value is not well tuned):

```
xyz漢字
{\scriptsize
  \ltjsetparameter{yjabaselineshift=-1pt,
    yalbaselineshift=-1pt}
  XYZひらがな
}abcかな
```

xyz 漢字 XYZ ひらがな abc かな

4.5 Cropmark

Cropmark is a mark for indicating 4 corners and horizontal/vertical center of the paper. In Japanese, we call cropmark as tombo(w). pLaTeX and this LuaTeX-ja support ‘tombow’ by their kernel. The following steps are needed to typeset cropmark:

1. First, define the banner which will be printed at the upper left of the paper. This is done by assigning a token list to `\@bannertoken`.

   For example, the following sets banner as ‘`filename (YYYY-MM-DD hh:mm)`’:

   ```
   \makeatletter

   \hour\time \divide\hour by 60 \@tempcnta\hour \multiply\@tempcnta 60\relax
   \minute\time \advance\minute-\@tempcnta
   \@bannertoken{%
      \jobname\space(\number\year-\two@digits\month-\two@digits\day
      \space\two@digits\hour:\two@digits\minute)}%
   ```

2. ...

Part II

Reference

5 Font Metric and Japanese Font

5.1 `\jfont` primitive

To load a font as a Japanese font, you must use the `\jfont` primitive instead of `\font`, while `\jfont` admits the same syntax used in `\font`. LuaTeX-ja automatically loads luaotfload package, so TrueType/OpenType fonts with features can be used for Japanese fonts:

```
\jfont\tradgt={file:ipaexg.ttf:script=latn;%
  +trad;-kern;jfm=ujis} at 14pt
\tradgt{}当／体／医／区
```

當／體／醫／區

Note that the defined control sequence (`\tradgt` in the example above) using `\jfont` is not a *font_def* token, hence the input like `\fontname\tradgt` causes a error. We denote control sequences which are defined in `\jfont` by ⟨*jfont_cs*⟩.

JFM As noted in Introduction, a JFM has measurements of characters and glues/kerns that are automatically inserted for Japanese typesetting. The structure of JFM will be described in the next subsection. At the calling of `\jfont` primitive, you must specify which JFM will be used for this font by the following keys:

`jfm=`⟨*name*⟩ Specify the name of JFM. If specified JFM has not been loaded, LuaTeX-ja search and load a file named `jfm-`⟨*name*⟩`.lua`.

The following JFMs are shipped with LuaTeX-ja:

Table 4. Differences between JFMs shipped with LuaTeX-ja

	`jfm-ujis.lua`	`jfm-jis.lua`	`jfm-min.lua`
Example 1[1]	◆◆◆◆◆◆◆ ある日モモちゃ んがお使いで迷 子になって泣き ました．	◆◆◆◆◆◆◆ ある日モモちゃ んがお使いで迷 子になって泣き ました．	◆◆◆◆◆◆◆ ある日モモちゃ んがお使いで迷 子になって泣き ました．
Example 2	ちょっと！　何	ちょっと！何	ちょっと！何
Bounding Box	漢	漢	漢

`jfm-ujis.lua` A standard JFM in LuaTeX-ja. This JFM is based on `upnmlminr-h.tfm`, a metric for UTF/OTF package that is used in upTeX. When you use the `luatexja-otf` package, you should use this JFM.

`jfm-jis.lua` A counterpart for `jis.tfm`, 'JIS font metric' which is widely used in pTeX. A major difference of `jfm-ujis.lua` and this `jfm-jis.lua` is that most characters under `jfm-ujis.lua` are square-shaped, while that under `jfm-jis.lua` are horizontal rectangles.

`jfm-min.lua` A counterpart for `min10.tfm`, which is one of the default Japanese font metric shipped with pTeX. There are notable difference between this JFM and other 2 JFMs, as shown in Table 4.

`jfmvar=`⟨*string*⟩ Sometimes there is a need that ....

Note: kern feature Some fonts have information for inter-glyph spacing. However, this information is not well-compatible with LuaTeX-ja. More concretely, this kerning space from this information are inserted *before* the insertion process of **JAglue**, and this causes incorrect spacing between two characters when both a glue/kern from the data in the font and it from JFM are present.

- You should specify `-kern` in `jfont` primitive, when you want to use other font features, such as `script=...`.
- If you want to use Japanese fonts in proportional width, and use information from this font, use `jfm-prop.lua` for its JFM, and.... TODO: kanjiskip?

5.2 Prefix `psft`

Besides `file:` and `name:` prefixes, one can use `psft:` prefix in `\jfont` (and `\font`) primitive, to specify a 'name-only' Japanese font which will not be embedded to PDF. Typical use of this prefix is to specify the 'standard' Japanese fonts, namely, 'Ryumin-Light' and 'GothicBBB-Medium'.

`cid` key The default font defined by using `psft:` prefix is for Japanese typesetting; it is Adobe-Japan1-6 CID-keyed font. One can specify `cid` key to use other CID-keyed non-embedded fonts for Chinese or Korean typesetting.

```
\jfont\testJ={psft:Ryumin-Light:cid=Adobe-Japan1-6;jfm=jis}     % Japanese
\jfont\testD={psft:Ryumin-Light:jfm=jis}                        % default value is Adobe-Japan1-6
\jfont\testC={psft:AdobeMingStd-Light:cid=Adobe-CNS1-5;jfm=jis} % Traditional Chinese
\jfont\testG={psft:SimSun:cid=Adobe-GB1-5;jfm=jis}              % Simplified Chinese
\jfont\testK={psft:Batang:cid=Adobe-Korea1-2;jfm=jis}           % Korean
```

Note that the code above specifies `jfm-jis.lua`, which is for Japanese fonts, as JFM for Chinese and Korean fonts.

At present, LuaTeX-ja supports only 4 values written in the sample code above. Specifying other values, e.g.,

```
\jfont\test={psft:Ryumin-Light:cid=Adobe-Japan2;jfm=jis}
```

---

[1] from: 乙部厳己, min10 フォントについて. `http://argent.shinshu-u.ac.jp/~otobe/tex/files/min10.pdf`.

occurs the following error:

```
! Package luatexja Error: bad cid key `Adobe-Japan2'.

See the luatexja package documentation for explanation.
Type  H <return>  for immediate help.
<to be read again>
                   \par
l.78

? h
I couldn't find any non-embedded font information for the CID
`Adobe-Japan2'. For now, I'll use `Adobe-Japan1-6'.
Please contact the LuaTeX-ja project team.
?
```

5.3 Structure of JFM file

A JFM file is a Lua script which has only one function call:

```
luatexja.jfont.define_jfm { ... }
```

Real data are stored in the table which indicated above by `{ ... }`. So, the rest of this subsection are devoted to describe the structure of this table. Note that all lengths in a JFM file are floating-point numbers in design-size unit.

`dir=`⟨*direction*⟩ (required)

The direction of JFM. At the present, only `'yoko'` is supported.

`zw=`⟨*length*⟩ (required)

The amount of the length of the ‘full-width’.

`zh=`⟨*length*⟩ (required)

The amount of the length of the ‘full-height’ (height + depth).

`kanjiskip={`⟨*natural*⟩`,` ⟨*stretch*⟩`,` ⟨*shrink*⟩`}` (optional)

This field specifies the ‘ideal’ amount of kanjiskip. As noted in Subsection 4.2, if the parameter kanjiskip is `\maxdimen`, the value specified in this field is actually used (if this field is not specified in JFM, it is regarded as 0 pt). Note that ⟨*stretch*⟩ and ⟨*shrink*⟩ fields are in design-size unit too.

`xkanjiskip={`⟨*natural*⟩`,` ⟨*stretch*⟩`,` ⟨*shrink*⟩`}` (optional)

Like the kanjiskip field, this field specifies the ‘ideal’ amount of xkanjiskip.

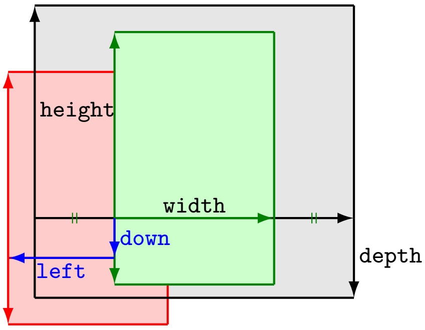
Besides from above fields, a JFM file have several sub-tables those indices are natural numbers. The table indexed by $i \in \omega$ stores information of ‘character class’ i. At least, the character class 0 is always present, so each JFM file must have a sub-table whose index is `[0]`. Each sub-table (its numerical index is denoted by i) has the following fields:

`chars={`⟨*character*⟩`, ...}` (required except character class 0)

This field is a list of characters which are in this character type i. This field is not required if $i = 0$, since all **JAchar** which are not in any character class other than 0 are in the character class 0 (hence, the character class 0 contains most of **JAchar**s). In the list, a character can be specified by its code number, or by the character itself (as a string of length 1). Moreover, there are ‘imaginary characters’ which specified in the list. We will describe these later.

`width=`⟨*length*⟩`, height=`⟨*length*⟩`, depth=`⟨*length*⟩`, italic=`⟨*length*⟩ (required)

Specify width of characters in character class i, height, depth and the amount of italic correction. All characters in character class i are regarded that its width, height and depth are as values of these fields. But there is one exception: if `'prop'` is specified in `width` field, width of a character becomes that of its ‘real’ glyph



Consider a node containing Japanese character whose value of the `align` field is `'middle'`.

- The black rectangle is a frame of the node. Its width, height and depth are specified by JFM.
- Since the `align` field is `'middle'`, the ‘real’ glyph is centered horizontally (the green rectangle).
- Furthermore, the glyph is shifted according to values of fields `left` and `down`. The ultimate position of the real glyph is indicated by the red rectangle.

Figure 1. The position of the ‘real’ glyph.

`left=`⟨*length*⟩`,` `down=`⟨*length*⟩`,` `align=`⟨*align*⟩

These fields are for adjusting the position of the ‘real’ glyph. Legal values of `align` field are `'left'`, `'middle'` and `'right'`. If one of these 3 fields are omitted, `left` and `down` are treated as 0, and `align` field is treated as `'left'`. The effects of these 3 fields are indicated in Figure 1.

