The Lua\TeX-ja package

The Lua\TeX-ja project team

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This documentation is far from complete. It may have many grammatical (and contextual) errors. Also, several parts 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 p\TeX, an extension of \TeX, and its derivatives are used to typeset Japanese documents in \TeX. p\TeX 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: p\TeX is left behind from other extensions of \TeX, especially \ɛ\TeX and pdf\TeX, and from changes about Japanese processing in computers (e.g., the UTF-8 encoding).

Recently extensions of p\TeX, namely up\TeX (Unicode-implementation of p\TeX) and ɛ-p\TeX (merging of p\TeX and ɛ-\TeX extension), have developed to fill those gaps to some extent, but gaps still exist.

However, the appearance of Lua\TeX changed the whole situation. With using Lua “callbacks”, users can customize the internal processing of Lua\TeX. 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 p\TeX

The Lua\TeX-ja package is under much influence of p\TeX engine. The initial target of development was to implement features of p\TeX. However, implementing all feature of p\TeX is impossible, since all process of Lua\TeX-ja must be implemented only by Lua and \TeX macros. Hence Lua\TeX-ja is not a just porting of p\TeX; unnatural specifications/behaviors of p\TeX were not adopted.

The followings are major changes from p\TeX. For more detailed information, see Part III or other sections of this manual.

■Command names  p\TeX adds several primitives, such as \kanjiskip, \prebreakpenalty, and \ifydir. They can be used as follows:
\kanjiskip=10pt \dimen0=kanjiskip
\tbaselineshift=0.1zw
\dimen0=tbaselineshift
\prebreakpenalty=100
\ifydir...time

However, we cannot use them under Lua\TeX-ja. Instead of them, we have to write as the following.
\ltjsetparameter{kanjiskip=10pt} \ltjgetparameter{kanjiskip}
\ltjsetparameter{tbaselineshift=0.1zw} \ltjgetparameter{tbaselineshift}
\ltjsetparameter{prebreakpenalty={`,100}} \ltjgetparameter{direction}=4 ...time

Note that p\TeX adds new two useful units, namely zw and zh. As shown above, they are changed to \zw and \zh respectively in Lua\TeX-ja. ¹

■Linebreak after a Japanese character  In p\TeX, 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, Lua\TeX-ja doesn’t have this feature completely, because of a specification of Lua\TeX. For the detail, see Section 13.

¹Lua\TeX-ja 20200127.0 introduces \ltj@zw and \ltj@zh, which are copy of \zw and \zh.
Spaces related to Japanese characters  The insertion process of glues/kerns between two Japanese characters and between a Japanese character and other characters (we refer glues/kerns of both kinds as JAglue) is rewritten from scratch.

- As LuaTeX’s internal ligature handling is node-based (e.g., \texttt{office} 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., \texttt{\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 \texttt{p\LaTeX} are not effective anymore. In concrete terms, the following two methods are not effective anymore:
  ちょ{}っと ちょ\hbox{}っと

  If you want to do so, please put an empty horizontal box (hbox) between it instead:
  ちょ\hbox{}っと

- In the process, two Japanese fonts which only differ in their “real” fonts are identified.

Directions  From version 20150420.0, Lua\TeX-ja supports vertical writing. We implement this feature by using callbacks of Lua\TeX; so it must not be confused with \Omega-style direction support of Lua\TeX itself. Due to implementation, the dimension returned by \texttt{\wd}, \texttt{\ht}, or \texttt{\dp} depends on the content of the register only. This is major difference with \texttt{p\LaTeX}.

\texttt{\discretionary}  Japanese characters in discretionary break (\texttt{\discretionary}) is not supported.

Greek and Cyrillic letters, and ISO 8859-1 symbols  By default, Lua\TeX-ja uses Japanese fonts to typeset Greek and Cyrillic letters. To change this behavior, put \texttt{\ltjsetparameter{ja\texttt{acharrange}=\{-2,\}}\{-3\}} in the preamble. For the detailed description, see Subsection 4.1.

From version 20150906.0, characters which belongs both ISO 8859-1 and JIS X 0208, such as ¶ and §, are now typeset in alphabetic fonts.

1.3 Notations

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

- Characters are classified into following two types. Note that the classification can be customized by a user (see Subsection 4.1).
  - JAchar: standing for characters which is used in Japanese typesetting, such as Hiragana, Katakana, Kanji, and other Japanese punctuation marks.
  - ALchar: standing for all other characters like latin 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 with underline (like \texttt{prebreakpenalty}) means an internal parameter for Japanese typesetting, and it is used as a key in \texttt{\ltjsetparameter} command.

- A word in a sens-serif font without underline (like fontspec) means a package or a class of \texttt{\LaTeX}.

- In this document, natural numbers start from zero. \(\omega\) denotes the set of all natural numbers which can be used in \texttt{\LaTeX}.
1.4 About the project

■ Project Wiki  Project Wiki is under construction.
  • https://osdn.jp/projects/luatex-ja/wiki/FrontPage%28en%29 (English)
  • https://osdn.jp/projects/luatex-ja/wiki/FrontPage (Japanese)
  • https://osdn.jp/projects/luatex-ja/wiki/FrontPage%28zh%29 (Chinese)

This project is hosted by OSDN.

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2 Getting Started

2.1 Installation

The following packages are needed for the LuaTeX-ja package.

- **LuaTeX** 1.10.0 (or later)
- **recent luaotfload** (v3.1 or later recommended)
- adobemapping (Adobe cmap and pdfmapping files)
- **EJPX 2020-02-02** patch level 5 or later (if you want to use LuaTeX-ja with EJPX 2ε)
- etoolbox, everysec (if you want to use LuaTeX-ja with EJPX 2ε)
- ltxcmds, pdftexcmds, filehook, atbegshi
- fontspec v2.7c (or later)
- Harano Aji fonts ([https://github.com/trueroad/HaranoAjiFonts](https://github.com/trueroad/HaranoAjiFonts))
  More specifically, HaranoAjiMincho-Regular and HaranoAjiGothic-Medium.

Now LuaTeX-ja is available from CTAN (in the `macros/luatex/generic/luatexja` directory), and the following distributions:

- **TEX Live** (in `texmf-dist/tex/luatex/luatexja`)
- W32TEX (in `luatexja.tar.xz`)
- MiKTeX (in `luatexja.tar.lzma`); see the next subsection

Harano Aji fonts are available in TEX Live and MiKTeX.

- **HarfBuzz and LuaTeX-ja** Using LuaTeX-ja with LuaHBTeX (LuaTeX integrated with HarfBuzz) is not well tested. Maybe documents can typeset without an error, but with unwanted results (especially, vertical typesetting and \CID).
  
  Especially, *We don’t recommend defining a Japanese font with HarfBuzz*, by specifying `Renderer=Harfbuzz` etc. (`fontspec`) or `mode=harf` (otherwise).

- **Manual installation**

  1. Download the source, by one of the following method. At the present, LuaTeX-ja has no stable release.
     
     - Clone the Git repository by
       
       ```
       $ git clone git://git.osdn.jp/gitroot/latex-ja/latexja.git
       ```
     
     - Download the tar.gz archive of HEAD in the master branch from
       
       ```
       http://git.osdn.jp/view?p=latex-ja/latexja.git;a=snapshot;h=HEAD;sf=tgz.
       ```

     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. If you downloaded this package from CTAN, you have to run following commands to generate classes and `ltj-kinsoku.lua` (the file which stores default "kinsoku" parameters):
$ cd src
$ lualatex ltjclasses.ins
$ lualatex ltjsclasses.ins
$ lualatex ltjtxdoc.ins
$ luatex ltj-kinsoku_make.tex

Do not forget processing ltj-kinsoku_make.tex.*.{dtx,ins} and ltj-kinsoku_make.tex used here are not needed in regular use.

4. 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.

5. If mktexlsr is needed to update the file name database, make it so.

2.2 Cautions

For changes from p\TeX, see Subsection 1.2.

- The encoding of your source file must be UTF-8. Other encodings, such as EUC-JP or Shift-JIS, are not supported.
- Lua\TeX-ja is very slower than p\TeX, and uses a lot of memory.
- (Outdated) note for MiK\TeX users Lua\TeX-ja requires that several CMap files\footnote{UniJIS2004-UTF32-{H,V} and Adobe-Japan1-UCS2.} must be found from Lua\TeX. Strictly speaking, those CMAPs are needed only in the first run of Lua\TeX-ja after installing or updating. But it seems that MiK\TeX does not satisfy this condition, so you will encounter an error like the following:

  ! LuaTeX error ...iles (x86)/MiKTeX 2.9/tex/luatex/luatexja/ltj-rmlgbm.lua
  bad argument #1 to 'open' (string expected, got nil)

If so, please execute a batch file which is written on the Project Wiki (English). This batch file creates a temporary directory, copy CMAPs in it, run a test file which loads Lua\TeX-ja in this directory, and finally delete the temporary directory.

- Note that when Lua\TeX-ja is loaded in plain Lua\TeX, we cannot use color specification on font loading, such as

  \font\hoge=lmroman10-regular.otf:color=FF0000 \% \font primitive

This is because codes for shifting baseline in math mode (Lua\TeX-ja) collide with and prevents loading codes for font color (luaotfload) in these environments. We recommend to use \TeX 2020-02-02 (or later), since we can avoid this collision in there.

2.3 Using in plain \TeX

To use Lua\TeX-ja in plain \TeX, simply put the following at the beginning of the document:

\input luatexja.sty

This does minimal settings (like p\TeX.\tex) for typesetting Japanese documents:

- The following 12 Japanese fonts are preloaded:

<table>
<thead>
<tr>
<th>direction (classification)</th>
<th>font name</th>
<th>“10 pt”</th>
<th>“7 pt”</th>
<th>“5 pt”</th>
</tr>
</thead>
<tbody>
<tr>
<td>yoko (horizontal) mincho</td>
<td>HaranoAjiMincho-Regular \tentmin \sevenmin \fivemin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gothic</td>
<td>HaranoAjiGothic-Medium  \tentgt \seventgt \fivegt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tate (vertical) mincho</td>
<td>HaranoAjiMincho-Regular \tentmin \sevenmin \fivemin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gothic</td>
<td>HaranoAjiGothic-Medium  \tentgt \seventgt \fivegt</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- The "default" Japanese fonts (and JFMs for them) can be modified by defining `\jstmdcfont` etc. before one inputs `luatexja.sty` (Subsection 7.3).
- 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 `\textmc{...}` and an `\textgt{...}` (the parameter `xkanjiskip`) is set to
    \[ (0.25 \cdot 0.962216 \cdot 10 \text{ pt})^+_{-1 \text{ pt}} = 2.40554 \text{ pt}^+_{-1 \text{ pt}}. \]

2.4 Using in \LaTeX

Using in \LaTeX\raisebox{1pt}{\scriptsize 2e} is basically same. To set up the minimal environment for Japanese, you only have to load `luatexja.sty`:

\begin{verbatim}
\usepackage{luatexja}
\end{verbatim}

It also does minimal settings (counterparts in \LaTeX\raisebox{1pt}{\scriptsize 2e} are `plfonts.dtx` and `pldefs.ltx`).

* Font encodings for Japanese fonts are JY3 (for horizontal direction) and JT3 (for vertical direction).
* Traditionally, Japanese documents use only two families: `mincho` (明朝体) and `gothic` (ゴシック体). `mincho` is used in the main text, while `gothic` is used in the headings or for emphasis.

\begin{table}[h]
\centering
\begin{tabular}{llll}
\hline
\textbf{classification} & \textbf{commands} & \textbf{family} \\
\hline
\texttt{mincho} (明朝体) & \texttt{textmc{...}} & \texttt{mcdefault} \\
\texttt{gothic} (ゴシック体) & \texttt{textgt{...}} & \texttt{gtdefault} \\
(Japanese counterpart for typewriter font) & & & \\
\hline
\end{tabular}
\end{table}

Here `\jttdefault` specifies the Japanese font family in `\verb` or `verbatim` environment, and its default value is `\mcdefault` (mincho family).\footnote{When `ltjclasses` classes are used, or `luatexja-fontspec` (or `luatexja-preset`) is loaded with `match` option, `\jttfamily` changes the current Japanese font family to `\jttdefault`. These classes and packages also redefine `\jttdefault` to `\gtfamily` (gothic family).}

- By default, the following fonts are used for these two families.

\begin{table}[h]
\centering
\begin{tabular}{lllll}
\hline
\textbf{classification} & \textbf{family} & \textbf{\texttt{mdseries}} & \textbf{\texttt{bfseries}} & \textbf{scale} \\
\hline
\texttt{mincho} (明朝体) & \texttt{mc} & HaranoAjiMincho-Regular & HaranoAjiGothic-Medium & 0.962216 \\
\texttt{gothic} (ゴシック体) & \texttt{gt} & HaranoAjiGothic-Medium & HaranoAjiGothic-Medium & 0.962216 \\
\hline
\end{tabular}
\end{table}

* Note that the bold series (series `bx` or `b`) in both family are same as the medium series of gothic family. There is no italic nor slanted shape for these `mc` and `gt`.
* From version 20181102.0, one can specifies `disablejfam` option at loading Lua\TeX-ja. This option prevents loading a patch for \LaTeX\raisebox{1pt}{\scriptsize 2e}, which are needed to support Japanese characters in math mode. Without `disablejfam` option, one can typeset Japanese characters in math mode as `\$\$` (see Page 11) as before. Japanese characters in math mode are typeset by the font family `mc`.
* If you use the beamer class with the default font theme (which uses sans serif fonts) and with Lua\TeX-ja, you might want to change default Japanese fonts to the gothic family. The following line changes the default Japanese font family to it:

\begin{verbatim}
\renewcommand{\kanjifamilydefault}{\gtfamily}
\end{verbatim}
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, Lua\TeX\-ja has the counterparts of jclasses (standard classes in p\TeX) and jsclasses (classes by Haruhiko Okumura), namely, ltjclasses\footnote{ltjarticle.cls, ltjbook.cls, ltjreport.cls, ltjtarticle.cls, ltjbook.cls, ltjreport.cls. The latter ltjt*.cls are for vertically written Japanese documents.} and ltjsclasses\footnote{ltjsarticle.cls, ltjsbook.cls, ltjsreport.cls, ltjskiyou.cls. Same effect as the BXjcls classes (by Takayuki Yato) and jsclasses. However, these classes uses only \TeX code, but ltjsclasses uses Lua code.}.

Original jsclasses use \texttt{\textbackslash mag} primitive to set the main document font size. However, Lua\TeX\ does not support \texttt{\textbackslash mag} in PDF output, so ltjsclasses uses the \texttt{nomag\*} option\footnote{Same effect as the BXjcls classes (by Takayuki Yato) and jsclasses. However, these classes uses only \TeX code, but ltjsclasses uses Lua code.} by default to set the main font size. If this causes some unexpected behavior, specify \texttt{nomag option in \texttt{documentclass}}.

\section*{\bf geometry package and classes for vertical writing}  
It is well-known that the geometry package produces the following error, when classes for vertical writing is used:

\begin{verbatim}
! Incompatible direction list can't be unboxed.
\@begindvi \->\unvbox \@begindvi
\global \let \@begindvi \empty
\end{verbatim}

Now, Lua\TeX\-ja automatically applies the patch \texttt{ltj\textbackslash p-geometry} to the \texttt{geometry} package, when the direction of the document is \texttt{tate} (vertical writing). This patch \texttt{ltj\textbackslash p-geometry} also can be used in p\TeX; for the detail, please refer \texttt{ltj\textbackslash p-geometry.pdf} (Japanese).

\section{Changing Fonts}

\subsection*{plain \TeX and \LaTeX} \footnote{ltjarticle.cls, ltjbook.cls, ltjreport.cls, ltjtarticle.cls, ltjbook.cls, ltjreport.cls. The latter ltjt*.cls are for vertically written Japanese documents.}

\subsubsection*{plain \TeX} To change Japanese fonts in plain \TeX, you must use the command \texttt{\textbackslash jfont} and \texttt{\textbackslash tfont}. So please see Subsection 7.1.

\subsubsection*{\LaTeX} \footnote{ltjsarticle.cls, ltjsbook.cls, ltjsreport.cls, ltjskiyou.cls. Same effect as the BXjcls classes (by Takayuki Yato) and jsclasses. However, these classes uses only \TeX code, but ltjsclasses uses Lua code.} For \LaTeX\, Lua\TeX\-ja adopted most of the font selection system of p\TeX\ (in \texttt{plfonts.dtx}).


\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
 encoding & family & series & shape & selection \\
\hline
 Alphabetic fonts & \texttt{\romanencoding} & \texttt{\romanfamily} & \texttt{\romanseries} & \texttt{\romanshape} & \texttt{\userroman} \\
 Japanese fonts & \texttt{\kanjicoding} & \texttt{\kanjifamily} & \texttt{\kanjiseries} & \texttt{\kanjishape} & \texttt{\usekanji} \\
 both & - & - & \texttt{\fontshape} & \texttt{\fontshape} & - \\
 auto select & \texttt{\fontencoding} & \texttt{\fontfamily} & - & - & \texttt{\usefont} \\
\hline
\end{tabular}
\end{table}

\begin{itemize}
\item \texttt{\fontfamily}, \texttt{\fontseries}, and \texttt{\fontshape} try to change attributes of Japanese fonts, as well as those of alphabetic fonts. Of course, \texttt{\selectfont} is needed to select current text fonts.
\item Note that \texttt{\fontshape} always changes current alphabetic font shape, but it does \textit{not} change current Japanese font shape if the target shape is unavailable for current Japanese encoding/family/series. For the detail, see Subsection 10.2.
\item \texttt{\fontencoding{\langle encoding\rangle}} changes the encoding of alphabetic fonts or Japanese fonts depending on the argument. For example, \texttt{\fontencoding{JY3}} changes the encoding of Japanese fonts to JY3, and \texttt{\fontencoding{T1}} changes the encoding of alphabetic fonts to T1. \texttt{\fontfamily} also changes the current Japanese font family, the current alphabetic font family, or \textit{both}. For the detail, see Subsection 10.2.
\item For defining a Japanese font family, use \texttt{\DeclareKanjiFamily} instead of \texttt{\DeclareFontFamily}. (In previous version of Lua\TeX\-ja, using \texttt{\DeclareFontFamily} didn't cause any problem. But this no longer applies the current version.)
\item Defining a Japanese font shape can be done by usual \texttt{\DeclareFontShape}:
\begin{verbatim}
\DeclareFontShape{JY3}{mc}{b}{n}{<-> s\textbackslash HaranoAjiMincho--Bold:jf\texttt{\textbackslash fm=ujis;\texttt{kern}}}{
  % Harano Aji Mincho Bold
\end{verbatim}
\end{itemize}
Table 1. Commands of luatexja-fontspec

<table>
<thead>
<tr>
<th></th>
<th>\jfontspec</th>
<th>\setmainjfont</th>
<th>\setsansjfont</th>
<th>\setmonojfont</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese fonts</td>
<td>\jfontspec</td>
<td>\setmainjfont</td>
<td>\setsansjfont</td>
<td>\setmonojfont</td>
</tr>
<tr>
<td>Alphabetic fonts</td>
<td>\fontspec</td>
<td>\setmainfont</td>
<td>\setsansfont</td>
<td>\setmonofont</td>
</tr>
<tr>
<td>Japanese fonts</td>
<td>\newjfontfamily</td>
<td>\renewjfontfamily</td>
<td>\setjfontfamily</td>
<td></td>
</tr>
<tr>
<td>Alphabetic fonts</td>
<td>\newfontfamily</td>
<td>\renewfontfamily</td>
<td>\setfontfamily</td>
<td></td>
</tr>
<tr>
<td>Japanese fonts</td>
<td>\newjfontface</td>
<td>\defaultjfontfeatures</td>
<td>\addjfontfeatures</td>
<td></td>
</tr>
<tr>
<td>Alphabetic fonts</td>
<td>\newfontface</td>
<td>\defaultfontfeatures</td>
<td>\addfontfeatures</td>
<td></td>
</tr>
</tbody>
</table>

Japanese characters in math mode

Since \LaTeX{} supports Japanese characters in math mode, there are sources like the following:

1. $f_{\text{高温}}$ \text{~} \text{($f_{\text{high temperature}}$)}.
2. $y = (x-1)^2 + 2$ \text{よって} \text{~} \text{$y>0$}
3. $5 \in \text{素} := \{ p \in \mathbb{N} : \text{p is a prime} \}$.

