

LaTeX to Braille

**Solutions for the automatic
transcription of math in braille
with 6 and/or 8 points &
automatic conversion system
from, amongst and for latex to
mathml and braille**

JULY 2021

PROGETTO DDMATH

**Digital learning in mathematics
for blind students**

ERASMUS+ Program

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of the European Union



DDMATH

ERASMUS+ Program

DDMATH PROJECT

Digital learning in mathematics for blind students

LaTeX to Braille

Solutions for the automatic transcription of math in braille with 6 and/or 8 points & automatic conversion system from, amongst and for latex to mathml and braille.

July 2021

Project within the ERASMUS+ program – School Education Gateway – Action KA2 -
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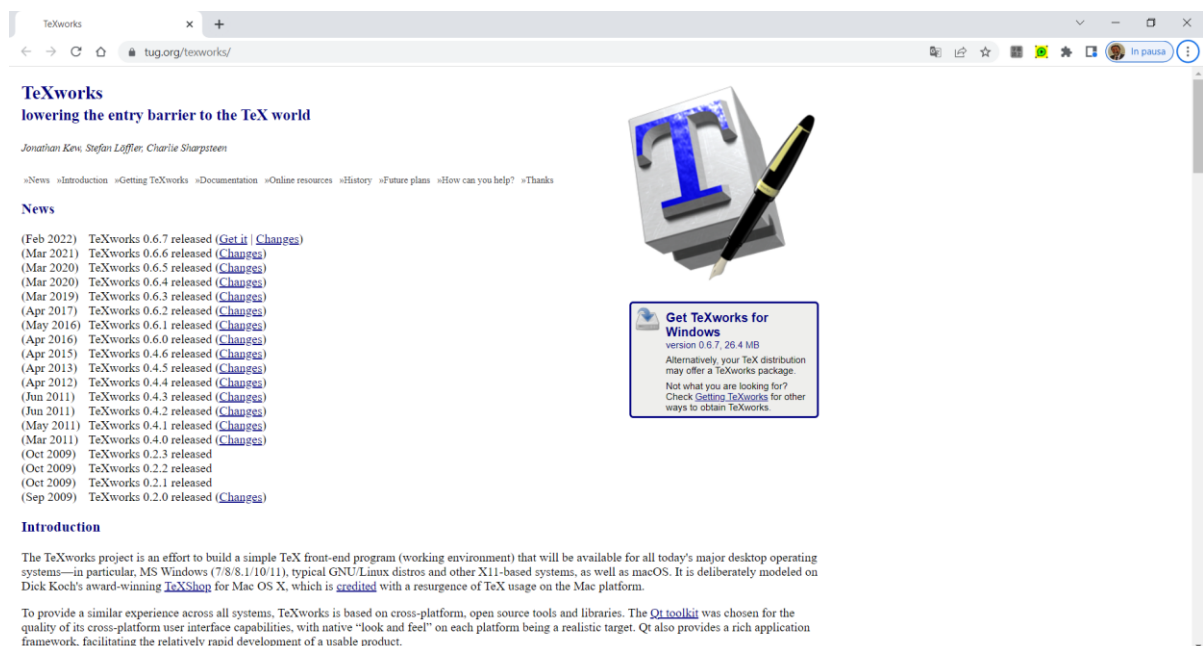
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1 INTRODUCTION

1.1 LATEX

<https://tug.org/texworks/>

TeX is a complex program that resembles a programming language, but actually isn't. What it does is processing a series of strings from an input source and, hopefully, developing it into a well layed-out document to print or look at, on screen. The TeXworks project is an effort to build a simple TeX front-end program (working environment) that will be available for all today's major desktop operating systems. TeXworks includes an integrated PDF viewer.



The screenshot shows the TeXworks website homepage. At the top, the title is "TeXworks" with the subtitle "lowering the entry barrier to the TeX world". Below this, there is a navigation menu with links for "»News", "»Introduction", "»Getting TeXworks", "»Documentation", "»Online resources", "»History", "»Future plans", "»How can you help?", and "»Thanks". A "News" section lists various releases from 2009 to 2022, each with a date and a link to "Changes". To the right of the news list is a large image of a 3D letter 'T' with a pen nib pointing at it. Below the image is a box titled "Get TeXworks for Windows" with version 0.6.7 and a size of 26.4 MB. The box also mentions that the Windows distribution may offer a TeXworks package and provides a link to "Get it" for more information. At the bottom of the page, there is an "Introduction" section that describes the TeXworks project as an effort to build a simple TeX front-end program (working environment) that will be available for all today's major desktop operating systems—in particular, MS Windows (7/8/8.1/10/11), typical GNU/Linux distros and other X11-based systems, as well as macOS. It is deliberately modeled on Dick Koch's award-winning TeXShop for Mac OS X, which is credited with a resurgence of TeX usage on the Mac platform. The introduction also mentions that TeXworks is based on cross-platform, open source tools and libraries, and that the Qt toolkit was chosen for the quality of its cross-platform user interface capabilities, with native "look and feel" on each platform being a realistic target. Qt also provides a rich application framework, facilitating the relatively rapid development of a usable product.

1.2 MATHML

<https://www.mathmlcentral.com/Tools/ToMathML.jsp>

The screenshot shows a web browser window with the URL `mathmlcentral.com/Tools/ToMathML.jsp`. The page title is "Convert Expression to MathML". The interface includes a sidebar with navigation links such as "Render MathML...", "Convert Expression to MathML", "Validate MathML", "Plot MathML", and "Integrate MathML". The main content area contains instructions: "Enter an expression in the text area below or choose a randomly selected expression, and then click the Generate button to produce the MathML." Below this, there is a dropdown menu set to "TraditionalForm" and a button labeled "Enter Expression or choose Random Expression". A text input field contains the expression `cos(x^3)`. At the bottom of the main area, there is a "GENERATE" button and a "results" link.

