

# Axessibility 2.0: creating tagged PDF documents with accessible formulae

D. Ahmetovic, **T. Armano**, C. Bernareggi, A. Capietto, S.  
Coriasco, B. Doubrov, A. Kozlovskiy, **N. Murru**

Università di Torino, Dipartimento di Matematica “G. Peano”

# 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

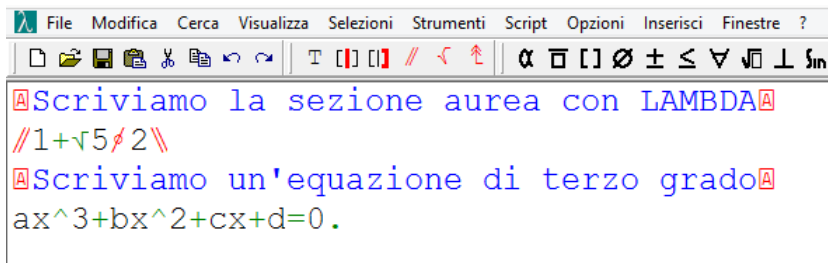
- Reading formulae → 'axessibility' package
- Graphs → 'Audiofunctions.Web' software
- Surfaces and solids → 3D Printer

# 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 software interface with a menu bar at the top containing: File, Modifica, Cerca, Visualizza, Selezioni, Strumenti, Script, Opzioni, Inserisci, Finestre, ?. Below the menu bar is a toolbar with various icons for file operations and mathematical 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<sup>A</sup>T<sub>E</sub>X 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  $\text{\LaTeX}$ , replace dollars e double dollars with  $\text{\( \)}$  and  $\text{\[ \]}$ .
- 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](http://www.integr-abile.unito.it)

Documents:

- Analysis 1
- Analysis 2
- Discrete Mathematics

# Biblioteca accessibile

Grazie al pacchetto Axessibility stiamo realizzando una biblioteca di testi scientifici accessibili, liberamente consultabili sul sito

[www.integr-abile.unito.it](http://www.integr-abile.unito.it)

Prossimamente

- Linear Algebra and Analitic Geometry (ready for being published)
- Physics
- Computer science
- ecc...

## 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!