We (the project members of Lua\TeX-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:

1. $f_{\text{高温}}$ \text{~} \text{($f_{\text{high temperature}}$)}.
2. $y = (x-1)^2 + 2$ \text{よって} \text{~} \text{$y>0$}
3. $5 \in \text{素} := \{ p \in \mathbb{N} : \text{p is a prime} \}$.

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 7.6.

When Lua\TeX-ja is loaded with \texttt{disablejfam} option, one cannot write Japanese characters in math mode as $\text{素}$. At that case, one have to use $\texttt{\mbox{}}$ (or $\texttt{\text{}}$ in the amsmath package).

3.2 luatexja-fontspec package

To use the functionality of the fontspec package to Japanese fonts, it is needed to load the luatexja-fontspec package in the preamble, as follows:

\begin{verbatim}
\usepackage[⟨options⟩]{luatexja-fontspec}
\end{verbatim}

This luatexja-fontspec package automatically loads luatexja and fontspec packages, if needed.

In the luatexja-fontspec package, several commands are defined as counterparts of original commands in the fontspec package (see Table 1):

The package option of luatexja-fontspec are the followings:

\textbf{match}

If this option is specified, usual family-changing commands such as \texttt{\rmfamily}, \texttt{\textrm}, \texttt{\sffamily}, ... also change Japanese font family.

\textbf{pass=(opts)}

(Obsoleted) Specify options \texttt{(opts)} which will be passed to the fontspec package.
Override the ratio of the font size of Japanese fonts to that of alphabetic fonts. The default value is determined as follows:

- The value of $\texttt{\Cjascale}$ is used, if this control sequence is already defined.
- It is calculated automatically from the current Japanese font at the loading of the package, if $\texttt{\Cjascale}$ is not defined.

$\texttt{\Cjascale}$ is defined in \texttt{ltjclasses} and \texttt{ltjsclasses}.

All other options listed above are simply passed to the \texttt{fontspec} package. This means that two lines below are equivalent, for example.

\begin{verbatim}
\usepackage[no-math]{fontspec}\usepackage{luatexja-fontspec}
\usepackage[no-math]{luatexja-fontspec}
\end{verbatim}

Note that kerning information in a font is not used (that is, \texttt{kern} feature is set off) by default in these seven (or eight) commands. This is because of the compatibility with previous versions of Lua\TeX{}-ja (see 7.1).

Below is an example of \texttt{\jfontspec}.

\begin{verbatim}
1 \jfontspec[CJKShape=NLC]{HaranoAjiMincho-Regular} JIS X 0213:2004 →辻鯵
2 \jfontspec[CJKShape=JIS1990]{HaranoAjiMincho-Regular} JIS X 0208-1990 →辻鯵
3 \jfontspec[CJKShape=JIS1978]{HaranoAjiMincho-Regular} JIS C 6226-1978 →辻鯵
\end{verbatim}

3.3 Presets of Japanese fonts

With \texttt{luatexja-presets} package, one use one of “preset” to simplify Japanese font setting. For details of package options, and those of each presets, please see Subsection 11.6. The following presets are defined:

- haranoaji, hiragino-pro, hiragino-pron, ipa, ipa-hg, ipaex, ipaex-hg,
- kozuka-pr6, kozuka-pr6n, kozuka-pro, moga-mobo, moga-mobo-ex, bizud,
- morisawa-pr6n, morisawa-pro, ms, ms-hg, noembed, noto-otc, noto-otf,
- sourcehan, sourcehan-jp, ume, yu-osx, yu-win, yu-win10

For example, this document loads \texttt{luatexja-presets} package by

\begin{verbatim}
\usepackage[haranoaji]{luatexja-presets}
\end{verbatim}

which means that Harano Aji fonts will be used in this document.

3.4 \texttt{\CID}, \texttt{\UTF}, and macros in \texttt{japanese-otf} package

Under p\TeX{}, \texttt{japanese-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, Lua\TeX{}-ja supports some of functions in the japanese-otf package, as an external package \texttt{luatexja-otf}.

4 Changing Internal Parameters

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

LuaTeX-ja divides the Unicode codespace \( U+0080 \text{--} U+10FFFF \) into character ranges, numbered 1 to 217. The grouping can be (globally) customized by \texttt{\textbackslash ltjdefcharrange}. The next line adds whole characters in Supplementary Ideographic Plane and the character “漢” to the character range 100.

\texttt{\textbackslash ltjdefcharrange\{100\}\{\textbackslash u20000\textendash\textbackslash u2FFFF, `漢\}}

A character can belong to only one character range. For example, whole SIP belong to the range 4 in the default setting of LuaTeX-ja, and if one executes the above line, then SIP will belong to the range 100 and be removed from the range 4.

The distinction between \texttt{ALchar} and \texttt{JAchar} is performed by character ranges. This can be edited by setting the jacharrange parameter. For example, the code below is just the default setting of LuaTeX-ja, and it sets

- a character which belongs character ranges 1, 4, 5, and 8 is \texttt{ALchar},
- a character which belongs character ranges 2, 3, 6, 7, and 9 is \texttt{JAchar}.

\texttt{\textbackslash ltjsetparameter\{jacharrange\\{\textbackslash{-1, +2, +3, -4, -5, +6, +7, -8, +9\}\}}

The argument to jacharrange parameter is a list of non-zero integer. Negative integer \(-n\) in the list means that “each character in the range \(n\) is an \texttt{ALchar}”, and positive integer \(+n\) means that “… is a \texttt{JAchar}”.

Note that characters \(U+0000\text{--}U+007F\) are always treated as an \texttt{ALchar} (this cannot be customized).

\section*{Default character ranges} LuaTeX-ja predefines nine character ranges for convenience. They are determined from the following data:

- Blocks in Unicode 12.0.0.
- The Adobe-Japan1-UCS2 mapping between a CID Adobe-Japan1- and Unicode.
- The PXbase bundle for upTeX by Takayuki Yato.

Now we describe these nine ranges. The superscript “J” or “A” after the number shows whether each character in the range is treated as \texttt{JAchars} or not by default. These settings are similar to the prefercjk settings defined in PXbase bundle. Any characters equal to or above \(U+0080\) which does not belong to these eight ranges belongs to the character range 217.

**Range 8** The intersection of the upper half of ISO 8859-1 (Latin-1 Supplement) and JIS X 0208 (a basic character set for Japanese). The character list is indicated in Table 2.

**Range 1** Latin characters that some of them are included in Adobe-Japan1-7. This range consists of the Unicode ranges indicated in Table 3, except characters in the range 8 above.

**Range 2** Greek and Cyrillic letters. JIS X 0208 (hence most of Japanese fonts) has some of these characters.
Table 4. Unicode blocks in predefined character range 3.

<table>
<thead>
<tr>
<th>Block Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U+2070–U+209F</td>
<td>Superscripts and Subscripts</td>
</tr>
<tr>
<td>U+20A0–U+20CF</td>
<td>Currency Symbols</td>
</tr>
<tr>
<td>U+2100–U+214F</td>
<td>Letterlike Symbols</td>
</tr>
<tr>
<td>U+21BA–U+21FF</td>
<td>Arrows</td>
</tr>
<tr>
<td>U+2300–U+237F</td>
<td>Miscellaneous Technical Symbols</td>
</tr>
<tr>
<td>U+2500–U+257F</td>
<td>Box Drawing</td>
</tr>
<tr>
<td>U+2580–U+259F</td>
<td>Block Elements</td>
</tr>
<tr>
<td>U+25A0–U+25FF</td>
<td>Geometric Shapes</td>
</tr>
<tr>
<td>U+2700–U+27BF</td>
<td>Dingbats</td>
</tr>
<tr>
<td>U+2900–U+297F</td>
<td>Supplemental Arrows-B</td>
</tr>
<tr>
<td>U+2980–U+29FF</td>
<td>Misc. Math Symbols-B</td>
</tr>
</tbody>
</table>

U+2002–U+206F: Comb. Diacritical Marks for Symbols
U+2070–U+209F: Superscripts and Subscripts
U+20A0–U+20CF: Currency Symbols
U+2100–U+214F: Letterlike Symbols
U+21BA–U+21FF: Arrows
U+2300–U+237F: Miscellaneous Technical
U+2500–U+257F: Box Drawing
U+2580–U+259F: Block Elements
U+25A0–U+25FF: Geometric Shapes
U+2700–U+27BF: Dingbats
U+2900–U+297F: Supplemental Arrows-B
U+2980–U+29FF: Misc. Math Symbols-B

Table 5. Characters in predefined character range 9.

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U+2002)</td>
<td>En space</td>
</tr>
<tr>
<td>(U+2011)</td>
<td>Non-breaking hyphen</td>
</tr>
<tr>
<td>(U+2014)</td>
<td>Em dash</td>
</tr>
<tr>
<td>(U+2016)</td>
<td>Double vertical line</td>
</tr>
<tr>
<td>(U+2019)</td>
<td>Right single quotation mark</td>
</tr>
<tr>
<td>(U+201C)</td>
<td>Left double quotation mark</td>
</tr>
<tr>
<td>(U+201E)</td>
<td>Double low-9 quotation mark</td>
</tr>
<tr>
<td>(U+2021)</td>
<td>Double dagger</td>
</tr>
<tr>
<td>(U+2025)</td>
<td>Two dot leader</td>
</tr>
<tr>
<td>(U+2030)</td>
<td>Per mille sign</td>
</tr>
<tr>
<td>(U+2033)</td>
<td>Double prime</td>
</tr>
<tr>
<td>(U+2034)</td>
<td>Single right-pointing angle quot.</td>
</tr>
<tr>
<td>(U+203C)</td>
<td>Double exclamation mark</td>
</tr>
<tr>
<td>(U+203E)</td>
<td>Overline</td>
</tr>
<tr>
<td>(U+2042)</td>
<td>Asterism</td>
</tr>
<tr>
<td>(U+2047)</td>
<td>Double question mark</td>
</tr>
<tr>
<td>(U+2048)</td>
<td>Question exclamation mark</td>
</tr>
<tr>
<td>(U+2051)</td>
<td>Two asterisks aligned vertically</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U+2002)</td>
<td>En space</td>
</tr>
<tr>
<td>(U+2011)</td>
<td>Non-breaking hyphen</td>
</tr>
<tr>
<td>(U+2014)</td>
<td>Em dash</td>
</tr>
<tr>
<td>(U+2016)</td>
<td>Double vertical line</td>
</tr>
<tr>
<td>(U+2019)</td>
<td>Right single quotation mark</td>
</tr>
<tr>
<td>(U+201C)</td>
<td>Left double quotation mark</td>
</tr>
<tr>
<td>(U+201E)</td>
<td>Double low-9 quotation mark</td>
</tr>
<tr>
<td>(U+2021)</td>
<td>Double dagger</td>
</tr>
<tr>
<td>(U+2025)</td>
<td>Two dot leader</td>
</tr>
<tr>
<td>(U+2030)</td>
<td>Per mille sign</td>
</tr>
<tr>
<td>(U+2033)</td>
<td>Double prime</td>
</tr>
<tr>
<td>(U+2034)</td>
<td>Single right-pointing angle quot.</td>
</tr>
<tr>
<td>(U+203C)</td>
<td>Double exclamation mark</td>
</tr>
<tr>
<td>(U+203E)</td>
<td>Overline</td>
</tr>
<tr>
<td>(U+2042)</td>
<td>Asterism</td>
</tr>
<tr>
<td>(U+2047)</td>
<td>Double question mark</td>
</tr>
<tr>
<td>(U+2048)</td>
<td>Question exclamation mark</td>
</tr>
<tr>
<td>(U+2051)</td>
<td>Two asterisks aligned vertically</td>
</tr>
</tbody>
</table>

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

Range 3

Miscellaneous symbols. The block list is indicated in Table 4.

Range 9

The intersection of the "General Punctuation" block (U+2000–U+206F) and Adobe-Japan1-7 character collection. This character range characters in Table 5.

Range 4

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.

\ldefcharrange{4}{% "500-"10FF, "1200-"1DFF, "2440-"25FF, "27C0-"28FF, "2A00-"2AFF, "2B00-"2EFF, "4C00-"4EFF, "6000-"6BFF, "8000-"90FF, "A000-"A8FF, "D000-"D7FF, "E100-"E6FF, "1F000-"1FFF, ... (characters in "2000-"206F which are not in range 9) } % non-Japanese

Range 5

Surrogates and Supplementary Private Use Areas.

Range 6

Characters used in Japanese. The block list is indicated in Table 6.

Range 7

Characters used in CJK languages, but not included in Adobe-Japan1-7. The block list is indicated in Table 7.

Notes on U+0080–U+00FF

You should treat characters in textttU+0080–U+00FF as \texttt{A1char}, when you use traditional 8-bit fonts, such as the marvosym package.
Table 6. Unicode blocks in predefined character range 6.

<table>
<thead>
<tr>
<th>Block Name</th>
<th>Code Points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosed Alphaneumeric</td>
<td>U+2460–U+24FF</td>
<td></td>
</tr>
<tr>
<td>CJK Symbols and Punctuation</td>
<td>U+3000–U+303F</td>
<td></td>
</tr>
<tr>
<td>Katakana</td>
<td>U+3080–U+30FF</td>
<td></td>
</tr>
<tr>
<td>Katakana Phonetic Extensions</td>
<td>U+31FB–U+31FF</td>
<td></td>
</tr>
<tr>
<td>CJK Compatibility</td>
<td>U+3308–U+33FF</td>
<td></td>
</tr>
<tr>
<td>CJK Unified Ideographs</td>
<td>U+4E00–U+4FF</td>
<td></td>
</tr>
<tr>
<td>Vertical Forms</td>
<td>U+FE18–U+FE1F</td>
<td></td>
</tr>
<tr>
<td>Small Form Variants</td>
<td>U+FE5B–U+FE6F</td>
<td></td>
</tr>
<tr>
<td>Kana Supplement</td>
<td>U+1B00–U+1BFF</td>
<td></td>
</tr>
<tr>
<td>Enclosed Alphanumeric Supp.</td>
<td>U+1F280–U+1FFFF</td>
<td></td>
</tr>
<tr>
<td>(Supp. Ideographic Plane)</td>
<td>U+30000–U+30FFF</td>
<td></td>
</tr>
<tr>
<td>Variation Selectors Supp.</td>
<td>U+2E100–U+2E1EF</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Unicode blocks in predefined character range 7.

<table>
<thead>
<tr>
<th>Block Name</th>
<th>Code Points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hangul Jamo</td>
<td>U+1100–U+11FF</td>
<td></td>
</tr>
<tr>
<td>Ideographic Description Characters</td>
<td>U+2F00–U+2FFF</td>
<td></td>
</tr>
<tr>
<td>Hangul Compatibility Jamo</td>
<td>U+3100–U+31FF</td>
<td></td>
</tr>
<tr>
<td>CJK Strokes</td>
<td>U+3108–U+31FF</td>
<td></td>
</tr>
<tr>
<td>Yi Radicals</td>
<td>U+4A00–U+4AFF</td>
<td></td>
</tr>
<tr>
<td>Hangul Syllables</td>
<td>U+AC00–U+ADFF</td>
<td></td>
</tr>
</tbody>
</table>

For example, \Fromy which is provided by the marvosym package has the same codepoint as § (U+00A7). Hence, as previous versions of Lua\TeX-ja, if these characters are treated as JAchar, then \Fromy produces “ § ” (in a Japanese font).

To avoid such situations, the default setting of Lua\TeX-ja is changed in version 20150906.0 so that all characters U+0080–U+00FF are treated as ALchar.

If you want to output a character as ALchar and JAchar regardless the range setting, you can use \ltjachar and \ltjaachar respectively, as the following example.

```
\gtfamily\large% default, ALchar, JAchar
\protect\ttfamily$\ft,$, \ltjaachar$\tt$,$, \ltjachar$\tt$\}
% default: ALchar
\protect\ttfamily$\alpha$, \ltjaachar$\tt\alpha$, \ltjachar$\tt\alpha$% default: JAchar
```

### 4.2 kanjiskip and xkanjiskip

JAglue is divided into the following three categories:

- Glues/kerns specified in JFM. If \ inhibitglue is issued around a JAchar, this glue will not be inserted at the place.
- The default glue which inserted between two JAchars (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. Note that only their values at the end of a paragraph or a hbox are adopted in the whole paragraph or the whole hbox.

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

Here \zw is a internal dimension which stores fullwidth of the current Japanese font. This \zw can be used as the unit zw in \hbox.

The value of these parameter can be get by \ltjgetparameter. Note that the result by \ltjgetparameter is not the internal quantities, but a string (hence the cannot be prefixed).

```
kanjiskip: \ltjgetparameter{kanjiskip},\\   kanjiskip: 0.0pt plus 0.4pt minus 0.5pt,
xkanjiskip: \ltjgetparameter{xkanjiskip}   xkanjiskip: 2.40555pt plus 1pt minus 1.0pt
```

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 (these “ideal width” cannot be retrived by \ltjgetparameter).
4.3 Insertion setting of xkanjiskip

It is not desirable that xkanjiskip is inserted into every boundary between JAchars and ALchars. 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 JAchars and alxspmode parameters ALchars respectively.

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

The second argument preonly means that 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:
\ltxsetparameter{alxspmode={`あ,preonly}, jaxspmode={`!',postonly}}

One can use also numbers to specify these two parameters (see Subsection 8.1).

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

4.4 Shifting the 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 \TeXX, this is achieved by setting \ybaselineshift (or \tbaselineshift) to a non-zero length (the baseline of ALchar 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 and that of Japanese fonts.

<table>
<thead>
<tr>
<th>Horizontal writing (yoko direction) etc.</th>
<th>Vertical writing(tate direction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alphabetic fonts</td>
<td>Japanese fonts</td>
</tr>
<tr>
<td>ylabaselineshift parameter</td>
<td>yjabaselineshift parameter</td>
</tr>
<tr>
<td>talbaselineshift parameter</td>
<td>tjabaselineshift parameter</td>
</tr>
</tbody>
</table>

Here the horizontal line in the below example is the baseline of a line.