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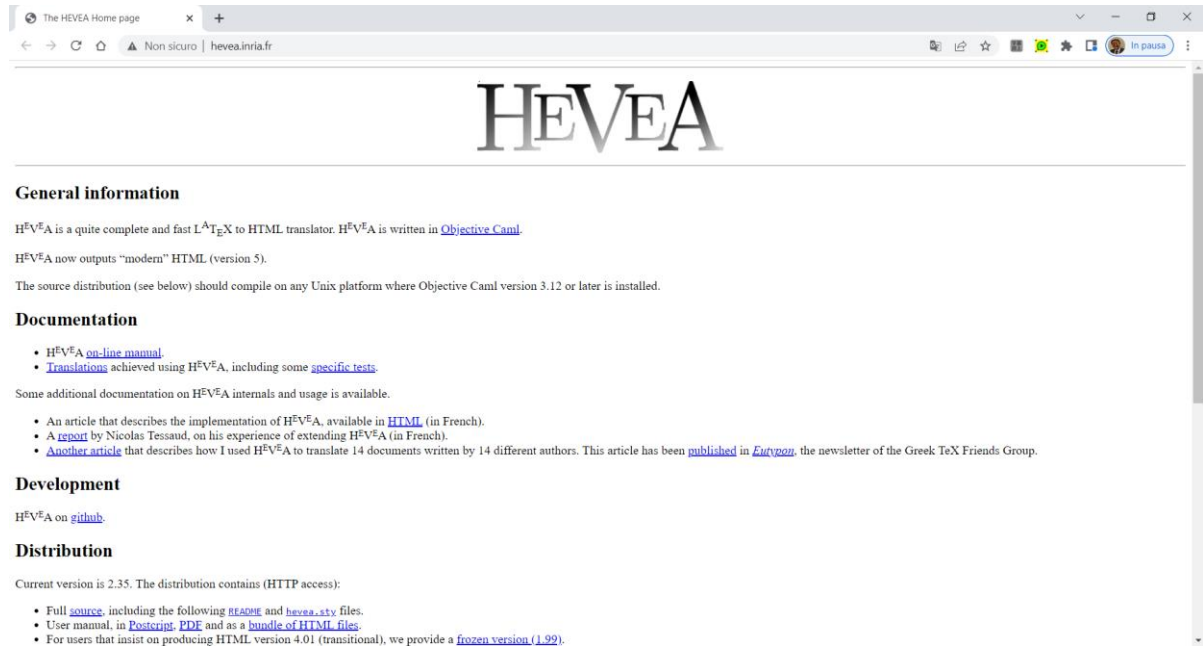
The MathML (acronym of Mathematical Markup Language) is a web language used to represent symbols and math formulas, which also allows to assign a semantic meaning to formulas. It has been derived from XML, as a specification of the W3C workgroup regarding mathematics. MathML not only deals with the presentation but also with the components meaning of formulas. Numerous programs are available, that can convert math expressions into MathML, that includes also converters between TEX and MathML. Additionally, Wolfram Research make a program that can convert mathematical expressions into MathML. Among the major browsers, those that directly support the format are the recent versions of Mozilla and its derivatives, Opera versions starting from 11.60 and Google Chrome, from version 24.

There are external plugins that allow to use the format with also other browsers; Internet Explorer, for example, supports it through MathPlayer. MathML is also supported by office software like Apple suite (Pages, Keynote, Numbers), LibreOffice and Microsoft Word, and by math software, such as Mathematica.

2 RELATED WORK

2.1 HEVEA

<http://hevea.inria.fr/>



The screenshot shows the HEVEA homepage in a web browser. The browser's address bar displays 'hevea.inria.fr'. The page features the HEVEA logo at the top. Below the logo, there are sections for 'General information', 'Documentation', 'Development', and 'Distribution'. The 'General information' section states that HEVEA is a complete and fast L^AT_EX to HTML translator, written in Objective Caml, and outputs modern HTML (version 5). The 'Documentation' section lists links to an on-line manual, translations, and additional internal documentation. The 'Development' section mentions a GitHub repository. The 'Distribution' section provides details about the current version (2.35) and offers links to the full source, user manual, and a frozen version (1.99).

HEVEA is a quite complete and fast L^AT_EX to HTML translator. HEVEA is written in Objective Caml. HEVEA now outputs “modern” HTML (version 5). The source distribution should compile on any Unix platform where Objective Caml version 3.12 or later is installed.

2.2 LATEXML

<https://math.nist.gov/~BMiller/LaTeXML/>



The screenshot shows a web browser window displaying the LaTeXML website. The browser's address bar shows the URL math.nist.gov/~BMiller/LaTeXML/. The website has a purple header with the LaTeXML logo and a cat illustration. The main content area is titled "LaTeXML A LaTeX to XML/HTML/MathML Converter" and includes the following text:

Now available: [LaTeXML 0.8.6!](#)

In the process of developing the [Digital Library of Mathematical Functions](#), we needed a means of transforming the LaTeX sources of our material into XML which would be used for further manipulations, rearrangements and construction of the web site. In particular, a true 'Digital Library' should focus on the *semantics* of the material, and so we should convert the mathematical material into both content and presentation MathML. At the time, we found no software suitable to our needs, so we began development of LaTeXML in-house.

The approach is to emulate TeX as far as possible (in Perl), converting the TeX or (LaTeX) document into LaTeXML's XML format. That format is modelled on the typical document structure found in LaTeX, and inspired by HTML, MathML, OpenMath and others. That abstract document is then further transformed into HTML of various flavors, with MathML and SVG, or into JATS or ePub or Of course, emulating TeX is kinda hard, there are many clever LaTeX package developers, and the Web moves quickly, so there are gaps in fidelity and coverage.

Examples of LaTeXML's work include:

- [LaTeX tabular](#) from the LaTeX manual, p.205. ([TeX](#), [PDF](#))
- [DLMF](#) The Digital Library of Mathematical Functions was the primary instigator for this project.
- [LaTeXML Manual](#) The LaTeXML User's manual ([PDF](#)).

These pages were produced using LaTeXML, as well.

