

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

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1 INTRODUCTION

Tex (Knuth, 1987) was developed as a typesetting (markup) code, capable of representing a wide range of printed notation, including mathematics. Let's say right away that it was not born as a notation for blind users. Later, Latex (Lamport, 1988) was developed, based on Tex, and designed to be more easily usable. (Its name derives from 'Tex for Laymen'). LaTeX has been widely adopted by those who write technical texts. Latex is very much geared towards the needs of typographers and not mathematicians, as it was originally intended not as a notation to be read in its raw form by human readers, but to be interpreted by composition software before being read by people.

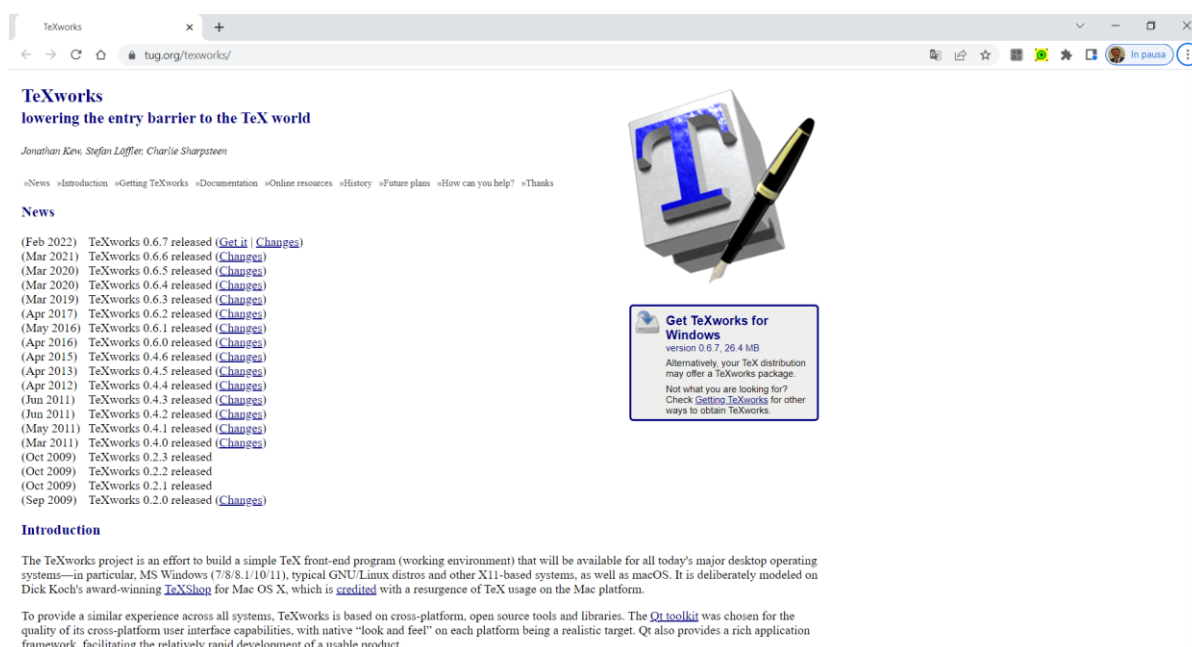
However, LaTeX has been used extensively by blind mathematicians. There are a number of reasons for this. Firstly, it is very clear, most of the printed mathematical notation can be expressed in Latex. Secondly, it is used extensively by sighted people as a means of carrying out their work. It can therefore be used equally by blind and sighted mathematicians. The sighted can see it as rendered by a typewriter, while the blind can read the raw markup - usually using a computer with a screen reader that renders text to speech or Braille.

Latex is a notation that uses prefixes. It is quite verbose in the sense that it uses words to represent symbols

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 in a web browser. The page has a header with the TeXworks logo and the tagline "lowering the entry barrier to the TeX world". Below the header is a navigation menu with links like "News", "Introduction", "Getting TeXworks", etc. The main content area features a "News" section with a list of releases from 2009 to 2022, each with a date and a link to "Changes". To the right of the news list is a large graphic of a blue 'T' on a white cube with a black pen resting on it. Below the graphic is a box titled "Get TeXworks for Windows" with details about the version (0.6.7, 26.4 MB) and instructions on how to obtain it. The page also includes an "Introduction" section at the bottom, which describes the project's goals and the tools used.