\vrule width 150pt height 0.2pt depth 0.2pt \hskip-120pt
\ltxsetparameter{yjabaselineshift=0pt, ylabaselineshift=0pt}abcあいう
\ltxsetparameter{yjabaselineshift=5pt, ylabaselineshift=2pt}abcあいう

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

\vrule width 150pt height4.417pt depth-4.217pt\%\kern-150pt
\large xyz漢字
{\scriptsize
\ltxsetparameter{yjabaselineshift=-1.757pt, ylabaselineshift=-1.757pt}
漢字xyzあいう
}あいうabc

Note that setting positive ylabaselineshift or talbaselineshift parameters does not increase the depth of one-letter syllable p of Alchar, if its left-protrusion (\lpcode) and right-protrusion (\rpcode) are both non-zero. This is because

- These two parameters are implemented by setting yoffset field of a glyph node, and this does not increase the depth of the glyph.

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• To cope with the above situation, LuaTeX-ja automatically supplies a rule in every syllable.

• However, we cannot use this "supplying a rule" method if a syllable comprises just one letter whose \lpcode and \rpcode are both non-zero.

This problem does not apply for \yjabaselineshift nor \tjabaselineshift, because a JAchar is encapsulated by a horizontal box if needed.

4.5 kinsooku parameters and OpenType features

Among parameters which related to Japanese word-wrapping process (kinsoku shori),

\ixa{}mode, \aixa{}mode, \prebreakpenalty, \postbreakpenalty and \kcatcode

are stored by each character codes.

OpenType font features are ignored in these parameters. For example, a fullwidth katakana “ア” on line 10 in the below input is replaced to its halfwidth variant “ア”, by hwid feature. However, the penalty inserted after it is 10 which is the \postbreakpenalty of “ア”, not 20.

1 \ltjsetparameter{postbreakpenalty={‘ア’, 10}}
2 \ltjsetparameter{postbreakpenalty={‘7’, 20}}
3 \newcommand\showpostpena[1]{%
4 \leavevmode\setbox0=\hbox{#1\hbox{}}%
5 \unhbox0\setbox0=\lastbox\the\lastpenalty}
6 \showpostpena{ア}, \showpostpena{ア}, \showpostpena{ア}
7 \newcommand\showpostpena[1]{%
8 \leavevmode\setbox0=\hbox{#1\hbox{}}%
9 \unhbox0\setbox0=\lastbox\the\lastpenalty}
10 \showpostpena{ア}, \showpostpena{ア}, \showpostpena{ア}

ア 10, ア 20, ア 10
Part II

Reference

5 \texttt{\textbackslash catcode} in Lua\TeX\-ja

5.1 Preliminaries: \texttt{\textbackslash catcode} in p\TeX\ and up\TeX

In p\TeX and up\TeX, the value of \texttt{\textbackslash catcode} determines whether a Japanese character can be used in a control word. For the detail, see Table 8.

\texttt{\textbackslash catcode} can be set by a row of JIS X 0208 in p\TeX, and generally by a Unicode block\footnote{up\TeX divides U+FF00–U+FFEF (Halfwidth and Fullwidth Forms) into three subblocks, and \texttt{\textbackslash catcode} can be set by a subblock.} in up\TeX. So characters which can be used in a control word slightly differ between p\TeX and up\TeX.

5.2 Case of Lua\TeX-ja

The role of \texttt{\textbackslash catcode} in p\TeX and up\TeX can be divided into the following four kinds, and Lua\TeX-ja can control these four kinds separately:

- Distinction between \texttt{JAchar} or \texttt{ALchar} is controlled by the character range, see Subsection 4.1.
- Whether the character can be used in a control word is controlled by setting \texttt{\textbackslash catcode} to 11 (enabled) or 12 (disabled), as usual.
- Whether \texttt{icharwidowpenalty} can be inserted before the character is controlled by the lowermost bit of the \texttt{\textbackslash catcode} parameter.
- Linebreak after a \texttt{JAchar} does not produce a space.

Default setting of \texttt{\textbackslash catcode} of Unicode characters are located in plain Lua\TeX 1uang\TeX-\texttt{unicode-letters.tex}, which is based on \texttt{unicode-letters.tex} for \TeX. However, the default setting of \texttt{\textbackslash catcode} differs between \TeX and Lua\TeX, by the following reasons:

- (plain format) \texttt{lua\TeX-unicode-letters.tex} is based on old \texttt{unicode-letters.tex}.
- The latter half of \texttt{unicode-letters.tex} and \texttt{unicode-letters.def} sets \texttt{\textbackslash catcode} of several characters to 11, via setting \texttt{\textbackslash Xe\TeX\charclass}. However, this latter half does not exist (plain case), or not executed (Lua\TeX case) in Lua\TeX.

In other words,

plain Lua\TeX Kanji nor kana characters cannot be used in a control word, in the default setting of plain Lua\TeX.

Lua\texttt{\textbackslash TeX} In recent (2015-10-01 or later) Lua\texttt{\textbackslash TeX}, Kanji and kana characters in a control word is supported (these catcode are 11), but not fullwidth alphanumerics and several other characters.

This would be inconvenient for p\TeX users to shifting to Lua\TeX-ja, since several control words containing Kanji or other fullwidth characters, such as \texttt{\textbackslash Kalendar} or \texttt{\textbackslash Year} are used in p\TeX. Hence, Lua\TeX-ja have a counterpart of \texttt{unicode-letters.tex} for Lua\TeX, \texttt{to match the \textbackslash catcode setting with that of \TeX}.  

5.3 Non-kanji characters in a control word

Because the engine differ, so non-kanji JIS X 0208 characters which can be used in a control word differ in p\TeX, in up\TeX, and in Lua\TeX-ja. Table 9 shows the difference. Except for four characters “・”, “゛”, “゜”, “゠”, Lua\TeX-ja admits more characters in a control word than up\TeX.

Difference becomes larger, if we consider non-kanji JIS X 0213 characters. For the detail, see https://github.com/h-kitagawa/kct.
Table 8. `\kcatcode` in up\TeX

<table>
<thead>
<tr>
<th>\kcatcode</th>
<th>meaning</th>
<th>control word (treated as usual \TeX)</th>
<th>widow penalty</th>
<th>linebreak</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>non-cjk</td>
<td>Y</td>
<td>Y</td>
<td>ignored</td>
</tr>
<tr>
<td>16</td>
<td>kanji</td>
<td>Y</td>
<td>Y</td>
<td>ignored</td>
</tr>
<tr>
<td>17</td>
<td>kana</td>
<td>Y</td>
<td>Y</td>
<td>ignored</td>
</tr>
<tr>
<td>18</td>
<td>other</td>
<td>N</td>
<td>N</td>
<td>ignored</td>
</tr>
<tr>
<td>19</td>
<td>hangul</td>
<td>Y</td>
<td>Y</td>
<td>space</td>
</tr>
</tbody>
</table>

Table 9. Difference of the set of non-kanji JIS X 0208 characters which can be used in a control word

<table>
<thead>
<tr>
<th>row</th>
<th>col.</th>
<th>p\TeX</th>
<th>up\TeX</th>
<th>Lua\TeX-ja</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U+30FB)</td>
<td>1</td>
<td>6</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>(U+309B)</td>
<td>1</td>
<td>11</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>(U+309C)</td>
<td>1</td>
<td>12</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>(U+FF48)</td>
<td>1</td>
<td>14</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FFE3)</td>
<td>1</td>
<td>17</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FFE3F)</td>
<td>1</td>
<td>18</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+3003)</td>
<td>1</td>
<td>23</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+3E0D)</td>
<td>1</td>
<td>24</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>(U+3005)</td>
<td>1</td>
<td>25</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+3006)</td>
<td>1</td>
<td>26</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+3007)</td>
<td>1</td>
<td>27</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+30FC)</td>
<td>1</td>
<td>28</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>(U+FF0F)</td>
<td>1</td>
<td>31</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FFE3C)</td>
<td>1</td>
<td>32</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>row</th>
<th>col.</th>
<th>p\TeX</th>
<th>up\TeX</th>
<th>Lua\TeX-ja</th>
</tr>
</thead>
<tbody>
<tr>
<td>(U+FF5C)</td>
<td>1</td>
<td>35</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF0B)</td>
<td>1</td>
<td>60</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF1D)</td>
<td>1</td>
<td>65</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF1C)</td>
<td>1</td>
<td>67</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF1E)</td>
<td>1</td>
<td>68</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF03)</td>
<td>1</td>
<td>84</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF06)</td>
<td>1</td>
<td>85</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF0A)</td>
<td>1</td>
<td>86</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FF20)</td>
<td>1</td>
<td>87</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+3812)</td>
<td>2</td>
<td>9</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+3813)</td>
<td>2</td>
<td>14</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+FFE2)</td>
<td>2</td>
<td>44</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(U+212B)</td>
<td>2</td>
<td>82</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Greek letters (row 6) Y N Y

Cyrillic letters (row 7) N N Y

6 Directions

Lua\TeX supports four Ω-style directions: TLT, TRT, RTT and LTL. However, neither directions are not well-suited for typesetting Japanese vertically, hence we implemented vertical writing by rotating TLT-box by 90 degrees.

Lua\TeX-ja supports four directions, as shown in Table 10. The second column (yoko direction) is just horizontal writing, and the third column (tate direction) is vertical writing. The fourth column (dtou direction) is actually a hidden feature of p\TeX. We implemented this for debugging purpose. The fifth column (utod direction) corresponds the “tate (math) direction” of p\TeX.

Directions can be changed by \yoko, \tate, \dtou, \utod, only when the current list is null. These commands cannot be executed in unrestricted horizontal modes, nor math modes. The direction of a math formula is changed to utod, when the direction outside the math formula is tate (vertical writing).

6.1 Boxes in different direction

As in p\TeX, one can use boxes of different direction in one document. The below is an example.
Table 10. Directions supported by LuaTeX-ja

<table>
<thead>
<tr>
<th>Commands</th>
<th>horizontal (yoko direction)</th>
<th>vertical (tate direction)</th>
<th>dtou direction</th>
<th>utod direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning of the page</td>
<td>yoko</td>
<td>tate</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>Beginning of the line</td>
<td>Left</td>
<td>Top</td>
<td>Top</td>
<td>Bottom</td>
</tr>
<tr>
<td>Used Japanese font</td>
<td>horizontal (\jfont)</td>
<td>vertical (\tfont)</td>
<td>horizontal (90° rotated)</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>銀は、Ag</td>
<td>銀是，Ag</td>
<td>銀是，Ag</td>
<td>銀是，Ag</td>
</tr>
</tbody>
</table>

(Notation used in Ω)

| TLT           | RTR, RTT       | LBL           | RTR           |

Table 11 shows how a box is arranged when the direction inside the box and that outside the box differ.

\[\textbf{\textbackslash{wd and direction}}\] In \LaTeX, \textbackslash{wd}, \textbackslash{ht}, \textbackslash{dp} means the dimensions of a box register \textit{with respect to the current direction}. This means that the value of \textbackslash{wd} etc. might differ when the current direction is different, even if \textbackslash{box0} stores the same box. However, this no longer applies in Lua\TeX-ja.

```
\setbox0=\hbox to 20pt{foo}
\the\wd0, \hbox{\tate\vrule\the\wd0}
\wd0=100pt
\the\wd0, \hbox{\tate\the\wd0}
```

To access box dimensions \textit{with respect to current direction}, one has to use the following commands instead of \textbackslash{wd} wtc.

\begin{itemize}
\item \texttt{\ltjgetwd(num)}
\item \texttt{\ltjgetht(num)}
\item \texttt{\ltjgetdp(num)}
\end{itemize}

These commands return \textit{an internal dimension} of \textbackslash{box(num)} with respect to the current direction. One can use these in \texttt{dimexpr} primitive, as the followings.

```
\dimexpr 2*\ltjgetwd42-3pt\relax, \the\ltjgetwd1701
```

The following is an example.

```
\parindent0pt
\setbox32767=\hbox{よこぐみ}
\fboxsep=0mm\fbox{\copy32767}
\vbox{\hsize=20mm\raggedleft}
\the\ltjgetwd32767, \the\ltjgetht32767, \the\ltjgetdp32767.}
```

Example:

```
\begin{itemize}
\item こんにちは横組\% yoko
\item \hbox{\tate\% tate}
\item \hbox{縦組\% tate}
\item 中に\% tate
\item \hbox{\yoko横組の内容\% yoko}
\item を挿入する
\item }
\item また横組に戻る\% yoko
\end{itemize}
```
Table 11. Boxes in different direction

<table>
<thead>
<tr>
<th>typeset in yoko direction</th>
<th>typeset in tate or utod direction</th>
<th>typeset in dtou direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>( W_y = h_y + d_y )</td>
<td>( W_T = h_T + d_T )</td>
<td>( W_D = h_D + d_D )</td>
</tr>
<tr>
<td>( H_T = w_T )</td>
<td>( H_T = w_T / 2 )</td>
<td>( H_D = w_D )</td>
</tr>
<tr>
<td>( D_T = 0 ) pt</td>
<td>( D_T = w_T / 2 )</td>
<td>( D_D = h_T )</td>
</tr>
</tbody>
</table>

\ltjsetwd(\texttt{num})=\langle\texttt{dimen}\rangle, \ltjsetht(\texttt{num})=\langle\texttt{dimen}\rangle, \ltjsetdp(\texttt{num})=\langle\texttt{dimen}\rangle

These commands set the dimension of \texttt{\box\langle\texttt{num}\rangle}. One does not need to group the argument \langle\texttt{num}\rangle; four calls of \ltjsetwd below have the same meaning.

\ltjsetwd42 20 pt, \ltjsetwd42=20 pt, \ltjsetwd42=20 pt, \ltjsetwd42=20 pt

6.2 Getting current direction

The \texttt{direction} parameter returns the current direction, and the \texttt{boxdir} parameter (with the argument \langle\texttt{num}\rangle) returns the direction of a box register \texttt{\box\langle\texttt{num}\rangle}. The returned value of these parameters are a \textit{string}:

<table>
<thead>
<tr>
<th>Direction</th>
<th>yoko</th>
<th>tate</th>
<th>dtou</th>
<th>utod</th>
<th>(empty)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returned value</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>11</td>
<td>0</td>
</tr>
</tbody>
</table>

1 \leavevmode\def\DIR{\ltjgetparameter{direction}}
2 \hbox\{\yoko \DIR\}, \hbox\{\tate\DIR\},
3 \hbox\{\utod\DIR\}, \hbox\{\tate\DIR\}
4 \hbox\{\tate\}$\hbox\{\tate\math: \DIR\}$
5 \setbox2=\hbox\{\tate\}\ltjgetparameter{boxdir}\{2\}

\leavevmode\def\DIR{\ltjgetparameter{direction}}
\hbox\{\yoko \DIR\}, \hbox\{\tate\DIR\}, \hbox\{\utod\DIR\}, \hbox\{\tate\}$\hbox\{\tate\math: \DIR\}$
\setbox2=\hbox\{\tate\}\ltjgetparameter{boxdir}\{2\}
Table 12. Differences between horizontal JFMs shipped with Lua\TeX-ja

<table>
<thead>
<tr>
<th>Blue: jfm-ujis.lua, Black: jfm-jis.lua, Red: jfm-min.lua</th>
</tr>
</thead>
<tbody>
<tr>
<td>ある日モモちゃんがお使いで迷子になって泣きました。</td>
</tr>
<tr>
<td>漢つ</td>
</tr>
</tbody>
</table>

6.3 Overridden box primitives

To cope with multiple directions, the following primitives are overridden by Lua\TeX-ja, using \texttt{\textbackslash protected\textbackslash def}.

\texttt{\unhbox\langle num\rangle, \unvbox\langle num\rangle, \unhcopy\langle num\rangle, \unvcopy\langle num\rangle}

\texttt{\vadjust\langle material\rangle}

\texttt{\insert\langle number\rangle\{\langle material\rangle\}}

\texttt{\lastbox}

\texttt{\raise\langle dimen\rangle\langle box\rangle, \lower\langle dimen\rangle\langle box\rangle etc., \vcenter}

\texttt{\vcenter}

7 Font Metric and Japanese Font

7.1 \texttt{\jfont}

To load a font as a Japanese font (for horizontal direction), you must use the \texttt{\jfont} instead of \texttt{\font}, while \texttt{\jfont} admits the same syntax used in \texttt{\font}. Lua\TeX-ja automatically loads luaotfload package, so TrueType/OpenType fonts with features can be used for Japanese fonts:

1\texttt{\jfont}\texttt{\tradmc={IPAexMincho:script=latn;\%}

2\texttt{+trad;\-kern;jfm=ujis}} at 14pt

3\texttt{\tradmc 当／体／医／区}

Note that the defined control sequence (\texttt{\tradmc} in the example above) using \texttt{\jfont} is not a \texttt{font.def} token, but a macro. Hence the input like \texttt{\fontname\tradmc} causes a error. We denote control sequences which are defined in \texttt{\jfont} by \texttt{\langle jfont cs \rangle}.

\begin{itemize}
  \item \textbf{JFM} 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 \texttt{\jfont}, you must specify which JFM will be used for this font by the following keys:

    \begin{itemize}
      \item \texttt{jfm=\langle name\rangle}
      \begin{itemize}
        \item Specify the name of (horizontal) JFM. If specified JFM has not been loaded, Lua\TeX-ja search and load a file named \texttt{jfm-\langle name\rangle}.lua.
      \end{itemize}
      
      The following horizontal JFMs are shipped with Lua\TeX-ja:

      \begin{itemize}
        \item \texttt{jfm-ujis.lua} A standard horizontal JFM in Lua\TeX-ja. This JFM is based on \texttt{upnmlmr-h.tfm}, a metric for UTF/OTF package that is used in up\TeX. When you use the \texttt{luatexja-of package}, you should use this JFM.
      \end{itemize}
    \end{itemize}
\end{itemize}
A counterpart for jis.tfm, “JIS font metric” which is widely used in p\TeX. A major difference between 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.

The difference among these three JFMs is shown in Table 12.

Example of \texttt{\textbackslash setmainjfont} etc. which are provided by luatexja-fontspec package, kerning option is set off (Kerning=Off) by default, because of the compatibility with previous versions of Lua\TeX-ja.

The following setting can be specified as OpenType font features:

\begin{verbatim}
extend=(extend) expand the font horizontally by (extend).
\end{verbatim}
\slant=(\textit{slant}) \ slant the font.

Note that Lua\TeX-ja doesn’t adjust JFMs by these \texttt{extend} and \texttt{slant} settings; you have to write new JFMs on purpose. For example, the following example uses the standard JFM \texttt{jfm-ujis.lua}, hence letter-spacing and the width of italic correction are not correct:

1 \begin{verbatim}
\jfont\E=HaranoAjiMincho-Regular:extend=1.5;jfm=ujis;-kern
\jfont\S=HaranoAjiMincho-Regular:slant=1;jfm=ujis;-kern
\end{verbatim}

\begin{verbatim}
\Eあいうえお \Sあいうえお
\end{verbatim}

\begin{verbatim}
あ \Eうえお
あ \Sうえお
ABC
\end{verbatim}

\section*{ltjksp}
 Kanjiskip\_natural, kanjiskip\_stretch, kanjiskip\_shrink keys (Page ??) makes that Lua\TeX-ja inserts not only a glue which is specified by a JFM, and also the natural width/stretch part/shrink part of \texttt{kanjiskip}.