See also

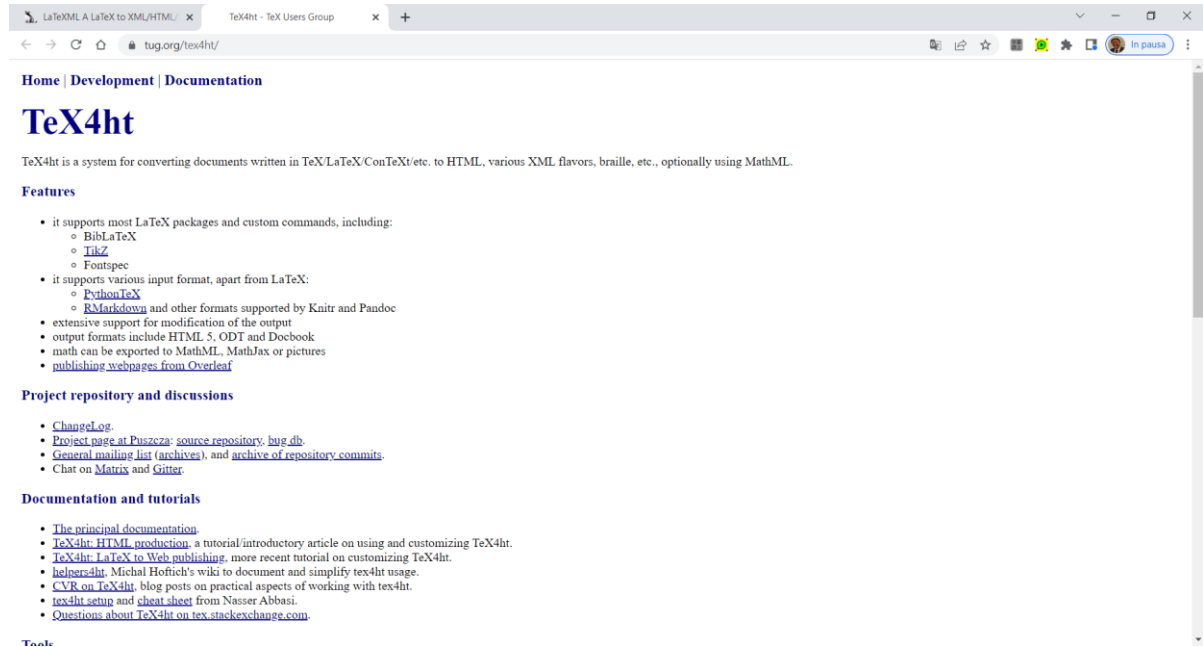
- <https://latexml.mathweb.org/editor> an online editor/showcase of things that LaTeXML can do.
- <https://arxiv.kuarc.info> An experiment processing the entire <https://arxiv.org>.

[Usage](#)

The approach is to emulate TeX as far as possible (in Perl), converting the TeX or (LaTeX) document into LaTeXML's XML format. That format is modelled on the typical document structure found in LaTeX, and inspired by HTML, MathML, OpenMath and others. That abstract document is then further transformed into HTML of various flavors, with MathML and SVG, or into JATS or ePub or Of course, emulating TeX is kinda hard, there are many clever LaTeX package developers, and the Web moves quickly, so there are gaps in fidelity and coverage.

2.3 TEX4HT

<https://www.tug.org/tex4ht/>

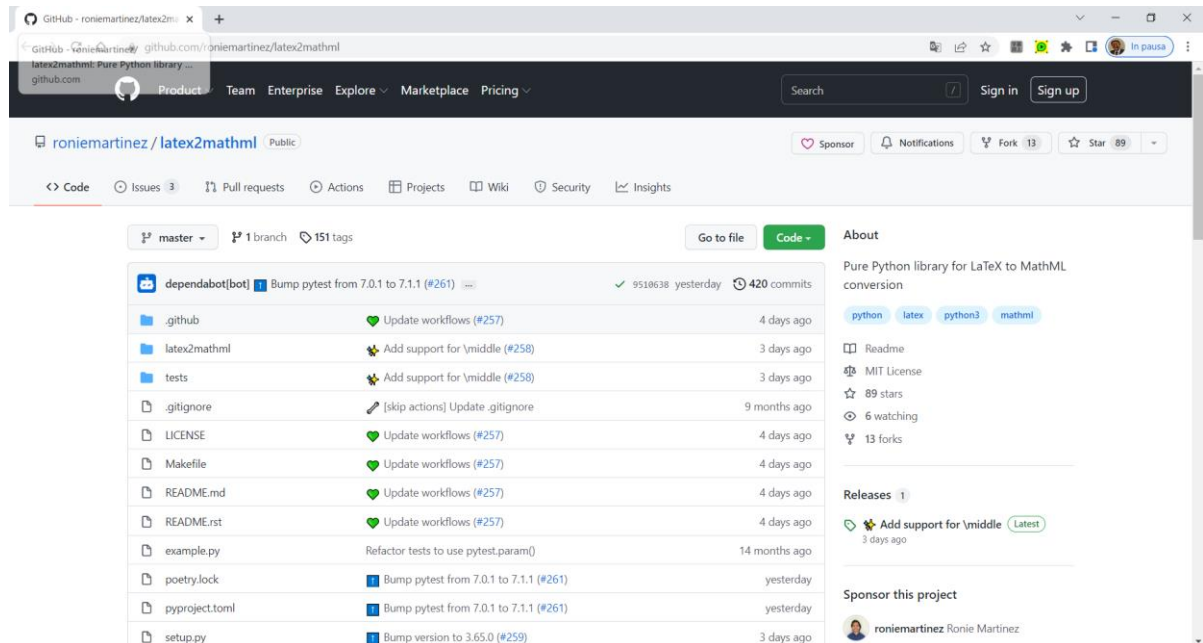


The screenshot shows the TeX4ht website in a browser. The page has a navigation bar with links for Home, Development, and Documentation. The main heading is "TeX4ht". Below it, a paragraph states: "TeX4ht is a system for converting documents written in TeX/LaTeX/ConTeXt/etc. to HTML, various XML flavors, braille, etc., optionally using MathML." The "Features" section lists several capabilities, such as supporting most LaTeX packages and custom commands, and various input/output formats. The "Project repository and discussions" section provides links to ChangeLog, source repository, mailing lists, and chat. The "Documentation and tutorials" section lists several resources, including the principal documentation, HTML production tutorial, and various help pages.

TeX4ht is a system for converting documents written in TeX/LaTeX/ConTeXt/etc. to HTML, various XML flavors, braille, etc., optionally using MathML.

