

LuaTeX-ja パッケージ

LuaTeX-ja プロジェクトチーム

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目次

第 I 部	ユーザズマニュアル	3
1	はじめに	3
1.1	背景	3
1.2	pT _E X からの主な変更点	3
1.3	用語と記法	4
1.4	プロジェクトについて	4
2	使い方	5
2.1	インストール	5
2.2	注意点	5
2.3	plain T _E X で使う	5
2.4	L ^A T _E X で使う	6
2.5	フォントの変更	7
3	パラメータの変更	8
3.1	J _A char の範囲の設定	8
3.2	kanjiskip と xkanjiskip	10
3.3	xkanjiskip の設定の挿入	10
3.4	ベースラインの移動	11
3.5	トンボ	11
第 II 部	リファレンス	12
4	フォントメトリックと日本語フォント	12
4.1	\jfont プリミティブ	12
4.2	JFM ファイルの構造	13
4.3	数式フォントファミリ	15
4.4	コールバック	15
5	パラメータ	17
5.1	\ltjsetParameter プリミティブ	17
5.2	パラメーター一覧	17
6	その他のプリミティブ	19
6.1	互換プリミティブ	19
6.2	\inhibitglue プリミティブ	19

7	LaTeX _{2ϵ} 用のコントロールシーケンス	19
7.1	NFSS2 へのパッチ	19
7.2	トンボ	21
8	拡張	21
8.1	luatexja-fontspec.sty	21
8.2	luatexja-otf.sty	21
第 III 部 実装		21
9	パラメータの保持	21
9.1	ディメンション, アトリビュート, whatsit ノードを用いて	21
9.2	LuaTeX-ja のスタックシステム	22
10	和文文字直後の改行	23
10.1	参考: pTeX の挙動	23
10.2	LuaTeX-ja の挙動	24
11	JFM グルーの挿入, kanjiskip と xkanjiskip	25
11.1	概要	25
11.2	「クラスタ」の定義	25

本ドキュメントはまだまだ未完成です。

第 I 部

ユーザズマニュアル

1 はじめに

LuaTeX-ja パッケージは、次世代標準 TeX である LuaTeX の上で、pTeX と同等/それ以上の品質の日本語組版を実現させようとするマクロパッケージである。

1.1 背景

従来、「TeX を用いて日本語組版を行う」といったとき、エンジンとしては ASCII pTeX やその拡張物が用いられることが一般的であった。pTeX は TeX のエンジン拡張であり、(少々仕様上不便な点はあるものの) 商業印刷の分野にも用いられるほどの高品質な日本語組版を可能としている。だが、それは弱点にもなってしまった：pTeX という(組版的に) 満足なものがあつたため、海外で行われている数々の TeX の拡張 例へば ϵ -TeX や pdfTeX や、TrueType, OpenType, Unicode といった計算機で日本語を扱う際の状況の変化に追従することを怠ってしまったのだ。

ここ数年、若干状況は改善されてきた。現在手に入る大半の pTeX バイナリでは外部 UTF-8 入力を利用可能となり、さらに Unicode 化を推進し、pTeX の内部処理まで Unicode 化した pTeX も開発されている。また、pTeX に ϵ -TeX 拡張をマージした ϵ -pTeX も登場し、TeX Live 2011 では pL^ATeX が ϵ -pTeX の上で動作するようになった。だが、pdfTeX 拡張(pdf 直接出力や micro-typsetting) を pTeX に対応させようという動きはなく、海外との gap は未だにあるのが現状である。

しかし、LuaTeX の登場で、状況は大きく変わるようになった。Lua コードで ‘callback’ を書くことにより、LuaTeX の内部処理に割り込みをかけることが可能となった。これは、エンジン拡張という真似をしなくても、Lua コードとそれに関する TeX マクロを書けば、エンジン拡張とほぼ同程度のことができるようになったということの意味する。LuaTeX-ja は、このアプローチによって Lua コード・TeX マクロによって日本語組版を LuaTeX の上で実現させようという目的で開発が始まったパッケージである。

1.2 pTeX からの主な変更点

LuaTeX-ja は、pTeX に多大な影響を受けている。初期の開発目標は、pTeX の機能を Lua コードにより実装することであった。しかし、開発が進むにつれ、pTeX の完全な移植は不可能であり、また pTeX における実装がいささか不可解になっているような状況も発見された。そのため、LuaTeX-ja は、もはや pTeX の完全な移植は目標とはしない。pTeX における不自然な仕様・挙動があれば、そこは積極的に改める。

以下は pTeX からの主な変更点である。

- 和文フォントは「実際の」フォント、和文フォントメトリック (JFM と呼ぶ)、そして ‘variation’ と呼ばれる文字列の組である。
- 日本語の文書中では改行はほとんどどこでも許されるので、pTeX では和文文字直後の改行は無視される (スペースが入らない) ようになっていた。しかし、LuaTeX-ja では LuaTeX の仕様のためにこの機能は完全には実装されていない。
- 2 つの和文文字の間、和文文字と欧文文字の間に入るグルー / カーン (JAglue と呼ぶ) の挿入処理が 0 から書き直されている。
 - LuaTeX の内部での文字の扱いが「ノードベース」になっているように (例へば、of{}fice で合字は抑制されない)、JAglue の挿入処理も「ノードベース」である。

