Accessibility in LaTeX

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The status quo

- Pure mathematics uniquely only requires imagination
- LaTeX makes beautiful documents
  - "Mostly"
- STEM subjects naturally contain equations
  - 50-100 maths elements per page!
- Screen readers and other Assistive Technologies (AT) cannot parse equations
- https://youtu.be/oCTsAqZqm9A?t=262

Other teaching tools

- https://vimeo.com/1101373386/0242dabc46?fl=pl&fe=cm

- Less mathematically dense subjects
- New subjects

[ADD YOUR WELCOME MESSAGE HERE - Can be text, video or audio]

To read an overview for the subject, go to the Subject Overview page.

To see the components of this subject, go to Modules

Below is an equation:

$a^2 + b^2 = c^2$

Theorem:

If $\triangle ABC$ has a right angle $\angle C = 90°$ then the above equation holds.

Theorem:

If x solves the equation $ax^2 + bx + c = 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Here are the solutions to the previous exercise sheet.

test-document.pdf ⤓

test-document-1.pdf ⤓

STEM Research

- Much more mathematically dense
- Longer
- Dissemination through ArXiv/Journals (in PDF format)
- ATs for HTML/Markdown require knowledge of LaTeX anyway
- LLMs/OCR are not sufficient
  - Generating alt-texts

C_K such that

$$|G_0(x;y)| \leq C_K \rho_0(y) \quad (2.13)$$

for $x \in K, y \in M^\circ$ with $\rho_0(y) \ll \min_{x \in K} \rho_0(x)$.

Proof. For each fixed $x_0 \in M^\circ$ and $y \in \partial M$ we have

$$G_0(x_0, y)|_{y \in \partial M} = 0 . \quad (2.14)$$

Now, because $G_0(x_0; y)$ is smooth for each fixed $x_0 \in M^\circ$ and $y \in \partial M$, by applying Taylor's theorem in its integral from to the function $G_0(x_0; \cdot)$, it follows that at $y = (\rho_0(y), \theta(y))$

$$G_0(x_0; y) = \rho_0(y) \int_0^1 \frac{\partial G_0(x_0; t\rho_0(y), \theta(y))}{\partial \rho_0(y)} dt .$$

Hence, there is a positive constant C_{x_0} such that

$$|G_0(x_0; y)| \leq C_{x_0} \rho_0(y)$$

for $y \in M^\circ$ such that $\rho_0(y) \ll \rho_0(x_0)$. If $K \Subset M^\circ$ is compact, we can take $C_K = \max_{x \in K} C_x$, then

$$|G_0(x; y)| \leq C_K \rho_0(y)$$

for $x \in K, y \in M^\circ$ with $\rho_0(y) \ll \min_{x \in K} \rho_0(x)$. □

We will now give a decomposition of the Green's function $G_0(x; y)$ into a sum of a *principal Green's function* $G_{0,\text{prin}}(x; y)$ and *remainder Green's function* $G_{0,\text{rem}}(x; y)$.

DEFINITION 2.8. *Assume without loss of generality that $(M \setminus M_\delta, \bar{g}_0)$ can be extended to some manifold $(\widetilde{M} \setminus M_\delta, \bar{g}_0)$ isometric to $(\mathbb{R}^2 \setminus \mathbb{D}_{1-\delta}, g_{\text{Euc}})$, and let $\Phi : \widetilde{M} \setminus M_\delta \to \mathbb{R}^2 \setminus \mathbb{D}_{1-\delta}$ be this isometry. For $x, y \in M \setminus M_\delta$ denote*

$$|x| := |\Phi(x)| , \quad |x - y| := |\Phi(x) - \Phi(y)| , \quad \text{and} \quad \frac{x}{|x|^2} := \Phi^{-1}\left(\frac{\Phi(x)}{|\Phi(x)|^2}\right) \in \widetilde{M} \setminus M_\delta , \quad (2.15)$$

then define the distribution $G_{0,\text{prin}}(x; y) \in \mathcal{D}'(M \times M)$ *by*

$$G_{0,\text{prin}}(x; y) = \frac{\kappa(x; y)}{2\pi}\left[\log|x - y| - \log\left||x| \cdot \left(y - \frac{x}{|x|^2}\right)\right|\right] , \quad (2.16)$$

where $\kappa(x; y) = \kappa_1(x) \cdot \kappa_1(y) \cdot \kappa_0(x; y)$ *and* $\kappa_1 \in C^\infty(M), \kappa_0(x; y) \in C^\infty(M \times M)$ *are smooth cutoff functions on M with the properties that*

