A Modern Guide to **LuaLaTeX**

For Linguists and Beginners (2026 Edition)

Adapted for Modern TeX Live

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1 Introduction: What is LuaLaTeX?

In the past, most people used **pdfLaTeX**. However, pdfLaTeX was designed in the 1990s, before the modern internet and Unicode. Today, if you want to use the actual fonts installed on your computer (like Times New Roman, Arial, or specialized linguistic fonts) and type any character from any language directly (like **ə, ʃ, ɛ̃**), you need a modern engine.

LuaLaTeX is that modern engine. It has three major advantages:

1. **Native Unicode Support:** You can type characters from any language (French, German, IPA) directly into your document. You don't need weird commands like `\'e` for é; you just type é.
2. **Modern Fonts:** It uses the `fontspec` package to access TrueType and OpenType fonts installed on your Mac or PC.
3. **Lua Scripting:** It embeds the Lua programming language, allowing for advanced automation (though you rarely need this as a beginner).

2 The Golden Rules: Switching from pdfLaTeX to LuaLaTeX

If you find a tutorial online that was written for pdfLaTeX, **do not copy its preamble blindly**. There are four golden rules for LuaLaTeX:

- **Never use `inputenc`.** LuaLaTeX handles UTF-8 natively. (Delete `\usepackage{inputenc}`).
- **Do not load `fontenc` or `textcomp`.** Under LuaLaTeX, `fontenc` is superseded by `fontspec`, and `textcomp` is already folded into current LaTeX. If you see them in an older tutorial, just delete those lines.
- **Use `fontspec` instead.** This is how you load fonts.
- **Use `polyglossia` instead of `babel`.** `polyglossia` is the modern language package built for Unicode.

3 Migration Table: Pre-2015 vs 2026

If you are porting a template from an older tutorial, this is the shortest path. Everything on the left is from pre-2015 tutorials you may still find on StackExchange, Overleaf, or university handouts; everything on the right is the current practice under LuaLaTeX.

Topic	Old way (pre-2015)	New way (2026)	Remark
Input encoding	`\usepackage[utf8]{inputenc}`	Delete it.	LuaLaTeX is UTF-8 native.
Font encoding	`\usepackage[T1]{fontenc}`	`\usepackage{fontspec}`	`textcomp` is also obsolete.
Fonts	`\usepackage{times}` and friends	`\setmainfont{...}`	Any OpenType font on your OS.
Languages	`\usepackage[french]{babel}`	`\usepackage{polyglossia}`	Then `\setotherlanguages{...}`.
IPA	`\usepackage{tipa}`	`\usepackage{tipauni}`*	See note below.
Quotes	``` ``...'' ```, `<<...>>` by hand	`\enquote{...}` (`csquotes`)	Language-aware.
Glosses	`\usepackage{gb4e}`	`\usepackage{gb4e}` + `\noautomath`	Same package, essential workaround.
Compile	`pdflatex`, click twice	`latexmk -lualatex -pdf`	Handles multi-pass + Biber.

* `tipauni` is a Unicode-era replacement for `tipa`. Because it uses true Unicode characters, it is compatible with `fontspec` and `polyglossia`; the old `tipa` is not.

4 How to Handle Fonts

Because LuaLaTeX uses your operating system's fonts, you use `\setmainfont` to choose your text font. By default, LuaLaTeX uses *Latin Modern*, which is fine.

If you want to change it (for example, to a font that has excellent IPA support, like *Charis SIL* or *Doulos SIL*), you simply add this to your preamble:

```
\usepackage{fontspec}
\setmainfont{Charis SIL} % The font must be installed on your computer!
```

5 Modern Linguistics Packages

In the 2010s, linguists used the `tipa` package for phonetic symbols. However, `tipa` breaks easily with modern fonts. Today, we use **`tipauni`** (TIPA Unicode), which is specifically designed for LuaLaTeX.

5.1 IPA Symbols

Load the package like this:

```
\usepackage{tipauni}
```

Then, you can use the familiar `\textipa{}` shortcuts, or simply type the Unicode symbols directly if your font supports it.

5.2 Glosses and Examples (`gb4e`)

The `gb4e` package is still the standard for numbered examples and interlinear glosses. However, it sometimes conflicts with math and phonetic packages. **The Fix:** Always put `\noautomath` right after loading `gb4e` to prevent crashes.

```
\usepackage{gb4e}
\noautomath % Fixes a known infinite loop bug
```

6 A Complete Minimal Preamble

Here is a safe, modern preamble you can copy for your computational linguistics assignments:

```
\documentclass[11pt,a4paper]{article}

% 1. Modern Engine & Fonts
\usepackage{fontspec}
% \setmainfont{Charis SIL} % Uncomment to change font

% 2. Languages
\usepackage{polyglossia}
\setmainlanguage{english}
\setotherlanguages{french,spanish,german}

% 3. Math
\usepackage{amsmath,amssymb}

% 4. Linguistics
\usepackage{tipauni}     % Modern IPA
\usepackage{gb4e}
\noautomath              % CRITICAL for gb4e to work with other packages
\usepackage{forest}      % Syntax trees

% 5. Layout
\usepackage{geometry}
\geometry{margin=2.5cm}
\usepackage{hyperref}
```

7 Common Troubleshooting (The "Gotchas")

7.1 Common First Errors — a quick lookup

Scan this table before anything else. Nine out of ten first-time errors are in it.