This functionality is disabled by \texttt{-ltjksp} specification.

\section*{tfont}
 \texttt{tfont} loads a font as a Japanese font for vertical direction. This command admits the same syntax used in \texttt{font} and \texttt{jfont}. A font defined by \texttt{tfont} differs the following points from that by \texttt{jfont}:

\begin{itemize}
  \item OpenType Feature \texttt{vrt2} is automatically activated, unless \texttt{vert} and/or \texttt{vrt2} are explicitly activated or deactivated (as the second line in the example below).

  \begin{verbatim}
  \jfont\S=HaranoAjiMincho-Regular:jfm=ujisv\ % vrt2 is automatically activated
  \jfont\T=HaranoAjiMincho-Regular:jfm=ujisv;-vert\ % vert and vrt2 are not activated
  \jfont\U=file:ipaexm.ttf:jfm=ujisv\ % vert is automatically activated, since this font does not have vrt2
  \end{verbatim}

  \item Sometimes \texttt{vert} and/or \texttt{vrt2} are not activated while one specified activation of these feature. This is because the font does not define these features in current combination of script tag and language system identifier. In this situation, Lua\TeX-ja performs all replacements which is defined in \texttt{vert} feature for some scripts for some languages.

  \item Furthermore, a glyph is automatically rotated 90 degrees, if it is not replaced by \texttt{vert} feature for \texttt{any} script for \texttt{any} language, and if it is marked as ‘r” or “Tr” in UAX \#50.

  \item One have to specify the name of vertical JFM in \texttt{jfm=(\textit{name})}. Lua\TeX-ja ships following vertical JFMs:

    \begin{itemize}
      \item \texttt{jfm-ujisv.lua} A standard vertical JFM in Lua\TeX-ja. This JFM is based on upm1minr-v.ttf, a metric for UTF/OTF package that is used in upTEX.
      \item \texttt{jfm-tmin.lua} A counterpart for tmin10.ttf, which is one of the default Japanese font metric shipped with \texttt{p\TeX}.
    \end{itemize}

    \item If \texttt{vert} and/or \texttt{vrt2} features are activated, one can specify \texttt{jpotf} to additional substitutions. By default, it substitutes ideographic comma/period for fullwidth comma/period, and double prime quotation marks for double quotation marks (See Figure 3).
\end{itemize}

\footnote{If the font does not define \texttt{vrt2} feature, use \texttt{vert} instead.}
7.3 Default Japanese fonts and JFMs

If following commands are defined at loading LuaTEX-ja package, these change default Japanese fonts and JFMs for them:

\ltj@stdmcfont The default Japanese font for the mincho family.
\ltj@stdgtfont The default Japanese font for the gothic family.
\ltj@stdyokojfm The default JFM for horizontal direction.
\ltj@stdtatejfm The default JFM for vertical direction.

For example,
\def\ltj@stdmcfont{IPAMincho}
\def\ltj@stdgtfont{IPAGothic}

makes that IPA Mincho and IPA Gothic will be used as default Japanese fonts, instead of Harano Aji fonts.

This feature is intended for classes which use special JFMs\footnote{This is because commands has @ in their names.}. It is recommended to use \luatexja-preset or \luatexja-fontspec package to select standard fonts in ordinary LaTeX sources.

For compatibility with earlier versions, LuaTEX-ja reads \luatexja.cfg automatically if it is found by LuaTEX. One should not overuse this \luatexja.cfg; it will overwrite the definition of \ltj@stdmcfont and others.

7.4 Prefix psft

Besides “file” and “name” prefixes which are introduced in the luaotfload package, LuaTEX-ja adds “psft” prefix in \jfont (and \font), to specify a “name-only” Japanese font which will not be embedded to PDF. Note that these non-embedded fonts under current LuaTEX has Identity-H encoding, and this violates the standard ISO32000-1:2008 (\cite{10}).

OpenType font features, such as “+jp90”, have no meaning in name-only fonts using “psft” prefix, because we can’t expect what fonts are actually used by the PDF reader. Note that extend and slant settings (see above) are supported with psft prefix, because they are only simple linear transformations.

\textbf{cid key} The default font defined by using psft prefix is for Japanese typesetting; it is Adobe-Japan1-7 CID-keyed font. One can specify cid key to use other CID-keyed non-embedded fonts for Chinese or Korean typesetting.
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 5 values written in the sample code above. Specifying other values, e.g.,
\[\jfont\textD={psft:Ryumin-Light:cid=Adobe-Japan2;jfm=jis}\]
produces the following error:

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

See the luatexja package documentation for explanation.

Type H <return> for immediate help.

\par
1.78
\par
? 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.

7.5 Structure of a JFM file

A JFM file is a Lua script which has only one function call:
\[\text{jfont.define_jfm \{ \ldots \}}\]

Real data are stored in the table which indicated above by \{ \ldots \}. 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.

\textbf{version=}(version) (optional, default value is 1)

The version JFM. Currently 1, 2, and, 3 are supported

\textbf{dir=}(direction) (required)

The direction of JFM. 'yoko' (horizontal) or 'tate' (vertical) are supported.

\textbf{zw=}(length) (required)

The amount of the length of the "full-width".

\textbf{zh=}(length) (required)

The amount of the "full-height" (height + depth).

\textbf{kanjiskip=}(\{natural\}, \{stretch\}, \{shrink\}) (optional)

This field specifies the "ideal" amount of \texttt{kanjiskip}. As noted in Subsection 4.2, if the parameter \texttt{kanjiskip} is \texttt{\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.

\textbf{xkanjiskip=}(\{natural\}, \{stretch\}, \{shrink\}) (optional)

Like the \texttt{kanjiskip} field, this field specifies the "ideal" amount of \texttt{xkanjiskip}. 

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Consider a Japanese character node which belongs to a character class whose align field is 'middle'.

- The black rectangle is the imaginary body 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) first.
- 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.

<table>
<thead>
<tr>
<th>Direction of JFM</th>
<th>'yoko' (horizontal)</th>
<th>'tate' (vertical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>width field</td>
<td>the width of the &quot;real&quot; glyph</td>
<td>0.0</td>
</tr>
<tr>
<td>height field</td>
<td>the height of the &quot;real&quot; glyph</td>
<td>0.0</td>
</tr>
<tr>
<td>depth field</td>
<td>the depth of the &quot;real&quot; glyph</td>
<td>0.0</td>
</tr>
<tr>
<td>italic field</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 13. Default values of width field and other fields

Character classes

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 optional if $i = 0$, since all JChar which do not belong any character classes other than 0 are in the character class 0 (hence, the character class 0 contains most of JChars). In the list, character(s) can be specified in the following form:
  - a Unicode code point
  - the character itself (as a Lua string, like 'あ')
  - a string like 'あ*' (the character followed by an asterisk)
  - several "imaginary" characters (We will describe these later.)

- **width**=(length), **height**=(length), **depth**=(length), **italic**=(length) (required)

  Specify the width of characters in character class $i$, the height, the 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. The default values are shown in Table 13.

- **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 4 and Figure 5.

  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), [⟨j’⟩]=(kern), [ratio=(ratio)], ...}

  Specifies the amount of kern which will be inserted between characters in character class $i$ and those in character class $j$.

- **glue**=[⟨j⟩]=⟨⟨width⟩, ⟨stretch⟩, ⟨shrink⟩, [ratio=(ratio), ...]⟩, ...}

  Specifies the amount of glue which will be inserted between characters in character class $i$ and those in character class $j$.

Figure 4. The position of the real glyph (horizontal Japanese fonts)
\( \langle \text{ratio} \rangle \) specifies how much the glue is originated in the "right" character. It is a real number between 0 and 1, and treated as 0.5 if omitted. For example, the width of a glue between an ideographic full stop “。” and a fullwidth middle dot “・” is three-fourth of fullwidth, namely halfwidth from the ideographic full stop, and quarter-width from the fullwidth middle dot. In this case, we specify \( \langle \text{ratio} \rangle \) to \( 0.25/(0.5 + 0.25) = 1/3 \).

In case of glue, one can specify following additional keys in each \([j]\) subtable:

\[
\begin{align*}
\text{priority} &= \langle \text{priority} \rangle \\
&\text{An integer in } [-4, 3] \text{ (treated as 0 if omitted), or a pair of these integers } \{ \langle \text{stretch} \rangle, \langle \text{shrink} \rangle \} \text{ (version 2 or later). This is used only in line adjustment with priority by luatexja-adjust (see Subsection 11.3). Higher value means the glue is easy to stretch, and is also easy to shrink.}
\end{align*}
\]

\[
\begin{align*}
\text{kanjiskip\natural} &= \langle \text{num} \rangle, \quad \text{kanjiskip\stretch} &= \langle \text{num} \rangle, \quad \text{kanjiskip\shrink} &= \langle \text{num} \rangle
\end{align*}
\]

These keys specifies the amount of the natural width of \text{kanjiskip} (the stretch/shrink part, respectively) which will be inserted in addition to the original JFM glue. Default values of them are all 0.

As an example, in \text{jfm-ujis.lua}, the standard JFM in horizontal writing, we have

- Between an ordinal letter “あ” and an ideographic opening bracket, we have a glue whose natural part and shrink part are both half-width, while its stretch part is zero. However, this glue also can be stretched as much as the stretch part of \text{kanjiskip} times the value of \text{kanjiskip\stretch} key (1 in this case).
- Between an ideographic closing brackets (the ideographic comma “，” is included) and an ordinal letter, we have the same glue. Again, this glue also can be stretched as much as the stretch part of \text{kanjiskip} times the value of \text{kanjiskip\stretch} key (1 in this case).
- Between an ideographic opening bracket and an ordinal letter and between an ordinal letter and an ideographic closing bracket, we have a glue whose natural part and stretch part are both zero, while its shrink part as much as the shrink part of \text{kanjiskip}.

Hence we have the following result:

\[
\begin{align*}
\text{\texttt{\leavevmode}} &\text{\texttt{\ltjsetparameter{kanjiskip=0pt plus 3\zw}}} \\
\text{\texttt{\vrule\bbox to 15\zw}} &\text{\texttt{あ「い」う, えお}} \text{\texttt{\vrule}} \\
\text{\texttt{\vrule\bbox{あ「い」う, えお}} \text{\texttt{\vrule\par}}} \\
\text{\texttt{\ltjsetparameter{kanjiskip=0pt minus \zw}}} \\
\text{\texttt{\vrule\bbox to 6.5\zw}} &\text{\texttt{あ「い」う, えお}} \text{\texttt{\vrule}}
\end{align*}
\]

\[
\begin{align*}
\text{end\stretch} &= \langle \text{kern} \rangle, \quad \text{end\shrink} &= \langle \text{kern} \rangle \quad \text{(optional, version 1 only)}
\end{align*}
\]

\[
\begin{align*}
\text{end\adjust} &= \{(\text{kern}), \langle \text{kern} \rangle, \ldots \} \quad \text{(optional, version 2 or later)}
\end{align*}
\]

\begin{itemize}
  \item \textbf{Character to character classes} We explain how the character class of a character is determined, using \text{jfm-test.lua} which contains the following:
\end{itemize}
Now consider the following input/output:

```plaintext
\jfont\a=IPAexMincho:jfm=test;+hwid
\setbox0\hbox{\a
      漢
}\the\wd0
```

Now we look why the above source outputs 15 pt.

1. The character “ヒ” is converted to its half width form “ヒ” by hwid feature.
2. According to the JFM, the character class of “ヒ” is 2000, hence its width is halfwidth.
3. The character class of “漢” is zero, hence its width is fullwidth.
4. Hence the width of \hbox equals to 15 pt.

This example shows that the character class of a character is generally determined after applying font features by luaotfload.

However, if the class determined by the glyph after application of features is zero, LuaTEX-ja adopts the class determined by the glyph before application of features. The following input is an example.

```plaintext
\jfont\a=HaranoAjiMincho-Regular:jfm=test;+vert
\ inhibitglue
\ 漢　漢
```

Here, the character class of the ideographic full stop “。” (U+3002) is determined as follows:

1. As the case of “ヒ”, the ideographic full stop “。” is converted to its vertical form “○” (U+FE12) by vert feature.
2. The character class of “○”, according to the JFM is zero.
3. However, LuaTEX-ja remembers that this “○” is obtained from “。” by font features. The character class of “○” is non-zero value, namely, 2000.
4. Hence the ideographic full stop “○” in above belongs the character class 2000.

### Imaginary characters

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 \hbox. As a result, LuaTEX-ja can control typesetting finer than \hbox. The following is the list of imaginary characters:

- **'boxbdd'**
  The beginning/ending of a hbox, and the beginning of a noindented (i.e., began by \noindent) paragraph. If a hbox \b begins (resp. ends) a glue or kern between this “charater” and a JAchar, JAgue won’t be inserted before(resp. after) the hbox \b. \kanjiskip and \xkanjiskip around a hbox.

- **'parbdd'**
  The beginning of an (indented) paragraph.

- **'jcharbdd'**
  A boundary between JAchar and anything else.

- **'alchar', 'nox_alchar'**
  (version 3 or later) A boundary between JAchar and ALchar.

- **'glue'**
  (version 3 or later) A boundary between JAchar, and, a glue or kern.

−1 The left/right boundary of an inline math formula.
Table 14. Commands for Japanese math fonts

<table>
<thead>
<tr>
<th>Japanese fonts</th>
<th>alphabetic fonts</th>
</tr>
</thead>
<tbody>
<tr>
<td>\fam</td>
<td>\fam</td>
</tr>
<tr>
<td>\jatextfont = {(jfam), (jfont_cs)}</td>
<td>\textfont(fam)=(font_cs)</td>
</tr>
<tr>
<td>\javascriptfont = {(jfam), (jfont_cs)}</td>
<td>\scriptfont(fam)=(font_cs)</td>
</tr>
<tr>
<td>\javascriptscriptfont = {(jfam), (jfont_cs)}</td>
<td>\scriptscriptfont(fam)=(font_cs)</td>
</tr>
</tbody>
</table>

■Porting JFM from \texttt{p\TeX} See Japanese version of this manual.

7.6 Math font family

\texttt{\TeX} handles fonts in math formulas by 16 font families\(^{10}\), and each family has three fonts: \texttt{textfont}, \texttt{\scriptfont} and \texttt{\scriptscriptfont}.

Lua\TeX-ja’s handling of Japanese fonts in math formulas is similar; Table 14 shows counterparts to \texttt{\TeX}’s primitives for math font families. There is no relation between the value of \texttt{\fam} and that of \texttt{\jfam}; with appropriate settings, you can set both \texttt{\fam} and \texttt{\jfam} to the same value. Here (\texttt{\jfont_cs}) in the argument of \texttt{\jatextfont} etc. is a control sequence which is defined by \texttt{\jfont}, i.e., a horizontal Japanese font.

7.7 Callbacks

Lua\TeX-ja also has several callbacks. These callbacks can be accessed via \texttt{luatexbase.add_to_callback} function and so on, as other callbacks.

\texttt{luatexja.load_jfm} callback

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

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

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

An example of this callback is the \texttt{ltjarticle} class, with forcefully assigning character class 0 to 'parbdd' in the JFM \texttt{jfm-min.lua}.

\texttt{luatexja.define_jfont} callback

This callback and the next callback form a pair, and you can assign characters which do not have fixed code points in Unicode to non-zero character classes. This \texttt{luatexja.define_jfont} callback is called just when new Japanese font is loaded.

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

\texttt{jfont_info} has the following fields, \textit{which may not overwritten by a user}:

- **size** The font size specified at \texttt{\jfont} in scaled points (1 \texttt{sp} = \texttt{2^{-16}} \texttt{pt}).
- **zw, zh, kanjiskip, xkanjiskip** These are scaled value of those specified by the JFM, by the font size.
- **jfam** The internal number of the JFM.
- **var** The value of jfmvar key, which is specified at \texttt{\jfont}. The default value is the empty string.
- **chars** The mapping table from character codes to its character classes.
    - The specification \texttt{[i].chars={character, ...}} in the JFM will be stored in this field as \texttt{chars={[character]=i, ...}}.

\(^{10}\text{Omega, Aleph, Lua\TeX and } r(0)\text{i\TeX can handles 256 families, but an external package is needed to support this in plain \texttt{\TeX} and \texttt{\LaTeX}.}\)
**char_type** For \( i \in \omega \), \( \text{char\_type}[i] \) is information of characters whose class is \( i \), and has the following fields:

- \( \text{width}, \text{height}, \text{depth}, \text{italic}, \text{down}, \text{left} \) are just scaled value of those specified by the JFM, by the font size.
- \( \text{align} \) is a number which is determined from \( \text{align} \) field in the JFM:

\[
\begin{align*}
1 & ('right' \text{ in JFM}), \\
0.5 & ('middle' \text{ in JFM}), \\
0 & (\text{otherwise}).
\end{align*}
\]

For \( i, j \in \omega \), \( \text{char\_type}[i][j] \) stores a kern or a glue which will be inserted between character class \( i \) and class \( j \).

The returned table `new_jfont_info` also should include these fields, but you are free to add more fields (to use them in the `luatexja.find_char_class` callback). 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 Lua\TeX\-ja.

**luatexja.find_char_class callback**

This callback is called just when Lua\TeX\-ja is trying to determine which character class a character \( \text{chr\_code} \) belongs. A function used in this callback should be in the following form:

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

The argument `char_class` is the result of Lua\TeX\-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 Lua\TeX\-ja's default routine.

**luatexja.set_width callback**

This callback is called when Lua\TeX\-ja is trying to encapsule a JA\texttt{Char glyph_node}, to adjust its dimension and position.

```lua
function (<table> shift_info, <table> jfont_info, <table> char_type)
  return <table> new_shift_info
end
```

The argument `shift_info` and the returned `new_shift_info` have \( \text{down} \) and \( \text{left} \) 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 (\( \text{height} : \text{depth} \)) of glyphs is adjusted to be that of letters in the character class 0. For example, suppose that

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

Then, the position of glyphs is shifted up by

\[
\frac{88x}{88x + 12x} (28y + 5y) - 28y = \frac{26}{25} y = 1.04y.
\]
8 Parameters

8.1 \ltjsetparameter

As described before, \ltjsetparameter and \ltjgetparameter are commands for accessing most parameters of LuaTeX-ja. One of the main reason that LuaTeX-ja didn’t adopted the syntax similar to that of p\TeX (e.g., \prebreakpenalty = 10000) is the position of hpack_filter callback in the source of LuaTeX, see Section 12.

\ltjsetparameter and \ltjglobalsetparameter are commands for assigning parameters. These take one argument which is a key-value list. The difference between these two commands is the scope of assignment; \ltjsetparameter does a local assignment and \ltjglobalsetparameter does a global one by default. They also obey the value of \globaldefs, like other assignments.

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

- “∗” : values at the end of a paragraph or a hbox are adopted in the whole paragraph or the whole hbox.
- “†” : assignments are always global.

\textbf{jcharwidowpenalty} = \langle \text{penalty} \rangle ∗ [jcharwidowpenalty]

Penalty value for suppressing orphans. This penalty is inserted just after the last JAchar which is not regarded as a (Japanese) punctuation mark.

