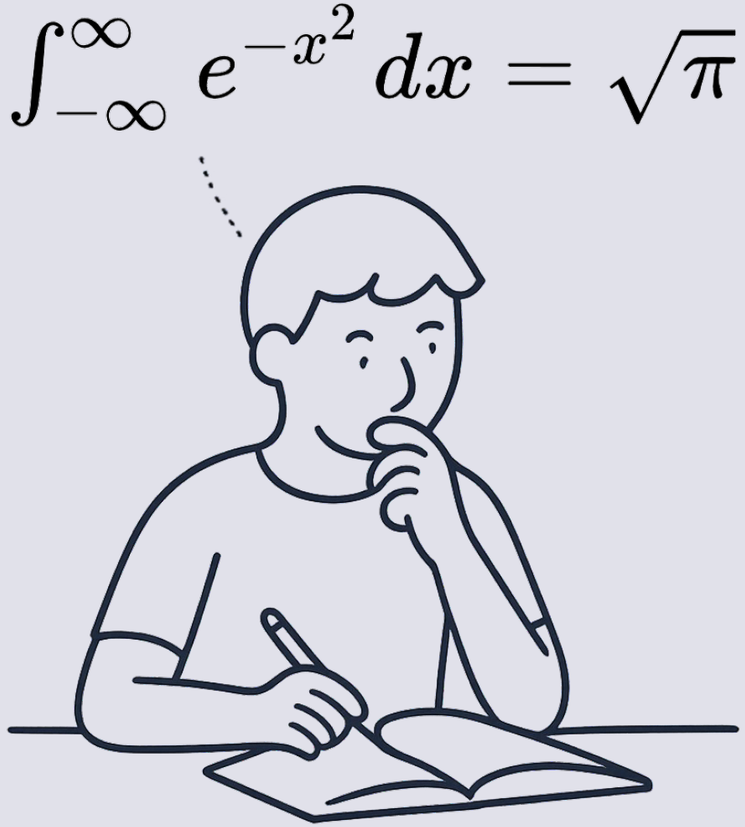
A Practical Guide to Accessible Math



Presenters

- **John Williams**, Consultant
  Digital Accessibility Services (DAS)
- **Nicholas McNab**, Specialist
  Assistive Technology Center (ATC)

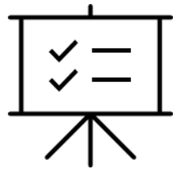
Digital Accessibility Services
Harvard University Information Technology

Harvard
Assistive Technology Center

Icebreaker

What are the biggest challenges you face (or think others might face) in making math accessible?

Agenda



1. **The Problem**
   Standard processes, bottlenecks, and gaps.
2. **Our Approach**
   Focus on formats and widely available tools.
3. **Limitations & Next Steps**

The Problem

Traditional Math Workflows Lack Accessibility.

LaTeX → PDF Only

Most faculty author in LaTeX and compile to PDFs. Even when these PDFs are tagged, the math itself consists of glyphs and symbols that carry no semantic information.

Math as Images with alt text

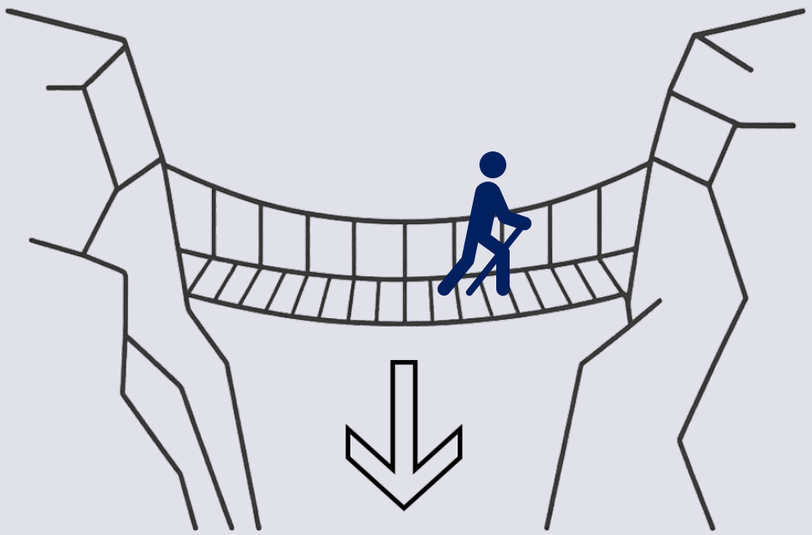
Some users try inserting plain text descriptions, but this lacks true semantic navigation, and is a poor substitute for proper math content

Assistive Technologies Require Properly Encoded Content

Students using screen readers or reading tools cannot reliably navigate or review the math in PDF/image-only format.