2.4 LATEX2MATHML

<https://github.com/roniemartinez/latex2mathml>



The screenshot shows the GitHub repository page for `roniemartinez/latex2mathml`. The repository is public and has 151 tags and 420 commits. The main content is a list of files and folders with their commit history:

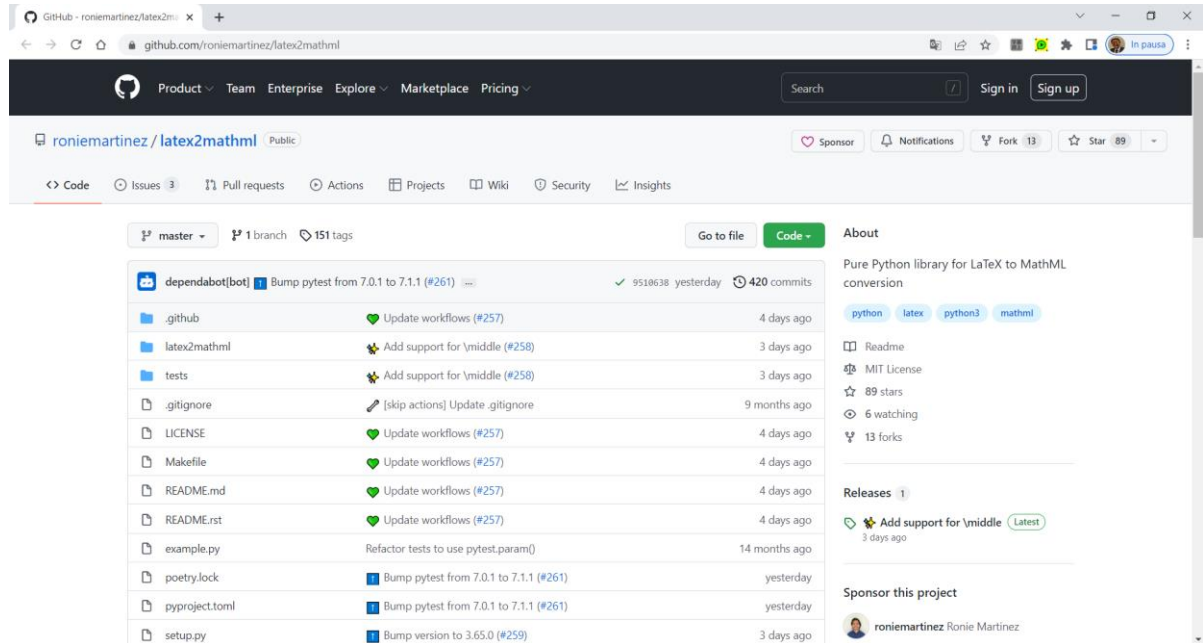
File/Folder	Commit Message	Time Ago
<code>.github</code>	Update workflows (#257)	4 days ago
<code>latex2mathml</code>	Add support for \middle (#258)	3 days ago
<code>tests</code>	Add support for \middle (#258)	3 days ago
<code>.gitignore</code>	[skip actions] Update .gitignore	9 months ago
<code>LICENSE</code>	Update workflows (#257)	4 days ago
<code>Makefile</code>	Update workflows (#257)	4 days ago
<code>README.md</code>	Update workflows (#257)	4 days ago
<code>README.rst</code>	Update workflows (#257)	4 days ago
<code>example.py</code>	Refactor tests to use pytest.param()	14 months ago
<code>poetry.lock</code>	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
<code>pyproject.toml</code>	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
<code>setup.py</code>	Bump version to 3.65.0 (#259)	3 days ago

The 'About' section on the right describes the repository as a 'Pure Python library for LaTeX to MathML conversion'. It includes tags for `python`, `latex`, `python3`, and `mathml`. The repository has 89 stars, 6 watchers, and 13 forks. The latest release is 'Add support for \middle' (Latest), released 3 days ago. The sponsor section shows 'roniemartinez Ronie Martinez' as the sponsor, updated 3 days ago.

Pure Python library for LaTeX to MathML conversion.

2.5 MATHCONVERTER

<https://github.com/oerpub/mathconverter>



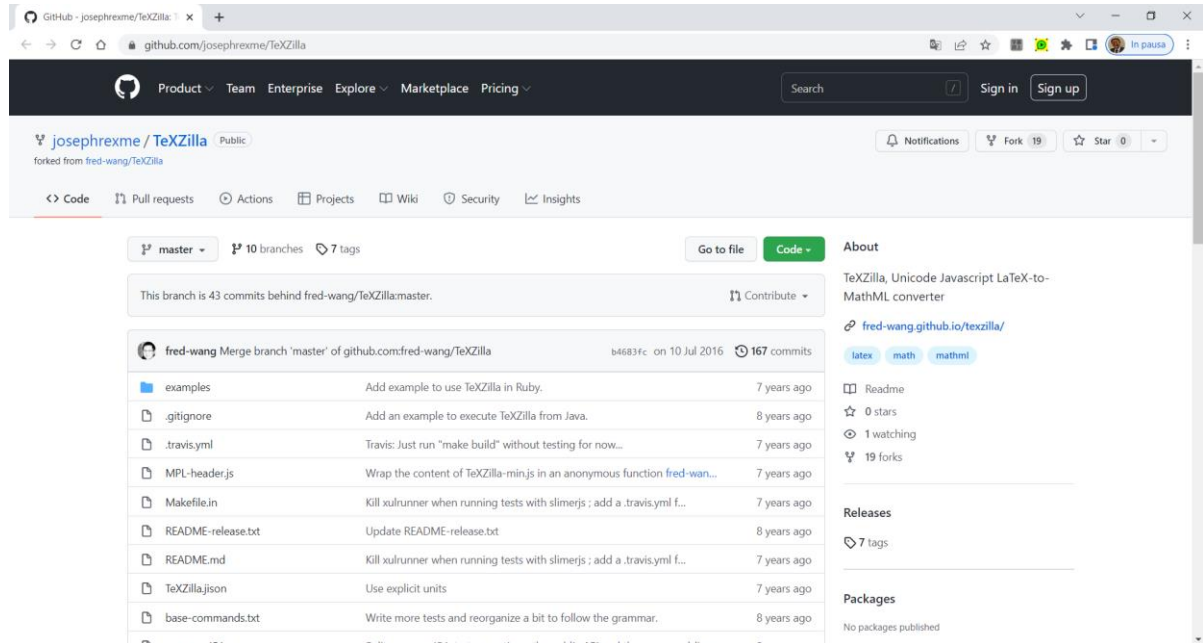
The screenshot shows the GitHub repository page for `roniemartinez/latex2mathml`. The repository is public and has 89 stars and 13 forks. The main content area displays a list of recent commits, including updates to workflows, support for `\middle`, and version bumps. The sidebar on the right provides information about the project, including its description as a "Pure Python library for LaTeX to MathML conversion", its license (MIT), and a list of releases.

