

Axessibility 2.0: creating tagged PDF documents with accessible formulae

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Project 'For an accessible and inclusive mathematics'

"Laboratory S. Polin for Research and Experimentation with Novel Assistive Technologies for STEM" at the Department of Mathematics G. Peano, University of Torino.

- Research
- Technical activities
- Knowledge transfer (Terza missione)

Numbers of visually impaired people

- About 130.000 blind people in Italy (INPS, 2012), 5 times partially sighted
- Other statistics talk about 380.000 blind people
- About 45 millions in the world (OMS 2007), 269 millions of partially sighted people

The problem of accessible scientific texts

- At the moment, there are assistive technologies (screen reader, Braille display) that allows to use the PC and read digital documents.
- These assistive technologies work well for texts without formulae and graphs, since they are able to manage one-dimensional structures. It is necessary to write formulae by means of, e.g., mark-up languages.
- Visually impaired people, who would like to approach university and/or jobs that need the use of scientific documents, have many difficulties and, unfortunately, are often forced to perform other activities.

The problem of accessible scientific texts

- Reading formulae \rightarrow 'axessibility' package
- Graphs \rightarrow 'Audiofunctions.Web' software
- Surfaces and solids \rightarrow 3D Printer

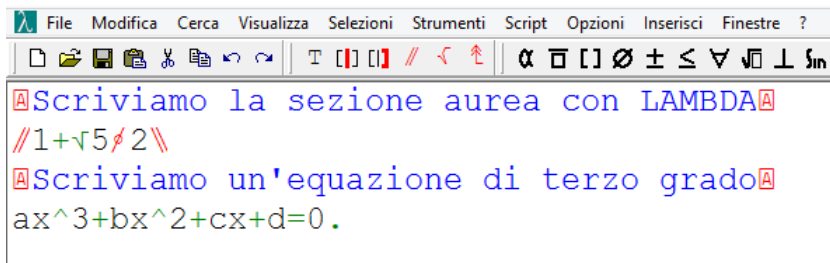
Formulae on the web

```
<math xmlns="http://www.w3.org/1998/Math/MathML">
  <mrow>
    <mfrac linethickness="1">
      <mrow>
        <mn>1</mn>
        <mo>+</mo>
        <msqrt>
          <mn>5</mn>
        </msqrt>
      </mrow>
      <mrow>
        <mn>2</mn>
      </mrow>
    </mfrac>
  </mrow>
</math>
```

```
<mrow>
  <mi>a</mi>
  <msup>
    <mi>x</mi>
    <mn>3</mn>
  </msup>
  <mo>+</mo>
  <mi>b</mi>
  <msup>
    <mi>x</mi>
    <mn>2</mn>
  </msup>
  <mo>+</mo>
  <mi>c</mi>
  <mi>x</mi>
  <mo>+</mo>
  <mi>d</mi>
  <mo>=</mo>
  <mn>0</mn>
</mrow>
```



The LAMBDA system



The screenshot shows a graphical user interface for the LAMBDA system. At the top is a menu bar with the following items: File, Modifica, Cerca, Visualizza, Selezioni, Strumenti, Script, Opzioni, Inserisci, Finestre, and ?. Below the menu bar is a toolbar containing various icons for file operations (such as open, save, print, copy, paste, delete) and mathematical symbols (including pi, infinity, square root, and various geometric symbols). The main text area contains the following text:

```
A Scriviamo la sezione aurea con LAMBDA A  
//1+√5/2\  
A Scriviamo un'equazione di terzo grado A  
ax^3+bx^2+cx+d=0.
```

```
1 \documentclass{article}
2
3 \usepackage{amsmath}
4
5 \title{Un breve esempio}
6
7 \begin{document}
8 \maketitle
9
10 La sezione aurea
11 
$$\left[\frac{1 + \sqrt{5}}{2}\right].$$

12 Un'equazione di terzo grado  $ax^3 + bx^2 + cx + d = 0$ .
13
14 \end{document}
```


The PDF obtained by L^AT_EX is not accessible

- Formuale are not readable
- No language of the document
- No heading levels and no tags

The first version of axessibility

- Readable vs Accessible
- Formulae and contents are read by screen reader e Braille displays
- Dictionaries for reading in natural language
- Use of the package accsupp
- PDF not tagged and bad structured
- No multilines environments
- Problems with underscore

Axessibility 2.0

- Formulae e contents accessible
- tagged PDF
- Multiline environments
- No problems with underscore
- Use of the package tagpdf of Ulrike Fischer
- LuaLaTeX
- Manual job by the author
- Problems with copy and paste
- Possibility to choice between first and second version

The cleaner

- A first version of the cleaner allows to replace macros of the author with original commands \LaTeX , replace dollars e double dollars with \(\) and \[\] .
- Problems with complex files and/or projects containing more files, problems with nested dollars.
- Working on a new version, by B.Doubrov (member of the PDF association) and A. Kozlovski

Accessible Library

Using the axessibility package we are realizing a digital library containing accessible scientific documents, free on our website

www.integr-abile.unito.it

Documents:

- Analysis 1
- Analysis 2
- Discrete Mathematics

Future works

- Minimize the work of an author who uses our package
- Improve the structure of the document – > PDF/UA
- Overcome the problem of copy and
- Further optimization of the cleaner

GRAZIE PER L'ATTENZIONE!