cacography

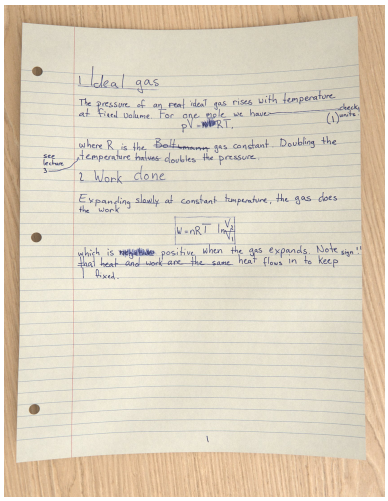
Typeset a document, get photographed handwritten notes back

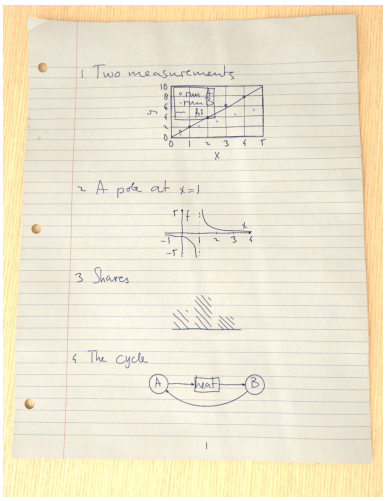
Version 0.14 (beta)

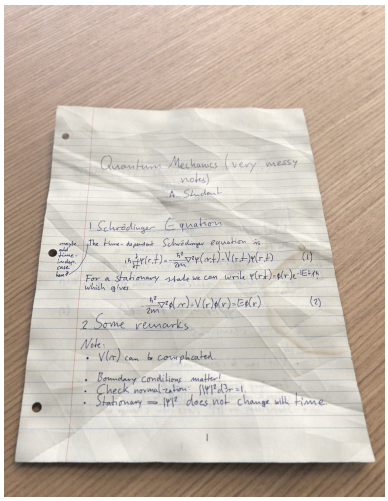
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https://github.com/aynader/cacography

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1 What it does

LaTeX still does the layout, the equations and the structure. A handwriting model trained on real pen recordings then writes every page, on procedurally made paper, which is photographed as a phone would: on a desk or on cloth, in a room's light, perhaps with a pen lying beside it. The PDF keeps the typeset text invisibly under each photo, so it stays searchable and copyable. It covers English and German.

Licence. The LaTeX package (`cacography.sty`, `cacography.lua`), this manual and its examples are under the LPPL 1.3c or later; no file of the LaTeX package is under any other licence. Distributed separately, and not part of the LaTeX package: the Python renderer (MIT licence) and its handwriting models, which are for non-commercial research only because the datasets they were trained on (BRUSH, IAM-OnDB, MathWriting) allow only that. Bug reports: `https://github.com/aynader/cacography/issues`.

2 Installing

You need LuaLaTeX (TeX Live or MiKTeX). Then, from a download of the repository:

```
.\install.ps1 % Windows
sh install.sh % macOS, Linux
```

The installer uses `uv`, which brings its own Python. It installs the renderer (PyTorch, and Mitsuba 3 for photos traced in 3D), runs `cacography setup` to put the LaTeX package where TeX finds it and fetch the models, then checks everything with `cacography doctor`. By hand:

```
pip install cacography
cacography setup % LaTeX files, models, and how LuaLaTeX starts the renderer
cacography doctor % what is missing, and how to fix it
```

- **The LaTeX package**: `cacography.sty` and `cacography.lua`. If your TeX distribution already has them (from CTAN), `setup` leaves them alone.
- **3D photos** (props, cloth, real light) need an NVIDIA GPU. Without one, pages are photographed with formulas, with no props and simpler light.
- **The handwriting models** go into the cache folder's `models/` (`%LOCALAPPDATA%\cacography` on Windows, `~/.cache/cacography` elsewhere), or wherever `CACOGRAPHY_MODELS` points. `cacography setup --models <zip>` installs a downloaded copy.
- Textures and room lights (CC0, from Poly Haven and ambientCG) are downloaded once on first use into the same cache folder. Offline, or with `CACOGRAPHY_OFFLINE` set, procedural stand-ins are used.