- さらに、2つの文字の間にある行末では効果を持たないノード（例えば`\special` ノード）は挿入処理中では無視される。
- 処理中では、2つの和文フォントは「実際の」フォントが異なる場合のみ区別される。
- 現時点では、縦書きは `LuaTeX-ja` ではサポートされていない。

詳細については第 III 部を見よ。

1.3 用語と記法

本ドキュメントでは、以下の用語と記法を用いる：

- 文字は2種類に分けられる：
 - `JAchar`: ひらがな、カタカナ、漢字、和文用の約物といった和文文字のことを指す。
 - `ALchar`: アルファベットを始めとする、その他全ての文字を指す。
 そして、`ALchar` に用いられるフォントを「欧文フォント」と呼び、`JAchar` に用いられるフォントを「和文フォント」と呼ぶ。
- サンセリフ体で書かれた語（例：`prebreakpenalty`）は日本語組版用のパラメータを表し、これらは `\ltjsetparameter` コマンドのキーとして用いられる。
- 下線付きのタイプライタ体で書かれた語（例：`fontspec`）は `LaTeX` のパッケージやクラスを表す。
- 「プリミティブ」という語を、`LuaTeX` のプリミティブだけではなく `LuaTeX-ja` のコアモジュールで定義されたコントロールシーケンスに対しても用いる。
- 本ドキュメントでは、自然数は0から始まる。

1.4 プロジェクトについて

プロジェクト Wiki プロジェクト Wiki は構築中である。

- <http://sourceforge.jp/projects/luatex-ja/wiki/FrontPage> (日本語)
- <http://sourceforge.jp/projects/luatex-ja/wiki/FrontPage%28en%29> (英語)

本プロジェクトは SourceForge.JP のサービスを用いて運営されている。

開発メンバー

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2 使い方

2.1 インストール

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

- LuaTeX (version 0.65.0-beta or later) and its supporting packages.
If you are using TeX Live 2011 or current W32TeX, you don't have to worry.
- The source archive of LuaTeX-ja, of course:)

The installation methods are as follows:

1. Download the source archive.

At the present, LuaTeX-ja has no official release, so you have to retrieve the archive from the repository. You can retrieve the Git repository via

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

or download the archive of HEAD in master branch from

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

Note that the forefront of development may not be in master branch.

2. Extract the archive. You will see `src/` and several other sub-directories.
3. Copy all the contents of `src/` into one of your TEXMF tree.
4. If `mktexlsr` is needed to update the filename database, make it so.

2.2 注意点

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

For example, the default setting of **JAchar** in the present version does not coexist with the unicode-math package. Putting the following line in preamble makes that mathematical symbols will be typeset correctly, but several Japanese characters will be treated as an **ALchar** as side-effect:

```
\ltjsetparameter{jacharrange={-3, -8}}
```

2.3 plain TeX で使う

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

```
\input luatexja.sty
```

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

- The following 6 Japanese fonts are preloaded:

classification	font name	'10 pt'	'7 pt'	'5 pt'
<i>mincho</i>	Ryumin-Light	<code>\tenmin</code>	<code>\sevenmin</code>	<code>\fivemin</code>
<i>gothic</i>	GothicBBB-Medium	<code>\tengt</code>	<code>\sevengt</code>	<code>\fivegt</code>

- The ‘Q’ is a unit used in Japanese phototypesetting, and $1\text{ Q} = 0.25\text{ mm}$. This length is stored in a dimension `\jq`.
- It is widely accepted that the font ‘Ryumin-Light’ and ‘GothicBBB-Medium’ aren’t embedded into PDF files, and PDF reader substitute them by some external Japanese fonts (*e.g.*, Kozuka Mincho is used for Ryumin-Light in Adobe Reader). We adopt this custom to the default setting.
- A character in an alphabetic font is generally smaller than a Japanese font in the same size. So actual size specification of these Japanese fonts is in fact smaller than that of alphabetic fonts, namely scaled by 0.962216.
- The amount of glue that are inserted between a **J**Achar and an **A**Lchar (the parameter `xkanjiskip`) is set to

$$(0.25 \cdot 13.5\text{ Q})_{-1\text{ pt}}^{+1\text{ pt}} = \frac{27}{32}\text{ mm}_{-1\text{ pt}}^{+1\text{ pt}}.$$

2.4 L^AT_EX で使う

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

```
\usepackage{luatexja}
```

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

- JY3 is the font encoding for Japanese fonts (in horizontal direction).
When vertical typesetting is supported by LuaT_EX-ja in the future, JT3 will be used for vertical fonts.
- Two font families `mc` and `gt` are defined:

classification	family	<code>\mdseries</code>	<code>\bfseries</code>	scale
<i>mincho</i>	<code>mc</code>	Ryumin-Light	GothicBBB-Medium	0.962216
<i>gothic</i>	<code>gt</code>	GothicBBB-Medium	GothicBBB-Medium	0.962216

Remark that the bold series in both family are same as the medium series of *gothic* family. This is a convention in pL^AT_EX.