TeXworks
lowering the entry barrier to the TeX world

Jonathan Kne, Stefan Löffler, Charlie Sharpsteen

»News »Introduction »Getting TeXworks »Documentation »Online resources »History »Future plans »How can you help? »Thanks

News

- (Feb 2022) TeXworks 0.6.7 released ([Get it](#) | [Changes](#))
- (Mar 2021) TeXworks 0.6.6 released ([Changes](#))
- (Mar 2020) TeXworks 0.6.5 released ([Changes](#))
- (Mar 2020) TeXworks 0.6.4 released ([Changes](#))
- (Mar 2019) TeXworks 0.6.3 released ([Changes](#))
- (Apr 2017) TeXworks 0.6.2 released ([Changes](#))
- (May 2016) TeXworks 0.6.1 released ([Changes](#))
- (Apr 2016) TeXworks 0.6.0 released ([Changes](#))
- (Apr 2015) TeXworks 0.4.6 released ([Changes](#))
- (Apr 2013) TeXworks 0.4.5 released ([Changes](#))
- (Apr 2012) TeXworks 0.4.4 released ([Changes](#))
- (Jun 2011) TeXworks 0.4.3 released ([Changes](#))
- (Jun 2011) TeXworks 0.4.2 released ([Changes](#))
- (May 2011) TeXworks 0.4.1 released ([Changes](#))
- (Mar 2011) TeXworks 0.4.0 released ([Changes](#))
- (Oct 2009) TeXworks 0.2.3 released
- (Oct 2009) TeXworks 0.2.2 released
- (Oct 2009) TeXworks 0.2.1 released
- (Sep 2009) TeXworks 0.2.0 released ([Changes](#))

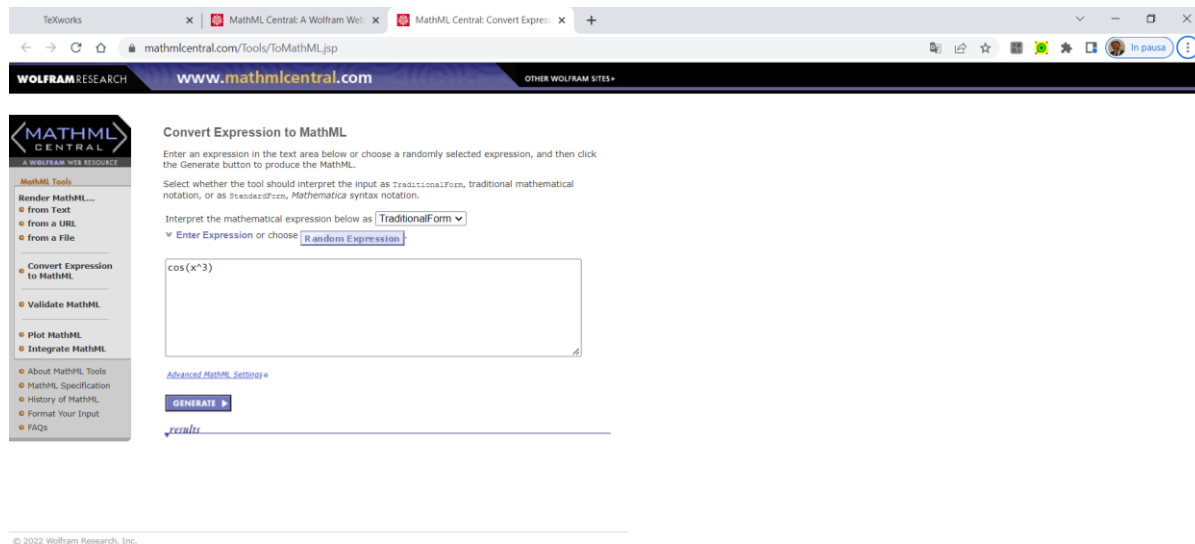
Introduction

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—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.

To provide a similar experience across all systems, TeXworks is based on cross-platform, open source tools and libraries. 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>