File	Commit Message	Time
<code>dependabot[bot]</code>	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
<code>.github</code>	Update workflows (#257)	4 days ago
<code>latex2mathml</code>	Add support for <code>\middle</code> (#258)	3 days ago
<code>tests</code>	Add support for <code>\middle</code> (#258)	3 days ago
<code>.gitignore</code>	[skip actions] Update .gitignore	9 months ago
<code>LICENSE</code>	Update workflows (#257)	4 days ago
<code>Makefile</code>	Update workflows (#257)	4 days ago
<code>README.md</code>	Update workflows (#257)	4 days ago
<code>README.rst</code>	Update workflows (#257)	4 days ago
<code>example.py</code>	Refactor tests to use <code>pytest.param()</code>	14 months ago
<code>poetry.lock</code>	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
<code>pyproject.toml</code>	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
<code>setup.py</code>	Bump version to 3.65.0 (#259)	3 days ago

Converts from AsciiMath, LaTeX, MathML to LaTeX, MathML utilizes MathMLCloud (for MathML output) and XSL transforms.

2.6 TEXZILLA

<https://github.com/josephrexme/TeXZilla>



The screenshot shows the GitHub repository page for `TeXZilla`, which is a fork of `fred-wang/TeXZilla`. The repository is public and has 10 branches and 7 tags. The current branch is `master`, which is 43 commits behind `fred-wang/TeXZilla:master`. The repository was merged by `fred-wang` on 10 Jul 2016, with 167 commits. The file list includes:

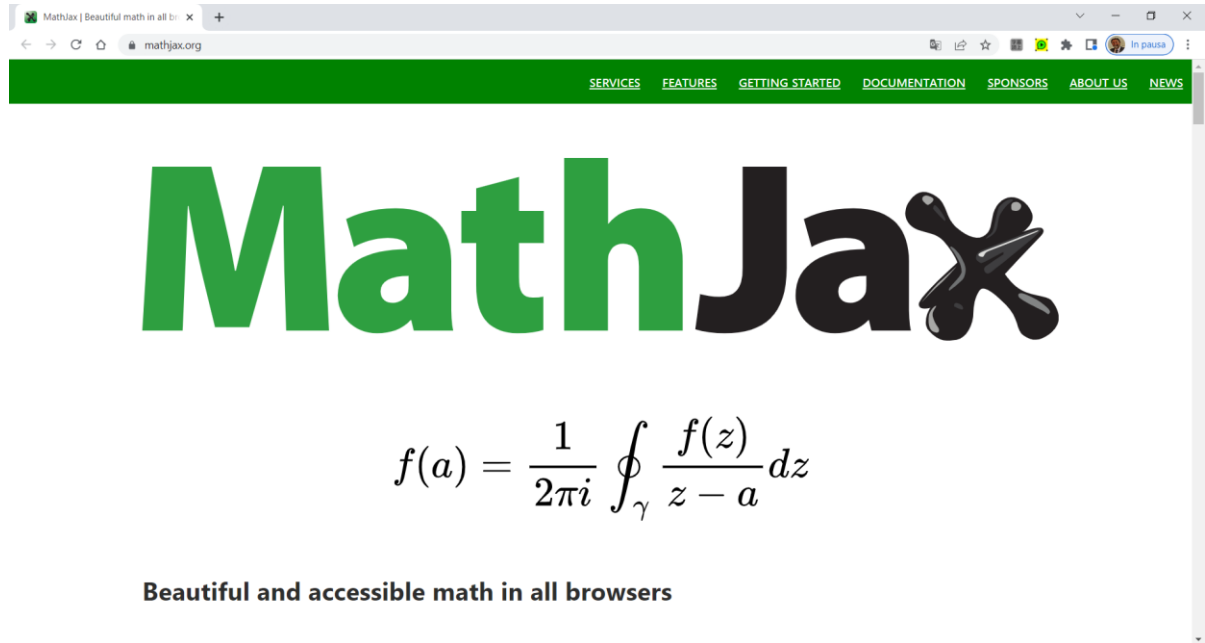
File	Description	Age
<code>examples</code>	Add example to use TeXZilla in Ruby.	7 years ago
<code>.gitignore</code>	Add an example to execute TeXZilla from Java.	8 years ago
<code>.travis.yml</code>	Travis: Just run "make build" without testing for now...	7 years ago
<code>MPL-header.js</code>	Wrap the content of TeXZilla-min.js in an anonymous function <code>fred-wan...</code>	7 years ago
<code>Makefile.in</code>	Kill xulrunner when running tests with <code>slimerjs</code> ; add a <code>.travis.yml</code> f...	7 years ago
<code>README-release.txt</code>	Update README-release.txt	8 years ago
<code>README.md</code>	Kill xulrunner when running tests with <code>slimerjs</code> ; add a <code>.travis.yml</code> f...	7 years ago
<code>TeXZilla.json</code>	Use explicit units	7 years ago
<code>base-commands.txt</code>	Write more tests and reorganize a bit to follow the grammar.	8 years ago

The right sidebar shows repository statistics: 0 stars, 1 watching, and 19 forks. It also lists releases (7 tags) and packages (No packages published).

TeXZilla is a Javascript LaTeX-to-MathML converter compatible with Unicode. This is still a work in progress and things may change in the future.