In most cases, `left` and `down` fields are 0, while it is not uncommon that the `align` field is `'middle'` or `'right'`. For example, setting the `align` field to `'right'` is practically needed when the current character class is the class for opening delimiters’.

`kern={[`*j*`]=`⟨*kern*⟩`, ...}`

`glue={[`*j*`]={`⟨*width*⟩`,` ⟨*stretch*⟩`,` ⟨*shrink*⟩`}, ...}`

As described before, you can specify several ‘imaginary characters’ in `chars` field. The most of these characters are regarded as the characters of class 0 in pTeX. As a result, LuaTeX-ja can control typesetting finer than pTeX. The following is the list of ‘imaginary characters’:

`'lineend'` An ending of a line.

`'diffmet'` Used at a boundary between two **JAchar**s whose JFM or size is different.

`'boxbdd'` The beginning/ending of a horizontal box, and the beginning of a noindented paragraph.

`'parbdd'` The beginning of an (indented) paragraph.

`'jcharbdd'` A boundary between **JAchar** and anything else (such as **ALchar**, kern, glue, …).

-1 The left/right boundary of an inline math formula.

Porting JFM from pTeX …

5.4 Math Font Family

TeX handles fonts in math formulas by 16 font families[2], and each family has three fonts: `\textfont`, `\scriptfont` and `\scriptscriptfont`.

LuaTeX-ja’s handling of Japanese fonts in math formulas is similar; Table 5 shows counterparts to TeX’s primitives for math font families. There is no relation between the value of `\fam` and that of `\jfam`; with appropriate settings, you can set both `\fam` and `\jfam` to the same value.

---

[2] Omega, Aleph, LuaTeX and ε-(u)pTeX can handles 256 families, but an external package is needed to support this in plain TeX and LaTeX.

Table 5. Primitives for Japanese math fonts.

Japanese fonts	**alphabetic fonts**
`\jfam` $\in [0, 256)$	`\fam`
jatextfont ={⟨*jfam*⟩,⟨*jfont_cs*⟩}	`\textfont`⟨*fam*⟩=⟨*font_cs*⟩
jascriptfont ={⟨*jfam*⟩,⟨*jfont_cs*⟩}	`\scriptfont`⟨*fam*⟩=⟨*font_cs*⟩
jascriptscriptfont ={⟨*jfam*⟩,⟨*jfont_cs*⟩}	`\scriptscriptfont`⟨*fam*⟩=⟨*font_cs*⟩

5.5 Callbacks

Like LuaTEX itself, LuaTEX-ja also has callbacks. These callbacks can be accessed via `luatexbase.add_to_callback` function and so on, as other callbacks.

`luatexja.load_jfm` **callback** With this callback you can overwrite JFMs. This callback is called when a new JFM is loaded.

```
function (<table> jfm_info, <string> jfm_name)
  return <table> new_jfm_info
end
```

The argument `jfm_info` contains a table similar to the table in a JFM file, except this argument has `chars` field which contains character codes whose character class is not 0.

An example of this callback is the `ltjarticle` class, with forcefully assigning character class 0 to `'parbdd'` in the JFM `jfm-min.lua`. This callback doesn't replace any code of LuaTEX-ja.

`luatexja.define_font` **callback** This callback and the next callback form a pair, and you can assign letters which don't have fixed code points in Unicode to non-zero character classes. This `luatexja.define_font` callback is called just when new Japanese font is loaded.

```
function (<table> jfont_info, <number> font_number)
  return <table> new_jfont_info
end
```

You may assume that `jfont_info` has the following fields:

`jfm` The index number of JFM.

`size` Font size in a scaled point ($= 2^{-16}$ pt).

`var` The value specified in `jfmvar=...` at a call of `\jfont`.

The returned table `new_jfont_info` also should include these three fields. The `font_number` is a font number.

A good example of this and the next callbacks is the `luatexja-otf` package, supporting `"AJ1-xxx"` form for Adobe-Japan1 CID characters in a JFM. This callback doesn't replace any code of LuaTEX-ja.

`luatexja.find_char_class` **callback** This callback is called just when LuaTEX-ja is trying to determine which character class a character `chr_code` belongs. A function used in this callback should be in the following form:

```
function (<number> char_class, <table> jfont_info, <number> chr_code)
  if char_class~=0 then return char_class
  else
    ....
    return (<number> new_char_class or 0)
  end
end
```

The argument `char_class` is the result of LuaTEX-ja's default routine or previous function calls in this callback, hence this argument may not be 0. Moreover, the returned `new_char_class` should be as same as `char_class` when `char_class` is not 0, otherwise you will overwrite the LuaTEX-ja's default routine.

This callback doesn't replace any code of LuaTEX-ja.

`luatexja.set_width` **callback** This callback is called when LuaTeX-ja is trying to encapsule a **JAchar** *glyph_node*, to adjust its dimension and position.

```
function (<table> shift_info, <table> jfont_info, <number> char_class)
  return <table> new_shift_info
end
```

The argument `shift_info` and the returned `new_shift_info` have `down` and `left` fields, which are the amount of shifting down/left the character in a scaled-point.

A good example is `test/valign.lua`. After loading this file, the vertical position of glyphs is automatically adjusted; the ratio (height : depth) of glyphs is adjusted to be that of letters in the character class 0. For example, suppose that

- The setting of the JFM: (height) $= 88x$, (depth) $= 12x$ (the standard values of Japanese OpenType fonts);
- The value of the real font: (height) $= 28y$, (depth) $= 5y$ (the standard values of Japanese TrueType fonts).

Then, the position of glyphs is shifted up by

$$\frac{88x}{88x+12x}(28y+5y)-28y=\frac{26}{25}y=1.04y.$$

6 Parameters

6.1 `\ltjsetparameter` primitive

As noted before, `\ltjsetparameter` and `\ltjgetparameter` are primitives for accessing most parameters of LuaTeX-ja. One of the main reason that LuaTeX-ja didn't adopted the syntax similar to that of pTeX (*e.g.*, ``\prebreakpenalty`)=10000``) is the position of `hpack_filter` callback in the source of LuaTeX, see Section 10.

`\ltjsetparameter` and `\ltjglobalsetparameter` are primitives for assigning parameters. These take one argument which is a ⟨*key*⟩=⟨*value*⟩ list. Allowed keys are described in the next subsection. The difference between `\ltjsetparameter` and `\ltjglobalsetparameter` is only the scope of assignment; `\ltjsetparameter` does a local assignment and `\ltjglobalsetparameter` does a global one. They also obey the value of `\globaldefs`, like other assignment.

`\ltjgetparameter` is the primitive for acquiring parameters. It always takes a parameter name as first argument, and also takes the additional argument—a character code, for example—in some cases.

```
\ltjgetparameter{differentjfm},
\ltjgetparameter{autospacing},
\ltjgetparameter{prebreakpenalty}{`)}.
```

average, 1, 10000.

The return value of `\ltjgetparameter` *is always a string*. This is outputted by `tex.write()`, so any character other than space ‘ ’ (U+0020) has the category code 12 (other), while the space has 10 (space).

6.2 List of Parameters

The following is the list of parameters which can be specified by the `\ltjsetparameter` command. [`\cs`] indicates the counterpart in pTeX, and symbols beside each parameter has the following meaning:

- No mark: values at the end of the paragraph or the hbox are adopted in the whole paragraph/hbox.
- ‘$*$’ : local parameters, which can change everywhere inside a paragraph/hbox.
- ‘†’: assignments are always global.

jcharwidowpenalty =⟨*penalty*⟩ [`\jcharwidowpenalty`] Penalty value for suppressing orphans. This penalty is inserted just after the last **JAchar** which is not regarded as a (Japanese) punctuation mark.

kcatcode ={⟨*chr_code*⟩,⟨*natural number*⟩} An additional attributes which each character whose character code is ⟨*chr_code*⟩ has. At the present version, the lowermost bit of ⟨*natural number*⟩ indicates whether the character is considered as a punctuation mark (see the description of jcharwidowpenalty above).

prebreakpenalty ={⟨*chr_code*⟩,⟨*penalty*⟩} [`\prebreakpenalty`]

postbreakpenalty ={⟨*chr_code*⟩,⟨*penalty*⟩} [`\postbreakpenalty`]

jatextfont ={⟨*jfam*⟩,⟨*jfont_cs*⟩} [`\textfont` in TeX]

jascriptfont ={⟨*jfam*⟩,⟨*jfont_cs*⟩} [`\scriptfont` in TeX]

jascriptscriptfont ={⟨*jfam*⟩,⟨*jfont_cs*⟩} [`\scriptscriptfont` in TeX]

yjabaselineshift =⟨*dimen*⟩*

yalbaselineshift =⟨*dimen*⟩* [`\ybaselineshift`]

jaxspmode ={⟨*chr_code*⟩,⟨*mode*⟩} Setting whether inserting xkanjiskip is allowed before/after a **JAchar** whose character code is ⟨*chr_code*⟩. The followings are allowed for ⟨*mode*⟩:

0, `inhibit` Insertion of xkanjiskip is inhibited before the character, nor after the character.

1, `preonly` Insertion of xkanjiskip is allowed before the character, but not after.

2, `postonly` Insertion of xkanjiskip is allowed after the character, but not before.

3, `allow` Insertion of xkanjiskip is allowed both before the character and after the character. This is the default value.

This parameter is similar to the `\inhibitxspcode` primitive of pTeX, but not compatible with `\inhibitxspcode`.

alxspmode ={⟨*chr_code*⟩,⟨*mode*⟩} [`\xspcode`]

Setting whether inserting xkanjiskip is allowed before/after a **ALchar** whose character code is ⟨*chr_code*⟩. The followings are allowed for ⟨*mode*⟩:

0, `inhibit` Insertion of xkanjiskip is inhibited before the character, nor after the character.

1, `preonly` Insertion of xkanjiskip is allowed before the character, but not after.