LaTeX → PDF Demo

- Show LaTeX document
- Show PDF



The Gap

Authors Unaware

Many faculty are open to doing the right thing, but do not know how to create accessible math materials.

Missing Guidance

Until now, DAS has not provided concrete, end-to-end guidance for math accessibility workflows.

This is the gap we are addressing, and this presentation outlines our solution.

Collaborative Solution

Assistive Technology Center (**ATC**) + Digital Accessibility Services (**DAS**)

In the spirit of accessibility, we asked:

- What **formats** really work with screen readers and assistive technologies?
- Which **authoring tools** are already available to every instructor?
- What are **realistic “low-lift" workflows** that faculty can adopt now?

Accessible Formats

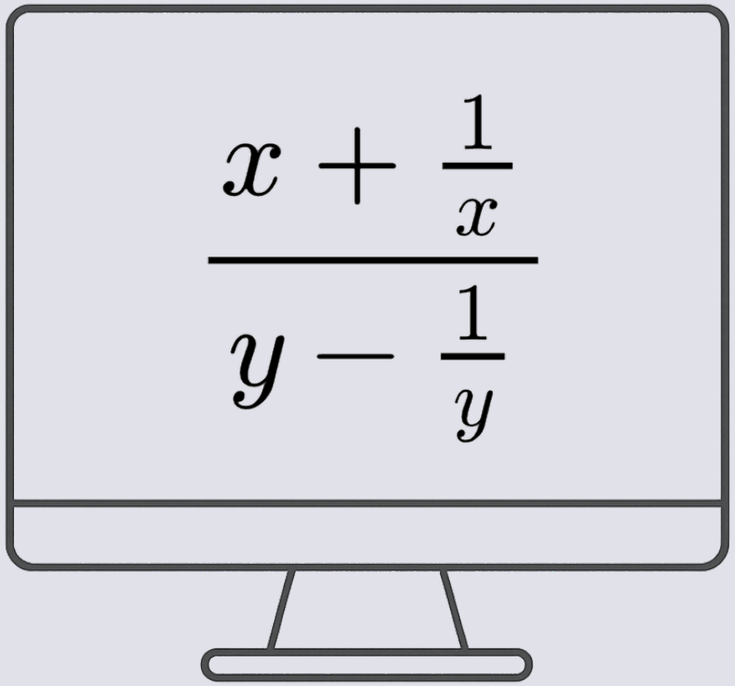
We focus on formats that are fully navigable with screen readers and preserve math as real math, not just images or plain text.

1. HTML with MathML

Expressions encoded as MathML in the browser, navigable by screen readers and reading tools.

2. Word/DOCX with OMML

Microsoft 365 documents using the built-in equation editor store math as OMML, accessible to many assistive technologies.



Key Tools, No New Purchases

- Recommend workflows use tools faculty already have access to.
- Meet them where they are rather than asking them to adopt a new platform.

Canvas

- The LMS already in use.
- Includes a built-in equation editor, supports a subset of LaTeX notation
- Powered by MathJax scripts that create MathML automatically.

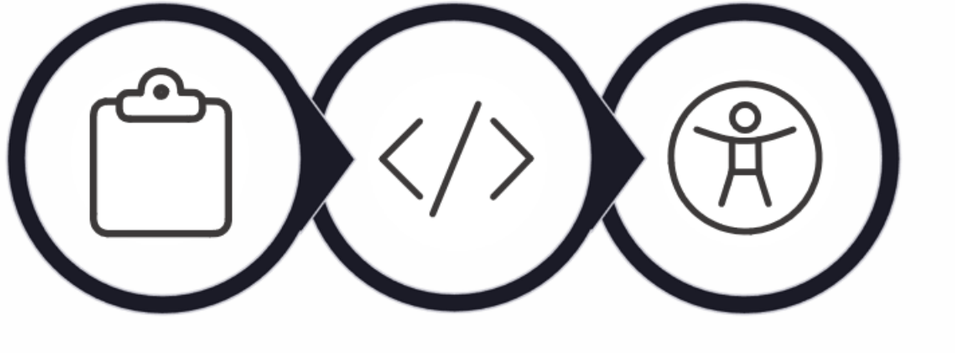
Word/DOCX

- Includes a native equation editor.
- Stores math as OMML.
- No plugins or add-ons required.