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

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

`\CID`, `\UTF` and macros in OTF package Under pT_EX, `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, LuaT_EX-ja supports some of functions in `otf` package.

```

1 森
2 \UTF{9DD7}外と内田百\UTF{9592}とが\UTF{9AD9}
   島屋に行く。
3
4 \CID{7652}飾区の\CID{13706}野家 ,
5 葛飾区の吉野家

```

森鷗外と内田百閒とが高島屋に行く。
葛飾区の吉野家 , 葛飾区の吉野家

2.5 フォントの変更

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

```

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

```

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

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

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

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

```

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

```

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

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

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

NFSS2 For L^AT_EX_{2 ϵ} , LuaTeX-ja simply adopted the font selection system from that of pL^AT_EX_{2 ϵ} (in `plfonts.dtx`).

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

	encoding	family	series	shape	selection
alphabetic fonts	<code>\romanencoding</code>	<code>\romanfamily</code>	<code>\romanseries</code>	<code>\romanshape</code>	<code>\useroman</code>
Japanese fonts	<code>\kanjiencoding</code>	<code>\kanjifamily</code>	<code>\kanjiserie</code>	<code>\kanjishape</code>	<code>\usekanji</code>
both	—	—	<code>\fontseries</code>	<code>\fontshape</code>	—
auto select	<code>\fontencoding</code>	<code>\fontfamily</code>	—	—	<code>\usefont</code>

ここで、`\fontencoding{<encoding>}`は、引数により和文側か欧文側かのどちらかが切り替わる。例えば、次の入力で最初の`\fontencoding`の呼び出しは和文フォントのエンコーディングをJT3に変更し、2回目の呼び出しでは欧文フォント側をT1へと変更する。

```
\fontencoding{JY3}\fontencoding{T1}
```

`\fontfamily`も引数により和文側、欧文側、あるいは両方のフォントファミリが切り替わる。詳細はSubsection 7.1を参照すること。

- For defining a Japanese font family, use `\DeclareKanjiFamily` instead of `\DeclareFontFamily`. However, in the present implementation, using `\DeclareFontFamily` doesn't cause any problem.

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

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

Japanese fonts	<code>\jfontspec</code>	<code>\setmainjfont</code>	<code>\setsansjfont</code>	<code>\newjfontfamily</code>
alphabetic fonts	<code>\fontspec</code>	<code>\setmainfont</code>	<code>\setsansfont</code>	<code>\newfontfamily</code>
Japanese fonts	<code>\newjfontface</code>	<code>\defaultjfontfeatures</code>	<code>\addjfontfeatures</code>	
alphabetic fonts	<code>\newfontface</code>	<code>\defaultfontfeatures</code>	<code>\addfontfeatures</code>	

使用例

Note that there is no command named `\setmonojfont`, since it is popular for Japanese fonts that nearly all Japanese glyphs have same widths. Also note that the kerning feature is set off by default in these 7 commands, since this feature and **JAg**lue will clash (see 4.1).

3 パラメータの変更

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

3.1 JAchar の範囲の設定

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

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

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

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

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

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

表 1. Unicode blocks in predefined character range 3.

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

The argument to `jacharrange` parameter is a list of integer. Negative interger $-n$ in the list means that ‘the character range n is ...’.

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

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

Now we describe these eight ranges. The alphabet ‘J’ or ‘A’ after the number shows whether characters in the range is treated as **J**Achars or not by default. These settings are similar to `prefercjk ...`

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

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

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

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

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

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

Range 3^J Punctuations and Miscellaneous symbols. The block list is indicated in Table 1.

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

表 2. Unicode blocks in predefined character range 6.

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

表 3. Unicode blocks in predefined character range 7.

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

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

Range 5^A Surrogates and Supplementary Private Use Areas.

Range 6^J Characters used in Japanese. The block list is indicated in Table 2.

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

3.2 kanjiskip と xkanjiskip

JAglue is divided into the following three categories:

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

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

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

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

3.3 xkanjiskip の設定の挿入

It is not desirable that xkanjiskip is inserted between every boundary between **JA**chars and **AL**chars. 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 **J**Achars and alxspmode parameters **A**Lchars respectively.

```

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

```

The second argument `preonly` means ‘the insertion of `xkanjiskip` is allowed before this character, but not after’. the other possible values are `postonly`, `allow` and `inhibit`. For the compatibility with pTeX, natural numbers between 0 and 3 are also allowed as the second argument^{*1}.