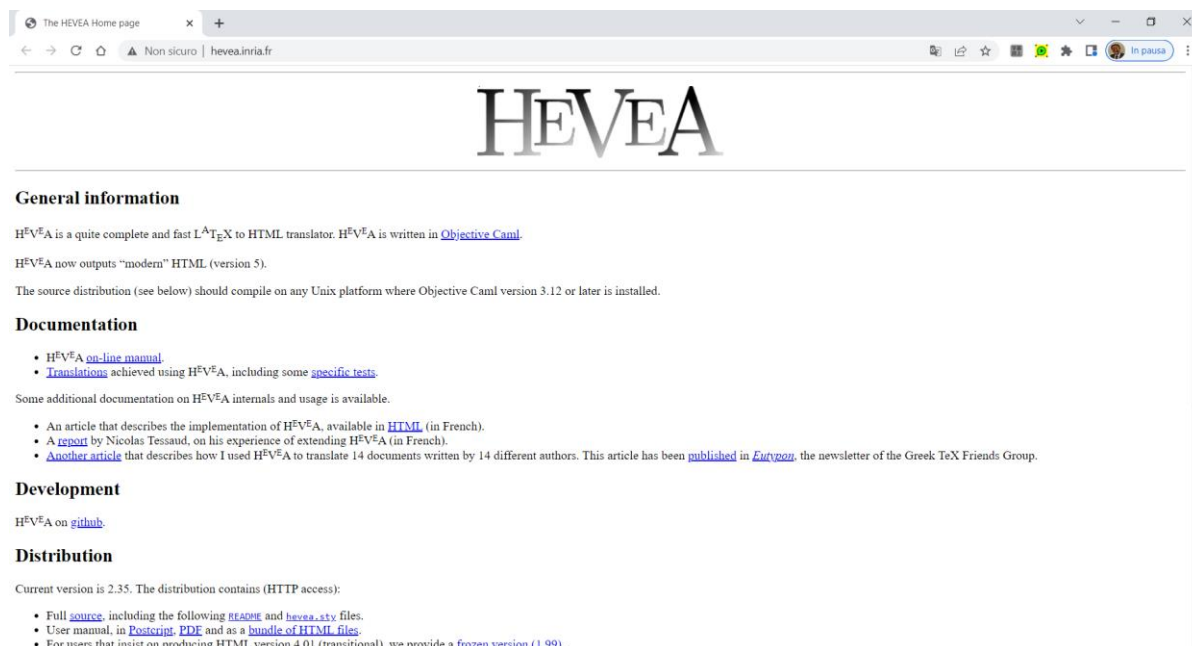
The MathML (acronym of Mathematical Markup Language) is a web language used to represent symbols and math formulas, which also allows to assign a semantic meaning to formulas. It has been derived from XML, as a specification of the W3C workgroup regarding mathematics. MathML not only deals with the presentation 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/>



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

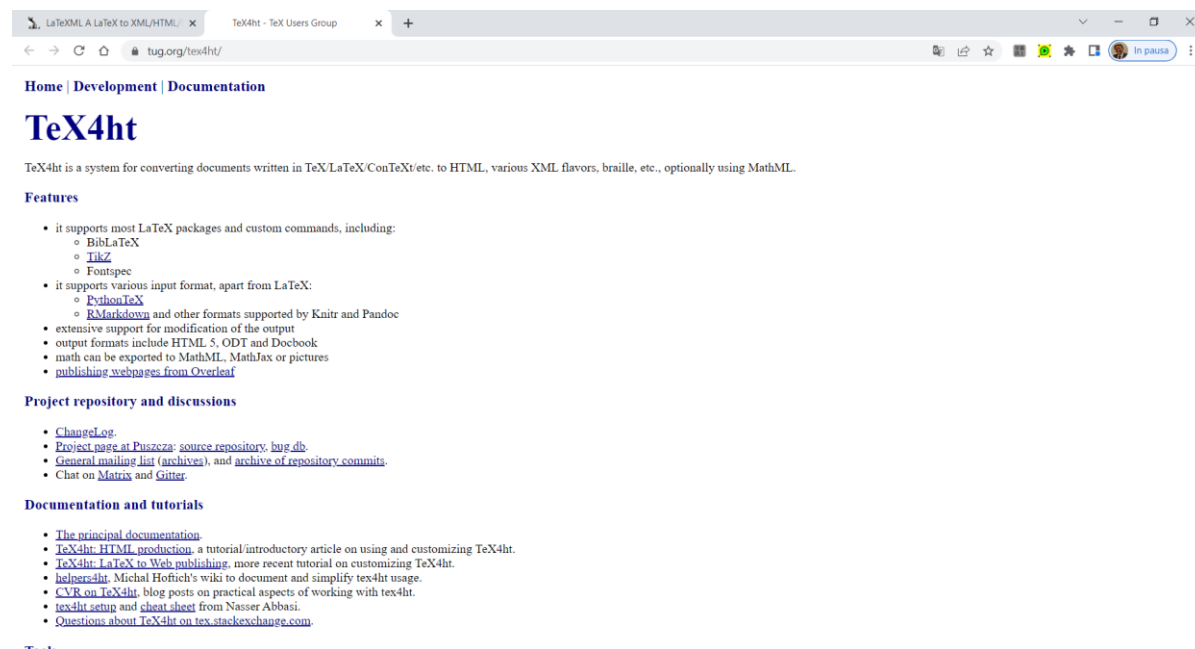
<https://math.nist.gov/~BMiller/LaTeXML/>