3 Building a document

Load the package, with any options:

```
\usepackage[paper=notebook, ink=blue, sloppiness=0.5, seed=123]{cacography}
```

From the command line, `cacography notes.tex` lays the document out, writes every page by hand and puts the photos in `notes.pdf`. Options after the file name go to the renderer: `cacography notes.tex --device cuda`.

In an editor (TeXstudio, TeXworks, Texmaker, VS Code, …), compile with LuaLaTeX and shell escape turned on. The first run lays the document out and draws the pages itself; the second puts them in, as with references. In TeXstudio, put these two lines at the top of the file (it asks once whether to allow them):

```
% !TeX program = lualatex
% !TeX TXS-program:compile = txs:///lualatex/[--shell-escape]
```

With latexmk (and so VS Code's LaTeX Workshop), copy `.latexmkrc` from the repository next to the document: it turns shell escape on and runs LuaLaTeX again by itself. Without shell escape the PDF shows the typeset text, and the log says what to run. The package option `render=manual` never starts the renderer.

While the pages are drawn from an editor, a small window shows how far it has got, with a Cancel button; in a terminal, a progress bar does. Cancelling keeps the pages already drawn, and the rest are drawn on the next run. `progress=none` shows neither.

By hand, the three steps are:

```
lualatex notes % lays out, records each page in notes.cacography/
cacography render notes % writes and photographs each page
lualatex notes % puts the photos in notes.pdf
```

Only pages whose layout or settings changed are drawn again, and written words are cached. The same seed gives the same pages on the CPU (the default); `--device cuda` is much faster but not bit-for-bit reproducible. `--all` redraws every page; `--flat` photographs with formulas even when a GPU is there.

4 Options

Every option can be given to `\usepackage`. Those marked *per page* can also be set for one sheet with `\cacographypage{…}` (Section 5). Anything about the photo left `random` is chosen from the seed, each part with its own seed, so changing one never reshuffles another.

The writing and the sheet

`paper`	`notebook` (college ruled, binder holes), `wide`, `legal` (yellow pad), `graph` (5 mm grid), `blank`
`papersize`	`letter` (default), `a4`, …
`ink`	`blue`, `black`, `red` (ballpoint), `pencil`
`sloppiness`	0 to 1: neat, even lines at 0; at 1, words that change size, tilt and wander off the line
`seed`	a number, or `random` (the renderer prints the one it used)
`wear`	0 to 1, how handled sheets are: makes crumples, folds, stains, props and the rest likelier
`underline`	`headings` (section titles underlined by hand), `none`, `random`
`camera`	`phone`, `scan` (a flatbed scan), `none` (just the paper)
`render`	`auto` (with shell escape, LuaLaTeX draws the pages itself), `manual`
`progress`	`auto` (a window from an editor, a bar in a terminal), `window`, `bar`, `none`