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

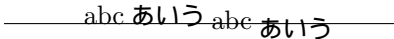
3.4 ベースラインの移動

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

```

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

```



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

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

```

1 xyz 漢字
2 {\scriptsize
3 \ltjsetparameter{yjabaselineshift=-1pt,
4 yalbaselineshift=-1pt}           xyz 漢字 XYZ ひらがな abc かな
5 XYZ ひらがな
6 }abc かな

```

3.5 トンボ

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

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

For example, the following sets banner as ‘`filename (2012-01-01 17:01)`’:

^{*1} But we don’t recommend this: since numbers 1 and 2 have opposite meanings in `jaxspmode` and `alxspmode`.

```

\makeatletter

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

```

2. ...

第 II 部

リファレンス

4 フォントメトリックと日本語フォント

4.1 \jfont プリミティブ

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

```

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

```

當 / 體 / 醫 / 區

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

Prefix psft Besides `file:` and `name:` prefixes, `psft:` can be used as a prefix in `\jfont` (and `\font`) primitive. Using this prefix, you can specify a ‘name-only’ Japanese font which will be not embedded to PDF. Typical use of this prefix is to specify the ‘standard’ Japanese fonts, namely, ‘Ryumin-Light’ and ‘GothicBBB-Medium’. For kerning or other informations, that of Kozuka Mincho Pr6N Regular (this is a font by Adobe Inc., and included in Japanese Font Packs for Adore Reader) will be used.

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

`jfm=<name>` Specify the name of JFM. A file named `jfm-<name>.lua` will be searched and/or loaded.

The followings are JFMs shipped with LuaTeX-ja:

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

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

表 4. Differences between JFMs shipped with LuaTeX-ja

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

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

`jfmvar=<string>` Sometimes there is a need that

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

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

4.2 JFM ファイルの構造

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

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

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

`dir=<direction>` (required)

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

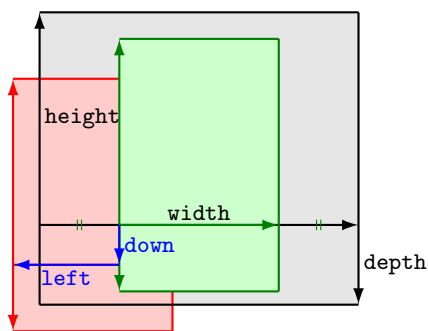
`zw=<length>` (required)

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

`zh=<length>` (required)

`kanjiskip={<natural>, <stretch>, <shrink>}` (optional)

This field specifies the 'ideal' amount of `kanjiskip`. As noted in Subsection 3.2, if the parameter `kanjiskip` is `\maxdimen`, the value specified in this field is actually used (if this field is not specified in JFM, it is regarded as 0pt). Note that `<stretch>` and `<shrink>` fields are in design-size unit too.



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

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

図 1. The position of the 'real' glyph.

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

Like the `kanjiskip` field, this field specifies the 'ideal' amount of `xkanjiskip`.

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

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

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

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

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

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

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

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

`kern`={ $[j]$ =*⟨kern⟩*, ...}

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

上で説明した通り, `chars` フィールド中にはいくつかの「特殊文字」も指定可能である. これらは, 大半が pTeX の JFM グルーの挿入処理ではみな「文字クラス 0 の文字」として扱われていた文字であり, その結果として pTeX より細かい組版調整ができるようになっている. 以下のその一覧を述べる:

'lineend' 行の終端を表す.

'diffmet'

'boxbdd' hbox の先頭と末尾, 及びインデントされていない (`\noindent` で開始された) 段落の先頭を表す.

- 'parbdd' 通常の (\noindent で開始されていない) 段落の先頭 .
- 'jcharbdd' 和文文字と「その他のもの」(欧文文字, glue, kern 等)との境界 .
- 1 行中数式と地の文との境界 .

pTeX 用和文フォントメトリックの移植 以下に, pTeX 用和文フォントメトリックを LuaTeX-japan 用に移植する場合の注意点を挙げておく .

- 実際に出力される和文フォントのサイズが design size となる . このため, 例えば 1zw が design size の 0.962216 倍である JIS フォントメトリック等を移植する場合は,
 - JFM 中の全ての数値を 1/0.962216 倍しておく .
 - TeX ソース中で使用するところで, サイズ指定を 0.962216 倍にする . L^ATeX でのフォント宣言なら, 例えば次のように :

```
\DeclareFontShape{JY3}{mc}{m}{n}{<-> s*[0.962216] psft:Ryumin-Light:jfm=jis}{}
```

- 上に述べた特殊文字は, 'boxbdd' を除き文字クラスを全部 0 とする (JFM 中に単に書かなければよい).
- 'boxbdd' については, それのみで一つの文字クラスを形成し, その文字クラスに関しては glue/kern の設定はしない .

これは, pTeX では, hbox の先頭・末尾とインデントされていない (\noindent で開始された) 段落の先頭には JFM グルーは入らないという仕様を実現させるためである .