Pandoc

- Open-source document converter.
- LaTeX users can author once, and then output to multiple accessible formats
- Flexible, customizable, and can run in browser

Canvas Workflow



1. Copy/Paste LaTeX
2. MathJax Renders
3. Supports Assistive Tech

- For instructors who already use Canvas, this workflow does not require any new tools.
- Use headings, lists, and other Rich Content Editor features to provide document structure alongside the math.

Word/DOCX Workflow

For problem sets, exams, and handouts authored in Word, the built-in equation editor is the key to accessible math.

01

Use the Built-In Equation Editor

Use the native equation editor in Word, or paste supported LaTeX directly into it. Avoid inserting images of equations.

02

Math Stored as OMML

Word automatically stores equations as **Office Math Markup Language** (OMML) inside the document, preserving math structure.

03

Apply Styles, Check Accessibility

Use Word heading styles, lists, and tables for document structure. Run the built-in Accessibility Checker before distributing.

Canvas and Word Demos

- Equation Editors
- Listen with screen reader

Bridging LaTeX with Pandoc

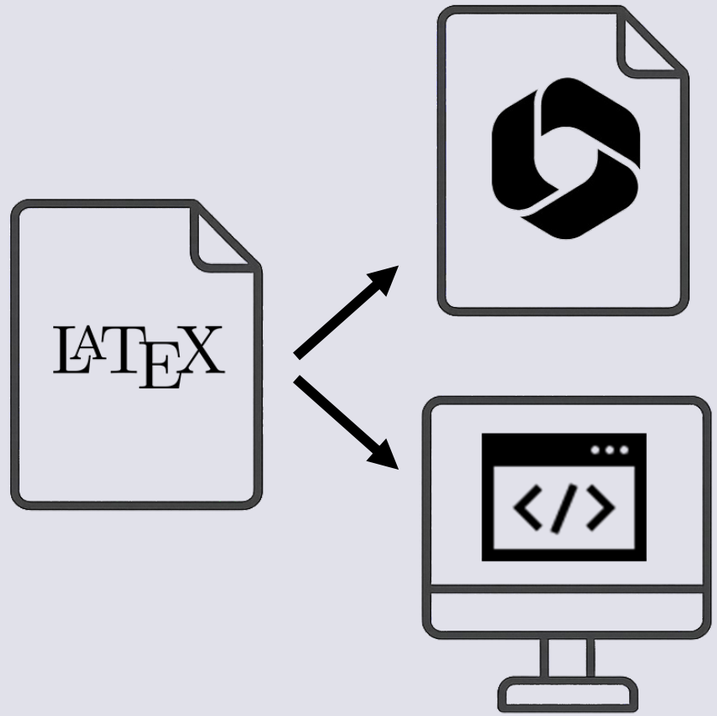
For faculty who currently create LaTeX content for students, there is no need to abandon the authoring environment you know. Pandoc acts as a bridge to accessible output formats.

Author in LaTeX

- Continue working in .tex files as you always have.
- Goal is to author once, convert to multiple formats as needed