2, `postonly` Insertion of xkanjiskip is allowed after the character, but not before.

3, `allow` Insertion of xkanjiskip is allowed before the character and after the character. This is the default value.

Note that parameters jaxspmode and alxspmode use a common table, hence these two parameters are synonyms of each other.

autospacing =⟨*bool*⟩* [`\autospacing`]

autoxspacing =⟨*bool*⟩* [`\autoxspacing`]

kanjiskip =⟨*skip*⟩ [`\kanjiskip`]

xkanjiskip =⟨*skip*⟩ [`\xkanjiskip`]

differentjfm =⟨*mode*⟩† Specify how glues/kerns between two **JAchar**s whose JFM (or size) are different. The allowed arguments are the followings:

`average`

`both`

`large`

`small`

jacharrange =⟨*ranges*⟩*

kansujichar ={⟨*digit*⟩, ⟨*chr_code*⟩} [`\kansujichar`]

7 Other Primitives

7.1 Primitives for Compatibility

The following primitives are implemented for compatibility with pTEX:

```
\kuten

\jis

\euc

\sjis

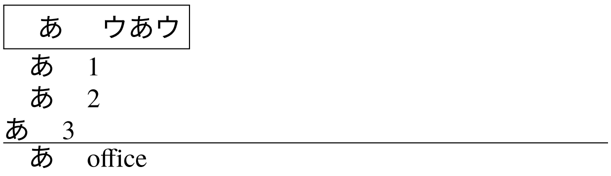
\ucs

\kansuji
```

7.2 `\inhibitglue` primitive

The primitive `\inhibitglue` suppresses the insertion of **JAglue**. The following is an example, using a special JFM that there will be a glue between the beginning of a box and 'あ', and also between 'あ' and 'ウ'.

```
\jfont\g=psft:Ryumin-Light:jfm=test \g
\fbox{\hbox{あウあ\inhibitglue ウ}}
\inhibitglue\par\noindent あ1
\par\inhibitglue\noindent あ2
\par\noindent\inhibitglue あ3
\par\hrule\noindent あ off\inhibitglue ice
```



With the help of this example, we remark the specification of `\inhibitglue`:

- The call of `\inhibitglue` in the (internal) vertical mode is simply ignored.
- The call of `\inhibitglue` in the (restricted) horizontal mode is only effective on the spot; does not get over boundary of paragraphs. Moreover, `\inhibitglue` cancels ligatures and kernings, as shown in the last line of above example.
- The call of `\inhibitglue` in math mode is just ignored.

8 Control Sequences for LATEX 2$_\varepsilon$

8.1 Patch for NFSS2

As described in Subsection 2.4, LuaTEX-ja simply adopted `plfonts.dtx` in pLATEX 2$_\varepsilon$ for the Japanese patch for NFSS2. For an convenience, we will describe commands which are not described in Subsection 3.1.

`\DeclareYokoKanjiEncoding{`⟨*encoding*⟩`}{`⟨*text-settings*⟩`}{`⟨*math-settings*⟩`}`

In NFSS2 under LuaTEX-ja, distinction between alphabetic font families and Japanese font families are only made by their encodings. For example, encodings OT1 and T1 are for alphabetic font families, and a Japanese font family cannot have these encodings. This command defines a new encoding scheme for Japanese font family (in horizontal direction).

`\DeclareKanjiEncodingDefaults{`⟨*text-settings*⟩`}{`⟨*math-settings*⟩`}`

`\DeclareKanjiSubstitution{`⟨*encoding*⟩`}{`⟨*family*⟩`}{`⟨*series*⟩`}{`⟨*shape*⟩`}`

`\DeclareErrorKanjiFont{`⟨*encoding*⟩`}{`⟨*family*⟩`}{`⟨*series*⟩`}{`⟨*shape*⟩`}{`⟨*size*⟩`}`

The above 3 commands are just the counterparts for `DeclareFontEncodingDefaults` and others.

`\reDeclareMathAlphabet{`⟨*unified-cmd*⟩`}{`⟨*al-cmd*⟩`}{`⟨*ja-cmd*⟩`}`

`\DeclareRelationFont{`⟨*ja-encoding*⟩`}{`⟨*ja-family*⟩`}{`⟨*ja-series*⟩`}{`⟨*ja-shape*⟩`}`
`{`⟨*al-encoding*⟩`}{`⟨*al-family*⟩`}{`⟨*al-series*⟩`}{`⟨*al-shape*⟩`}`

This command sets the 'accompanied' alphabetic font family (given by the latter 4 arguments) with respect to a Japanese font family given by the former 4 arguments.

`\SetRelationFont`

This command is almost same as `\DeclareRelationFont`, except that this command does a local assignment, where `\DeclareRelationFont` does a global assignment.

`\userelfont`

Change current alphabetic font encoding/family/… to the 'accompanied' alphabetic font family with respect to current Japanese font family, which was set by `\DeclareRelationFont` or `\SetRelationFont`. Like `\fontfamily`, `\selectfont` is required to take an effect.

`\adjustbaseline`

…

`\fontfamily{`⟨*family*⟩`}`

As in LaTeX 2ε, this command changes current font family (alphabetic, Japanese, *or both*) to ⟨*family*⟩. Which family will be changed is determined as follows:

- Let current encoding scheme for Japanese fonts be ⟨*ja-enc*⟩. Current Japanese font family will be changed to ⟨*family*⟩, if one of the following two conditions is met:
  - The family ⟨*fam*⟩ under the encoding ⟨*ja-enc*⟩ has been already defined by `\DeclareKanijFamily`.
  - A font definition named ⟨*enc*⟩⟨*ja-enc*⟩`.fd` (the file name is all lowercase) exists.
- Let current encoding scheme for alphabetic fonts be ⟨*al-enc*⟩. For alphabetic font family, the criterion as above is used.
- There is a case which none of the above applies, that is, the font family named ⟨*family*⟩ doesn't seem to be defined neither under the encoding ⟨*ja-enc*⟩, nor under ⟨*al-enc*⟩. In this case, the default family for font substitution is used for alphabetic and Japanese fonts. Note that current encoding will not be set to ⟨*family*⟩, unlike the original implementation in LaTeX.

As closing this subsection, we shall introduce an example of `\SetRelationFont` and `\userelfont`:

```
\gtfamily{}あいう abc
\SetRelationFont{JY3}{gt}{m}{n}{OT1}{pag}{m
  }{n}
\userelfont\selectfont{}あいう abc
```

あいう abc　あいう abc

8.2 Cropmark/'tombow'

9 Extensions

9.1 `luatexja-fontspec.sty`

As described in Subsection 3.2, this optional package provides the counterparts for several commands defined in the fontspec package. In addition to 'font features' in the original fontspec, the following 'font features' specifications are allowed for the commands of Japanese version:

`CID=`⟨*name*⟩

`JFM=`⟨*name*⟩

`JFM-var=`⟨*name*⟩

These 3 font features correspond to `cid`, `jfm` and `jfmvar` keys for `\jfont` primitive, respectively. `CID` is effective only when with `NoEmbed` described below. See Subsections 5.1 and 5.2 for details.

`NoEmbed` By specifying this font feature, one can use 'name-only' Japanese font which will not be embedded in the output PDF file. See Subsection 5.2.

9.2 `luatexja-otf.sty`

This optional package supports typesetting characters in Adobe-Japan1. `luatexja-otf.sty` offers the following 2 low-level commands:

`\CID{`⟨*number*⟩`}` Typeset a character whose CID number is ⟨*number*⟩.

`\UTF{`⟨*hex_number*⟩`}` Typeset a character whose character code is ⟨*hex_number*⟩ (in hexadecimal). This command is similar to `\char"`⟨*hex_number*⟩, but please remind remarks below.

Remarks Characters by `\CID` and `\UTF` commands are different from ordinary characters in the following points:

- Always treated as **JAchar**s.
- Processing codes for supporting OpenType features (*e.g.*, glyph replacement and kerning) by the `luaotfload` package is not performed to these characters.

Additional Syntax of JFM `luatexja-otf.sty` extends the syntax of JFM; the entries of `chars` table in JFM now allows a string in the form `'AJ1-xxx'`, which stands for the character whose CID number in Adobe-Japan1 is `xxx`.

Part III

Implementations

10 Storing Parameters

10.1 Used Dimensions, Attributes and whatsit nodes

Here the following is the list of dimensions and attributes which are used in LuaTEX-ja.

`\jQ` (dimension) `\jQ` is equal to 1 Q = 0.25 mm, where ‘Q’ (also called ‘級’) is a unit used in Japanese phototypesetting. So one should not change the value of this dimension.

`\jH` (dimension) There is also a unit called ‘歯’ which equals to 0.25 mm and used in Japanese phototypesetting. This `\jH` is a synonym of `\jQ`.

`\ltj@zw` (dimension) A temporal register for the ‘full-width’ of current Japanese font.

`\ltj@zh` (dimension) A temporal register for the ‘full-height’ (usually the sum of height of imaginary body and its depth) of current Japanese font.

`\jfam` (attribute) Current number of Japanese font family for math formulas.

`\ltj@curjfnt` (attribute) The font index of current Japanese font.

`\ltj@charclass` (attribute) The character class of Japanese *glyph_node*.

`\ltj@yablshift` (attribute) The amount of shifting the baseline of alphabetic fonts in scaled point (2^{-16} pt).

`\ltj@ykblshift` (attribute) The amount of shifting the baseline of Japanese fonts in scaled point (2^{-16} pt).

`\ltj@autospc` (attribute) Whether the auto insertion of kanjiskip is allowed at the node.

`\ltj@autoxspc` (attribute) Whether the auto insertion of xkanjiskip is allowed at the node.

`\ltj@icflag` (attribute) An attribute for distinguishing ‘kinds’ of a node. One of the following value is assigned to this attribute:

***italic* (1)** Glues from an italic correction (`\/`). This distinction of origins of glues (from explicit `\kern`, or from `\/`) is needed in the insertion process of xkanjiskip.