- pTeX の組版を再現させようというのが目的であれば以上の注意を守れば十分である .
 ところで, pTeX では通常の段落の先頭に JFM グルーが残るという仕様があるので, 段落先頭の開き括弧は全角二分下がりになる . 全角下がりを実現させるには, 段落の最初に手動で \inhibitglue を追加するか, あるいは \everypar の hack を行い, それを自動化させるしかなかった .
 一方, LuaTeX-japan では, 'parbdd' によって, それが JFM 側で調整できるようになった . 例えば, LuaTeX-japan 同梱の JFM のように, 'boxbdd' と同じ文字クラスに 'parbdd' を入れれば全角下がりとなる .

```
1 \jfont\g=psft:Ryumin-Light:jfm=test \g
2 \parindent1\zw\noindent{}
3 \par{}「      二分下がり
4 \par{}【      全角下がり
5 \par{}〔      全角二分下がり
```

4.3 数式フォントファミリ

TeX handles fonts in math formulas by 16 font families^{*2}, and each family has three fonts: \textfont, \scriptfont and \scriptscriptfont.

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

4.4 コールバック

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

luatexja.load_jfm callback With this callback you can overwrite JFMs.

^{*2} Omega, Aleph, LuaTeX and ε-(u)pTeX can handles 256 families, but an external package is needed to support this in plain TeX and L^ATeX.

表 5. Primitives for Japanese math fonts.

	Japanese fonts	alphabetic fonts
font family	<code>\jfam ∈ [0, 256)</code>	<code>\fam</code>
text size	<code>jatextfont={⟨jfam⟩,⟨jfont_cs⟩}</code>	<code>\textfont⟨fam⟩=⟨font_cs⟩</code>
script size	<code>jascriptfont={⟨jfam⟩,⟨jfont_cs⟩}</code>	<code>\scriptfont⟨fam⟩=⟨font_cs⟩</code>
scriptscript size	<code>jascriptscriptfont={⟨jfam⟩,⟨jfont_cs⟩}</code>	<code>\scriptscriptfont⟨fam⟩=⟨font_cs⟩</code>

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

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

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

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

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

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

jfm The index number of JFM.

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

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

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

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

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

```
1 function (<number> char_class, <table> jfont_info, <number> chr_code)
2   if char_class~=0 then return char_class
3   else
4     ....
5     return (<number> new_char_class or 0)
6   end
7 end
```

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

5 パラメータ

5.1 `\ltjsetparameter` プリミティブ

As noted before, `\ltjsetparameter` and `\ltjgetparameter` are primitives for accessing most parameters of LuaTeX-ja. One of the main reason that LuaTeX-ja didn't adopted the syntax similar to that of pTeX (e.g., `\prebreakpenalty'=10000`) is the position of `hpack_filter` callback in the source of LuaTeX, see Section 9.

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

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

```
1 \ltjgetparameter{differentjfm},
2 \ltjgetparameter{autospacing},           average, 1, 10000.
3 \ltjgetparameter{prebreakpenalty}{' }.
```

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

5.2 パラメーター一覧

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

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

`jcharwidowpenalty = \langle penalty \rangle` `[\jcharwidowpenalty]`

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

`kcatcode = { \langle chr_code \rangle, \langle natural number \rangle }`

An additional attributes having each character whose character code is $\langle chr_code \rangle$. At the present version, the lowermost bit of $\langle natural\ number \rangle$ indicates whether the character is considered as a punctuation mark (see the description of `jcharwidowpenalty` above).

`prebreakpenalty = { \langle chr_code \rangle, \langle penalty \rangle }` `[\prebreakpenalty]` 文字コード $\langle chr_code \rangle$ の **J**Achar が行頭にくることを抑止するために、この文字の前に挿入/追加されるペナルティの量を指定する。

例えば閉じ括弧「`】`」は絶対に行頭にきてはならないので、標準で読み込まれる `luatexja-kinsoku.tex` において

```
\ltjsetparameter{prebreakpenalty}={'】',10000}}
```

と、最大値の 10000 が指定されている。他にも、小書きのカナなど、絶対禁止というわけではないができれば行頭にはきて欲しくない場合に、0 と 10000 の間の値を指定するのも有用であろう。

`\ltjsetparameter{prebreakpenalty}={‘か’,150}`

`postbreakpenalty={⟨chr_code⟩,⟨penalty⟩}` [`\postbreakpenalty`] 文字コード `⟨chr_code⟩` の **JA**char が行末にくることを抑止するために、この文字の後に挿入/追加されるペナルティの量を指定する。

pTeX では、`\prebreakpenalty`、`\postbreakpenalty` において、

- 一つの文字に対して、`pre`、`post` どちらか一つしか指定することができなかった（後から指定した方で上書きされる）。
- `pre`、`post` 合わせて 256 文字分の情報を格納することしかできなかった。

という制限があったが、LuaTeX-ja ではこれらの制限は解消されている。

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

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

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

`yjabaselineshift=⟨dimen⟩*`

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

`jaxspmode={⟨chr_code⟩,⟨mode⟩}` [`\inhibitxspcode`]

Setting whether inserting `xkanjiskip` is allowed before/after a **JA**char whose character code is `⟨chr_code⟩`.