The 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

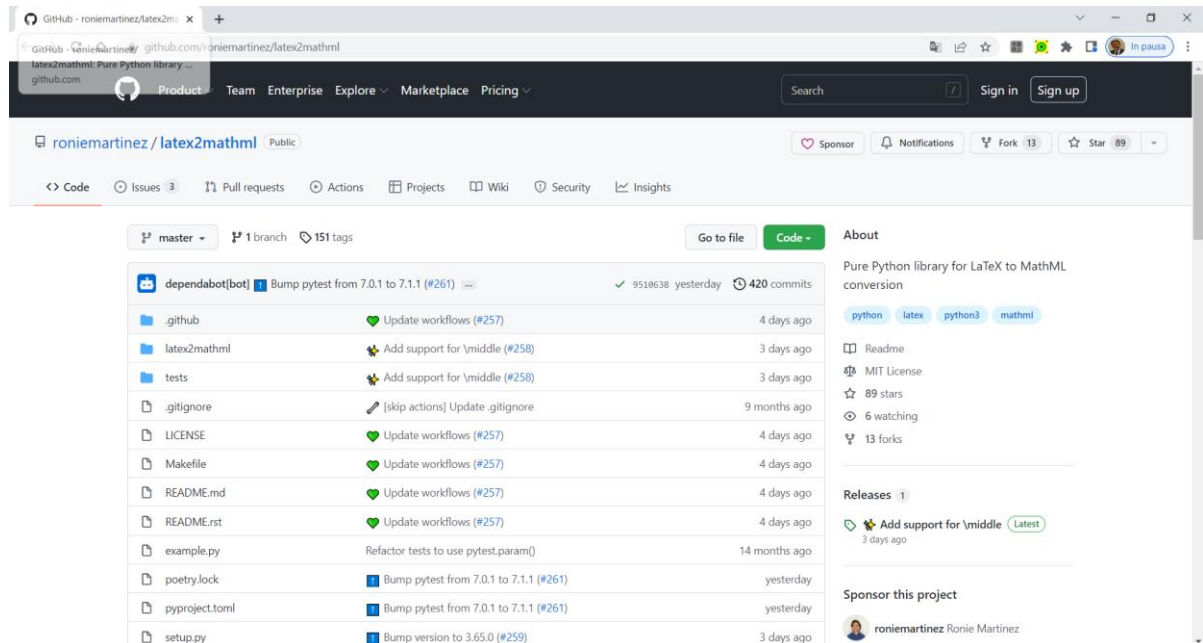
<https://www.tug.org/tex4ht/>



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 1 branch. The file list includes:

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 \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 sidebar on the right contains the following information:

- About:** Pure Python library for LaTeX to MathML conversion. Tags: `python`, `latex`, `python3`, `mathml`.
- Readme:** MIT License, 89 stars, 6 watching, 13 forks.
- Releases:** 1 release: "Add support for \middle" (Latest, 3 days ago).
- Sponsor this project:** roniemartinez Ronie Martinez.

Pure Python library for LaTeX to MathML conversion.

2.5 MATHCONVERTER

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

GitHub - roniemartinez/latex2mathml

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roniemartinez/latex2mathml Public