2.7 MATHJAX

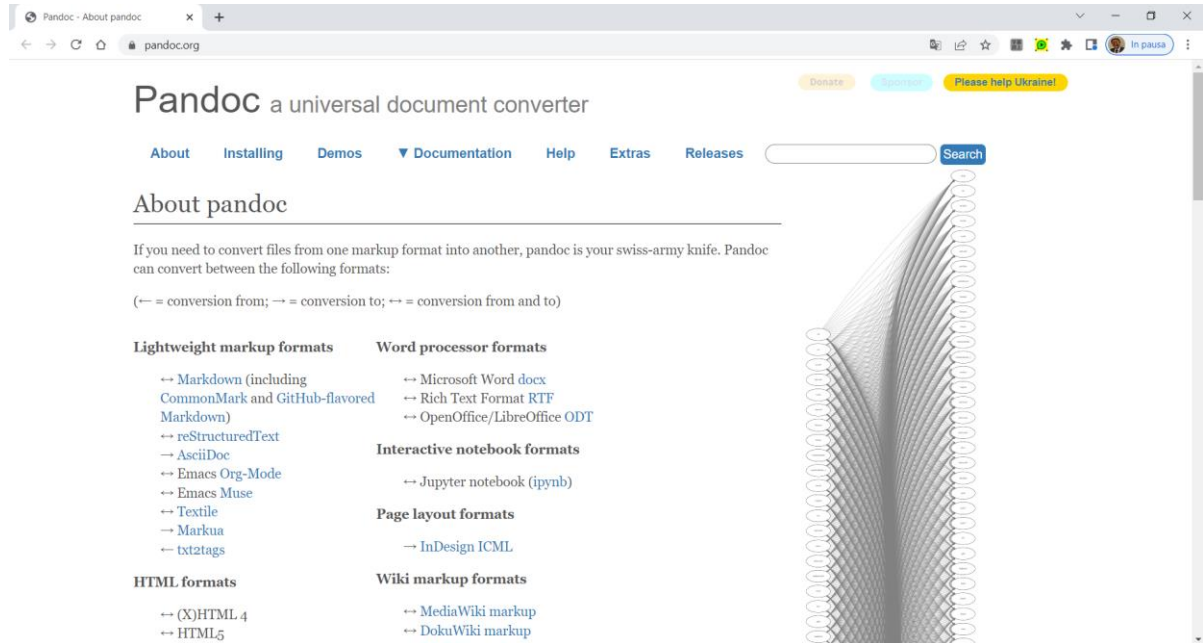
<https://www.mathjax.org/>



A JavaScript display engine for mathematics that works in all browsers. No more setup for readers. MathJax is highly modular on input and output. Use MathML, TeX, and ASCIImath as input and produce HTML+CSS, SVG, or MathML as output.

2.8 PANDOC

<https://pandoc.org/>

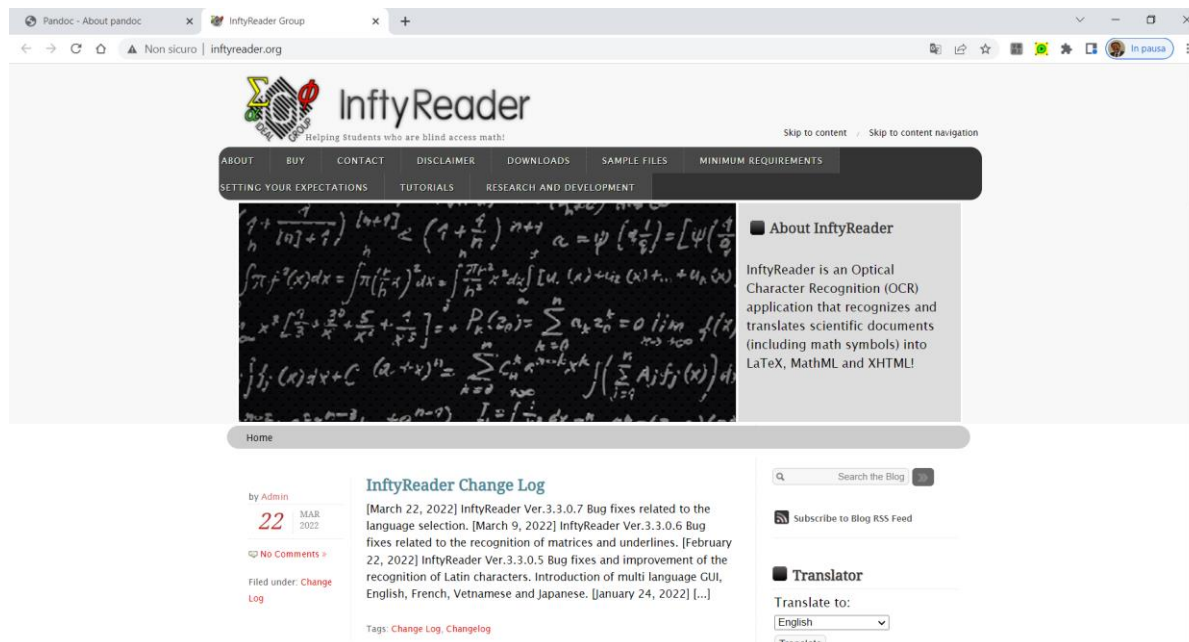


Pandoc understands a number of useful markdown syntax extensions, including document metadata (title, author, date); footnotes; tables; definition lists; superscript and subscript; strikethrough; enhanced ordered lists (start number and numbering style are significant); running example lists; delimited code blocks with syntax highlighting; smart quotes, dashes, and ellipses; markdown inside HTML blocks; and inline LaTeX. If strict markdown compatibility is desired, all of these extensions can be turned off. LaTeX math (and even macros) can be used in markdown documents. Several different methods of rendering math in HTML are provided, including MathJax and translation to MathML. LaTeX math is converted (as needed by the output format) to unicode, native Word equation objects, MathML, or roff eqn.

2.9 INFYREADER

<http://www.inftyreader.org/>

<https://www.sciaccess.net/en/InftyReader/>



The screenshot shows the InftyReader website homepage. At the top, there is a navigation menu with links: ABOUT, BUY, CONTACT, DISCLAIMER, DOWNLOADS, SAMPLE FILES, MINIMUM REQUIREMENTS, SETTING YOUR EXPECTATIONS, TUTORIALS, and RESEARCH AND DEVELOPMENT. Below the menu is a large image of mathematical formulas. To the right of the image is an 'About InftyReader' section. Below the image is a 'Home' section with a 'Change Log' entry dated March 22, 2022. On the right side, there is a search bar, a 'Subscribe to Blog RSS Feed' button, and a 'Translator' section with a dropdown menu set to 'English' and a 'Translate' button.