The followings are allowed for `⟨mode⟩`:

- 0, `inhibit` Insertion of `xkanjiskip` is inhibited before the charater, nor after the charater.
- 2, `preonly` Insertion of `xkanjiskip` is allowed before the charater, but not after.
- 1, `postonly` Insertion of `xkanjiskip` is allowed after the charater, but not before.
- 3, `allow` Insertion of `xkanjiskip` is allowed before the charater and after the charater. This is the default value.

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

Setting whether inserting `xkanjiskip` is allowed before/after a **AL**char whose character code is `⟨chr_code⟩`.

The followings are allowed for `⟨mode⟩`:

- 0, `inhibit` Insertion of `xkanjiskip` is inhibited before the charater, nor after the charater.
- 1, `preonly` Insertion of `xkanjiskip` is allowed before the charater, but not after.
- 2, `postonly` Insertion of `xkanjiskip` is allowed after the charater, but not before.
- 3, `allow` Insertion of `xkanjiskip` is allowed both before the charater and after the charater. This is the default value.

Note that parameters `jaxspmode` and `alxspmode` use a common table.

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

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

`kanjiskip=⟨skip⟩` [`\kanjiskip`]

`xkanjiskip=⟨skip⟩` [`\xkanjiskip`]

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

`average`

`both`

`large`

`small`

`jacharrange=⟨ranges⟩*`

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

6 その他のプリミティブ

6.1 互換プリミティブ

The following primitives are implemented for compatibility with pTeX:

```
\kuten
\jis
\euc
\sjis
\ucs
\kansuji
```

6.2 \inhibitglue プリミティブ

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

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

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

- The call of `\inhibitglue` in the (internal) vertical mode is effective at the beginning of the next paragraph. This is realized by hacking `\everypar`.
- The call of `\inhibitglue` in the (restricted) horizontal mode is only effective on the spot; does not get over boundary of paragraphs. Moreover, `\inhibitglue` cancels ligatures and kernings, as shown in line 4 of above example.
- The call of `\inhibitglue` in math mode is just ignored.

7 L^AT_EX 2_ε 用のコントロールシーケンス

7.1 NFSS2 へのパッチ

As described in Subsection 2.4, LuaTeX-ja simply adopted `plfonts.dtx` in pL^AT_EX 2_ε for the Japanese patch for NFSS2. For an convinience, we will describe commands which are not described in Subsection 2.5.

```
\DeclareYokoKanjiEncoding{<encoding>}{<text-settings>}{<math-settings>}
```

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

```
\DeclareKanjiEncodingDefaults{<text-settings>}{<math-settings>}
```

```
\DeclareKanjiSubstitution{<encoding>}{<family>}{<series>}{<shape>}
```

`\DeclareErrorKanjiFont{<encoding>}{<family>}{<series>}{<shape>}{<size>}`

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

`\reDeclareMathAlphabet{<unified-cmd>}{<al-cmd>}{<ja-cmd>}`

和文・欧文の数式用フォントファミリーを一度に変更する命令を作成する．具体的には，欧文数式用フォントファミリー変更の命令 `<al-cmd>` と，和文数式用フォントファミリー変更の命令 `<ja-cmd>` の2つを同時に行う命令として `<unified-cmd>` を（再）定義する．実際の使用では `<unified-cmd>` と `<al-cmd>` に同じものを指定する，すなわち，`<al-cmd>` に和文側も変更させるようにするのが一般的と思われる．

本コマンドの使用については，`plATEX` 配布中の `plfonts.dtx` に詳しく注意点が述べられているので，そちらを参照されたい．

`\DeclareRelationFont{<ja-encoding>}{<ja-family>}{<ja-series>}{<ja-shape>}`
`{<al-encoding>}{<al-family>}{<al-series>}{<al-shape>}`

いわゆる「従属欧文」を設定するための命令である．前半の4引数で表される和文フォントファミリーに対して，そのフォントに対応する「従属欧文」フォントファミリーを後半の4引数により与える．

`\SetRelationFont`

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

`\userelfont`

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

`\adjustbaseline`

...

`\fontfamily{<family>}`

As in `LATEX 2ε`, this command changes current font family (alphabetic, Japanese, or both) to `<family>`. Which family will be changed is determined as follows:

- Let current encoding scheme for Japanese fonts be `<ja-enc>`. Current Japanese font family will be changed to `<family>`, if one of the following two conditions is met:
 - The family `<fam>` under the encoding `<ja-enc>` is already defined by `\DeclareKanijFamily`.
 - A font definition named `<enc><ja-enc>.fd` (the filename is all lowercase) exists.
- Let current encoding scheme for Japanese fonts be `<al-enc>`. For alphabetic font family, the criterion as above is used.
- There is a case which none of the above applies, that is, the font family named `<family>` doesn’t seem to be defined neither under the encoding `<ja-enc>`, nor under `<al-enc>`.