***packed* (2)**

***kinsoku* (3)** Penalties inserted for the word-wrapping process of Japanese characters (*kinsoku*).

***from_jfm* (4)** Glues/kerns from JFM.

***line_end* (5)** Kerns for …

***kanji_skip* (6)** Glues for kanjiskip.

***xkanji_skip* (7)** Glues for xkanjiskip.

***processed* (8)** Nodes which is already processed by ….

***ic_processed* (9)** Glues from an italic correction, but also already processed.

***boxbdd* (15)** Glues/kerns that inserted just the beginning or the ending of an hbox or a paragraph.

`\ltj@kcat`*i* (attribute) Where *i* is a natural number which is less than 7. These 7 attributes store bit vectors indicating which character block is regarded as a block of **JAchar**s.

Furthermore, LuaTEX-ja uses several 'user-defined' whatsit nodes for inrernal processing. All those nodes store a natural number (hence the node's `type` is 100). The following `user_id`s are used:

30111 Nodes for indicating that `\inhibitglue` is specified. The `value` field of these nodes doesn't matter.

30112 Nodes for LuaTEX-ja's stack system (see the next subsection). The `value` field of these nodes is current group.

30113 Nodes for Japanese Characters which the callback process of `luaotfload` won't be applied, and the character code is stored in the `value` field. Each node having this `user_id` is converted to a 'glyph_node' *after* the callback process of luaotfload. This `user_id` is only used by the `luatexja-otf` package.

30114 Nodes for indicating beginning of a paragraph. A paragraph which is started by `\item` in list-like environments has a horizontal box for its label before the actual contents. So …

These whatsits will be removed during the process of inserting **JAglue**s.

10.2 Stack System of LuaTEX-ja

Background LuaTEX-ja has its own stack system, and most parameters of LuaTEX-ja are stored in it. To clarify the reason, imagine the parameter kanjiskip is stored by a skip, and consider the following source:

```
\ltjsetparameter{kanjiskip=0pt}ふがふが.%
\setbox0=\hbox{\ltjsetparameter{kanjiskip=5
    pt}ほげほげ}
\box0.ぴよぴよ\par
```

ふがふが. ほ げ ほ げ. ぴよぴよ

As described in Subsection 6.2, the only effective value of kanjiskip in an hbox is the latest value, so the value of kanjiskip which applied in the entire hbox should be 5 pt. However, by the implementation method of LuaTEX, this '5 pt' cannot be known from any callbacks. In the `tex/packaging.w` (which is a file in the source of LuaTEX), there are the following codes:

```
void package(int c)
{
    scaled h;                   /* height of box */
    halfword p;                 /* first node in a box */
    scaled d;                   /* max depth */
    int grp;
    grp = cur_group;
    d = box_max_depth;
    unsave();
    save_ptr -= 4;
    if (cur_list.mode_field == -hmode) {
        cur_box = filtered_hpack(cur_list.head_field,
                                 cur_list.tail_field, saved_value(1),
                                 saved_level(1), grp, saved_level(2));
        subtype(cur_box) = HLIST_SUBTYPE_HBOX;
```

Notice that `unsave` is executed *before* `filtered_hpack` (this is where `hpack_filter` callback is executed): so '5 pt' in the above source is orphaned at `unsave`, and hence it can't be accessed from `hpack_filter` callback.

The method The code of stack system is based on that in a post of Dev-luatex mailing list[3].

These are two TeX count registers for maintaining information: `\ltj@@stack` for the stack level, and `\ltj@@group@level` for the TeX's group level when the last assignment was done. Parameters are stored in one big table named `charprop_stack_table`, where `charprop_stack_table[`*i*`]` stores data of stack level i. If a new stack level is created by `\ltjsetparameter`, all data of the previous level is copied.

To resolve the problem mentioned in 'Background' above, LuaTeX-ja uses another thing: When a new stack level is about to be created, a whatsit node whose type, subtype and value are 44 (*user_defined*), 30112, and current group level respectively is appended to the current list (we refer this node by *stack_flag*). This enables us to know whether assignment is done just inside a hbox. Suppose that the stack level is s and the TeX's group level is t just after the hbox group, then:

- If there is no *stack_flag* node in the list of the hbox, then no assignment was occurred inside the hbox. Hence values of parameters at the end of the hbox are stored in the stack level s.
- If there is a *stack_flag* node whose value is $t+1$, then an assignment was occurred just inside the hbox group. Hence values of parameters at the end of the hbox are stored in the stack level $s+1$.
- If there are *stack_flag* nodes but all of their values are more than $t+1$, then an assignment was occurred in the box, but it is done is 'more internal' group. Hence values of parameters at the end of the hbox are stored in the stack level s.

Note that to work this trick correctly, assignments to `\ltj@@stack` and `\ltj@@group@level` have to be local always, regardless the value of `\globaldefs`. This problem is resolved by using `\directlua{tex.globaldefs=0}` (this assignment is local).

11 Linebreak after Japanese Character

11.1 Reference: Behavior in pTeX

In pTeX, a line break after a Japanese character doesn't emit a space, since words are not separated by spaces in Japanese writings. However, this feature isn't fully implemented in LuaTeX-ja due to the specification of callbacks in LuaTeX. To clarify the difference between pTeX and LuaTeX, We briefly describe the handling of a line break in pTeX, in this subsection.

pTeX's input processor can be described in terms of a finite state automaton, as that of TeX in Section 2.5 of [1]. The internal states are as follows:

- State N: new line
- State S: skipping spaces
- State M: middle of line
- State K: after a Japanese character

The first three states—N, S and M—are as same as TeX's input processor. State K is similar to state M, and is entered after Japanese characters. The diagram of state transitions are indicated in Figure 2. Note that pTeX doesn't leave state K after 'beginning/ending of a group' characters.

11.2 Behavior in LuaTeX-ja

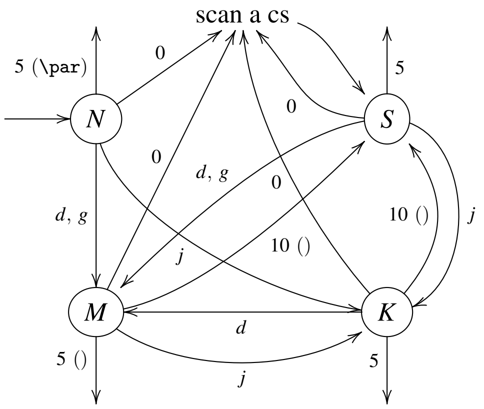
States in the input processor of LuaTeX is the same as that of TeX, and they can't be customized by any callbacks. Hence, we can only use `process_input_buffer` and `token_filter` callbacks for to suppress a space by a line break which is after Japanese characters.

However, `token_filter` callback cannot be used either, since a character in category code 5 (end-of-line) is converted into an space token *in the input processor*. So we can use only the `process_input_buffer` callback. This means that suppressing a space must be done *just before* an input line is read.

Considering these situations, handling of an end-of-line in LuaTeX-ja are as follows:

---

[3] `[Dev-luatex] tex.currentgrouplevel`, a post at 2008/8/19 by Jonathan Sauer.



$$d := \{3,4,6,7,8,11,12,13\},\quad g := \{1,2\},\quad j := (\text{Japanese characters})$$

- Numbers represent category codes.
- Category codes 9 (ignored), 14 (comment) and 15 (invalid) are omitted in the above diagram.

Figure 2. State transitions of pTEX's input processor.

A character U+FFFFF (its category code is set to 14 (comment) by LuaTEX-ja) is appended to an input line, *before LuaTEX actually process it*, if and only if the following three conditions are satisfied:

1. The category code of `\endlinechar`[4] is 5 (end-of-line).
2. The category code of U+FFFFF itself is 14 (comment).
3. The input line matches the following 'regular expression':

$$(\text{any char})^*(\textbf{JAchar})\big(\{\text{catcode}=1\}\cup\{\text{catcode}=2\}\big)^*$$

Remark The following example shows the major difference from the behavior of pTEX:

```
1 \ltjsetparameter{autoxspacing=false}
2 \ltjsetparameter{jacharrange={-6}}xあ
3 y\ltjsetparameter{jacharrange={+6}}zあ
4 u
```

xyzあ u

- There is no space between 'x' and 'y', since the line 2 ends with a **JAchar** 'あ' (this 'あ' considered as an **JAchar** at the ending of line 1).
- There is no space between 'あ' (in the line 3) and 'u', since the line 3 ends with an **ALchar** (the letter 'あ' considered as an **ALchar** at the ending of line 2).

12 Insertion of JFM glues, kanjiskip and xkanjiskip

12.1 Overview

LuaTEX-ja における和文処理グルーの挿入方法は，pTEX のそれとは全く異なる．pTEX では次のような仕様であった：

- JFM グルーの挿入は，和文文字を表すトークンを元に水平リストに（文字を表す）⟨*char_node*⟩ を追加する過程で行われる．
- xkanjiskip の挿入は，水平ボックスへのパッケージングや行分割前に行われる．

---

[4] Usually, it is ⟨return⟩ (whose character code is 13).

- kanjiskip はノードとしては挿入されない．パッケージングや行分割の計算時に「和文文字を表す 2 つの ⟨*char_node*⟩ の間には kanjiskip がある」ものとみなされる．

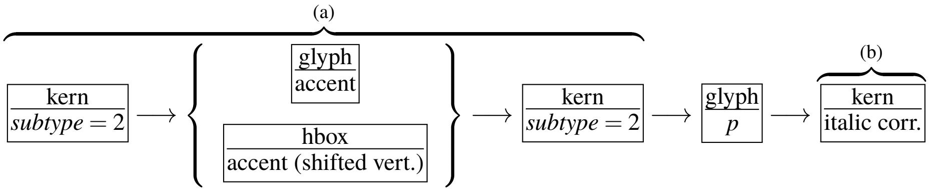
しかし，LuaTEX-ja では，水平ボックスへのパッケージングや行分割前に全ての **JAglue**，即ち JFM グルー・xkanjiskip・kanjiskip の 3 種類を一度に挿入することになっている．これは，LuaTEX において欧文の合字・カーニング処理がノードベースになったことに対応する変更である．

LuaTEX-ja における **JAglue** 挿入処理では，次節で定義する「クラスタ」を単位にして行われる．大雑把にいうと，「クラスタ」は文字とそれに付随するノード達（アクセント位置補正用のカーンや，イタリック補正）をまとめたものであり，2 つのクラスタの間には，ペナルティ，`\vadjust`，whatsit など，行組版には関係しないものがある．

12.2 definition of a ‘cluster’

Definition 1. A *cluster* is a list of consecutive nodes in one of the following forms, with the *id* of it:

1. Nodes whose value of `\ltj@icflag` is in $[3,15)$. These nodes come from a hbox which is already packaged, by unpackaging (`\unhbox`). The *id* is *id_pbox*.
2. A inline math formula, including two *math_node*s at the boundary of it. The *id* is *id_math*.
3. A *glyph_node* p with nodes which relate with it:
    (1) A kern for the italic correction of p.
    (2) An accent attached to p by `\accent`.