Convert to Accessible Formats

- Convert .tex files into:
  - HTML with MathML
  - DOCX with OMML

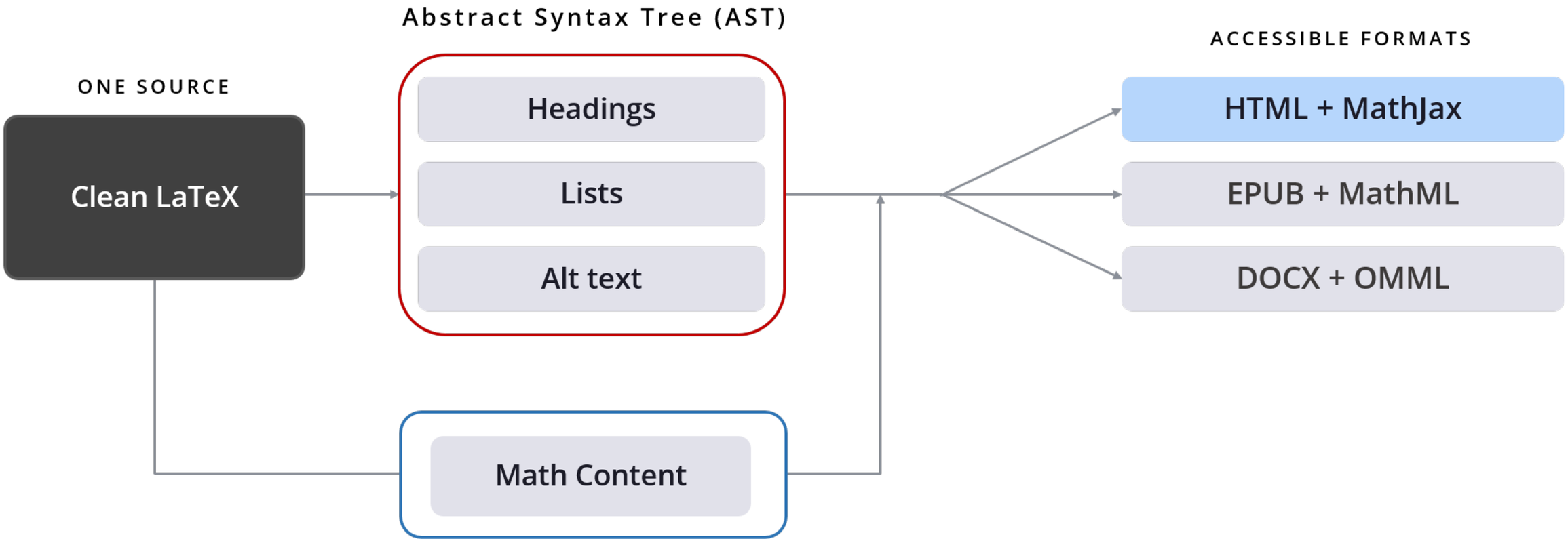


Pandoc Demo

- Converting LaTeX to HTML
- Pandoc math options
- DOCX and EPUB output

Refine One Source, Reach Every Format

Faculty refine one LaTeX source. Pandoc maps its structure into every format it writes — so authoring it well once reaches them all.



Pandoc Fixing minor issues - Demo

- Headings
- Ordered lists
- Language attribute

Why Not Just Fix the PDF?

Progress With PDF 2.0

- Significant improvements to structured, tagged PDFs, including math.
- This is genuine progress worth acknowledging.

But Challenges Remain

- Producing well-tagged, math-rich PDF requires an experimental LaTeX toolchain and configuration.
- Support for different reading tools and assistive technologies still inconsistent for math.

The "Plus-One" Strategy

(Tobin & Behling, 2018)

Provide the PDF **plus** at least one format that exposes math as MathML or OMML, such as HTML or Word.