In this case, the default family for font substitution is used for alphabetic and Japanese fonts. Note that current encoding will not be set to `<family>`, unlike the original implementation in `LATEX`.

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

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

7.2 トンボ

8 拡張

8.1 luatexja-fontspec.sty

8.2 luatexja-otf.sty

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

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

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

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

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

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

第 III 部

実装

9 パラメータの保持

9.1 ディメンション, アトリビュート, whatsit ノードを用いて

Here the following is the list of dimension and attributes which are used in LuaTeX-ja.

`\jQ` (dimension) As explained in Subsection 2.3, `\jQ` is equal to $1\text{Q} = 0.25\text{ mm}$, 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 ‘齒’ which equals to 0.25 mm and used in Japanese phototypesetting. The dimension `\jH` stores this length, similar to `\jQ`.

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

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

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

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

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

`\ltj@yablshift` (attribute) The amount of shifting the baseline of alphabetic fonts in scaled point (2^{-16} pt).
`\ltj@ykblshift` (attribute) The amount of shifting the baseline of Japanese fonts in scaled point (2^{-16} pt).
`\ltj@autospc` (attribute) Whether the auto insertion of `kanjiskip` is allowed at the node.
`\ltj@autoxspc` (attribute) Whether the auto insertion of `xkanjiskip` is allowed at the node.
`\ltj@icflag` (attribute) An attribute for distinguishing ‘kinds’ of a node. One of the following value is assigned to this attribute:

- italic* (1) Glues from an italic correction (`\/`). This distinction of origins of glues (from explicit `\kern`, or from `\/`) is needed in the insertion process of `xkanjiskip`.
- packed* (2)
- kinsoku* (3) Penalties inserted for the word-wrapping process of Japanese characters (*kinsoku*).
- from_jfm* (4) Glues/kerns from JFM.
- line_end* (5) Kerns for ...
- kanji_skip* (6) Glues for `kanjiskip`.
- xkanji_skip* (7) Glues for `xkanjiskip`.
- processed* (8) Nodes which is already processed by ...
- ic_processed* (9) Glues from an italic correction, but also already processed.
- boxbdd* (15) Glues/kerns that inserted just the beginning or the ending of an hbox or a paragraph.

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

Furthermore, Lua_{TEX}-ja uses several ‘user-defined’ whatsit nodes for typesetting. All those nodes store a natural number (hence the node’s `type` is 100).

- 30111 Nodes for indicating that `\inhibitglue` is specified. The `value` field of these nodes doesn’t matter.
- 30112 Nodes for Lua_{TEX}-ja’s stack system (see the next subsection). The `value` field of these nodes is current group.
- 30113 Nodes for Japanese Characters which the callback process of `luaotfload` won’t be applied, and the character code is stored in the `value` field. Each node having this `user_id` is converted to a ‘`glyph_node`’ after the callback process of `luaotfload`.

These whatsits will be removed during the process of inserting **J**Aglues.

9.2 Lua_{TEX}-ja のスタックシステム

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

```

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

```

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

```

void package(int c)
{

```

```

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

```

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

The method The code of stack system is based on that in a post of Dev-luatex mailing list^{*3}.

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

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

- If there is no *stack_flag* node in the list of 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 .

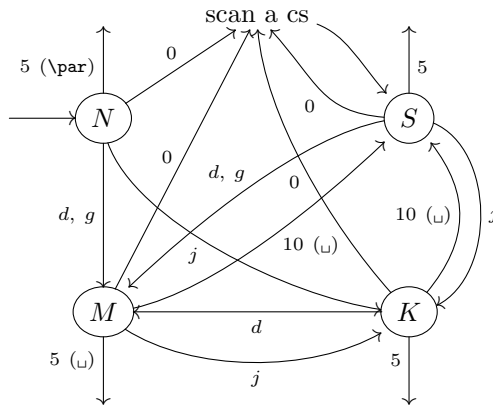
Note that to work this trick correctly, assignments to `\ltj@@stack` and `\ltj@@group@level` have to be local always, regardless the value of `\globaldefs`. This problem is resolved by using `\directlua{tex.globaldefs=0}` (this assignment is local).

10 和文文字直後の改行

10.1 参考: pT_EX の挙動

欧文では文章の改行は単語間でしか行わない。そのため、T_EX では、(文字の直後の)改行は空白文字と同じ扱いとして扱われる。一方、和文ではほとんどどこでも改行が可能のため、pT_EX では和文文字の直後の改行は単に無視されるようになっている。

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



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

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

図 2. State transitions of pTeX's input processor.