InftyReader is OCR software to recognize scientific documents including mathematical formulae. "InftyReader" converts PDF and scanned images to various types of accessible documents: LaTeX, XHTML(MathML), HRTeX, IML, Microsoft Word document, EPUB3, PDF with TeX and Chattybook (Audio HTML). For the scanned image files or Image PDF produced from scanned images, InftyReader uses OCR specially trained for STEM documents recognizing special math symbols and analyzing math structures. For e-born PDF, InftyReader uses a PDF parser rather than OCR, so the character recognition results are very accurate, not only for ordinary texts but also math symbols.

2.10 LIBLOUIS

<http://liblouis.org/>

Liblouis

The Liblouis software suite provides an open-source braille translator, back-translator and formatter for a large number of languages and braille codes. It is a set of libraries designed for use in any of a number of applications, both free and commercial. It is written in C so that it does not require a runtime environment and hence can be used in applications written in high-level languages such as Java and Python.

News

08 Mar 2022 [Liblouisutdml Release 2.11.0](#)
This minor Liblouisutdml release adds support for liblouis 3.20 and up.

07 Mar 2022 [Liblouis Release 3.21.0](#)
This release sees major updates for Hungarian and German. The Swiss Library for the Blind, Visually Impaired and Print Disabled has agreed to upstream their tables and Attila Hammer has adapted Hungarian to the latest standard. A bug in numeric mode was fixed which should make it more useful for languages other than UEB. Finally there are fixes for Norwegian and Danish.

06 Dec 2021 [Liblouis Release 3.20.0](#)

Braille translator and back-translator

Liblouis is an open-source braille translator and back-translator named in honor of **Louis Braille**. It features support for computer and literary braille, supports contracted and uncontracted translation for many languages and has support for hyphenation. New languages can easily be added through tables that support a rule- or dictionary based approach. Tools for testing and debugging tables are also included. Liblouis also supports math braille (Nemeth and Marburg).

Liblouis has features to support screen-reading programs. This has led to its use in numerous open-source and proprietary screenreaders such as **NVDA**, **Orca**, **BrailleBack** and **JAWS**. It is also used in some commercial assistive technology applications for example by **ViewPlus**.

Liblouis is the translator of choice for Benetech's **Bookshare**, providing braille access to more than 350,000 books to members worldwide. Bookshare currently offers titles in braille in more than a dozen languages, with the ability to quickly add new languages as

The Liblouis software suite provides an open-source braille translator, back-translator and formatter for a large number of languages and braille codes. It is a set of libraries designed for use in any of a number of applications, both free and commercial. It is written in C so that it does not require a runtime environment and hence can be used in applications written in high-level languages such as Java and Python.

2.11 NATBRAILLE

<http://natbraille.free.fr/>



The screenshot shows the homepage of the NatBraille project. The page title is "Natbraille un transcritteur Braille libre". On the left, there is a navigation menu with links such as "Qu'est-ce que NatBraille?", "NatBraille version 2.2rc1", "Téléchargement et installation", "Aide en ligne", "NatBraille version serveur", "Présentation", "Statistiques", "Accès", "Outils divers", "Documentation", "Réalisation", "Remerciements", "Participez!", and "L'association NatBraille". The main content area is titled "Qu'est-ce que NatBraille ?" and contains the following text:

NatBraille est un logiciel [libre](#) de transcription et détranscription du [Braille](#).

Le projet est soutenu depuis Juillet 2008 par le Ministère de l'Education Nationale grâce au service SDTICE. Il a aussi reçu le soutien du GIP Handicap et Compétence en 2007.

Téléchargez la [dernière version](#) (30 décembre 2014) de Natbraille Brailitti. **NOUVEAU :** [guide d'installation de NatBraille pour non-voyants](#).

Respectueux des normes Braille

La version 2.2.rc1 de [NatBraille \("Brailitti"\)](#) offre à toute personne la possibilité de produire une transcription de qualité sans posséder de connaissance en Braille, en respectant au mieux les [normes actuelles des différents types de Braille](#) pour :

- le Braille intégral ;
- le Braille mathématique ;
- le Braille abrégé complet et l'abrégé "progressif" (à visée pédagogique) ;
- la mise en page et structuration ;
- le Braille chimie (partiellement)

Les tests du logiciel ont été réalisés par un comité d'experts piloté par l'Institut national supérieur de formation et de recherche pour l'éducation des jeunes handicapés et les enseignements adaptés ([INS HFA](#)).

Utilisable par tous

Natbraille est utilisé par les Missions Handicap des universités de Lyon 1, Paris VIII, Paris VI, Paris V, l'[Association Bibliothèque Braille Enfantine](#), l'INSA de Lyon entre autres.

Une grande attention a été apportée à l'utilisabilité de NatBraille par les personnes aveugles, en particulier avec les [lecteurs d'écrans NVDA](#) et Jaws.

NatBraille est écrit en java et fonctionne sur toutes les plateformes disposant d'une machine virtuelle java, en particulier Microsoft Windows, MacOS et Linux.

NatBraille is free Braille transcription and detranscription software. The project has been supported since July 2008 by the Ministry of National Education thanks to the SDTICE service. It also received support from GIP Handicap et Competence in 2007. NatBraille can transcribe or detranscribe the following input formats: Documents in OpenDocument format such as those produced by LibreOffice or OpenOffice, Documents produced by Microsoft Word, Documents in text format that may contain mathematical expressions written in the MathML language Simple, standards-compliant HTML documents. Braille documents in text format for transcription.

2.12 EULER 2.0

<http://sklep.altix.pl/en/euler-20>

The screenshot shows the Altix website interface. At the top, there is a search bar and a shopping cart icon. The main navigation menu includes: News, About Us, Store, Training, Audits, Printing & Tactile Graphics, Technical Support, Contact, and My account. Below the navigation menu, there are several product categories: New products, Szkolenia, Dostosowanie obiektów, Tyflografika, mapy, terminale, oznaczenia, 3D printing, Blindness Products, Low Vision Products, Tactile paving, Drukarnia, Products for hearing impaired, Products for physically disabled, Products stimulating the development and support communication, Gry, Gadżety drewniane, and Monitory i tablice interaktywne. The breadcrumb trail reads: Home / Blindness Products / Software for the blind / Euler 2.0. The product title is "Euler 2.0" and the manufacturer is "Altix sp. z o.o.". A description states: "Thanks to this professional device blind people can work more efficiently. Euler supports teachers." At the bottom, there is a cookie consent banner: "Ta strona używa ciasteczek (cookies), dzięki którym nasz serwis może działać lepiej. Dowiedz się więcej. Zgadzam się".