\textbf{kcatcode} = \langle \langle \text{chr_code} \rangle , \langle \text{natural number} \rangle \rangle ∗

An additional attributes which each character whose character code is \langle \text{chr_code} \rangle has. At version 20120506.0 or later, the lowermost bit of \langle \text{natural number} \rangle indicates whether the character is considered as a punctuation mark (see the description of \jcharwidowpenalty above).

\textbf{prebreakpenalty} = \langle \langle \text{chr_code} \rangle , \langle \text{penalty} \rangle \rangle ∗ [prebreakpenalty]

Set a penalty which is inserted automatically before the character \langle \text{chr_code} \rangle, to prevent a line starts from this character. For example, a line cannot started with one of closing brackets “〗”, so Lua\TeX-ja sets

\ltjsetparameter{prebreakpenalty={`]],10000}}

by default.

p\TeX has following restrictions on \prebreakpenalty and \postbreakpenalty, but they don’t exist in Lua\TeX-ja:

- Both \prebreakpenalty and \postbreakpenalty cannot be set for the same character.
- We can set \prebreakpenalty and \postbreakpenalty up to 256 characters.

\textbf{postbreakpenalty} = \langle \langle \text{chr_code} \rangle , \langle \text{penalty} \rangle \rangle ∗ [postbreakpenalty]

Set a penalty which is inserted automatically after the character \langle \text{chr_code} \rangle, to prevent a line ends with this character.

\textbf{jatextfont} = \langle \langle \text{jfam} \rangle , \langle \text{jfont cs} \rangle \rangle ∗ [textfont in \TeX]

\textbf{jascriptfont} = \langle \langle \text{jfam} \rangle , \langle \text{jfont cs} \rangle \rangle ∗ [scriptfont in \TeX]

\textbf{jascriptscriptfont} = \langle \langle \text{jfam} \rangle , \langle \text{jfont cs} \rangle \rangle ∗ [scriptscriptfont in \TeX]

\textbf{yjabaselineshift} = \langle \text{dimen} \rangle

\textbf{yalbaselineshift} = \langle \text{dimen} \rangle [ybaselineshift]

\textbf{tjabaselineshift} = \langle \text{dimen} \rangle

\textbf{talbaselineshift} = \langle \text{dimen} \rangle [tbaselineshift]

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**jaxspmode** =\{(\textit{chr\_code}), (\textit{mode})\}*

Set whether inserting \textit{xkanjiskip} is allowed before/after a \textit{JAchar} whose character code is \textit{\langle chr\_code \rangle}. The followings are allowed for \textit{\langle mode \rangle}:

- **0**, \textit{inhibit} Insertion of \textit{xkanjiskip} is inhibited before the character, nor after the character.
- **1**, \textit{preonly} Insertion of \textit{xkanjiskip} is allowed before the character, but not after.
- **2**, \textit{postonly} Insertion of \textit{xkanjiskip} is allowed after the character, but not before.
- **3**, \textit{allow} Insertion of \textit{xkanjiskip} is allowed both before the character and after the character. This is the default value.

This parameter is similar to the \textit{\inhibitxspcode} primitive of p\TeX, but not compatible with \textit{\inhibitxspcode}.

**alxspmode** =\{(\textit{chr\_code}), (\textit{mode})\}*[\textit{xspcode}]

Set whether inserting \textit{xkanjiskip} is allowed before/after a \textit{ALchar} whose character code is \textit{\langle chr\_code \rangle}. The followings are allowed for \textit{\langle mode \rangle}:

- **0**, \textit{inhibit} Insertion of \textit{xkanjiskip} is inhibited before the character, nor after the character.
- **1**, \textit{preonly} Insertion of \textit{xkanjiskip} is allowed before the character, but not after.
- **2**, \textit{postonly} Insertion of \textit{xkanjiskip} is allowed after the character, but not before.
- **3**, \textit{allow} Insertion of \textit{xkanjiskip} is allowed both before the character and after the character. This is the default value.

Note that parameters \textit{jaxspmode} and \textit{alxspmode} share a common table, hence these two parameters are synonyms of each other.

**autospacing** =\textit{\{bool\}} [\textit{autospacing}]

**autoxspacing** =\textit{\{bool\}} [\textit{autoxspacing}]

**kanjiskip** =\textit{\{skip\}}*[\textit{kanjiskip}]

The default glue which inserted between two \textit{JAchars}. Changing current Japanese font does not alter this parameter, as p\TeX.

If the natural width of this parameter is \textit{\maxdimen}, Lua\TeX-ja uses the value which is specified in the JFM for current Japanese font (See Subsection 7.5).

**xkanjiskip** =\textit{\{skip\}}*[\textit{xkanjiskip}]

The default glue which inserted between a \textit{JAchar} and an \textit{ALchar}. Changing current font does not alter this parameter, as p\TeX.

As \textit{kanjiskip}, if the natural width of this parameter is \textit{\maxdimen}, Lua\TeX-ja uses the value which is specified in the JFM for current Japanese font (See Subsection 7.5).

**differentjfm** =\textit{\{mode\}}†

Specify how glues/kerns between two \textit{JAchars} whose JFM (or size) are different. The allowed arguments are the followings:

- \texttt{average}, \texttt{both}, \texttt{large}, \texttt{small}, \texttt{pleft}, \texttt{pright}, \texttt{paverage}

The default value is \texttt{paverage}.

**jacharrange** =\textit{\{ranges\}}

**kansujichar** =\{(\textit{digit}), \textit{\langle chr\_code \rangle}\}*[\textit{kansujichar}]

**direction** =\textit{\{dir\}} (always local)

Assigning to this parameter has the same effect as \texttt{\yoko} (if \textit{\langle dir \rangle} = 4), \texttt{\tate} (if \textit{\langle dir \rangle} = 3), \texttt{\dtou} (if \textit{\langle dir \rangle} = 1) or \texttt{\utod} (if \textit{\langle dir \rangle} = 11). If the argument \textit{\langle dir \rangle} is not one of 4, 3, 1 nor 11, the behavior of this assignment is undefined.
8.2 \ltjgetparameter

\ltjgetparameter is a control sequence for acquiring parameters. It always takes a parameter name as first argument.

\begin{verbatim}
\ltjgetparameter{differentjfm}, \ltjgetparameter{autospacing}, \ltjgetparameter{kanjiskip}, \ltjgetparameter{prebreakpenalty}(`).
\end{verbatim}

The return value of \ltjgetparameter is always a string, which is outputted by tex.write(). Hence any character other than space “” (U+0020) has the category code 12 (other), while the space has 10 (space).

- If first argument is one of the following, no additional argument is needed.
  - jcharwidowpenalty, yjabaselineshift, yalbaselineshift, autospacing, autoxspacing, kanjiskip, xkanjiskip, differentjfm, direction
  
  Note that \ltjgetparameter{autospacing} and \ltjgetparameter{autoxspacing} returns 1 or 0, not true nor false.

- If first argument is one of the following, an additional argument—a character code, for example—is needed.
  - kcatidcode, prebreakpenalty, postbreakpenalty, jaxspmode, alxspmode
  
  \ltjgetparameter{jaxspmode}{...} and \ltjgetparameter{alxspmode}{...} returns 0, 1, 2, or 3, instead of preonly etc.

- For an integer \langle digit \rangle between 0 and 9, \ltjgetparameter{kansujichar}{\langle digit \rangle} returns the character code of the result of \kansuji\langle digit \rangle.

- \ltjgetparameter{adjustdir} returns an integer which represents the direction of the surrounding vertical list. As direction, the return value 1 means down-to-up direction, 3 means tate direction (vertical typesetting), and 4 means yoko direction (horizontal typesetting).

- For an integer \langle reg_num \rangle between 0 and 65535, \ltjgetparameter{boxdim}{\langle reg_num \rangle} returns the direction of \box\langle reg_num \rangle. If this box register is void, the returned value is zero.

- The following parameter names cannot be specified in \ltjgetparameter.
  - jatextfont, jascriptfont, jascriptscriptfont, jacharrange

- \ltjgetparameter{chartorange}{\langle chr_code \rangle} returns the range number which \langle chr_code \rangle belongs to (although there is no parameter named "chartorange").

  If \langle chr_code \rangle is between 0 and 127, this \langle chr_code \rangle does not belong to any character range. In this case, \ltjgetparameter{chartorange}{\langle chr_code \rangle} returns −1.

  Hence, one can know whether \langle chr_code \rangle is JChar or not by the following:

  \begin{verbatim}
  \ltjgetparameter{chartorange}{\ltjgetparameter{chartorange}{\langle chr_code \rangle}} \percent 0 if JChar, 1 if ALChar
  \end{verbatim}

- Because the returned value is string, the following conditionals do not work if kanjiskip (or xkanjiskip) has the stretch part or the shrink part.

  \begin{verbatim}
  \ifdim\ltjgetparameter{kanjiskip}>\z@ \ldots \fi
  \ifdim\ltjgetparameter{xkanjiskip}>\z@ \ldots \fi
  \end{verbatim}

  The correct way is using a temporary register.

  \begin{verbatim}
  \@tempskipa=\ltjgetparameter{kanjiskip} \ifdim\@tempskipa>\z@ \ldots \fi
  \@tempskipa=\ltjgetparameter{xkanjiskip} \ifdim\@tempskipa>\z@ \ldots \fi
  \end{verbatim}
8.3 Alternative Commands to \ltjsetparameter

The basic method to set parameters of LuaTeX-ja is to use \ltjsetparameter or \ltjglobalsetparameter. However, these commands are slow, because they parse a key-value list, so several alternative commands are used in LuaTeX-ja. *This subsection is not for general LuaTeX-ja users.*

**Setting kanjiskip or xkanjiskip**: In \ltjsclasses, every size-changing command such as \Large changes \kanjiskip and \xkanjiskip. But a simple implementation, as the code below, is slow since two key-value lists are parsed by \ltjsetparameter:

```
\ltjsetparameter{kanjiskip=0\zw plus .1\zw minus .01\zw}
@tempskipa=\ltjgetparameter{xkanjiskip}
@ifdim@tempskipa>\z@  
  \if@slide  
    \ltjsetparameter{xkanjiskip=0.1em}
  \else
    \ltjsetparameter{xkanjiskip=0.25em plus 0.15em minus 0.06em}
  \fi
@fi
```

Hence, LuaTeX-ja defines more primitive commands, namely \ltj@setpar@global, \ltjsetkanjiskip, and \ltjsetxkanjiskip. Here \ltj@setpar@global\ltjsetkanjiskip 10pt and \ltjsetparameter{kanjiskip=10pt} has the same effect. The actual code of \ltjsclasses is shown below:

```
\ltj@setpar@global\ltjsetkanjiskip{\z@ plus .1\zw minus .01\zw}
@tempskipa=\ltjgetparameter{xkanjiskip}
@ifdim@tempskipa>\z@  
  \if@slide  
    \ltjsetxkanjiskip.1em
  \else
    \ltjsetxkanjiskip.25em plus 0.15em minus 0.06em
  \fi
@fi
```

Note that using \ltjsetkanjiskip or \ltjsetxkanjiskip alone, that is, without executing \ltj@setpar@global in advance, is not supported.

9 Other Commands for plain \TeX and \LaTeX 2ɛ

9.1 Commands for compatibility with p\TeX

The following commands are implemented for compatibility with p\TeX. Note that the former five commands don’t support JIS X 0213, but only JIS X 0208. The last \kansuji converts an integer into its Chinese numerals.

\kuten, \jis, \euc, \sjis, \ucs, \kansuji

These six commands takes an internal integer, and returns a string.

```
\newcount\hoge
\hoge=\string "2423 "
\the\hoge, \kansuji\hoge
\jis\hoge, \char\jis\hoge
\kansuji1701
```

To change characters of Chinese numerals for each digit, set \kansujichar parameter:

```
\ltjsetparameter{kansujichar={1,`壹}}
\ltjsetparameter{kansujichar={7,`漆}}
\ltjsetparameter{kansujichar={0,`零}}
\kansuji1701
```

9251, 二二五一
12355, いい
一七〇一
9.2 \texttt{\textbackslash inhibitglue}

\texttt{\textbackslash inhibitglue} suppresses the insertion of \texttt{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”.

\begin{verbatim}
\jfont\g=HaranoAjiMincho-Regular:jfm=test \g
\bbox{\bbox{あウあ inhibbitglue ウ}}
\inhibitglue\par\noindent あ 1
\par\noindent あ 2
\par\inhibitglue\par\noindent あ 3
\par\hrule\noindent あ office
\end{verbatim}

With the help of this example, we remark the specification of \texttt{\textbackslash inhibitglue}:

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

9.3 \texttt{\textbackslash ltjfakeboxbdd}, \texttt{\textbackslash ltjfakeparbegin}

Sometimes ‘parbdd’ and ‘boxbdd’ specifications look like “fail”, especially in paragraphs inside list environments. This is because \texttt{\everypar} inserts some nodes such as boxes and kerns, so the “first letter” in a paragraph is in fact not the first letter.

\begin{verbatim}
\parindent1\zw
\noindent ああああああああ\par % for comparison
「ああああああ\par % normal paragraph ああああああああ
「ああああああ
\everypar\{null\}
「ああああああ\par % ???
\end{verbatim}

\texttt{\textbackslash ltjfakeboxbdd} and \texttt{\textbackslash ltjfakeparbegin} primitives resolve this situation.

- \texttt{\textbackslash ltjfakeparbegin} creates a node which indicates “beginning of an indented paragraph” to the insertion process of \texttt{JAglue}.
- \texttt{\textbackslash ltjfakeboxbdd} creates a node which indicates “beginning/ending of a box” to the insertion process of \texttt{JAglue}.

As an example, the example above can be improved as follows:

\begin{verbatim}
\parindent1\zw
\noindent ああああああああ\par % for comparison ああああああああ
「ああああああ\par % normal paragraph ああああああああ
「ああああああ
\everypar\{null\}\ltjfakeparbegin
「ああああああ\par
\end{verbatim}

9.4 \texttt{\textbackslash ltjdeclarealtfont}

Using \texttt{\textbackslash ltjdeclarealtfont}, one can "compose" more than one Japanese fonts. This \texttt{\textbackslash ltjdeclarealtfont} uses in the following form:

\begin{verbatim}
\ltjdeclarealtfont{\texttt{base_font_cs}}{\texttt{alt_font_cs}}{(range)}
\end{verbatim}

where \texttt{\textbackslash base_font_cs} and \texttt{\textbackslash alt_font_cs} are defined by \texttt{\jfont}. Its meaning is

If the current Japanese font is \texttt{\textbackslash base_font_cs}, characters which belong to \texttt{\textbackslash range} is typeset by another Japanese font \texttt{\textbackslash alt_font_cs}, instead of \texttt{\textbackslash base_font_cs}.
Here (range) is a comma-separated list of character codes, but also accepts negative integers: \( -n \ (n \geq 1) \) means that all characters of character classes \( n \), with respect to JFM used by \( \langle base\_font\_cs \rangle \). Note that characters which do not exist in \( \langle alt\_font\_cs \rangle \) are ignored.

For example, if \hoge uses jfm-ujis.lua, the standard JFM of LuaTeX-ja, then
\[ \texttt{\\textbackslash ltjdeclarealtfont\hoge\piyo{"3000--30FF, {-1}--{-1}}} \]

does

If the current Japanese font is \hoge, \texttt{U+3000–U+30FF} and characters in class 1 (ideographic opening brackets) are typeset by \piyo.

Note that specifying negative numbers needs specification like \{-1\}--\{-1\}, because simple \"-1\" is treated as the range between 0 and 1.

10 Commands for \LaTeX 2\epsilon

10.1 Loading Japanese fonts in \LaTeX 2\epsilon

From version 20190107, Lua\TeX-ja does not load Japanese fonts for horizontal direction and that for vertical direction at same time, to reduce the number of loaded fonts. This will save time for typesetting and memory consumption of Lua side ([11]).

- \selectfont loads (and chooses) only the Japanese font for current direction, and does not load the Japanese font for other direction (Lua\TeX-ja only detects its size and JFM, to calculate the amount of shifting the baseline).

- Direction changing commands (\texttt{\yoko, \tate, \dtou, \utod}) are patched to include the following process:
  
  If the Japanese font for new direction is not loaded, Lua\TeX-ja loads it automatically.

Original commands are saved as \texttt{\textbackslash ltj@@orig\textbackslash yoko} etc.

- Specifying Japanese font command which is defined by \texttt{\jfont, \tfont, or \DeclareFixedFont} directly actually loads (and selects) the Japanese font. For example, \texttt{\JAchar}s in \texttt{\box0} will be typeset in \texttt{\HOGE}, in the following code:

\begin{verbatim}
\setbox0\hbox{あいう}
\DeclareFixedFont\HOGE{JT3}{gt}{m}{n}{12} % JT3: for vertical direction
\HOGE
\end{verbatim}

10.2 Patch for NFSS2

Japanese patch for NFSS2 in Lua\TeX-ja is based on plfonts.dtx which plays the same role in pl\TeX2\epsilon. We will describe commands which are not described in Subsection 3.1.

additonal dimensions

Like pl\TeX2\epsilon, Lua\TeX-ja defines the following dimensions for information of current Japanese font:

\texttt{\cht (height), \cdp (depth), \cht (sum of former two),}
\texttt{\cwd (width), \cvs (lineskip), \chs (equals to \cwd)}

and its \texttt{\normalsize} version:
Note that \cw and \chf may differ from \zw and \zh respectively. On the one hand the former dimensions are determined from a character whose character class is zero, but on the other hand \zw and \zh are specified by JFM.

In NFSS2 under LuaTeX-ja, distinction between alphabetic fonts and Japanese fonts are only made by their encodings. For example, encodings OT1 and T1 are encodings for alphabetic fonts, and Japanese fonts cannot have these encodings. These command define a new encoding scheme for Japanese font families.

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

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

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

(Only) at the next call of \selectfont, 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.

The following is an example of \SetRelationFont and \userelfont:

```
\makeatletter
\SetRelationFont{JY3}{\k@family}{m}{n}{TU}{lmss}{m}{n}
% \k@family: current Japanese font family
\userelfont\selectfontあいう abc
```

\adjustbaseline
In pL\TeX\ 2\k, \adjustbaseline sets \baselineskip to match the vertical center of “M” and that of “漢” in vertical typesetting:

\[
\text{\baselineskip} \leftarrow \frac{(h_M + d_M) - (h_\text{漢} + d_\text{漢})}{2} + d_\text{漢} - d_M.
\]

where $h_a$ and $d_a$ denote the height of “a” and the depth, respectively. In Lua\TeX\-ja, this \adjustbaseline does similar task, namely setting the talbaselineshift parameter (a Japanese character whose character class is zero is used, instead of “漢”).

\fontfamily{\family}
As in L\LaTeX\ 2\k, this command changes current font family (alphabetic, Japanese, or both) to \family. See Subsection 10.3 for detail.

\fontshape{\shape}, \fontshapeforce{\shape}
As in L\LaTeX\ 2\k, this command changes current alphabetic font shape according to shape change rules. Traditionally, \fontshape changes also current Japanese font shape always. However, this leads a lot of L\LaTeX font warning like
日本国民は、正当に選挙された国会における代表者を通じて行動し、……

Figure 6. An example of \DeclareAlternateKanjiFont

Font shape `JY3/mc/m/it' undefined using `JY3/mc/m/n' instead on ....

when \itshape is called, because almost all Japanese fonts only have shape "n", and \itshape calls \fontshape.
LuaTeX-ja 20200323.0 change the behavior. Namely, \fontshape{⟨shape⟩} and \fontshapeforce{⟨shape⟩} change current Japanese font shape, only if the required shape (according to shape changing rules) or ⟨shape⟩ is available in current Japanese font family/series. When this is not the case, an info such as

Kanji font shape JY3/mc/m/it' undefined
No change on ...

is issued instead of a warning.