このような動作は、pTeX が TeX からエンジンとして拡張されたことによって可能になったことである。pTeX の入力処理部は、TeX におけるそれと同じように、有限オートマトンとして記述することができ、以下に述べるような 4 状態を持っている。

- State *N*: 行の開始。
- State *S*: 空白読み飛ばし。
- State *M*: 行中。
- State *K*: 行中 (和文文字の後)。

また、状態遷移は、図ようになっており、図中の数字はカテゴリーコードを表している。最初の 3 状態は TeX の入力処理部と同じであり、図中から状態 *K* と「*j*」と書かれた矢印を取り除けば、TeX の入力処理部と同じものになる。

この図から分かることは、

行が和文文字 (とグループ境界文字) で終わっていれば、改行は無視される

ということである。

10.2 LuaTeX-ja の挙動

LuaTeX の入力処理部は TeX のそれと全く同じであり、callback によりユーザがカスタマイズすることはできない。このため、改行抑制の目的でユーザが利用できそうな callback としては、`process_input_buffer` や `token_filter` に限られてしまう。しかし、TeX の入力処理部をよく見ると、後者も役には経たないことが分かる：改行文字は、入力処理部によってトークン化される時に、カテゴリーコード 10 の 32 番文字へと置き換えられてしまうため、`token_filter` で非標準なトークン読み出しを行おうとしても、空白文字由来のトークンと、改行文字由来のトークンは区別できないのだ。

すると、我々のとれる道は、`process_input_buffer` を用いて LuaTeX の入力処理部に引き渡される前に入力文字列を編集するというものしかない。以上を踏まえ、LuaTeX-ja における「和文文字直後の改行抑制」の処理は、次のようになっている：

各入力行に対し、その入力行が読まれる前の内部状態で以下の 2 条件が満たされている場合、LuaTeX-ja は

U+FFFFF 番の文字^{*4}を末尾に追加する．よって，その場合に改行は空白とは見做されないこととなる．

1. 改行文字（文字コード 13 番）のカテゴリコードが 5 (end-of-line) である．
2. 入力行は次の「正規表現」にマッチしている：

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

この仕様は，前節で述べた p_TE_X の仕様にてできるだけ近づけたものとなっている．最初の条件は，verbatim 系環境などの日本語対応マクロを書かなくてすませるためのものである．しかしながら，完全に同じ挙動が実現できたわけではない．差異は，次の例が示すように，和文文字の範囲を変更した行の改行において見られる：

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

もし p_TE_X とまったく同じ挙動を示すならば，出力は「x yzあu」となるべきである．しかし，実際には上のように異なる挙動となっている．

- 2 行目は「あ」という和文文字で終わる（2 行目を処理する前の時点では，「あ」は和文文字扱いである）ため，直後の改行文字は無視される．
- 3 行目は「あ」という欧文文字で終わる（2 行目を処理する前の時点では，「あ」は欧文文字扱いである）ため，直後の改行文字は空白に置き換わる．

このため，トラブルを避けるために，和文文字の範囲を `\ltjsetparameter` で編集した場合，その行はそこで改行するようにした方がいいだろう．

11 JFM グルーの挿入，kanjiskip と xkanjiskip

11.1 概要

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

- JFM グルーの挿入は，和文文字を表すトークンを元に水平リストに（文字を表す） $\langle char_node \rangle$ を追加する過程で行われる．
- xkanjiskip の挿入は，hbox へのパッケージングや行分割前に行われる．
- kanjiskip はノードとしては挿入されない．パッケージングや行分割の計算時に「和文文字を表す 2 つの $\langle char_node \rangle$ の間には kanjiskip がある」ものとみなされる．

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

Lua_TE_X-ja における JAglue 挿入処理では，下の図??のように「塊」を単位にして行われる．大雑把にいうと，「塊」は文字とそれに付随するノード達（アクセント位置補正用の kern や，イタリック補正）をまとめたものであり，2 つの塊の間には，ペナルティ，`\vadjust`，`whatsit` など，行組版には関係しないものがある．そのため，……

11.2 「クラスタ」の定義

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

^{*4} この文字はコメント文字として扱われるように Lua_TE_X-ja 内部で設定をしている．

1. Nodes whose value of `\lj@icflag` is in $[3, 15)$. These nodes come from a `hbox` which is already packaged, by unpackaging (`\unhbox`). The *id* is *id_pbox*.
2. A inline math formula, including two *math_nodes* at the boundary of it: HOGE The *id* is *id_math*.
3. A *glyph_node* with nodes which relate with it: HOGE The *id* is *id_jglyph* or *id_glyph*, according to whether the *glyph_node* represents a Japanese character or not.
4. An box-like node, that is, an `hbox`, an `vbox` and an rule (`\vrule`). The *id* is *id_hlist* if the node is an `hbox` which is not shifted vertically, or *id_box_like* otherwise.
5. A glue, a kern whose subtype is not 2 (*accent*), and a discretionary break. The *id* is *id_glue*, *id_kern* and *id_disc*, respectively.

We denote a cluster by *Np*, *Nq* and *Nr*.

Internally, a cluster is represented by a table *Np* with the following fields.

first, last The first/last node of the cluster.

id The *id* in above definition.

nuc

auto_kspc, auto_xspc

xspc_before, xspc_after

pre, post

char

class

lend

met, var