   The *id* is *id_jglyph* or *id_glyph*, according to whether the *glyph_node* represents a Japanese character or not.

4. An box-like node, that is, an hbox, a vbox, a rule (`\vrule`) and an *unset_node*. The *id* is *id_hlist* if the node is an hbox which is not shifted vertically, or *id_box_like* otherwise.
5. A glue, a kern whose subtype is not 2 (*accent*), and a discretionary break. The *id* is *id_glue*, *id_kern* and *id_disc*, respectively.

Let *Np*, *Nq* and *Nr* denote a cluster.

***id* の意味**　*Np.id* の意味を述べるとともに，「先頭の文字」を表す *glyph_node Np.head* と，「最後の文字」を表す *glyph_node Np.tail* を次のように定義する．直感的に言うと，*Np* は *Np.head* で始まり *Np.tail* で終わるような単語，と見做すことができる．これら *Np.head*, *Np.tail* は説明用に準備した概念であって，実際の Lua コード中にそのように書かれているわけではないことに注意．

id_jglyph 和文文字．
Np.head, *Np.tail* は，その和文文字を表している *glyph_node* そのものである．

id_glyph 和文文字を表していない *glyph_node* p．
多くの場合，p は欧文文字を格納しているが，‘ﬃ’ などの合字によって作られた *glyph_node* である可能性もある．前者の場合，$Np.head, Np.tail = p$ である．一方，後者の場合，

- *Np.head* は，合字の構成要素の先頭→（その *glyph_node* における）合字の構成要素の先頭→……と再帰的に検索していってたどり着いた *glyph_node* である．
- *Np.last* は，同様に末尾→末尾→と検索してたどり着いた *glyph_node* である．

id_math インライン数式．
便宜的に，*Np.head*, *Np.tail* ともに「文字コード -1 の欧文文字」とおく．

id_hlist 縦方向にシフトされていない水平ボックス．
この場合，*Np.head*, *Np.tail* はそれぞれ p の内容を表すリストの，先頭・末尾のノードである．

- 状況によっては，TeX ソースで言うと

  `\hbox{\hbox{abc}...\hbox{\lower1pt\hbox{xyz}}}`

  のように，p の内容が別の水平ボックスで開始・終了している可能性も十分あり得る．そのような場合，*Np.head*, *Np.tail* の算出は，垂直方向にシフトされていない水平ボックスの場合だけ内部を再帰的に探索する．例えば上の例では，*Np.head* は文字「a」を表すノードであり，一方 *Np.tail* は垂直方向にシフトされた水平ボックス，`\lower1pt\hbox{xyz}`に対応するノードである．
- また，先頭にアクセント付きの文字がきたり，末尾にイタリック補正用のカーンが来ることもあり得る．この場合は，クラスタの定義のところにもあったように，それらは無視して算出を行う．
- 最初・最後のノードが合字によって作られた *glyph_node* のときは，それぞれに対して *id_glyph* と同様に再帰的に構成要素をたどっていく．

id_pbox 「既に処理された」ノードのリストであり，これらのノードが二度処理を受けないためにまとめて 1 つのクラスタとして取り扱うだけである．*id_hlist* と同じ方法で *Np.head*, *Np.tail* を算出する，

id_disc discretionary break (`\discretionary{pre}{post}{nobreak}`).
id_hlist と同じ方法で *Np.head*, *Np.tail* を算出するが，第 3 引数の `nobreak`（行分割が行われない時の内容）を使う．言い換えれば，ここで行分割が発生した時の状況は全く考慮に入れない．

id_box_like *id_hlist* とならない box や，rule．
この場合は，*Np.head*, *Np.tail* のデータは利用されないので，2 つの算出は無意味である．敢えて明示するならば，*Np.head*, *Np.tail* は共に nil 値である．

他 以上にない *id* に対しても，*Np.head*, *Np.tail* の算出は無意味．

クラスタの別の分類　さらに，JFM グルー挿入処理の実際の説明により便利なように，*id* とは別のクラスタの分類を行っておく．挿入処理では 2 つの隣り合ったクラスタの間に空白等の実際の挿入を行うことは前に書いたが，ここでの説明では，問題にしているクラスタ *Np* は「後ろ側」のクラスタであるとする．「前側」のクラスタについては，以下の説明で *head* が *last* に置き換わることに注意すること．

和文 **A** リスト中に直接出現している和文文字．*id* が *id_jglyph* であるか，
id が *id_pbox* であって *Np.head* が **JAchar** であるとき．

和文 **B** リスト中の水平ボックスの中身の先頭として出現した和文文字．和文 A との違いは，これの前に JFM グルーの挿入が行われない（xkanjiskip, kanjiskip は入り得る）ことである．
id が *id_hlist* か *id_disc* であって *Np.head* が **JAchar** であるとき．

欧文 リスト中に直接／水平ボックスの中身として出現している欧文文字．次の 3 つの場合が該当：

- *id* が *id_glyph* である．
- *id* が *id_math* である．
- *id* が *id_pbox* か *id_hlist* か *id_disc* であって，*Np.head* が **ALchar**．

箱 box，またはそれに類似するもの．次の 2 つが該当：

- *id* が *id_pbox* か *id_hlist* か *id_disc* であって，*Np.head* が *glyph_node* でない．
- *id* が *id_box_like* である．

12.3 段落／水平ボックスの先頭や末尾

先頭部の処理　まず，段落／水平ボックスの一番最初にあるクラスタ *Np* を探索する．水平ボックスの場合は何の問題もないが，段落の場合では以下のノード達を事前に読み飛ばしておく：

`\parindent` 由来の水平ボックス (*subtype* = 3)，及び *subtype* が 44 (*user_defined*) でないような whatsit．

これは，`\parindent` 由来の水平ボックスがクラスタを構成しないようにするためである．

次に，*Np* の直前に空白 g を必要なら挿入する：

1. この処理が働くような *Np* は和文 A である．
2. 問題のリストが字下げありの段落（`\parindent` 由来の水平ボックスあり）の場合は，この空白 *g* は「文字コード `'parbdd'` の文字」と *Np* の間に入るグルー／カーンである．
3. そうでないとき（`noindent` で開始された段落や水平ボックス）は，*g* は「文字コード `'boxbdd'` の文字」と *Np* の間に入るグルー／カーンである．

ただし，もし *g* が glue であった場合，この挿入によって *Np* による行分割が新たに可能になるべきではない．そこで，以下の場合には，*g* の直前に`\penalty10000` を挿入する：

- 問題にしているリストが段落であり，かつ
- *Np* の前には予めペナルティがなく，*g* は glue．

末尾の処理　末尾の処理は，問題のリストが段落のものか水平ボックスのものかによって異なる．後者の場合は容易い：最後のクラスタを *Nq* とおくと，*Nq* と「文字コード `'boxbdd'` の文字」の間に入るグルー／カーンを，*Nq* の直後に挿入するのみである．

一方．前者（段落）の場合は，リストの末尾は常に`\penalty10000` と，`\parfillskip` 由来のグルーが存在する．よって，最後のクラスタ *Np* はこの`\parfillskip` 由来のグルーとなり，実質的な中身の最後はその 1 つ前のクラスタ *Nq* となる．

1. まず *Nq* の直後に（後に述べる）line-end [E] によって定まる空白を挿入する．
2. 次に，段落の最後の「通常の和文文字 + 句点」が独立した行となるのを防ぐために，jcharwidowpenalty の値の分だけ適切な場所のペナルティを増やす．

   ペナルティ量を増やす場所は，*head* が **JAchar** であり，かつその文字の kcatcode が偶数であるような最後のクラスタの直前にあるものたちである[5]．

12.4　概観と典型例：2 つの「和文 A」の場合

先に述べたように，2 つの隣り合ったクラスタ，*Nq* と *Np* の間には，ペナルティ，`\vadjust`，whatsit など，行組版には関係しないものがある．模式的に表すと，

$$\begin{array}{|c|}\hline \text{cluster}\\ \hline Nq\\ \hline\end{array} \longrightarrow \overbrace{\begin{array}{|c|}\hline \text{penalty}\\ \hline p\\ \hline\end{array} \longrightarrow \cdots \longrightarrow \begin{array}{|c|}\hline \text{whatsit}\\ \hline \ \\ \hline\end{array}}^{(a)} \longrightarrow \begin{array}{|c|}\hline \text{cluster}\\ \hline Np\\ \hline\end{array}$$

のようになっている．間の (a) に相当する部分には，何のノードもない場合ももちろんあり得る．そうして，JFM グルー挿入後には，この 2 クラスタ間は次のようになる：

$$\begin{array}{|c|}\hline \text{cluster}\\ \hline Nq\\ \hline\end{array} \longrightarrow \begin{array}{|c|}\hline \text{kern}\\ \hline \text{左空白}\\ \hline\end{array} \longrightarrow \overbrace{\begin{array}{|c|}\hline \text{penalty}\\ \hline p+x\\ \hline\end{array} \longrightarrow \cdots \longrightarrow \begin{array}{|c|}\hline \text{whatsit}\\ \hline \ \\ \hline\end{array}}^{(a)} \longrightarrow \begin{array}{|c|}\hline \text{glue or kern}\\ \hline \text{右空白}\\ \hline\end{array} \longrightarrow \begin{array}{|c|}\hline \text{cluster}\\ \hline Np\\ \hline\end{array}$$