\kanjishape{⟨shape⟩}, \kanjishapeforce{⟨shape⟩}
\kanjishape{⟨shape⟩} changes current Japanese font shape according to shape change rules, and \kanjishapeforce{⟨shape⟩} changes current Japanese font shape to ⟨shape⟩, regardless of the rules. Hence \kanjishape{it} produces a warning

Font shape `JY3/mc/m/it' undefined using `JY3/mc/m/n' instead on ....

which is not produced by \fontshape{it}.

\DeclareAlternateKanjiFont{⟨base-encoding⟩}{⟨base-family⟩}{⟨base-series⟩}{⟨base-shape⟩}
{⟨alt-encoding⟩}{⟨alt-family⟩}{⟨alt-series⟩}{⟨alt-shape⟩}{⟨range⟩}
As \ltjdeclarealtfont (Subsection 9.4), characters in ⟨range⟩ of the Japanese font (we say the base font) which specified by first 4 arguments are typeset by the Japanese font which specified by fifth to eighth arguments (we say the alternate font). An example is shown in Figure 6.

• In \ltjdeclarealtfont, the base font and the alternate font must be already defined. But this \DeclareAlternateKanjiFont is not so. In other words, \DeclareAlternateKanjiFont is effective only after current Japanese font is changed, or only after \selectfont is executed.

• ...

Furthermore, LuaTeX-ja applies patches which enables NFSS2 commands, such as \DeclareSymbolFont and \SetSymbolFont, to specify Japanese fonts as math fonts.

Specifying disablejfam option in \usepackage prevents applying these patches. Hence one cannot write Japanese Characters in math mode directly if disablejfam option is specified. The code below does not work either:
\DeclareSymbolFont{mincho}{JY3}{mc}{m}{n}
\DeclareSymbolFontAlphabet{\mathmc}{mincho}
10.3 Detail of \texttt{\fontfamily{family}} command

In this subsection, we describe when \texttt{\fontfamily{family}} changes current Japanese/alphabetic font family. Basically, current Japanese font family is changed to \texttt{\fontfamily{family}} if it is recognized as a Japanese font family, and similar with alphabetic font family. There is a case that current Japanese/alphabetic font family are both changed to \texttt{\fontfamily{family}}, and another case that \texttt{\fontfamily{family}} isn’t recognized as a Japanese/alphabetic font family either.

\textbf{Recognition as Japanese font family} First, Whether Japanese font family will be changed is determined in following order. This order is very similar to \texttt{\fontfamily{family}} in \texttt{\sed 2}, but we re-implemented in Lua. We use an auxiliary list \texttt{\Nj}.

1. If the family \texttt{(family)} has been defined already by \texttt{\DeclareKanjiFamily}, \texttt{(family)} is recognized as a Japanese font family. Note that \texttt{(family)} need not be defined under current Japanese font encoding.
2. If the family \texttt{(family)} has been listed in a list \texttt{\Nj}, this means that \texttt{(family)} is not a Japanese font family.
3. If the \texttt{luatexja-fontspec} package is loaded, stop here, and \texttt{(family)} is not recognized as a Japanese font family.

If the \texttt{luatexja-fontspec} package is not loaded, now \texttt{\sed 2} looks whether there exists a Japanese font encoding \texttt{(enc)} such that a font definition named \texttt{(enc)(family)}, \texttt{.fd} (the file name is all lowercase) exists. If so, \texttt{(family)} is recognized as a Japanese font family (the font definition file won’t be loaded here). If not, \texttt{(family)} is not a Japanese font family, and \texttt{(family)} is appended to the list \texttt{\Nj}.

\textbf{Recognition as alphabetic font family} Next, whether alphabetic font family will be changed is determined in following order. We use auxiliary lists \texttt{\Fa} and \texttt{\Na}.

1. If the family \texttt{(family)} has been listed in a list \texttt{\Fa}, \texttt{(family)} is recognized as an alphabetic font family.
2. If the family \texttt{(family)} has been listed in a list \texttt{\Na}, this means that \texttt{(family)} is not an alphabetic font family.
3. If there exists an alphabetic font encoding such that the family \texttt{(family)} has been defined under it, \texttt{(family)} is recognized as an alphabetic font family, and to memorize this, \texttt{(family)} is appended to the list \texttt{\Fa}.
4. If not, \texttt{luatexja-fontspec} package is loaded, now \texttt{\sed 2} looks whether there exists an alphabetic font encoding \texttt{(enc)} such that a font definition named \texttt{(enc)(family)}, \texttt{.fd} (the file name is all lowercase) exists. If so, current alphabetic font family will be changed to \texttt{(family)} (the font definition file won’t be loaded here). If not, current alphabetic font family won’t be changed, and \texttt{(family)} is appended to the list \texttt{\Na}.

Also, each call of \texttt{\DeclareFontFamily} after loading of \texttt{\sed 2} makes the second argument \texttt{(family)} is appended to the list \texttt{\Fa}.

The above order is very similar to \texttt{\fontfamily{family}} in \texttt{\sed 2}, but more complicated (clause 3.). This is because \texttt{\sed 2} is a format however \texttt{\sed 2} is not, hence \texttt{\sed 2} does not know calls of \texttt{\DeclareFontFamily} before itself is loaded.

\textbf{Remarks} Of course, there is a case that \texttt{(family)} is not recognized as a Japanese font family, nor an alphabetic font family. In this case, \texttt{\sed 2} treats "the argument \texttt{(family)} is wrong", so set both current alphabetic and Japanese font family to \texttt{(family)}, to use the default family for font substitution.

10.4 Notes on \texttt{\DeclareTextSymbol}

From \texttt{\sed 2017/01/01}, the standard encoding of \texttt{\sed} is changed to the \texttt{TU} encoding. This menas that symbols defined by \texttt{T1} and \texttt{TS1} encodings can be used without loading any package. To produces these symbols in alphabetic fonts in \texttt{\sed 2}, \texttt{\sed} patches \texttt{\DeclareTextSymbol}, and reloads \texttt{\textquotedblleft def}.

Under original definition of \texttt{\DeclareTextSymbol}, internal commands which is defined by \texttt{\DeclareTextSymbol} (such as \texttt{\textquotedblleft def}) are \texttt{chardef} tokens. However, this no longer holds in \texttt{\sed}; for example, the meaning of \texttt{\textquotedblleft def} is \texttt{\textquotedblleft def}. 40
Table 15. strut

<table>
<thead>
<tr>
<th>box</th>
<th>direction</th>
<th>width</th>
<th>height</th>
<th>depth</th>
<th>user command</th>
</tr>
</thead>
<tbody>
<tr>
<td>\ystrutbox</td>
<td>yoko</td>
<td>0</td>
<td>0.7\baselineskip</td>
<td>0.3\baselineskip</td>
<td>\ystrut</td>
</tr>
<tr>
<td>\tstrutbox</td>
<td>tate, utod</td>
<td>0.5\baselineskip</td>
<td>0.5\baselineskip</td>
<td>\tstrut</td>
<td></td>
</tr>
<tr>
<td>\dstrutbox</td>
<td>dtou</td>
<td>0</td>
<td>0.7\baselineskip</td>
<td>0.3\baselineskip</td>
<td>\dstrut</td>
</tr>
<tr>
<td>\zstrutbox</td>
<td>—</td>
<td>0</td>
<td>0.7\baselineskip</td>
<td>0.3\baselineskip</td>
<td>\zstrut</td>
</tr>
</tbody>
</table>

\jfontspec[
\YokoFeatures={Color=FF1900}, \TateFeatures={Color=003FFF}, \TateFont=HaranoAjiGothic-Regular
\]{HaranoAjiMincho-Regular}
\hbox{\yoko 横組のテスト}\hbox{\tate 縦組のテスト}
\addjfontfeatures{Color=00AF00}
\hbox{\yoko 横組}\hbox{\tate 縦組}

Figure 7. An example of TateFeatures etc.

10.5 \strutbox

As p\TeX\ (2017/04/08 or later), \strutbox is a macro which is expanded to one of \ystrutbox, \tstrutbox, and \dstrutbox (all of them are shown in Table 15), according to the current direction. Similarly, \strut now uses one of these boxes.

11 Addon packages

Lua\TeX\-ja has several addon packages. These addons are written as \TeX\ packages, but luatexja-otf and luatexja-adjust can be loaded in plain Lua\TeX\ by \input.

11.1 luatexja-fontspec

As described in Subsection 3.2, this optional package provides the counterparts for several commands defined in the fontspec package (requires fontspec v2.4). In addition to OpenType font features in the original fontspec, the following "font features" specifications are allowed for the commands of Japanese version:

CID=⟨name⟩, JFNe⟨name⟩, JFM-var=⟨name⟩
These 3 keys correspond to cid, jfm and jfivar keys for \jfont and \tfont respectively. See Subsections 7.1 and 7.4 for details of cid, jfm and jfivar keys.

The CID key is effective only when with NoEmbed described below. The same JFM cannot be used in both horizontal Japanese fonts and vertical Japanese fonts, hence the JFM key will be actually used in YokoFeatures and TateFeatures keys.

\textbf{NoEmbed}

By specifying this key, one can use "name-only" Japanese font which will not be embedded in the output PDF file. See Subsection 7.4.

\textbf{Kanjiskip=⟨bool⟩}

\textbf{TateFeatures=⟨(features)⟩, TateFont=⟨font⟩}

The TateFeatures key specifies font features which are only turned on in vertical writing, such as Style=VerticalKana (vkna feature). Similarly, the TateFont key specifies the Japanese font which will be used only in vertical writing. A demonstration is shown in Figure 7.
日本国民は、正当に選挙された国会における代表者を通じて行動し、われらとわれらの子孫のために、諸国民との協和による成果と、わが国全土にわたって自由のもたらす恵沢を確保し、……

Figure 8. An example of AltFont

YokoFeatures={(features)}

The YokoFeatures key specifies font features which are only turned on in horizontal writing. A demonstration is shown in Figure 7.

AltFont

As \texttt{\textbackslash ltj\textbackslash declarealtfont (Subsection 9.4) and \textbackslash DeclareAlternateKanjiFont (Subsection 10.2)}, with this key, one can typeset some Japanese characters by a different font and/or using different features. The AltFont feature takes a comma-separated list of comma-separated lists, as the following:

\begin{verbatim}
AltFont = {
  ...
  { Range=(\textbackslash range), (features) },
  { Range=(\textbackslash range), Font=(\textbackslash font name), (features) },
  ...
}
\end{verbatim}

Each sublist should have the Range key (sublist which does not contain Range key is simply ignored). A demonstration is shown in Figure 8.

Remark on AltFont, YokoFeatures, TateFeatures keys

In AltFont, YokoFeatures, TateFeatures keys, one cannot specify per-shape settings such as BoldFeatures. For example,

\begin{verbatim}
AltFont = {
  { Font=HogeraMin-Light, BoldFont=HogeraMin-Bold, Range="3000-"30FF, BoldFeatures={Color=FF1900} }
}
\end{verbatim}

does not work. Instead, one have to write

\begin{verbatim}
UprightFeatures = {
  AltFont = { { Font=HogeraMin-Light, Range="3000-"30FF, } },
},
BoldFeatures = {
  AltFont = { { Font=HogeraMin-Bold, Range="3000-"30FF, Color=FF1900 } },
}
\end{verbatim}

On the other hand, YokoFeatures, TateFeatures and TateFont keys can be specified in each list in the AltFont key. Also, one can specify AltFont inside YokoFeatures, TateFeatures.

Note that features which are specified in YokoFeatures and TateFeatures are always interpreted after other "direction-independent" features. This explains why \texttt{\textbackslash addjfontfeatures} at line 6 in Figure 7 has no effect, because a color specification is already done in YokoFeatures and TateFeatures keys.
11.2 \texttt{luatexja-otf}

This optional package supports typesetting glyphs by specifying a CID number. The package \texttt{luatexja-otf} offers the following 2 low-level commands:

\begin{verbatim}
\CID{(number)}
\end{verbatim}

Typeset a glyph whose CID number is \texttt{(number)}. If the Japanese font is neither Adobe-Japan1, Adobe-GB1, Adobe-CNS1, Adobe-Korea1, nor Adobe-KR CID-keyed font, LuaT\TeX\-ja treats that \texttt{(number)} is a CID number of Adobe-Japan1 character collection, and tries to typeset a “most suitable glyph”.

Note that if the Japanese font is loaded using the HarfBuzz library, this \texttt{CID} command does not work.

\begin{verbatim}
\UTF{(hex_number)}
\end{verbatim}

Typeset a character whose character code is \texttt{(hex_number)} (in hexadecimal). This command is similar to \texttt{\char”(hex_number)}), but please remind remarks below.

This package automatically loads \texttt{luatexja-ajmacros.sty}, which is slightly modified version of \texttt{ajmacros.sty}\textsuperscript{11}. Hence one can use macros which are defined in \texttt{ajmacros.sty}, such as \texttt{\aj半角}.

\begin{table}[h]
\begin{tabular}{|l|l|}
\hline
    no adjustment & 以上の原理は、「包除原理」とよく呼ばれるが
    \hline
    without priority & 以上の原理は、「包除原理」とよく呼ばれるが
    \hline
    with priority & 以上の原理は、「包除原理」とよく呼ばれるが
    \hline
\end{tabular}
\end{table}

\textbf{Remarks} Characters by \texttt{CID} and \texttt{UTF} commands are different from ordinary characters in the following points:

- Always treated as \texttt{JA\texttt{ch}}

- In vertical direction, \texttt{vert/vert2} feature are automatically applied to characters by \texttt{UTF}, regardless these feature are not activated in current Japanese font.

- Processes for supporting other OpenType features (for example, glyph replacement and kerning) by the \texttt{luaotfload} package is not performed to these characters.

\begin{table}[h]
\begin{tabular}{|c|c|}
\hline
\textbf{Additional syntax of JFM} & The package \texttt{luatexja-otf} extends the syntax of JFM; the entries of \texttt{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 \texttt{xxx}.

This extended notation is used in the standard JFM \texttt{jfm-ujis.lua} to typeset halfwidth Hiragana glyphs (CID 516–598) in halfwidth.
\hline
\textbf{11.3 \texttt{luatexja-adjust}} & (see Japanese version of this manual)
\hline
\textbf{11.4 \texttt{luatexja-ruby}} & This addon package provides functionality of “ruby” (\texttt{furigana}) annotations using callbacks of Lua\TeX\-ja. There is no detailed manual of \texttt{luatexja-ruby.sty} in English. (Japanese manual is another PDF file, \texttt{luatexja-ruby.pdf}.)

\textbf{Group-ruby} By default, ruby characters (the second argument of \texttt{ruby}) are attached to base characters (the first argument), as one object. This type of ruby is called \texttt{group-ruby}.

\textsuperscript{11}Useful macros by INOUE Koichi! for the \texttt{Japanese-otf} package.
As the above example, ruby hangover is allowed on the Hiragana before/after its base characters.

**Mono-ruby** To attach ruby characters to each base characters (mono-ruby), one should use \ruby multiple times:

1. \ruby{妙}{みよう}典駅は……
2. \ruby{葛}{かさい}西駅は……
3. \ruby{神楽}{かぐら}坂駅は……

**Jukugo-ruby** Vertical bar | denotes a boundary of groups.

1. \ruby{妙}{みよう}典駅は……
2. \ruby{葛}{かさい}西駅は……
3. \ruby{妙}{みよう}典駅は……

If the width of ruby characters are longer than that of base characters, \ruby automatically selects the appropriate form among the line-head form, the line-middle form, and the line-end form.

1. \vbox{\hspace=6|zw\noindent}京急蒲田
2. \hbox to 2.5|zw{\ruby{京急蒲田}{けいきゆうかまた}}
3. \hbox to 2.5|zw{\ruby{京急蒲田}{けいきゆうかまた}}
4. \hbox to 3|zw{\ruby{京急蒲田}{けいきゆうかまた}}
5. }

If there are multiple groups in one \ruby call, A linebreak between two groups is allowed.

1. \vbox{\hspace=6|zw\noindent}京 急 蒲 田
2. \null\kern3|zw|……を 承 る
3. \null\kern3|zw|……を 承 る
4. \null\kern3|zw|……を 承 る
5. }

11.5 **l1tjext.sty**

\l1tjext\TeX supplies additional macros for vertical writing in the \lplext\ package. The \l1tj ext package which we want to describe here is the Lua\l1tjext\-ja counterpart of the \lplext\ package.

**tabular, array, minipage environments**

These environments are extended by \dir, which specifies the direction, as follows:

\begin{tabular}<dir>[pos]{table spec} ... \end{tabular}
\begin{array}<dir>[pos]{table spec} ... \end{array}
\begin{minipage}<dir>[pos]{width} ... \end{minipage}

This option permits one of the following five values. If none of them is specified, the direction inside the environment is same as that outside the environment.

y yoko direction (horizontal writing)
t tate direction (vertical writing)
z utod direction if direction outside the env. is tate.
d dtou direction
u utod direction

\parbox<dir>[pos]{width}{contents}

\parbox command is also extended by \langle\dir\rangle.
This command typeset \textit{(contents)} in LR-mode, in \textit{(dir)} direction. If \textit{(width)} is positive, the width of the box becomes this \textit{(width)}. In this case, \textit{(contents)} will be aligned to left (when \textit{(pos)} is 1), center (c), or right (r).

\textbf{picture environment}

\begin{picture}(x_size, y_size)(x_offset,y_offset)
\end{picture}

\textbf{rensuij}[\textit{(pos)}]\{\textit{(contents)}\}, \textbf{rensujiskip}

\textbf{\textbackslash Kanji}\{\textit{counter\_name}\}

\textbf{\textbackslash kasen}\{\textit{contents}\}, \textbf{\textbackslash bou}\{\textit{contents}\}, \textbf{\textbackslash boutenchar}

参照番号

\subsection{luatexja-preset}

As described in Subsection 3.3, One can load the \texttt{luatexja-preset} package to use several “presets” of Japanese fonts. This package provides functions in a part of \texttt{japanese-otf} package (changing fonts) and a part of \texttt{PXchfon} package (presets) by Takayuki Yato.

Options which are given in \texttt{\usepackage} but not described in this subsection are simply passed to the \texttt{luatexja-fontspec} package by \texttt{Takayuki Yato.}

Options which are given in \texttt{\usepackage} but not described in this subsection are simply passed to the \texttt{luatexja-fontspec} package by \texttt{Takayuki Yato.}

\begin{verbatim}
\usepackage[no-math]{fontspec}
\usepackage[match]{luatexja-fontspec}
\usepackage[kozuka-pr6n]{luatexja-preset}
\end{verbatim}

\begin{verbatim}
\usepackage[no-math,match,kozuka-pr6n]{luatexja-preset}
\end{verbatim}

\subsubsection{General Options}

\textbf{fontspec (enabled by default)}

With this option, Japanese fonts are selected using functionality of the \texttt{luatexja-fontspec} package. This means that the \texttt{fontspec} package is automatically loaded by this package.