The photo

`background`	what the sheet lies on: wood (`oak`, `walnut`, `birch`, `pine`, `cherry`, `worn`, `painted`, `plywood`); plain (`laminate`, `white`, `black`, `glass`); stone (`marble`, `terrazzo`, `concrete`); fabric (`blanket`, `bedsheet`, `linen`, `canvas`, `twill`, `denim`, `knit`, `towel`, `corduroy`, `velvet`, `stripes`, `plaid`, `gingham`, `dots`, `print`, `grid`); pad (`leather`, `cork`, `felt`, `carpet`, `jute`); a group's name (`wood`, `fabric`, `patterned`, …) for one of the group; or `file:`*path* for your own photo of a surface
`light`	`lamp`, `overhead`, `window`, `soft`, `raking` (low, showing every crease), `flash`, `dim`
`angle` *(per page)*	`flat`, `slight`, `steep`, or a tilt in degrees
`framing` *(per page)*	`tight`, `loose` (more of the room), `cropped` (part of the sheet cut off)
`shadow` *(per page)*	`none`, `phone` (the phone and hand shading the page)
`props` *(per page)*	`none`, or any of `tape`, `clip`, `binder`, `staple`, `pen`, `sheet`: `props={tape, pen}`. A pen comes in many kinds, shaped after real ones (clear barrels showing the refill, gel pens with dimpled or ringed grips, soft-grip twist pens, click pens, capped pens with the cap on the point or posted), with real clips standing off the barrel and printing on it; with `ink=pencil` it is a sharpened wooden pencil (some with a worn eraser) or a mechanical one, sometimes with a case of leads. Only in 3D photos.

How the sheet has been handled *(all per page)*

`crumple`	`none`, or 0 to 1: crumpled and smoothed out again
`folds`	`none`, `half`, `thirds`, `quarters`
`creases`, `scores`	`none`, or how many
`edges`	`clean`, `worn`, `torn`, `spiral` (torn from a spiral notebook)
`stains`	`none`, `coffee`, `water`, `smudge`, or several: `stains={coffee, smudge}`
`grooves`	`none`, or 0 to 1: the pen's strokes pressed into the paper
`backside`	`writing` (the back is written on and shows through), `none`
`curl`	`none`, or 0 to 1: edges or corners rolling up
`age`	`none`, or 0 to 1: yellowed, foxed, the ink faded

`reroll={angle, light=2}` draws the named parts again, keeping everything else (the number picks a different new one).

5 Commands

`\cacographypage{`***options***`}` how this one sheet looks and is shot, e.g. `\cacographypage{`crumple=0.8, stains=coffee, props=pen}.

`\crossout{`***text***`}` writes the text and strikes it out by hand, as this writer does: one wavering line, two lines, or a scribble. `\crossout`[line], [double] or [scribble] choose. Write the right words after it: `\crossout{`halves} doubles.

`\erased{`***old***`}{`***new***`}` writes *new* where *old* was written first and rubbed out: a faint ghost of the old word under it (and its grooves in the paper), the paper a little grey and roughed up there, a few eraser crumbs nearby. The words after it keep the old word's room. Made

for `ink=pencil`; on a well-used pencil page (high `wear`) a word is now and then rubbed out and rewritten on its own.

`\cacographynote{`***text***`}` a small note in the left margin beside its line; `\cacographynote*` adds an arrow to the place it was written; `\cacographynote`[right] puts it in the right margin.

`\reroll{`***words***`}` writes just these words again with a new seed; `\reroll`[2], [3], … give further versions.

`\underline`, `\boxed`, `\fbox` are drawn by hand, along the slope the words were written at.

6 Drawings

TikZ and pgfplots figures are drawn again by hand: every line and curve one pen stroke, arrow tips flicked on, dashes as separate dashes, labels in handwriting where TeX put them (turned ones turned). Plots are cut to their axes as pgfplots clips them; shaded areas are hatched, closer for a darker grey and crossed when very dark; pale grid lines are ruled thin; round plot marks are filled in with a small spiral. Included images (`\includegraphics`) are not redrawn.

7 Good to know

- TeX lays the text out with handwriting proportions (letters 10% wider, word gaps 2.3 times wider), so lines break where a hand would; handwriting that still runs long moves a line down rather than overlapping.
- One document is shot in one room: desk, lamp and phone stay the same on every page, while each sheet lies, is handled and is framed in its own way.
- A word written badly can be fixed alone with `\reroll`; nothing else on the page changes.
- The renderer needs `latinmodern-math.otf` from your TeX distribution.



Some of the cloth backgrounds, woven thread by thread.