以後，典型的な例として，クラスタ ***Nq*** と ***Np*** が共に和文 A である場合を見ていこう，この場合が全ての場合の基本となる．

「右空白」の算出　まず，「右空白」にあたる量を算出する．通常はこれが，隣り合った 2 つの和文文字間に入る空白量となる．

JFM 由来 [M] JFM の文字クラス指定によって入る空白を以下によって求める．この段階で空白量が未定義（未指定）だった場合，デフォルト値 kanjiskip を採用することとなるので，次へ．

1. もし両クラスタの間で`\inhibitglue` が実行されていた場合（証として whatsit ノードが自動挿入される），代わりに kanjiskip が挿入されることとなる．次へ．

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[5] 大雑把に言えば，kcatcode が奇数であるような **JAchar** を約物として考えていることになる．kcatcode の最下位ビットはこの jcharwidowpenalty 用にのみ利用される．

2. Nq と Np が同じ JFM・同じ `jfmvar` キー・同じサイズの和文フォントであったならば，共通に使っている JFM 内で挿入される空白（グルーかカーン）が決まっているか調べる．
3. 1. でも 2. でもない場合は，Nq と Np が違う JFM/`jfmvar`/サイズである．この場合，まず

   $$gb := (Nq\text{ と「文字コードが}\texttt{'diffmet'}\text{ の文字」との間に入るグルー／カーン})$$
   $$ga := (\text{「文字コードが}\texttt{'diffmet'}\text{ の文字」と }Np\text{ との間に入るグルー／カーン})$$

   として，左側由来・右側由来の空白（グルー／カーン）を（それぞれの JFM から）求める．ga と gb のどちらか片方が未定義であるならば，定義されている側の値をそのまま採用する．もし ga と gb が両方決まっているならば，両者の値を平均[6]した値を採用する．

例えば，

```
\jfont\foo=psft:Ryumin-Light:jfm=ujis
\jfont\bar=psft:GothicBBB-Medium:jfm=ujis
\jfont\baz=psft:GothicBBB-Medium:jfm=ujis;jfmvar=piyo
```

という 3 フォントを考え，

$$\overbrace{\boxed{\begin{array}{c}\text{glyph}\\ \hline \texttt{\textbackslash foo},\ \text{‘あ’}\end{array}}}^{p} \longrightarrow \overbrace{\boxed{\begin{array}{c}\text{glyph}\\ \hline \texttt{\textbackslash bar},\ \text{‘い’}\end{array}}}^{q} \longrightarrow \overbrace{\boxed{\begin{array}{c}\text{glyph}\\ \hline \texttt{\textbackslash baz},\ \text{‘う’}\end{array}}}^{r}$$

という 3 ノードを考える（それぞれ単独でクラスタをなす）．この場合，p と q の間は，実フォントが異なるにもかかわらず (2) の状況となる一方で，q と r の間は（実フォントが同じなのに）`jfmvar` キーの内容が異なるので (3) の状況となる．

kanjiskip [K] 上の [M] において空白が定まらなかった場合，kanjiskip の値を以下で定め，それを「右空白」として採用する．この段階においては，`\inhibitglue` は効力を持たないため，結果として，2 つの和文文字間には常に何らかのグルー／カーンが挿入されることとなる．

1. 両クラスタ（厳密には $Nq.tail$，$Np.head$）の中身の文字コードに対する autospacing パラメタが両方とも false だった場合は，長さ 0 の glue とする．
2. ユーザ側から見た kanjiskip パラメタの自然長が `\maxdimen` $= (2^{30} - 1)$ sp でなければ，kanjiskip パラメタの値を持つ glue を採用する．
3. 2. でない場合は，Nq, Np で使われている JFM に指定されている kanjiskip の値を用いる．どちらか片方のクラスタだけが和文文字（和文 A・和文 B）のときは，そちらのクラスタで使われている JFM 由来の値だけを用いる．もし両者で使われている JFM が異なった場合は，上の [M] 3. と同様の方法を用いて調整する．

「左空白」の算出とそれに伴う補正　次に，「左空白」にあたる量を算出する：

line-end [E] Nq と Np の間で行分割が起きたときに，Nq と行末の間に入る空白である．ぶら下げ組の組版などに用いられることを期待している．

1. 既に算出した「右空白」がカーンである場合は，「左空白」は挿入されない．
2. 「右空白」が glue か未定義（長さ 0 の glue とみなす）の場合は，「左空白」は Nq と「文字コード `'lineend'` の文字」との間に入るカーンとして，JFM から決定される．
3. 2. で決まった「左空白」の長さが 0 でなければ，その分だけ先ほど算出した「右空白」の自然長を引く．

禁則用ペナルティの挿入　まず，

$$a := (Nq\text{[7]の文字に対する postbreakpenalty の値}) + (Np\text{[8]の文字に対する prebreakpenalty の値})$$

とおく．ペナルティは通常 $[-10000, 10000]$ の整数値をとり，また ±10000 は正負の無限大を意味することになっているが，この a の算出では単純な整数の加減算を行う．

a は禁則処理用に Nq と Np の間に加えられるべきペナルティ量である．

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[6] differentjfm パラメタの値によって，「大きい方」「小さい方」「合計」に変えることができる．

[8] 厳密にはそれぞれ $Nq.tail$，$Np.head$．

Table 6. Summary of JFM glues.

Np ↓	和文 A	和文 B	欧文	箱	glue	kern
和文 A	$\frac{\text{E}\quad\text{M}\to\text{K}}{\text{PN}}$	$\frac{\text{—}\quad\text{O}_\text{A}\to\text{K}}{\text{PN}}$	$\frac{\text{—}\quad\text{O}_\text{A}\to\text{X}}{\text{PN}}$	$\frac{\text{—}\qquad\text{O}_\text{A}}{\text{PA}}$	$\frac{\text{—}\qquad\text{O}_\text{A}}{\text{PN}}$	$\frac{\text{—}\qquad\text{O}_\text{A}}{\text{PS}}$
和文 B	$\frac{\text{E}\quad\text{O}_\text{B}\to\text{K}}{\text{PA}}$	$\frac{\text{—}\qquad\text{K}}{\text{PS}}$	$\frac{\text{—}\qquad\text{X}}{\text{PS}}$			
欧文	$\frac{\text{E}\quad\text{O}_\text{B}\to\text{X}}{\text{PA}}$	$\frac{\text{—}\qquad\text{X}}{\text{PS}}$				
箱	$\frac{\text{E}\qquad\text{O}_\text{B}}{\text{PA}}$					
glue	$\frac{\text{E}\qquad\text{O}_\text{B}}{\text{PN}}$					
kern	$\frac{\text{E}\qquad\text{O}_\text{B}}{\text{PS}}$					

Here $\frac{\text{E}\quad\text{M}\to\text{K}}{\text{PN}}$ means that

1. To determine the ‘right-space’, LuaTeX-ja first attempts by the method ‘JFM-origin [M]’. If this attempt fails, LuaTeX-ja use the method ‘kanjiskip [K]’.
2. The ‘left space’ between *Nq* and *Np* is determined by the method ‘line-end [E]’.
3. LuaTeX-ja adopts the method ‘P-normal [PN]’ to adjust the penalty between two clusters for *kinsoku shori*.

P-normal [PN] *Nq* と *Np* の間の (a) 部分にペナルティ (*penalty_node*) があれば処理は簡単である：それらの各ノードにおいて，ペナルティ値を（±10000 を無限大として扱いつつ）a だけ増加させればよい．また，$10000+(-10000)=0$ としている．

少々困るのは，(a) 部分にペナルティが存在していない場合である．直感的に，補正すべき量 a が 0 でないとき，その値をもつ *penalty_node* を作って「右空白」の（もし未定義なら *Np* の）直前に挿入……ということになるが，実際には僅かにこれより複雑である．

- 「右空白」がカーンであるとき，それは「*Nq* と *Np* の間で改行は許されない」ことを意図している．そのため，この場合は $a\neq 0$ であってもペナルティの挿入はしない．
- 「左空白」がカーンとしてきっちり定義されている時（このとき，「右空白」はカーンでない），この「左空白」の直後での行分割を許容しないといけないので，$a=0$ であっても *penalty_node* を作って挿入する．
- 以上のどれでもないときは，$a\neq 0$ ならば *penalty_node* を作って挿入する．

12.5　その他の場合

本節の内容は表 6 にまとめてある．

和文 A と欧文の間　*Nq* が和文 A で，*Np* が欧文の場合，JFM グルー挿入処理は次のようにして行われる．

- 「右空白」については，まず以下に述べる Boundary-B [O_B] により空白を決定しようと試みる．それが失敗した場合は，xkanjiskip [X] によって定める．
- 「左空白」については，既に述べた line-end [E] をそのまま採用する．それに伴う「右空白」の補正も同じ．
- 禁則用ペナルティも，以前述べた P-normal [PN] と同じである．

Boundary-B [O$_\mathrm{B}$] 和文文字と「和文でないもの」との間に入る空白を以下によって求め，未定義でなければそれを「右空白」として採用する．JFM-origin [M] の変種と考えて良い．これによって定まる空白の典型例は，和文の閉じ括弧と欧文文字の間に入る半角アキである．

1. もし両クラスタの間で`\inhibitglue`が実行されていた場合（証として whatsit ノードが自動挿入される），次へ．
2. そうでなければ，*Nq* と「文字コードが`'jcharbdd'`の文字」との間に入るグルー／カーンとして定まる．

xkanjiskip [X] この段階では，kanjiskip [K] のときと同じように，xkanjiskip の値を以下で定め，それを「右空白」として採用する．この段階で`\inhibitglue`は効力を持たないのも同じである．