$$(2.17) \quad \begin{cases} \kappa_1(x) \equiv 1 & \text{if } \rho_0(x) \leq \delta/4 \\ \kappa_1(x) \equiv 0 & \text{if } \rho_0(x) \geq \delta/3 \end{cases} \quad \text{and} \quad \begin{cases} \kappa_0(x; y) \equiv 1 & \text{if } d_{\bar{g}_0}(x; y) < \delta/4 \\ \kappa_0(x; y) \equiv 0 & \text{if } d_{\bar{g}_0}(x; y) > \delta/3 \\ \kappa_0(x; y) \equiv \kappa_0(y; x) & \text{for all } x, y \in M. \end{cases}$$

Remark 2.9. The distribution

$$G_{0,\text{prin},\mathcal{A}}(z_1; z_2) = \frac{1}{2\pi}\left[\log|z_1 - z_2| - \log\left||z_1| \cdot \left(z_2 - \frac{z_1}{|z_1|^2}\right)\right|\right] \quad (2.18)$$

is the symmetric Green's function on the unit disc, with the properties of (2.11) for the Euclidean metric g_{Euc} [14, Section 2.2 Equation (41)]. We therefore have

Tagged PDF

- "New" standards add 'tagging support'
  - PDF 2.0 (Originally specified in 2017, clarified in 2020)
  - Complete mathematics support
  - LaTeX3/LaTeX tagging project (started 2018)
  - Proper support since August 2025

- Minimal author input required

- https://youtu.be/oCTsAqZqm9A?t=1288

"Minimal author input"

- TeXLive ≥2025.11
- LuaLaTeX
- 4 lines of code
  - \DocumentMetadata{uncompress, lang=en-AU, tagging=on, pdfstandard=ua-2,pdfstandard=a-4f}
- Alternate text for images
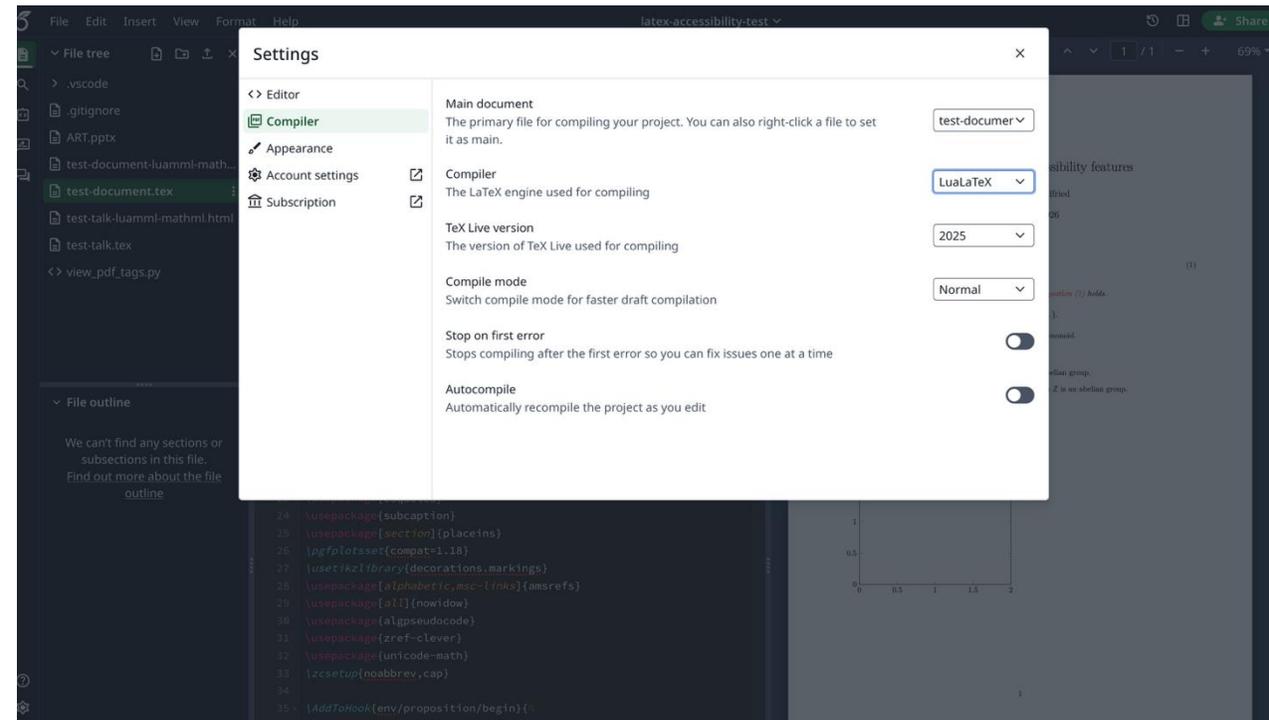
"Maximal author input"