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master 1 branch 151 tags

Go to file Code

About

Pure Python library for LaTeX to MathML conversion

python latex python3 mathml

Readme MIT License 89 stars 6 watching 13 forks

Releases 1

Add support for \middle Latest 3 days ago

Sponsor this project

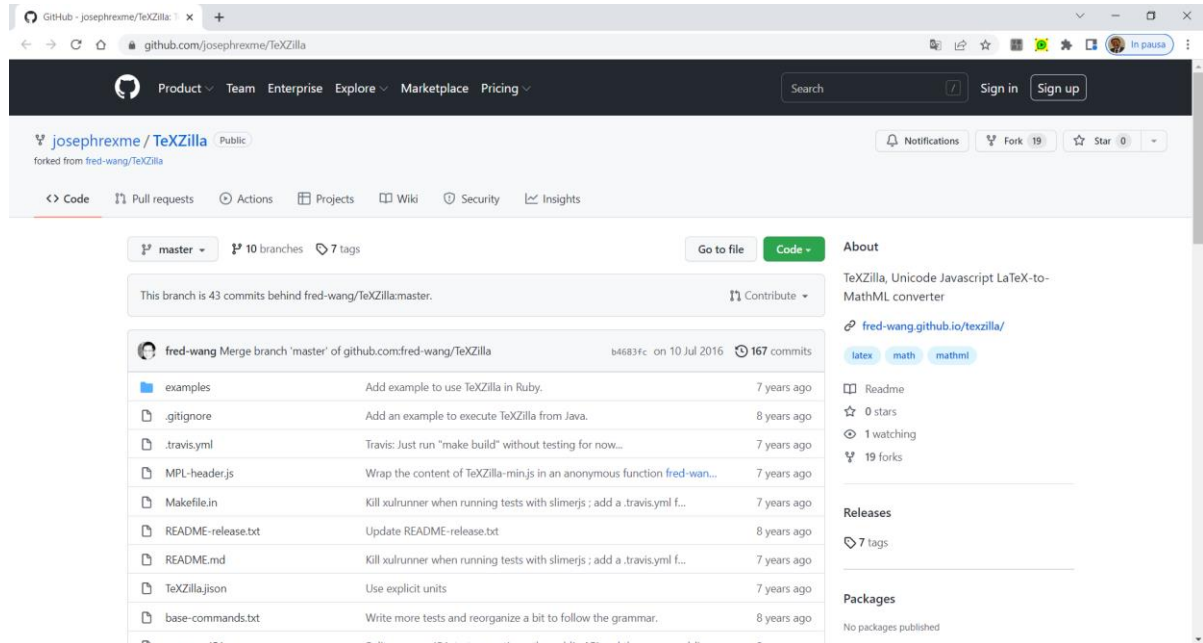
roniemartinez Ronie Martinez

File	Commit	Time
dependabot[bot]	Bump pytest from 7.0.1 to 7.1.1 (#261)	9510638 yesterday 420 commits
.github	Update workflows (#257)	4 days ago
latex2mathml	Add support for \middle (#258)	3 days ago
tests	Add support for \middle (#258)	3 days ago
.gitignore	[skip actions] Update .gitignore	9 months ago
LICENSE	Update workflows (#257)	4 days ago
Makefile	Update workflows (#257)	4 days ago
README.md	Update workflows (#257)	4 days ago
README.rst	Update workflows (#257)	4 days ago
example.py	Refactor tests to use pytest.param()	14 months ago
poetry.lock	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
pyproject.toml	Bump pytest from 7.0.1 to 7.1.1 (#261)	yesterday
setup.py	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>



GitHub - josephrexme/TeXZilla

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josephrexme / TeXZilla Public

forked from fred-wang/TeXZilla

Notifications Fork 19 Star 0

< Code Pull requests Actions Projects Wiki Security Insights

master 10 branches 7 tags

Go to file Code About

This branch is 43 commits behind fred-wang/TeXZilla:master. Contribute

fred-wang Merge branch 'master' of github.com:fred-wang/TeXZilla b4683fc on 10 Jul 2016 167 commits