If you need to pass some options to \texttt{fontspec}, you can load \texttt{fontspec} manually before \texttt{luatexja-preset}:

\begin{verbatim}
\usepackage[no-math]{fontspec}
\usepackage[...]{luatexja-preset}
\end{verbatim}

\textbf{nfssonly}

With this option, selecting Japanese fonts won’t be performed using the functionality of the \texttt{fontspec} package, but only standard NFSS2 (hence without \texttt{\addfontfeatures} etc.). This option is ignored when \texttt{luatexja-fontspec} package is loaded.

When this option is specified, \texttt{fontspec} and \texttt{luatexja-fontspec} are \textit{not} loaded by default. Nevertheless, the package\texttt{fontspec} can coexist with the option, as the following:

\begin{verbatim}
\usepackage{fontspec}
\usepackage[hiragino-pron,nfssonly]{luatexja-preset}
\end{verbatim}

In this case, one can use \texttt{\setmainfont} etc. to select \textit{alphabet} fonts.

\footnote{if \texttt{nfssonly} option is \textit{not} specified; in this case these options are simply ignored.}
match

If this option is specified, usual family-changing commands such as \textfamily, \textit, \sffamily, ... also change Japanese font family. This option is passed to luatexja-fontspec, if fontspec option is specified.

nodeluxe (enabled by default)

The negation of deluxe option. Use one-weighted mincho and gothic font families. This means that \textfamily\bfseries, \textit\bfseries, ... also change Japanese font family. This option is passed to luatexja-fontspec, if fontspec option is specified.

deluxe

Use the mincho family with three weights (light, medium, and bold), the gothic family with three weights (medium, bold, and extra bold), and rounded gothic\footnote{Provided by \textmg and \textmgfamily, because “rounded gothic” is called maru gothic (丸ゴシック) in Japanese.}. Mincho light and gothic extra bold can be by \textfamily\ltseries and \textgtfamily\ebseries, respectively.

- Some presets do not have the light weight of mincho. In this case, we substitute the medium weight for the light weight.
- luatexja-preset does not produce an error (only produces a warning), even if (one of) fonts for \textfamily\ltseries, \textgtfamily\ebseries, \textmgfamily do not exist.

expert

Use horizontal/vertical kana alternates, and define a command \rubyfamily to use kana characters designed for ruby.

bold

Substitute bold series of gothic for bold series of mincho. If nodeluxe option is enabled, medium series of gothic is also changed, since we use same font for both series of gothic.

jis90, 90jis

Use JIS X 0208:1990 glyph variants if possible.

jis2004, 2004jis

Use JIS X 0213:2004 glyph variants if possible.

jis90, 90jis, jis2004 and 2004jis only affect with mincho, gothic (and, possibly rounded gothic) families defined by this package. We didn’t taken account of when more than one options among them are specified.

11.6.2 Presets which support multi weights

Besides bizud, haranoaji, morisawa-pro, and morisawa-pr6n presets, fonts are specified by font name, not by file name. In following tables, starred fonts (e.g. KozGo...-Regular) are used for medium series of gothic, if and only if deluxe option is specified.

kozuka-pro Kozuka Pro (Adobe-Japan1-4) fonts.

kozuka-pr6 Kozuka Pr6 (Adobe-Japan1-6) fonts.

kozuka-pr6n Kozuka Pr6N (Adobe-Japan1-6, JIS04-savvy) fonts.

Kozuka Pro/Pr6N fonts are bundled with Adobe’s software, such as Adobe InDesign. There is not rounded gothic family in Kozuka fonts.
<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>kozuka-pro</th>
<th>kozuka-pr6</th>
<th>kozuka-pr6n</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>light</td>
<td>KozMinPro-Light</td>
<td>KozMinProVI-Light</td>
<td>KozMinPro6N-Light</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>KozMinPro-Regular</td>
<td>KozMinProVI-Regular</td>
<td>KozMinPro6N-Regular</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>KozMinPro-Bold</td>
<td>KozMinProVI-Bold</td>
<td>KozMinPro6N-Bold</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>KozGoPro-Regular*</td>
<td>KozGoProVI-Regular*</td>
<td>KozGoPro6N-Regular*</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>KozGoPro-Bold</td>
<td>KozGoProVI-Bold</td>
<td>KozGoPro6N-Bold</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KozGoPro-Heavy</td>
<td>KozGoProVI-Heavy</td>
<td>KozGoPro6N-Heavy</td>
</tr>
</tbody>
</table>

**hiragino-pro** Hiragino Pro (Adobe-Japan1-5) fonts.
**hiragino-pron** Hiragino ProN (Adobe-Japan1-5, JIS04-savvy) fonts.

Hiragino fonts (except Hiragino Mincho W2) are bundled with Mac OS X 10.5 or later. Note that fonts for gothic extra bold (HiraKakuStd[N]-W8) only contains characters in Adobe-Japan1-3 character collection, while others contains those in Adobe-Japan1-5 character collection.

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>hiragino-pro</th>
<th>hiragino-pron</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>light</td>
<td>Hiragino Mincho Pro W2</td>
<td>Hiragino Mincho ProN W2</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>Hiragino Mincho Pro W3</td>
<td>Hiragino Mincho ProN W3</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>Hiragino Mincho Pro W6</td>
<td>Hiragino Mincho ProN W6</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>Hiragino Kaku Gothic Pro W3*</td>
<td>Hiragino Kaku Gothic ProN W3*</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>Hiragino Kaku Gothic Pro W6</td>
<td>Hiragino Kaku Gothic ProN W6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hiragino Kaku Gothic Std W8</td>
<td>Hiragino Kaku Gothic StdN W8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hiragino Maru Gothic Pro W4</td>
<td>Hiragino Maru Gothic ProN W4</td>
</tr>
</tbody>
</table>

**bizud** BIZ UD fonts (by Morisawa Inc.) bundled with Windows 10 October 2018 Update.

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>BIZ-UDMinchoM.ttc</td>
</tr>
<tr>
<td></td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>bold</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
</tr>
<tr>
<td></td>
<td>rounded gothic</td>
</tr>
</tbody>
</table>
**morisawa-pro** Morisawa Pro (Adobe-Japan1-4) fonts.

**morisawa-pr6n** Morisawa Pr6N (Adobe-Japan1-6, JIS04-savvy) fonts.

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>morisawa-pro</th>
<th>morisawa-pr6n</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>medium</td>
<td>A-OTF-RyuminPro-Light.otf</td>
<td>A-OTF-RyuminPr6N-Light.otf</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>A-OTF-FutoMinA101Pro-Bold.otf</td>
<td>A-OTF-FutoMinA101Pr6N-Bold.otf</td>
</tr>
<tr>
<td>gothic</td>
<td>medium</td>
<td>A-OTF-GothicBBBPro-Medium.otf</td>
<td>A-OTF-GothicBBBPr6N-Medium.otf</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>A-OTF-FutoGoB101Pro-Bold.otf</td>
<td>A-OTF-FutoGoB101Pr6N-Bold.otf</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>A-OTF-MidashiGoPro-MB31.otf</td>
<td>A-OTF-MidashiGoPr6N-MB31.otf</td>
</tr>
<tr>
<td>rounded</td>
<td>gothic</td>
<td>A-OTF-Jun101Pro-Light.otf</td>
<td>A-OTF-ShinMGoPr6N-Light.otf</td>
</tr>
</tbody>
</table>

**yu-win** Yu fonts bundled with Windows 8.1.

**yu-win10** Yu fonts bundled with Windows 10.

**yu-osx** Yu fonts bundled with OSX Mavericks.

| family    | series     | yu-win          | yu-win10         | yu-osx           |
|-----------|------------|----------------|----------------|----------------|----------------|
| mincho    | light      | YuMincho-Light | YuMincho-Light  | (YuMincho Medium) |
|           | medium     | YuMincho-Regular | YuMincho-Regular | YuMincho Medium |
|           | bold       | YuMincho-DemiBold | YuMincho-DemiBold | YuMincho Demibold |
| gothic    | medium     | YuGothic-Regular | YuGothic-Regular | YuGothic Medium* |
|           | extra bold | YuGothic-Bold | YuGothic-Bold | YuGothic Bold |
|           |           | YuGothic-Bold | YuGothic-Bold | YuGothic Bold |

**moga-mobo** MogaMincho, MogaGothic, and MoboGothic.

**moga-mobo-ex** MogaExMincho, MogaExGothic, and MoboExGothic.

These fonts can be downloaded from [http://yozvox.web.fc2.com/](http://yozvox.web.fc2.com/).

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>moga-mobo</th>
<th>moga-mobo-ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>medium</td>
<td>Moga90Mincho</td>
<td>MogaMincho Bold</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>Moga90Mincho Bold</td>
<td>MogaMincho Bold</td>
</tr>
<tr>
<td>gothic</td>
<td>medium</td>
<td>Moga90Gothic</td>
<td>MogaGothic Bold</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>Moga90Gothic Bold</td>
<td>MogaGothic Bold</td>
</tr>
<tr>
<td>rounded</td>
<td>gothic</td>
<td>Mobo90Gothic</td>
<td>MoboGothic Bold</td>
</tr>
</tbody>
</table>

When moga-mobo-ex is specified, the font “MogaEx90Mincho” etc. are used.

**ume** Ume Mincho and Ume Gothic.


| family    | series     | ume             |
|-----------|------------|----------------|----------------|
| mincho    | medium     | Ume Mincho     | Ume Mincho     |
|           | bold       | Ume Gothic     | Ume Gothic     |
| gothic    | medium     | Ume Gothic O5  | Ume Gothic O5  |
|           | bold       | Ume Gothic O5  | Ume Gothic O5  |
|           | extra bold | Ume Gothic O5  | Ume Gothic O5  |

| family    | series     | default         |
|-----------|------------|----------------|----------------|
| mincho    | medium     | Ume Mincho     | Ume Mincho     |
|           | bold       | Ume Mincho     | Ume Mincho     |
| gothic    | medium     | Ume Gothic O5  | Ume Gothic O5  |
|           | bold       | Ume Gothic O5  | Ume Gothic O5  |
|           | extra bold | Ume Gothic O5  | Ume Gothic O5  |
| rounded   | gothic     | Ume Gothic O5  | Ume Gothic O5  |

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sourcehan  Source Han Serif and Source Han Sans fonts (Language-specific OTF or OTC)
sourcehan-jp  Source Han Serif JP and Source Han Sans JP fonts (Region-specific Subset OTF)

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>sourcehan</th>
<th>sourcehan-jp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>light</td>
<td>Source Han Serif Light</td>
<td>Source Han Serif JP Light</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>Source Han Serif Regular</td>
<td>Source Han Serif JP Regular</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>Source Han Serif Bold</td>
<td>Source Han Serif JP Bold</td>
</tr>
<tr>
<td>gothic</td>
<td>medium</td>
<td>Source Han Sans Regular*</td>
<td>Source Han Sans JP Regular*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source Han Sans Medium</td>
<td>Source Han Sans JP Medium</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>Source Han Sans Bold</td>
<td>Source Han Sans JP Bold</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>Source Han Sans Heavy</td>
<td>Source Han Sans JP Heavy</td>
</tr>
<tr>
<td></td>
<td>rounded gothic</td>
<td>Source Han Sans Heavy</td>
<td>Source Han Sans JP Heavy</td>
</tr>
</tbody>
</table>

noto-otc  Noto Serif CJK and Noto Sans CJK fonts (OTC)
noto-otf  Noto Serif CJK and Noto Sans CJK fonts (Language-specific OTF)

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>noto-otc</th>
<th>noto-otf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>light</td>
<td>Noto Serif CJK Light</td>
<td>Noto Serif CJK JP Light</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>Noto Serif CJK Regular</td>
<td>Noto Serif CJK JP Regular</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>Noto Serif CJK Bold</td>
<td>Noto Serif CJK JP Bold</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noto Sans CJK Regular*</td>
<td>Noto Sans CJK JP Regular*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noto Sans CJK Medium</td>
<td>Noto Sans CJK JP Medium</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>Noto Sans CJK Bold</td>
<td>Noto Sans CJK JP Bold</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>Noto Sans CJK Black</td>
<td>Noto Sans CJK JP Black</td>
</tr>
<tr>
<td></td>
<td>rounded gothic</td>
<td>Noto Sans CJK Black</td>
<td>Noto Sans CJK JP Black</td>
</tr>
</tbody>
</table>

haranoaji  Harano Aji Fonts.

These fonts can be downloaded from [https://github.com/trueroad/HaranoAjiFonts](https://github.com/trueroad/HaranoAjiFonts). There is not rounded gothic family in Harano Aji Fonts.

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>haranoaji</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>light</td>
<td>HaranoAjiMincho-Light.otf</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>HaranoAjiMincho-Regular.otf</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>HaranoAjiMincho-Bold.otf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HaranoAjiGothic-Regular.otf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HaranoAjiGothic-Medium.otf</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>HaranoAjiGothic-Bold.otf</td>
</tr>
<tr>
<td></td>
<td>extra bold</td>
<td>HaranoAjiGothic-Heavy.otf</td>
</tr>
</tbody>
</table>

11.6.3  Presets which do not support multi weights

Next, we describe settings for using only single weight.

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>ipa</th>
<th>ipaex</th>
<th>ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>Ryumin-Light</td>
<td>IPA Mincho</td>
<td>IPAex Mincho</td>
<td>MS Mincho</td>
</tr>
<tr>
<td>gothic</td>
<td>GothicBBB-Medium</td>
<td>IPA Gothic</td>
<td>IPAex Gothic</td>
<td>MS Gothic</td>
</tr>
</tbody>
</table>
11.6.4 Presets which use HG fonts

We can use HG fonts bundled with Microsoft Office for realizing multiple weights. In the table below, starred fonts (e.g., IPA Gothic*) are used only if jis2004 or nodeluxe option is specified.

<table>
<thead>
<tr>
<th>family</th>
<th>series</th>
<th>ipa-hg</th>
<th>ipaex-hg</th>
<th>ns-hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>mincho</td>
<td>medium</td>
<td>IPA Mincho</td>
<td>IPAex Mincho</td>
<td>MS Mincho</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>HG Mincho E</td>
<td>HG Mincho E</td>
<td>HG Mincho E</td>
</tr>
<tr>
<td>gothic</td>
<td>medium</td>
<td>IPA Gothic*</td>
<td>IPAex Gothic*</td>
<td>MS Gothic*</td>
</tr>
<tr>
<td></td>
<td>bold</td>
<td>HG Gothic M</td>
<td>HG Gothic M</td>
<td>HG Gothic M</td>
</tr>
<tr>
<td>rounded gothic</td>
<td></td>
<td>HG Soei Kaku Gothic UB</td>
<td>HG Soei Kaku Gothic UB</td>
<td>HG Soei Kaku Gothic UB</td>
</tr>
</tbody>
</table>

Note that HG Mincho E, HG Gothic E, HG Soei Kaku Gothic UB, and HG Maru Gothic PRO are internally specified by:

**default** by font name (HGMinchoE, etc.).

**jis00, 90jis** by file name (hgrme.ttc, hgrge.ttc, hgrsgu.ttc, hgrsmp.ttf).

**jis2004, 2004jis** by file name (hgrme04.ttc, hgrge04.ttc, hgrsgu04.ttc, hgrsmp04.ttf).

11.6.5 Define/Use Custom Presets

From version 20170904.0, one can define new presets using \ltjnewpreset, and use them by \ltjapplypreset. These two commands can only be used in the preamble.

\ltjnewpreset\{<name>\}\{(specification)\}

Define new preset \(<name>\). This \(<name>\) cannot be same as other presets, options described in Sub-subsection 11.6.1, nor following 11 strings:

- **mc mc-l mc-m mc-b mc-bx gt gt-m gt-b gt-bx gt-eb mg-m**

\(<specification>\) is a comma-separated list which consists of other presets and/or the following keys:

- **mc-l**(font) mincho light
- **mc-m**(font) mincho medium
- **mc-b**(font) mincho bold
- **mc-bx**(font) synonym for mc-b=(font)
- **gt-m**(font) gothic medium
- **gt-b**(font) gothic bold
- **gt-bx**(font) synonym for gt-b=(font)
- **gt-eb**(font) gothic extra bold
- **mg-m**(font) rounded gothic
- **mc**(font) Same as
  - mc-l=(font), mc-m=(font), mc-b=(font)
- **gt**(font) Same as
  - gt-m=(font), gt-b=(font), gt-eb=(font)

If \texttt{deluxe} is not specified at loading the package, only mc and gt keys (among above 11 keys) have a meaning.

\ltjnewpreset\*\{<name>\}\{(specification)\}

Almost same as \ltjnewpreset. However, if \(<name>\) matches a preset which already defined, this command simply overwrite it.
\texttt{\textbackslash ltjapplypreset\{\textit{name}\}}

Set Japanese font families using preset \textit{name}.

Note that \texttt{\textbackslash ltjnewpreset} does not "expand" the definition to define a preset. This means that one can write as the following:

\begin{verbatim}
\texttt{\textbackslash ltjnewpreset\{hoge\}\{piyo,mc-b=HiraMinProN-W6\}}
\texttt{\textbackslash ltjnewpreset\{piyo\}\{mg-m=HiraMaruProN-W4\}}
\texttt{\textbackslash ltjapplypreset\{hoge\}}
\end{verbatim}

**Restrictions** Presets which are defined by \texttt{\textbackslash ltjnewpreset} have following restrictions:

- One cannot specify non-embedded fonts (such as Ryumin-Light).
- Some presets, such as \texttt{ipa-hg}, have a feature that fonts are changed according to whether \texttt{90jis} or \texttt{jis2004} is specified. This feature is not usable in presets which are defined by \texttt{\textbackslash ltjnewpreset}.
Part III
Implementations

12 Storing Parameters

12.1 Used dimensions, attributes and whatsit nodes

Here the following is the list of dimensions and attributes which are used in Lua\TeX-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 the same \dimen register as \jQ.

\ltj@dimen@zw (dimension) A temporal register for the "full-width" of current Japanese font. The command \zw sets this register to the correct value, and "return" this register itself.

\ltj@dimen@zh (dimension) A temporal register for the "full-height" (usually the sum of height of imaginary body and its depth) of current Japanese font. The command \zh sets this register to the correct value, and "return" this register itself.

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

\ltj@curjfnt (attribute) If this attribute is a positive number, it stores the font number of current Japanese font for horizontal direction. If this attribute is negative, it means that the Japanese font for horizontal direction is not loaded—Lua\TeX-ja only knows its size and JFM.

\ltj@curtfnt (attribute) Similar to \ltj@curjfnt, but with current Japanese font for vertical direction.

\ltj@charclass (attribute) The character class of a \texttt{JAchar}. This attribute is only set on a \texttt{glyph_node} which contains a \texttt{JAchar}.

\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@tablshift (attribute)
\ltj@tkblshift (attribute)

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

\ltj@autoxspc (attribute) Whether the auto insertion of \texttt{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:

\texttt{italic (1)} Kerns from italic correction \((\diagup/\diagonal), or from kerning information of a Japanese font. These kerns are "ignored" in the insertion process of \texttt{JAg}, unlike explicit \kern.

\texttt{packed (2)}

\texttt{kinsoku (3)} Penalties inserted for the word-wrapping process \texttt{(kinsoku shori)} of Japanese characters.