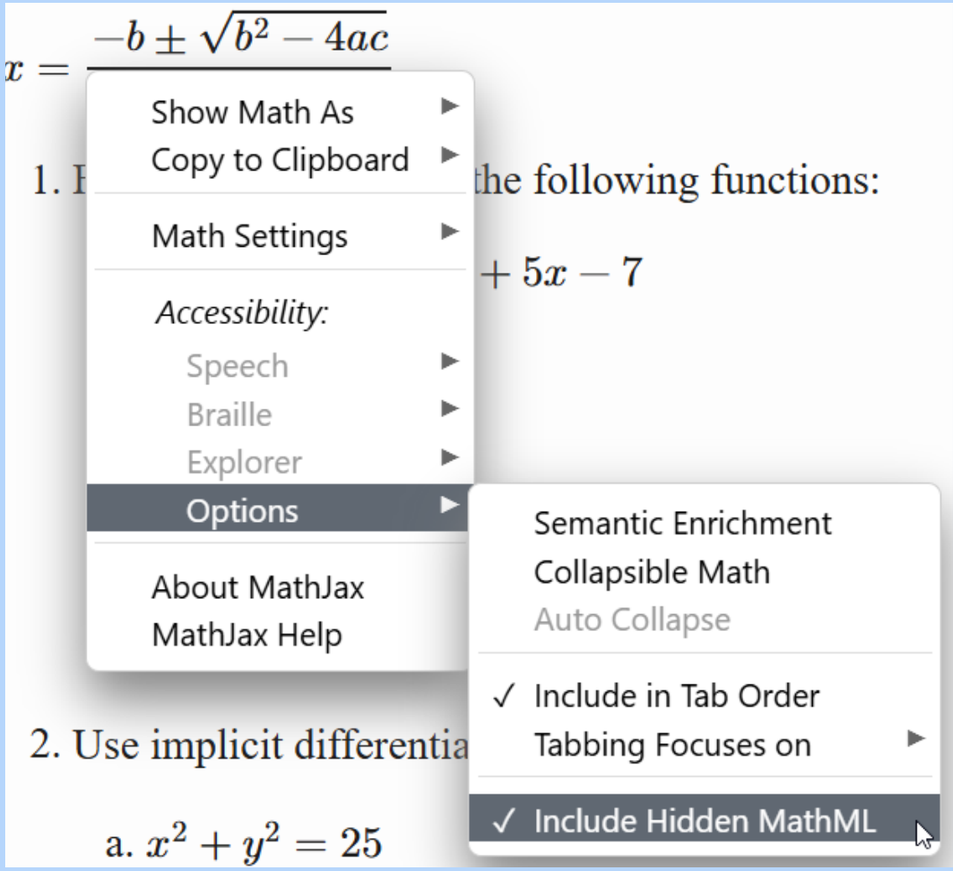
A Closer Look at MathJax

Why we lean on it

- Covers a wide range of math
- Can reach a wide range of students
- Makes proofing easy for faculty

What to watch for

- Usually requires internet access
- Canvas LMS still uses old version
- Help MathCAT users activate “Hidden MathML”



[Note: Hidden MathML and Speech subtitles are not available at the same time in version 4, but Hidden MathML allows reading via MathCat options in place of MathJax]

Extending Pandoc via Filters - Demo

- How to use a Pandoc filter
- What they can help you with

Current Scope and Future Work

What We're Covering Now

⟶ Standard LaTeX and Office-based workflows.

⟶ Canvas, Word, and Pandoc as the core tools.

⟶ Practical guidance for the most common faculty use cases.

Future Explorations

⟶ Build custom toolkit/platform that bundles Pandoc with preprocessing scripts and custom filters

⟶ Continue to track PDF 2.0 support for MathML and to experiment with LaTeXML

⟶ Explore authoring Markdown and PreTeXt

Takeaways

1 Math Is Structured

- Math accessibility is more than alt text or PDF 2.0 tags.
- It requires formats that preserve and expose math structure.

2 Low-lift Solutions

- Basic LaTeX notation or equation editors in Canvas and DOCX
- Converting LaTeX with Pandoc are all practical options available now.

3 Guidance Is Key

- Check if your institution has guidance for accessible math content, make sure it reflects current best practices
- Identify faculty and accessibility partners who can work on practical, tool-specific guidance.

Visit the DAS Website

Find the Practical Guide to Accessible Math and supporting resources at the DAS website.

Contact Us

Email digitalaccessibility@harvard.edu

or atc@fas.harvard.edu

Resources

Canvas, Word, and Pandoc

- Accessible Math, Harvard Digital Accessibility Services
- Use the Equation Editor in the Canvas
  - Math Expressions Using LaTeX
  - Chemistry Using LaTeX
- Microsoft OMML
- Linear equations using LaTeX in Word
- Make math inclusive for everyone with Microsoft365
- Pandoc for the people (public web app)
- Download and install Pandoc locally
- Pandoc manual

Additional Tools and Resources

- Indiana University math converter (for previewing math)
- MathCat Demo (test how math will read in NVDA and JAWS)
- MathJax Documentation (for developers)
- Overleaf: Learn LaTeX in 30 minutes
- Learn LaTeX: 16 short lessons
- Mathpix (optical character recognition for math content)
- Quarto (Markdown-based authoring tool, uses Pandoc
- PreTeXt (alternative XML-based authoring system)
- LaTeXML (alternative LaTeX/XML conversion tool)