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

Readme 0 stars 1 watching 19 forks

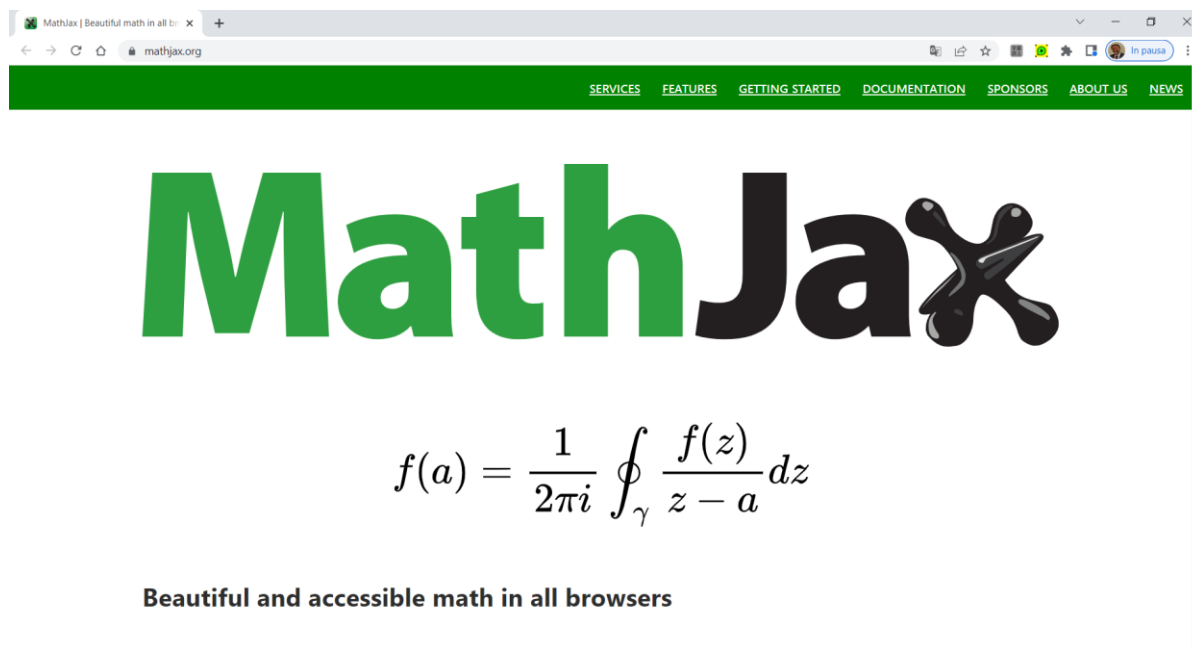
Releases 7 tags

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

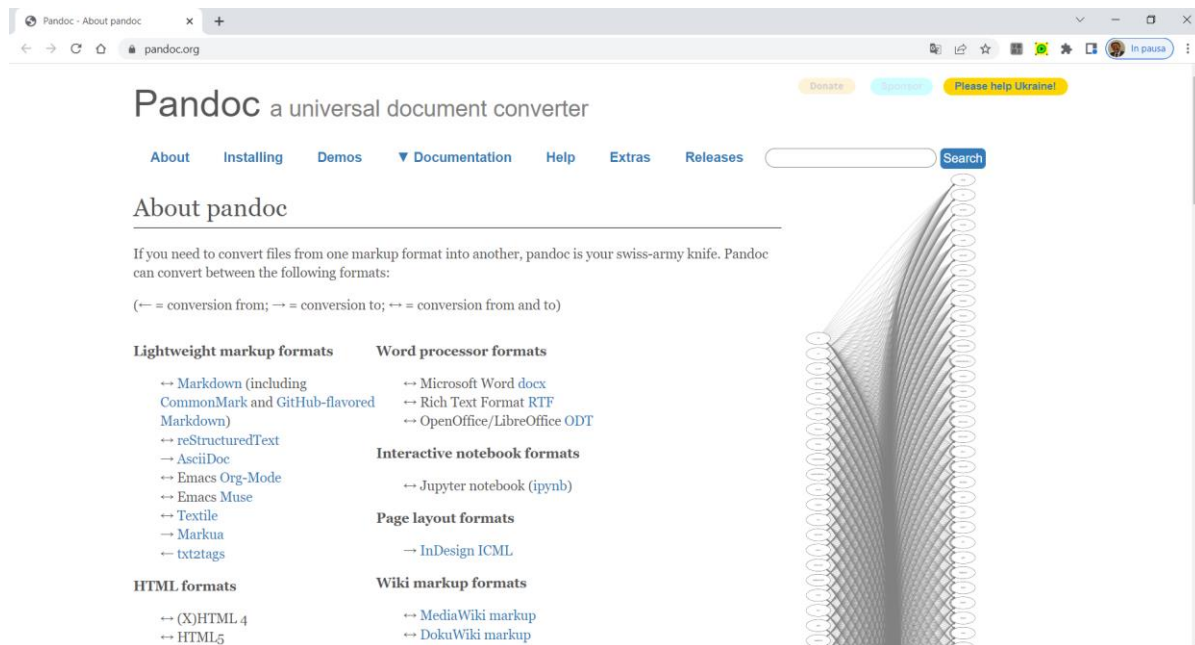
<https://www.mathjax.org/>



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/>

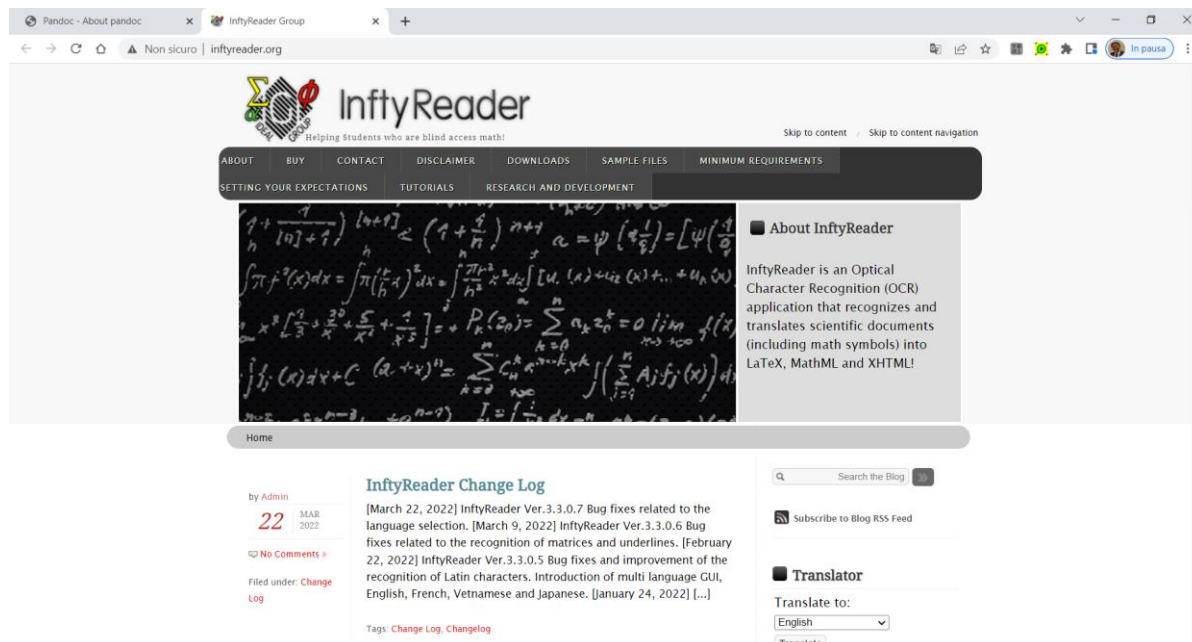


Pandoc understands a number of useful markdown syntax extensions, including document metadata (title, author, date); footnotes; tables; definition lists; superscript and subscript; strikethrough; enhanced ordered lists (start number and numbering style are significant); running example lists; delimited 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/>