- LaTeX has been expanded by packages and classes
  - **amsmath**
  - **hyperref**
  - etc
  - **article**
  - **amsart**
- >= 4000 packages total
  - ~1700 in the database
  - 747 fully compatible
  - 239 partially compatible

- Author needs to check compatibility
  - **amsart** (and its derivatives)
  - **beamer**
  - **tikz** (and its derivatives)
  - **cleveref**
- How many packages do you use?
  - Outdated (using base TeX)

How does a mathematician write mathematical documents

- Have a "starting document" or class with packages

- Copy this document every time you start a new project


```latex
\DocumentMetadata{uncompress,lang=en-GB,
  tagging=on,
  tagging-setup={math/setup=mathml-SE},
  pdfstandard=ua-2,pdfstandard=a-4f}

\documentclass{article}
\usepackage[british]{babel}
\usepackage{amsmath}
\usepackage{amsthm}
\usepackage{amssymb}
\usepackage{wasysym}
\usepackage{graphicx}
\usepackage{mathtools}
\usepackage[bottom]{footmisc}
\usepackage[a4paper, margin=1in]{geometry}
\usepackage[dvipsnames]{xcolor}
\usepackage[colorlinks=true,linkcolor=Red,citecolor=Green]{hyperref}
\usepackage{caption}
\usepackage[no-math]{fontspec}
\usepackage{tikz-cd}
\usepackage[depth=2]{bookmark}
\usepackage{pgfplots}
\usepackage{csquotes}
\usepackage{subcaption}
\usepackage[section]{placeins}
\pgfplotsset{compat=1.18}
\usetikzlibrary{decorations.markings}
\usepackage[alphabetic,msc-links]{amsrefs}
\usepackage[all]{nowidow}
\usepackage{algpseudocode}
\usepackage{zref-clever}
\usepackage{unicode-math}
\zcsetup{noabbrev,cap}

\AddToHook{env/proposition/begin}{%
    \zcsetup{countertype={definition=proposition}}}

\AddToHook{env/lemma/begin}{%
    \zcsetup{countertype={definition=lemma}}}
\AddToHook{env/remark/begin}{%
    \zcsetup{countertype={definition=remark}}}
\AddToHook{env/example/begin}{%
    \zcsetup{countertype={definition=example}}}
\AddToHook{env/corollary/begin}{%
    \zcsetup{countertype={definition=corollary}}}
\theoremstyle{plain}
\newtheorem{theorem}{Theorem}
\newtheorem*{theorem*}{Theorem}

\theoremstyle{definition}
\newtheorem{definition}{Definition}
\newtheorem{proposition}[definition]{Proposition}
```

Tips for making accessible documents

- Use LaTeX instead of "plain TeX"
  - **\(inline mathmode \)** instead of **$ inline mathmode $**
  - **\[display mathmode \]** instead of **$$ display mathmode $$**
- Give good descriptive alternative texts to figures
- Don't make paragraphs by newlines ****

- Remove any unnecessary packages/classes
  - **ltx-talk** instead of **beamer**
  - **article** instead of **amsart**
  - **zref-clever** instead of **cleveref**
  - Etc
- Use dyslexia-friendly fonts
- Use contrasting colours

One-time investment into making accessible documents

Using tagged PDFs

- PDF-readers such as Adobe Acrobat Reader and Foxit reader
- Screen readers also need support for MathML
  - NVDA + MathCAT add-on
  - https://www.nvaccess.org/download/
  - https://nvda-addons.org/addon.php?id=272
- Windows only ☹

Checking if the document is accessible

- The "new" pdf standard is still not widely supported
- Canvas accessibility checker
- Manually check with NVDA + MathCAT on a Windows PC
  - Unimelb has remote Windows desktops
  - https://rcp.research.unimelb.edu.au/
- **Don't make documents less accessible to satisfy Canvas!**

Make maths accessible to everyone!

- Find more information and documentation and discussion
  - https://latex3.github.io/tagging-project/
  - https://github.com/latex3/tagging-project
  - https://www.reddit.com/r/LaTeX/
    - https://www.reddit.com/user/u_fischer/