Euler 2.0 is a professional converter offering advanced editing options both in braille and regular printing formats. Thanks to the Euler functionalities users can write texts using Braille keyboards, and Euler translates Braille format into regular text, or one can translate regular text into braille format. The mathematical documents can be printed in each of these possible formats: Epheser, Nemeth Code and others. Euler enables users to read, edit and create documents in many formats such as: DOC, DOCX, RTF, HTML, PDF, XLS, XLSX, and TXT. The braille document can be saved as RTF, BRL or even XLS.

3 EXAMPLE

In these image sequences we present the steps of how to transcribe a page from Latex into Lambda Braille.

The first image shows a page written in LateX.

File TeX:

```

1 \documentclass[a4paper]{article}
2 \usepackage[italian]{babel}
3 \usepackage[utf8]{inputenc}
4 \usepackage[colorinlistoftodos]{todonotes}
5 \usepackage{amsthm}
6 \usepackage{amsmath}
7 \usepackage{siunitx} % gradi
8
9 \title{Esercizi}
10 \author{Liceo Scientifico}
11 \date{}
12
13 \begin{document}
14 \maketitle
15 \hrule
16
17 \section{Trigonometria}
18
19 Risolvere i seguenti esercizi:
20 \begin{itemize}
21   \item  $\sin(2x) = \sqrt{2} \cos x$ 
22   \item  $1 + 2 \cos^2 x = 2\sqrt{3} \sin x \cos x$ 
23   \item  $\cos(3x) - \sin(3x) < 1$ 
24   \item  $\frac{\sin x}{2 \sin^2 x - 3 \cos x} \geq 0$ 
25 \end{itemize}
26
27 \bigskip
28 \noindent Risolvere il seguente problema:
29 \bigskip
30
31 \noindent Si vuole misurare la distanza tra due alberi, rappresentati in figura dai due punti
32  $C$  e  $D$ . Non è possibile però farlo direttamente perchè i due alberi sono separati dai
33 due osservatori (rappresentati dai punti  $A$  e  $B$ ) da un fiume invalicabile. Il primo
34 osservatore, posto in  $A$ , misura i due angoli  $\hat{AC}$  e  $\hat{AD}$ : trova che essi
35 misurano rispettivamente  $\angle{40}$  e  $\angle{24}$ . Il secondo osservatore, posto in  $B$ ,
36 alla distanza di  $100$  m da  $A$ , misura i due angoli  $\hat{BD}$  e  $\hat{BC}$ : trova che
37 essi misurano rispettivamente  $\angle{52}$  e  $\angle{80}$ . Calcola:
38 \begin{itemize}
39   \item la distanza tra  $A$  e  $D$ .
40   \item la distanza tra i due alberi (ossia la distanza tra  $C$  e  $D$ ).
41 \end{itemize}

```

The page as it appears in PDF format.

File PDF:

Esercizi

Liceo Scientifico

1 Trigonometria

Risolvere i seguenti esercizi:

- $\sin(2x) = \sqrt{2} \cos x$
- $1 + 2 \cos^2 x = 2\sqrt{3} \sin x \cos x$
- $\cos(3x) - \sin(3x) < 1$
- $\frac{\sin x}{2 \sin^2 x - 3 \cos x} \geq 0$

Risolvere il seguente problema:

Si vuole misurare la distanza tra due alberi, rappresentati in figura dai due punti C e D . Non è possibile però farlo direttamente perchè i due alberi sono separati dai due osservatori (rappresentati dai punti A e B) da un fiume invalicabile. Il primo osservatore, posto in A , misura i due angoli \hat{BAC} e \hat{CAD} : trova che essi misurano rispettivamente 40° e 24° . Il secondo osservatore, posto in B , alla distanza di $100m$ da A , misura i due angoli \hat{ABD} e \hat{CBD} : trova che essi misurano rispettivamente 52° e 80° . Calcola:

- la distanza tra A e D .
- la distanza tra i due alberi (ossia la distanza tra C e D).

The image shows the LaTeX to MathML conversion, using Pandoc TeX to MathML.

Pandoc TeX to MathML:

```
<h1 class="title">Esercizi</h1>
<p class="author">Liceo Scientifico</p>
</header>
<hr />
<h1 id="trigonometria">Trigonometria</h1>
<p>Risolvere i seguenti esercizi:</p>
<ul>
<li>
<p><math display="inline" xmlns="http://www.w3.org/1998/Math/MathML">
  <semantics>
    <mrow>
      <mo>sin</mo>
      <mrow>
        <mo stretchy="true" form="prefix">( </mo><mn>2</mn></mrow><mi>x</mi><mo stretchy="true" form="postfix"> )</mo>
      </mrow>
      <mo>= </mo>
      <msqrt><mn>2</mn></msqrt>
      <mo>cos</mo><mi>x</mi>
    </mrow>
    <annotation encoding="application/x-tex">\sin (2x) = \sqrt{2} \cos x</annotation>
  </semantics>
</math>
</p>
</li>
```

From the MathML format the page is imported in 8-dot Lambda Braille.

File Lambda:

The screenshot shows the Lambda 2 software interface. The window title is "Lambda 2 - [Nuovo 2 *]". The menu bar includes "File", "Libri", "Modifica", "Strumenti", "Visualizza", "Inserisci", "Profili", and "Aiuto". The toolbar contains various icons for file operations and editing. The document content is displayed in Braille and includes the following text:

```

Esercizi
Liceo Scientifico
Trigonometria
Risolvere i seguenti esercizi:

- sen(2x) = sqrt(2) cos x
- 1 + 2 cos^2 x = 2 sqrt(3) sen x cos x
- cos(3x) - sen(3x) < 1
- // sen x / 2 sen^2 x - 3 cos x \ \ >= 0

Risolvere il seguente problema:
Si vuole misurare la distanza tra due alberi, rappresentati in figura:

- la distanza tra A e D.
- la distanza tra i due alberi (ossia la distanza tra C e D).
```