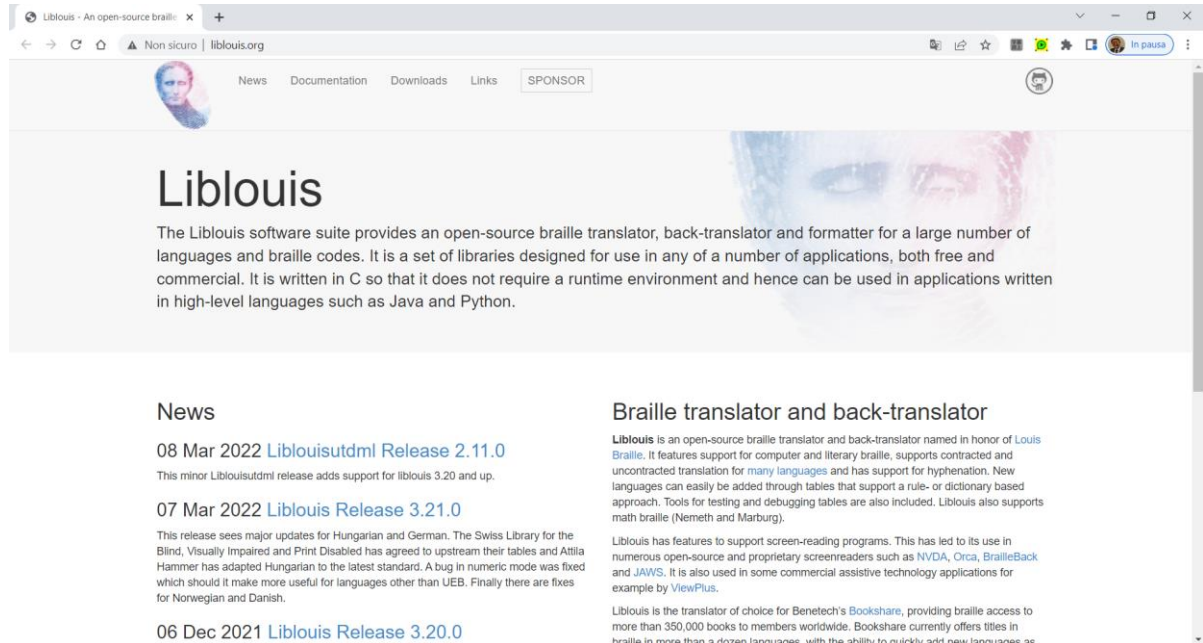
<https://www.sciaccess.net/en/InfyReader/>



InfyReader is OCR software to recognize scientific documents including mathematical formulae. "InfyReader" 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, InfyReader uses OCR specially trained for STEM documents recognizing special math symbols and analyzing math structures. For e-born PDF, InfyReader 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/>



The screenshot shows the Liblouis website in a web browser. The browser's address bar displays "liblouis.org". The website has a navigation bar with links for "News", "Documentation", "Downloads", "Links", and a "SPONSOR" button. The main heading is "Liblouis", followed by a descriptive paragraph: "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." Below this, there are two columns of content. The left column, titled "News", lists three releases: "08 Mar 2022 Liblouisutdml Release 2.11.0", "07 Mar 2022 Liblouis Release 3.21.0", and "06 Dec 2021 Liblouis Release 3.20.0", each with a brief description of the updates. The right column, titled "Braille translator and back-translator", provides a detailed description of the software's capabilities, including support for computer and literary braille, contracted and uncontracted translation, and various features like screen-reading support and integration with NVDA, Orca, BrailleBack, and JAWS.