1. 以下のいずれかの場合は，xkanjiskip の挿入は抑止される．しかし，実際には行分割を許容するために，長さ 0 の glue を採用する：
   - 両クラスタにおいて，それらの中身の文字コードに対する autoxspacing パラメタが共に false である．
   - *Nq* の中身の文字コードについて，「直後への xkanjiskip の挿入」が禁止されている（つまり，jaxspmode (or alxspmode) パラメタが 2 以上）．
   - *Np* の中身の文字コードについて，「直前への xkanjiskip の挿入」が禁止されている（つまり，jaxspmode (or alxspmode) パラメタが偶数）．
2. ユーザ側から見た xkanjiskip パラメタの自然長が $\texttt{\textbackslash maxdimen} = (2^{30}-1)\,\mathrm{sp}$ でなければ，xkanjiskip パラメタの値を持つ glue を採用する．
3. 2. でない場合は，*Nq*, *Np*（和文 A/和文 B なのは片方だけ）で使われている JFM に指定されている xkanjiskip の値を用いる．

欧文と和文 A の間　*Nq* が欧文で，*Np* が和文 A の場合，JFM グルー挿入処理は上の場合とほぼ同じである．和文 A のクラスタが逆になるので，Boundary-A [O$_\mathrm{A}$] の部分が変わるだけ．

- 「右空白」については，まず以下に述べる Boundary-A [O$_\mathrm{A}$] により空白を決定しようと試みる．それが失敗した場合は，xkanjiskip [X] によって定める．
- *Nq* が和文でないので，「左空白」は算出されない．
- 禁則用ペナルティは，以前述べた P-normal [PN] と同じである．

Boundary-A [O$_\mathrm{A}$] 「和文でないもの」と和文文字との間に入る空白を以下によって求め，未定義でなければそれを「右空白」として採用する．JFM-origin [M] の変種と考えて良い．これによって定まる空白の典型例は，欧文文字と和文の開き括弧との間に入る半角アキである．

1. もし両クラスタの間で`\inhibitglue`が実行されていた場合（証として whatsit ノードが自動挿入される），次へ．
2. そうでなければ，「文字コードが`'jcharbdd'`の文字」と *Np* との間に入るグルー／カーンとして定まる．

和文 A と箱・グルー・カーンの間　*Nq* が和文 A で，*Np* が箱・グルー・カーンのいずれかであった場合，両者の間に挿入される JFM グルーについては同じ処理である．しかし，そこでの行分割に対する仕様が異なるので，ペナルティの挿入処理は若干異なったものとなっている．

- 「右空白」については，既に述べた Boundary-B [O$_\mathrm{B}$] により空白を決定しようと試みる．それが失敗した場合は，「右空白」は挿入されない．
- 「左空白」については，既に述べた line-end [E] の算出方法をそのまま採用する．それに伴う「右空白」の補正も同じ．
- 禁則用ペナルティの処理は，後ろのクラスタ *Np* の種類によって異なる．なお，*Np.head* は無意味であるから，「*Np.head* に対する prebreakpenalty の値」は 0 とみなされる．言い換えれば，

$$a := (Nq^{9}\text{の文字に対する postbreakpenalty の値}).$$

箱 Np が箱であった場合は，両クラスタの間での行分割は（明示的に両クラスタの間に`\penalty10000`があった場合を除き）いつも許容される．そのため，ペナルティ処理は，後に述べる P-allow [PA] が P-normal [PN] の代わりに用いられる．

グルー Np がグルーの場合，ペナルティ処理は P-normal [PN] を用いる．

カーン Np がカーンであった場合は，両クラスタの間での行分割は（明示的に両クラスタの間にペナルティがあった場合を除き）許容されない．ペナルティ処理は，後に述べる P-suppress [PS] を使う．

これらの P-normal [PN]，P-allow [PA]，P-suppress [PS] の違いは，Nq と Np の間（以前の図だと (a) の部分）にペナルティが存在しない場合にのみ存在する．

P-allow [PA] Nq と Np の間の (a) 部分にペナルティがあれば，P-normal [PN] と同様に，それらの各ノードにおいてペナルティ値を a だけ増加させる．

(a) 部分にペナルティが存在していない場合，LuaTeX-ja は Nq と Np の間の行分割を可能にしようとする．そのために，以下の場合に a をもつ *penalty_node* を作って「右空白」の（もし未定義なら Np の）直前に挿入する：

- 「右空白」がグルーでない（カーンか未定義）であるとき．
- 「左空白」がカーンとしてきっちり定義されている時．

P-suppress [PS] Nq と Np の間の (a) 部分にペナルティがあれば，P-normal [PN] と同様に，それらの各ノードにおいてペナルティ値を a だけ増加させる．

(a) 部分にペナルティが存在していない場合，Nq と Np の間の行分割は元々不可能のはずだったのであるが，LuaTeX-ja はそれをわざわざ行分割可能にはしない．そのため，「右空白」が glue であれば，その直前に`\penalty10000`を挿入する．

なお，「右空白」はカーン，「左空白」は未定義の

$$\overbrace{\boxed{\begin{array}{c}\text{glyph}\\ \text{‘あ’}\end{array}}}^{Nq}\longrightarrow\overbrace{\boxed{\begin{array}{c}\text{glue}\\ 1\,\text{pt}\end{array}}}^{Np}$$

のような状況を考える．このとき，a，即ち「あ」の postbreakpenalty がいかなる値であっても，この 2 クラスタ間は最終的に

$$\overbrace{\boxed{\begin{array}{c}\text{glyph}\\ \text{‘あ’}\end{array}}}^{Nq}\longrightarrow\boxed{\begin{array}{c}\text{kern}\\ \text{右空白}\end{array}}\longrightarrow\overbrace{\boxed{\begin{array}{c}\text{glue}\\ 1\,\text{pt}\end{array}}}^{Np} \tag{1}$$

となり，a 分のペナルティは挿入されないことに注意して欲しい．postbreakpenalty は（a は）殆どの場合が非負の値と考えられ，そのような場合では (1) と

$$\overbrace{\boxed{\begin{array}{c}\text{glyph}\\ \text{‘あ’}\end{array}}}^{Nq}\longrightarrow\boxed{\begin{array}{c}\text{penalty}\\ a\end{array}}\longrightarrow\boxed{\begin{array}{c}\text{kern}\\ \text{右空白}\end{array}}\longrightarrow\overbrace{\boxed{\begin{array}{c}\text{glue}\\ 1\,\text{pt}\end{array}}}^{Np}$$

との間に差異は生じない[10]．

箱・グルー・カーンと和文 A の間 Np が箱・グルー・カーンのいずれかで，Np が和文 A であった場合は，すぐ上の（Nq と Np の順序が逆になっている）場合とほぼ同じであるが，「左空白」がなくなることにのみ注意．

- 「右空白」については，既に述べた Boundary-A [$\mathrm{O_A}$] により空白を決定しようと試みる．それが失敗した場合は，「右空白」は挿入されない．
- Nq が和文でないので，「左空白」は算出されない．

---

[10] kern→glue が 1 つの行分割可能点 (行分割に伴うペナルティは 0) であるため，たとえ $a = 10000$ であっても，Nq と Np の間で行分割を禁止することはできない．

- 禁則用ペナルティの処理は，Nq の種類によって異なる．$Nq.tail$ は無意味なので，

  $a :=$ (Np[11]の文字に対する prebreakpenalty の値).

  箱　Nq が箱の場合は，P-allow [PA] を用いる．

  グルー　Nq がグルーの場合は，P-normal [PN] を用いる．

  カーン　Nq がカーンの場合は，P-suppress [PS] を用いる．

和文 A と和文 B の違い　先に述べたように，和文 B は水平ボックスの中身の先頭（or 末尾）として出現している和文文字である．リスト内に直接ノードとして現れている和文文字（和文 A）との違いは，

- 和文 B に対しては，JFM の文字クラス指定から定まる空白 JFM-origin [M]，Boundary-A [O$_\mathrm{A}$]，Boundary-B [O$_\mathrm{B}$]）の挿入は行われない．「左空白」の算出も行われない．例えば，
  - 片方が和文 A，もう片方が和文 B のクラスタの場合，Boundary-A [O$_\mathrm{A}$] または Boundary-B [O$_\mathrm{B}$] の挿入を試み，それがダメなら kanjiskip [K] の挿入を行う．
  - 和文 B の 2 つのクラスタの間には，kanjiskip [K] が自動的に入る．
- 和文 B と箱・グルー・カーンが隣接したとき（どちらが前かは関係ない），間に JFM グルー・ペナルティの挿入は一切しない．
- 和文 B と和文 B，また和文 B と欧文とが隣接した時は，禁則用ペナルティ挿入処理は P-suppress [PS] が用いられる．
- 和文 B の文字に対する prebreakpenalty, postbreakpenalty の値は使われず，0 として計算される．

次が具体例である：

```
1 あ．\inhibitglue A\\
2 \hbox{あ．}A\\
3 あ． A
```

あ．A
あ．A
あ．　A

- 1 行目の`\inhibitglue` は Boundary-B [O$_\mathrm{B}$] の処理のみを抑止するので，ピリオドと「A」の間には xkanjiskip（四分アキ）が入ることに注意．
- 2 行目のピリオドと「A」の間においては，前者が和文 B となる（水平ボックスの中身の末尾として登場しているから）ので，そもそも Boundary-B [O$_\mathrm{B}$] の処理は行われない．よって，xkanjiskip が入ることとなる．
- 3 行目では，ピリオドの属するクラスタは和文 A である．これによって，ピリオドと「A」の間には Boundary-B [O$_\mathrm{B}$] 由来の半角アキが入ることになる．

13　psft

References

[1] Victor Eijkhout, *TEX by Topic, A TEXnician's Reference*, Addison-Wesley, 1992.