\texttt{from_jfm–(from_jfm + 63)} \(4\rightarrow 67\) Glues/kerns from JFM.

\texttt{kanji_skip (68), kanji_skip_jfm (69)} Glues from \texttt{kanjiskip}.

\texttt{xkanji_skip (70), xkanji_skip_jfm (71)} Glues from \texttt{kanjiskip}.

\texttt{processed (73)} Nodes which is already processed by ...
ic_processed (74) Glues from an italic correction, but already processed in the insertion process of \texttt{JAglues}.

boxbdd (75) Glues/kerns that inserted just the beginning or the ending of an hbox or a paragraph.

\texttt{\ltj@kcat i} (attribute) Where \textit{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 \texttt{JAChars}.

\texttt{\ltj@dir} (attribute) \texttt{dir_node_auto} (128)

\texttt{dir_node_manual} (256)

\texttt{\ltjlineendcomment} (counter)

Furthermore, \texttt{LuaTeX-ja} uses several user-defined whatsit nodes for internal processing. All those nodes except \texttt{direction} whatsits store a natural number (hence its type is 100). \texttt{direction} whatsits store a node list, hence its type is 110. Their \texttt{user_id} (used for distinguish user-defined whatsits) are allocated by \texttt{luatexbase.newuserwhatsitid}.

\texttt{inhibitglue} Nodes for indicating that \texttt{\inhibitglue} is specified. The \texttt{value} field of these nodes doesn’t matter.

\texttt{stack_marker} Nodes for \texttt{LuaTeX-ja’s} stack system (see the next subsection). The \texttt{value} field of these nodes is current group level.

\texttt{char_by_cid} Nodes for \texttt{JAChar} which processes by luaotfload won’t be applied, and the character code is stored in the \texttt{value} field. Each node of this type are converted to a \texttt{glyph_node} after processes by luaotfload. Nodes of this type is used in \texttt{\CID} and \texttt{\UTF}.

\texttt{replace_vs} Similar to \texttt{char_by_cid} whatsits above. These nodes are for \texttt{ALchar} which the callback process of luaotfload won’t be applied.

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

\texttt{direction}

These whatsits will be removed during the process of inserting \texttt{JAglues}.

### 12.2 Stack system of \texttt{LuaTeX-ja}

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

```
1 \LTJSetParameter{kanjiskip=0pt}ふがふが。
2 \setbox0=\hbox{%
3 \LTJSetParameter{kanjiskip=5pt}ほげほげ
4 \box0.ぴよぴよ
```

As described in Subsection 8.1, the only effective value of \texttt{kanjiskip} in an hbox is the latest value, so the value of \texttt{kanjiskip} which applied in the entire hbox should be 5 pt. However, by the implementation method of \texttt{LuaTeX}, this “5 pt” cannot be known from any callbacks. In the \texttt{tex/packaging.w}, which is a file in the source of \texttt{LuaTeX}, there are the following codes:

```latex
1228 void package(int c)
1229 {
1230     scaled h;     /* height of box */
1231     halfword p;   /* first node in a box */
1232     scaled d;     /* max depth */
1233     int grp;
1234     grp = cur_group;
1235     d = box_max_depth;
1236     unsave();
```
1235  save_ptr -= 4;
1236  if (cur_list.mode_field == -hmode) {
1237      cur_box = filtered_hpack(cur_list.head_field, 
1238                      cur_list.tail_field, saved.value(1), 
1239                      saved_level(1), grp, saved_level(2));
1240  subtype(cur_box) = HLIST_SUBTYPE_HBOX;
Notice that unsave() is executed before filtered_hpack(), where hpack_filter callback is executed) here. So "5 pt" in the above source is orphaned at unsave(), and hence it can’t be accessed from hpack_filter callback.

Implementation The code of stack system is based on that in a post of Dev-luatex mailing list14.

These are two TeX count registers for maintaining information: \the@stack for the stack level, and \the@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 \let@setparameter, all data of the previous level is copied.

To resolve the problem mentioned in above paragraph “Background”, LuaTeX-ja uses another trick. When the stack level is about to be increased, a whatsis node whose type, subtype and value are 44 (user_defined), stack_marker and the 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 contents 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 in 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 \the@stack and \the@group@level have to be local always, regardless the value of \globaldefs. To solve this problem, we use another trick: the assignment \directlua{tex.globaldefs=0} is always local.

12.3 Lua functions of the stack system

In this subsection, we will see how a user use LuaTeX-ja’s stack system to store some data which obeys the grouping of TeX.

The following function can be used to store data into a stack:

\directlua{tex.stack.set_stack_table(index, <any> data)}

Any values which except nil and NaN are usable as index. However, a user should use only negative integers or strings as index, since natural numbers are used by LuaTeX-ja itself. Also, whether data is stored locally or globally is determined by \directlua{latexjaxa.isglobal} (stored globally if and only if \directlua{latexjaxa.isglobal} == 'global').

Stored data can be obtained as the return value of

\directlua{tex.stack.get_stack_table(index, <any> default, <number> level)}

where level is the stack level, which is usually the value of \the@stack, and default is the default value which will be returned if no values are stored in the stack table whose level is level.

12.4 Extending Parameters

Keys for \let@setparameter and \let@getparameter can be extended, as in latexjaxa-adjust.

Figure 10. Definition of parameter setting commands

Setting parameters

Figure 10 shows the most outer definition of two commands, \ltjsetparameter and \ltjglobalsetparameter. Most important part is the last \setkeys, which is offered by the xkeyval package.

Hence, to add a key in \ltjsetparameter, one only have to add a key whose prefix is ltj and whose family is japaram, as the following.
\define@key[ltj]{japaram}{...}{...} \ltjsetparameter and \ltjglobalsetparameter automatically sets luatexja.isglobal. Its meaning is the following.

luatexja.isglobal = \begin{cases} 'global' & \text{(global assignment)}, \\
'local' & \text{(local assignment)}. \end{cases} (1)

This is determined not only by command name (\ltjsetparameter or \ltjglobalsetparameter), but also by the value of \globaldefs.

Getting parameters

\ltjgetparameter is implemented by a Lua script.

For parameters that do not need additional arguments, one only have to define a function in the table luatexja.unary_pars. For example, with the following function, \ltjgetparameter{hoge} returns a string 42.

\begin{verbatim}
1 function luatexja.unary_pars.hoge (t)
2 return 42
3 end
\end{verbatim}

Here the argument of luatexja.unary_pars.hoge is the stack level of LuaTEX-ja’s stack system (see Subsection 12.2).

On the other hand, for parameters that need an additional argument (this must be an integer), one have to define a function in luatexja.binary_pars first. For example,

\begin{verbatim}
1 function luatexja.binary_pars.fuga (c, t)
2 return tostring(c) .. ', ' .. tostring(42)
3 end
\end{verbatim}

Here the first argument \(t\) is the stack level, as before. The second argument \(c\) is just the second argument of \ltjgetparameter.

For parameters that need an additional argument, one also have to execute the \TeX code like \ltj@@decl@array@param{fuga} to indicate that “the parameter fuga needs an additional argument”.

13 Linebreak after a Japanese Character

13.1 Reference: behavior in \LaTeX

In \LaTeX, 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
Beginning of group (usually {} and ending of group (usually }).

Japanese characters.

end-of-line (usually ^^J).

space (usually \ ).

other characters, whose category code is in {3, 4, 6, 8, 11, 12, 13}

[␣], \par emits a space, or \par.

Figure 11. State transitions of p\TeX's input processor

callbacks in Lua\TeX. To clarify the difference between p\TeX and Lua\TeX, We briefly describe the handling of a line break in p\TeX, in this subsection.

p\TeX'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 11. Note that p\TeX doesn’t leave state \( K \) after “beginning/ending of a group” characters.

13.2 Behavior in Lua\TeX-ja

States in the input processor of Lua\TeX 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 Lua\TeX-ja are as follows:

A character whose character code is \ltjlineendcomment\textsuperscript{15} is appended to an input line, before Lua\TeX actually process it, if and only if the following three conditions are satisfied:

1. The category code of \ltjlineendchar\textsuperscript{16} is 5 (end-of-line).
2. The category code of \ltjlineendcomment itself is 14 (comment).

\textsuperscript{15}Its default value is "FFFFF, so U+FFFFF is used. The category code of U+FFFFF is set to 14 (comment) by Lua\TeX-ja.

\textsuperscript{16}Usually, it is (return) (whose character code is 13).
3. The input line matches the following "regular expression":

\[(\text{any char})^* \langle \text{JAchar} \rangle \{(\text{catcode} = 1) \cup \{\text{catcode} = 2\}\}^*\]

Remark The following example shows the major difference from the behavior of \texttt{p\LaTeX}.

\begin{lstlisting}
\texttt{\fontspec[Ligatures=TeX](Linux Libertine O)}
\texttt{\ltjsetparameter{autoxspacing=false}}
\texttt{\ltjsetparameter{jacharrange={-6}}xあ xy coll 
\texttt{\ltjsetparameter{jacharrange={+6}}}い u
\end{lstlisting}

It is not strange that "あ" does not printed in the above output. This is because \TeX\ Gyre Termes does not contain "あ", and because "あ" in line 3 is considered as an \texttt{ALchar}.

Note that there is no space before "y" in the output, but there is a space before "u". This follows from following reasons:

- When line 3 is processed by \texttt{process_input_buffer} callback, "あ" is considered as an \texttt{JAchar}. Since line 3 ends with an \texttt{JAchar}, the comment character (whose character code is \texttt{\ltjlineendcomment}) is appended to this line, and hence the linebreak immediately after this line is ignored.

- When line 4 is processed by \texttt{process_input_buffer} callback, "い" is considered as an \texttt{ALchar}. Since line 4 ends with an \texttt{ALchar}, the linebreak immediately after this line emits a space.

14 Patch for the listings Package

It is well-known that the listings package outputs weird results for Japanese input. The listings package makes most of letters active and assigns output command for each letter ([2]). But Japanese characters are not included in these activated letters. For \texttt{p\LaTeX} series, there is no method to make Japanese characters active; a patch \texttt{jlisting.sty} ([4]) resolves the problem forcibly.

In Lua\TeX\-ja, the problem is resolved by using the \texttt{process_input_buffer} callback. The callback function inserts the output command (active character \texttt{\ltjlineendcomment}) before each letter above \texttt{U+0080}. This method can omits the process to make all Japanese characters active (most of the activated characters are not used in many cases).

If the listings package and Lua\TeX\-ja were loaded, then the patch \texttt{lltjp-listings} is loaded automatically at \texttt{\begin{document}}.

14.1 Notes and additional keys

Variation selectors \texttt{lltjp-listings} add two keys, namely \texttt{vsraw} and \texttt{vscmd}, which specify how variation selectors are treated in \texttt{lstlisting} or other environments. Note that these additional keys are not usable in the preamble, since \texttt{lltjp-listings} is loaded at \texttt{\begin{document}}.

\texttt{vsraw} is a key which takes a boolean value, and its default value is false.

- If the \texttt{vsraw} key is true, then variation selectors are "combined" with the previous character.

\begin{lstlisting}
\texttt{\begin{lstlisting}[vsraw=true]}
葛城市,葛飾区,葛西
\texttt{\end{lstlisting}}
\end{lstlisting}

- If the \texttt{vsraw} key is false, then variation selectors are typeset by an appropriate command, which is specified by the \texttt{vscmd} key. The default setting of the \texttt{vscmd} key produces the following.

\begin{lstlisting}
\texttt{\begin{lstlisting}[vsraw=false, vscmd=\ltjlistingsvstdcmd]}
葛城市,葛飾区,葛西
\texttt{\end{lstlisting}}
\end{lstlisting}
For example, the following code is the setting of the vscmd key in this document.

\def\IVSA#1#2#3#4#5{%
\hbox to1em{\hss\textcolor{blue}{\raisebox{3.5pt}{\normalfont\ttfamily%
\fboxsep=0.5pt\fbox{\hbox to0.75em{\hss\tiny \oalign{0#1#2\crcr#3#4#5\crcr}\hss}}}}\hss}
%
}%
{\catcode`%=11
\edef\IVSB#1{\expandafter\IVSA\directlua{
local cat_str = luatexbase.catcodetables['string']
tex.sprint(cat_str, string.format('%X', 0xE00EF+#1))}}}
\lstset{vscmd=\IVSB}

The default output command of variation selectors is stored in \ltjlistingsvsstdcmd.

\section{The doubleletterspace key}

Even the column format is [c] fixed, sometimes characters are not vertically aligned. The following example is typeset with basewidth=2em, and you’ll see the leftmost "H" are not vertically aligned.

: H :
: H H H H :

\lltjp-listing adds the doubleletterspace key (not activated by default, for compatibility) to improve the situation, namely doubles inter-character space in each output unit. With this key, the above input now produces better output.

: H :
: H H H H :

\subsection{Class of characters}

Roughly speaking, the listings package processes input as follows:

1. Collects \textit{letters} and \textit{digits}, which can be used for the name of identifiers.

2. When reading an \textit{other}, outputs the collected character string (with modification, if needed).

3. Collects \textit{others}.

4. When reading a \textit{letter} or a \textit{digit}, outputs the collected character string.

5. Turns back to 1.

By the above process, line breaks inside of an identifier are blocked. A flag \lst@ifletter indicates whether the previous character can be used for the name of identifiers or not.

For Japanese characters, line breaks are permitted on both sides except for brackets, dashes, etc. Hence the patch \ltjp-listings introduces a new flag \lst@ifkanji, which indicates whether the previous character is a Japanese character or not. For illustration, we introduce following classes of characters:

<table>
<thead>
<tr>
<th>Letter</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>\lst@ifletter</td>
<td>T</td>
</tr>
<tr>
<td>\lst@ifkanji</td>
<td>T</td>
</tr>
</tbody>
</table>

\textbf{Meaning} char in an identifier other alphabet

<table>
<thead>
<tr>
<th>Kanji</th>
<th>Open</th>
<th>Close</th>
</tr>
</thead>
<tbody>
<tr>
<td>\lst@ifletter</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>\lst@ifkanji</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>

\textbf{Meaning} most of Japanese char opening brackets closing brackets
Note that digits in the listings package can be Letter or Other according to circumstances.

For example, let us consider the case an Open comes after a Letter. Since an Open represents Japanese open brackets, it is preferred to be permitted to insert line break after the Letter. Therefore, the collected character string is output in this case.

The following table summarizes $5 \times 5 = 25$ cases:

<table>
<thead>
<tr>
<th>Prev</th>
<th>Next</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Letter</td>
</tr>
<tr>
<td>Letter</td>
<td>collects</td>
</tr>
<tr>
<td>Other</td>
<td>outputs</td>
</tr>
<tr>
<td>Kanji</td>
<td>outputs</td>
</tr>
<tr>
<td>Open</td>
<td></td>
</tr>
<tr>
<td>Close</td>
<td></td>
</tr>
</tbody>
</table>

In the above table,

- “outputs” means to output the collected character string (i.e., line breaking is permitted there).
- “collects” means to append the next character to the collected character string (i.e., line breaking is prohibited there).

Characters above or equal to U+0080 except Variation Selectors are classified into above 5 classes by the following rules:

- **ALchars** above or equal to U+0080 are classified as Letter.
- **JAchars** are classified in the order as follows:
  1. Characters whose `prebreakpenalty` is greater than or equal to 0 are classified as Open.
  2. Characters whose `postbreakpenalty` is greater than or equal to 0 are classified as Close.
  3. Characters that don’t satisfy the above two conditions are classified as Kanji.

The width of halfwidth kana (U+FF61–U+FF9F) is same as the width of **ALchar**; the width of the other **JAchar** is double the width of **ALchar**.

This classification process is executed every time a character appears in the \texttt{lstlisting} environment or other environments/commands.

15 Cache Management of LuaTEX-ja

LuaTEX-ja creates some cache files to reduce the loading time. in a similar way to the luaotfload package:

- Cache files are usually stored in (and loaded from) \$TEXMFVAR/luatexja/.
- In addition to caches of the text form (the extension is \texttt{.lua}), caches of the binary, precompiled form are supported.
  - In loading a cache, the binary cache precedes the text form.
  - When LuaTEX-ja updates a cache \texttt{hoge.lua}, its binary version is also updated.

15.1 Use of cache

LuaTEX-ja uses the following cache:

\texttt{ltj-cid-auto-adobe-japan1.lua}

The font table of a CID-keyed non-embedded Japanese font. This is loaded in every run. It is created from three CMaps, \texttt{UniJIS2004-UTF32-\{H,V\}} and \texttt{Adobe-Japan1-UCS2}, and this is why these two CMaps are needed in the first run of LuaTEX-ja.

Similar caches are created as Table 16, if you specified \texttt{cid} key in \texttt{jfont} to use other CID-keyed non-embedded fonts for Chinese or Korean, as in Page 25.
Table 16. cid key and corresponding files

<table>
<thead>
<tr>
<th>cid key</th>
<th>name of the cache</th>
<th>used CMaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe-Japan1-*</td>
<td>ltj-cid-auto-adobe-japan1.lua</td>
<td>UniJIS2004-UTF32-*</td>
</tr>
<tr>
<td>Adobe-Korea1-*</td>
<td>ltj-cid-auto-adobe-korea1.lua</td>
<td>UniKS-UTF32-*</td>
</tr>
<tr>
<td>Adobe-GB1-*</td>
<td>ltj-cid-auto-adobe-gb1.lua</td>
<td>UniGB-UTF32-*</td>
</tr>
<tr>
<td>Adobe-CNS1-*</td>
<td>ltj-cid-auto-adobe-cns1.lua</td>
<td>UniCNS-UTF32-*</td>
</tr>
</tbody>
</table>

1lj-jisx0208.{luc|lub}

The bytecode version of 1lj-jisx0208.lua. This is the conversion table between JIS X 0208 and Unicode which is used in Kanji-code conversion commands for compatibility with p\TeX.

15.2 Internal

Cache management system of Lua\TeX-ja is stored in \texttt{luatexja.base} (\texttt{ltj-base.lua}). There are three public functions for cache management in \texttt{luatexja.base}, where \texttt{⟨filename⟩} stands for the file name \textit{without} suffix:

\begin{verbatim}
save_cache(⟨filename⟩, ⟨data⟩)

Save a non-nil table ⟨data⟩ into a cache ⟨filename⟩. Both the text form ⟨filename⟩.lua and its binary version are created or updated.

save_cache_luc(⟨filename⟩, ⟨data⟩[, ⟨serialized_data⟩])

Same as \texttt{save_cache}, except that only the binary cache is updated. The third argument ⟨serialized_data⟩ is not usually given. But if this is given, it is treated as a string representation of ⟨data⟩.

load_cache(⟨filename⟩, ⟨outdate⟩)

Load the cache ⟨filename⟩. ⟨outdate⟩ is a function which takes one argument (the contents of the cache), and its return value is whether the cache is outdated.

load_cache first tries to read the binary cache ⟨filename⟩.{luc|lub}. If its contents is up-to-date, \texttt{load_cache} returns the contents. If the binary cache is not found or its contents is outdated, \texttt{load_cache} tries to read the text form ⟨filename⟩.lua. Hence, the return value of \texttt{load_cache} is non-nil, if and only if the updated cache is found.
\end{verbatim}
References