Symptom / Error message	Likely cause	Fix
`Unicode character ... not set up for use with LaTeX`	The current font lacks that glyph.	Switch to a font with wide coverage: `\setmainfont{Charis SIL}` or Doulos SIL.
Missing references, broken Table of Contents	First pass has not yet resolved labels.	Compile again, or use `latexmk -lualatex -pdf`.
`File 'fontspec.sty' not found`	You are on a minimal TeX installation.	Install the recommended TeX Live collections (see installation section).
Strange IPA output or missing symbols	Legacy `tipa` workflow combined with a non-tipa font.	Switch to `tipauni` and a Unicode-capable font.
`gb4e` crashes on a subscript or superscript	Missing `\noautomath`.	Add `\noautomath` immediately after `\usepackage{gb4e}`.
`luaotfload: font ... not found`	Font cache is stale.	Linux: `fc-cache -fv`. macOS: `luaotfload-tool --update`.

7.2 Missing Packages (`tlmgr`)

If you get an error saying `File 'xyz.sty' not found`, it means your TeX installation is missing a package. If you are using a minimal installation (like BasicTeX on Mac), you must install it via the terminal:

```
sudo tlmgr install ifmtarg
```

7.3 Stale Font Caches

If you install a new font (such as *Charis SIL*) and LuaLaTeX cannot find it, the font database needs to be refreshed.

On **Ubuntu / Linux**, after dropping the `.ttf` files into `~/.local/share/fonts/`:

```
fc-cache -fv
```

On **macOS** the equivalent one-off command is:

```
luaotfload-tool --update
```

Do **not** prepend `sudo` to `luaotfload-tool` — it writes to your user cache and must run as your normal user. (On Windows the system handles font installation automatically; a LuaLaTeX cache refresh is rarely needed.)

7.4 Compilation Requirements

Unlike pdfLaTeX, LuaLaTeX sometimes requires **two compilation passes** to get the Table of Contents and cross-references right. If you are using `biblatex`, the full sequence is: LuaLaTeX → Biber → LuaLaTeX → LuaLaTeX.

Clicking the compile button four times is tedious and error-prone. Instead, open a terminal in the project folder and run:

```
latexmk -lualatex -pdf your-document.tex
```

`latexmk` inspects the output after each pass, detects whether references are still unresolved, runs Biber when the `.bib` file has changed, and recompiles exactly as many times as needed. It ships with every modern TeX Live installation; there is nothing to install.

For reproducibility (so a document still compiles cleanly a few years from now), the usual recipe is `latexmk` + `git` + a pinned TeX Live version. For teaching material or theses that may outlive their author's laptop, a Docker image such as `texlive/texlive` wraps the whole toolchain and can rebuild the exact same PDF on any machine.

8 A Note on Lua (Why We Use Python Instead)

LuaLaTeX embeds the Lua programming language. You can write loops, read CSV files, and do calculations directly inside your `.tex` source using `\directlua`. However, as a computational linguist, your real data processing almost certainly belongs in Python or R — not inside the typesetting engine. We include one tiny example here so you understand the bridge exists, but we deliberately do not teach Lua programming in this kit.

```
\documentclass{article}
\usepackage{fontspec}

\begin{document}

\directlua{
  local words = {"chat", "chien", "maison"}
  tex.sprint("Corpus contains " .. #words .. " items.")
}

\end{document}
```

When compiled, this prints "Corpus contains 3 items." in the body of the PDF. The Lua block runs at compile time, builds a string, and `tex.sprint` injects it into the LaTeX output as if you had typed it yourself.

For anything substantial, do your corpus processing in Python or R, write the result to a `.csv` or a `.tex` fragment, and let LaTeX `\input` that file. That is a cleaner division of labour than embedding complex logic inside your document — and it keeps your analysis reproducible with the tools your discipline already uses.

9 Recommended Learning Resources

- **Overleaf's 30-Minute Intro:** https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes (Remember to change the compiler to LuaLaTeX in the Overleaf menu!)
- **LearnLaTeX.org:** https://www.learnlatex.org/ (Highly recommended interactive tutorial).
- **Detexify:** http://detexify.kirelabs.org/classify.html (Draw a symbol with your mouse, and it tells you the LaTeX command).