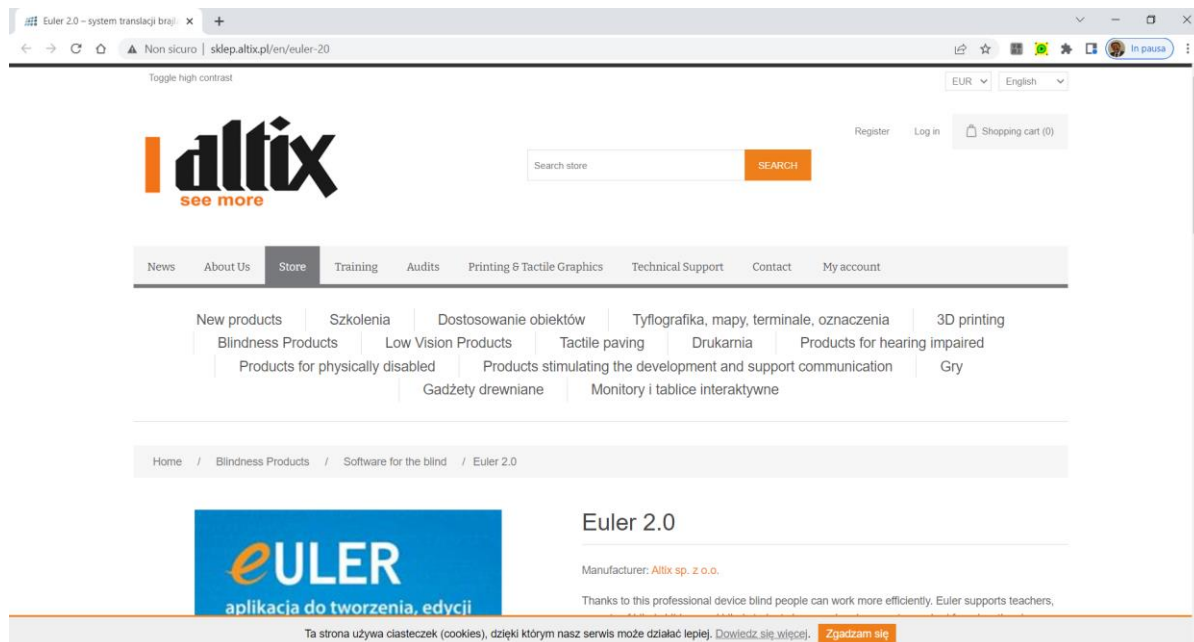
The Liblouis software suite provides an open-source braille translator, back-translator and formatter for a large number of languages and braille codes. It is a set of libraries designed for use in any of a number of applications, both free and commercial. It is written in C so that it does not require 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/>

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 Compétence 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>

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 $40^\circ$ e $24^\circ$. Il secondo osservatore, posto in $B$,
36 alla distanza di $100$ m da $A$, misura i due angoli $\hat{BD}$ e $\hat{AD}$: trova che
37 essi misurano rispettivamente $52^\circ$ e $80^\circ$. 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).

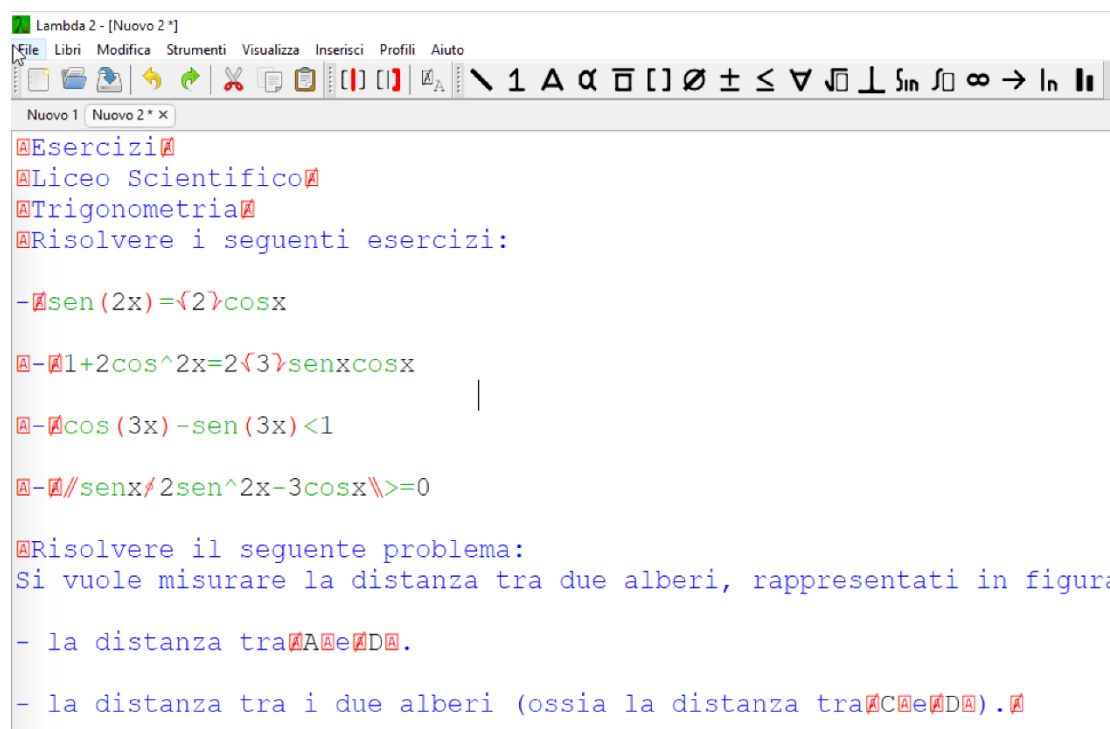
The image shows the LaTeX to MathML conversion, using Pandoc TeX to MathML.

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:



Lambda 2 - [Nuovo 2 *]

File Libri Modifica Strumenti Visualizza Inserisci Profili Aiuto

Nuovo 1 Nuovo 2 * x

Esercizi

Liceo Scientifico

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:

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