A Package versions used in this document

This document was typeset using the following packages:

`geometry.sty`	`2010/09/12 v5.6 Page Geometry`
`keyval.sty`	`1999/03/16 v1.13 key=value parser (DPC)`
`ifpdf.sty`	`2011/01/30 v2.3 Provides the ifpdf switch (HO)`
`ifvtex.sty`	`2010/03/01 v1.5 Detect VTeX and its facilities (HO)`
`ifxetex.sty`	`2010/09/12 v0.6 Provides ifxetex conditional`
`mathptmx.sty`	`2005/04/12 PSNFSS-v9.2a Times w/ Math, improved (SPQR, WaS)`
`amsmath.sty`	`2000/07/18 v2.13 AMS math features`
`amstext.sty`	`2000/06/29 v2.01`
`amsgen.sty`	`1999/11/30 v2.0`
`amsbsy.sty`	`1999/11/29 v1.2d`
`amsopn.sty`	`1999/12/14 v2.01 operator names`
`amssymb.sty`	`2009/06/22 v3.00`
`amsfonts.sty`	`2009/06/22 v3.00 Basic AMSFonts support`
`xcolor.sty`	`2007/01/21 v2.11 LaTeX color extensions (UK)`
`infwarerr.sty`	`2010/04/08 v1.3 Providing info/warning/error messages (HO)`
`ltxcmds.sty`	`2011/11/09 v1.22 LaTeX kernel commands for general use (HO)`
`pdftexcmds.sty`	`2011/11/29 v0.20 Utility functions of pdfTeX for LuaTeX (HO)`
`ifluatex.sty`	`2010/03/01 v1.3 Provides the ifluatex switch (HO)`
`luatex-loader.sty`	`2010/03/09 v0.4 Lua module loader (HO)`
`pict2e.sty`	`2011/04/05 v0.2y Improved picture commands (HjG,RN,JT)`
`trig.sty`	`1999/03/16 v1.09 sin cos tan (DPC)`
`multienum.sty`	
`amsthm.sty`	`2009/07/02 v2.20.1`
`float.sty`	`2001/11/08 v1.3d Float enhancements (AL)`
`booktabs.sty`	`2005/04/14 v1.61803 publication quality tables`
`listings.sty`	`2007/02/22 1.4 (Carsten Heinz)`
`lstmisc.sty`	`2007/02/22 1.4 (Carsten Heinz)`
`showexpl.sty`	`2011/08/22 v0.3i Typesetting example code (RN)`
`calc.sty`	`2007/08/22 v4.3 Infix arithmetic (KKT,FJ)`
`ifthen.sty`	`2001/05/26 v1.1c Standard LaTeX ifthen package (DPC)`
`graphicx.sty`	`1999/02/16 v1.0f Enhanced LaTeX Graphics (DPC,SPQR)`
`graphics.sty`	`2009/02/05 v1.0o Standard LaTeX Graphics (DPC,SPQR)`
`varwidth.sty`	`2009/03/30 ver 0.92;  Variable-width minipages`
`multicol.sty`	`2011/06/27 v1.7a multicolumn formatting (FMi)`
`metalogo.sty`	`2010/05/29 v0.12 Extended TeX logo macros`
`luatexja-otf.sty`	`2012/04/20 v0.2`
`luatexja.sty`	`2011/04/01 v0.1`
`luatexja-core.sty`	`2012/04/20 v0.2`
`luaotfload.sty`	`2012/03/27 v1.26 OpenType layout system`
`luatexbase.sty`	`2010/10/06 v0.3 Module utilities for LuaTeX`
`luatexbase-compat.sty`	`2010/10/10 v0.3 Compatibility tools for LuaTeX`
`luatexbase-loader.sty`	`2010/10/10 v0.3 Lua module loader for LuaTeX`
`luatexbase-regs.sty`	`2010/10/10 v0.3 Registers allocation for LuaTeX`
`etex.sty`	`1998/03/26 v2.0 eTeX basic definition package (PEB)`
`luatexbase-attr.sty`	`2011/05/21 v0.31 Attributes allocation for LuaTeX`
`luatexbase-cctb.sty`	`2010/10/10 v0.3 Catcodetable allocation for LuaTeX`
`luatexbase-mcb.sty`	`2010/10/10 v0.3 Callback management for LuaTeX`
`luatexbase-modutils.sty`	`2010/10/10 v0.3 Module utilities for LuaTeX`
`xkeyval.sty`	`2008/08/13 v2.6a package option processing (HA)`
`ltj-cctbreg.sty`	`2012/04/21 v0.2`
`ltj-base.sty`	`2012/04/21 v0.2`
`ltj-latex.sty`	`2012/04/21 LuaLaTeX-ja`
`lltjfont.sty`	`2011/11/22 Patch to NFSS2 for LuaLaTeX-ja`

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lltjdefs.sty            2011/11/22 Default font settings for LuaLaTeX-ja
lltjcore.sty            2011/11/22 Patch to LaTeX2e Kernel for LuaLaTeX-ja
luatexja-compat.sty     2011/04/01 v0.1
luatexja-ajmacros.sty   2012/05/08 v0.1a
luatexja-preset.sty     2012/05/18 v0.0
expl3.sty               2012/04/23 v3570 L3 Experimental code bundle wrapper
l3names.sty             2012/03/04 v3494 L3 Experimental namespace for primitives
l3bootstrap.sty         2011/12/29 v3110 L3 Experimental bootstrap code
luatex.sty              2010/03/09 v0.4 LuaTeX basic definition package (HO)
l3basics.sty            2012/03/04 v3491 L3 Experimental basic definitions
l3expan.sty             2012/02/26 v3460 L3 Experimental argument expansion
l3tl.sty                2012/03/04 v3490 L3 Experimental token lists
l3seq.sty               2012/03/04 v3490 L3 Experimental sequences and stacks
l3int.sty               2012/03/04 v3490 L3 Experimental integers
l3quark.sty             2012/02/12 v3384 L3 Experimental quarks
l3prg.sty               2012/03/04 v3490 L3 Experimental control structures
l3clist.sty             2012/03/04 v3490 L3 Experimental comma separated lists
l3token.sty             2012/03/04 v3491 L3 Experimental token manipulation
l3prop.sty              2012/03/04 v3490 L3 Experimental property lists
l3msg.sty               2012/04/23 v3568 L3 Experimental messages
l3file.sty              2012/03/09 v3520 L3 Experimental file and I/O operations
l3skip.sty              2012/03/05 v3499 L3 Experimental dimensions and skips
l3keys.sty              2012/03/03 v3487 L3 Experimental key-value interfaces
l3fp.sty                2012/03/04 v3490 L3 Experimental floating-point operations
l3box.sty               2012/03/04 v3490 L3 Experimental boxes
l3coffins.sty           2012/03/03 v3482 L3 Experimental coffin code layer
l3color.sty             2011/09/07 v2776 L3 Experimental colour support
l3luatex.sty            2012/02/09 v3355 L3 Experimental LuaTeX-specific functions
luatexja-fontspec.sty   2011/09/23 v0.2
fontspec.sty            2012/05/06 v2.2b Advanced font selection for XeLaTeX/LuaLaTeX
xparse.sty              2012/04/23 v3570 L3 Experimental document command parser
fontspec-patches.sty    2012/05/06 v2.2b Advanced font selection for XeLaTeX/LuaLaTeX
fixltx2e.sty            2006/09/13 v1.1m fixes to LaTeX
fontspec-luatex.sty     2012/05/06 v2.2b Advanced font selection for XeLaTeX/LuaLaTeX
fontenc.sty
xunicode.sty            2011/09/09 v0.981 provides access to latin accents and many other characters in Unicode
                        lower plane
hyperref.sty            2012/05/13 v6.82q Hypertext links for LaTeX
hobsub-hyperref.sty     2012/04/25 v1.12 Bundle oberdiek, subset hyperref (HO)
hobsub-generic.sty      2012/04/25 v1.12 Bundle oberdiek, subset generic (HO)
hobsub.sty              2012/04/25 v1.12 Construct package bundles (HO)
intcalc.sty             2007/09/27 v1.1 Expandable calculations with integers (HO)
etexcmds.sty            2011/02/16 v1.5 Avoid name clashes with e-TeX commands (HO)
kvsetkeys.sty           2012/04/25 v1.16 Key value parser (HO)
kvdefinekeys.sty        2011/04/07 v1.3 Define keys (HO)
pdfescape.sty           2011/11/25 v1.13 Implements pdfTeX's escape features (HO)
bigintcalc.sty          2012/04/08 v1.3 Expandable calculations on big integers (HO)
bitset.sty              2011/01/30 v1.1 Handle bit-vector datatype (HO)
uniquecounter.sty       2011/01/30 v1.2 Provide unlimited unique counter (HO)
letltxmacro.sty         2010/09/02 v1.4 Let assignment for LaTeX macros (HO)
hopatch.sty             2011/06/24 v1.1 Wrapper for package hooks (HO)
xcolor-patch.sty        2011/01/30 xcolor patch
atveryend.sty           2011/06/30 v1.8 Hooks at the very end of document (HO)
atbegshi.sty            2011/10/05 v1.16 At begin shipout hook (HO)
refcount.sty            2011/10/16 v3.4 Data extraction from label references (HO)
hycolor.sty             2011/01/30 v1.7 Color options for hyperref/bookmark (HO)
kvoptions.sty           2011/06/30 v3.11 Key value format for package options (HO)
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url.sty                2006/04/12  ver 3.3  Verb mode for urls, etc.
rerunfilecheck.sty     2011/04/15 v1.7 Rerun checks for auxiliary files (HO)
xy.sty                 2011/05/27 Xy-pic version 3.8.6
lltjp-xunicode.sty     2012/04/18 Patch to xunicode for LuaLaTeX-ja
lltjp-listings.sty     2012/02/02 0.51
epstopdf-base.sty      2010/02/09 v2.5 Base part for package epstopdf
grfext.sty             2010/08/19 v1.1 Manage graphics extensions (HO)
nameref.sty            2010/04/30 v2.40 Cross-referencing by name of section
gettitlestring.sty     2010/12/03 v1.4 Cleanup title references (HO)
lstlang1.sty           2004/09/05 1.3 listings language file
lstlang2.sty           2004/09/05 1.3 listings language file
lstlang3.sty           2004/09/05 1.3 listings language file
```