

Mathematics on the Web

A White Paper

MacKichan Software, Inc.

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The problem of displaying mathematics on the web

Currently, there are no completely satisfactory methods of displaying mathematics on the web. The standard for formatting documents on the web, the HyperText Markup Language or HTML, does not have a rich enough set of primitives to construct and display mathematical expressions. This means that without a helper application or a plug-in, the standard web browsers cannot display mathematics unless it is represented as graphics.

The situation will improve in the future. A successor to HTML, an eXtensible Markup Language or XML, gives authors more control, and an emerging standard, called MathML, standardizes a method of representing mathematics in XML. Browsers are beginning to support XML, but there is not yet native support for MathML in the browsers. It is possible to have a plug-in display MathML mathematics, but this solution is still not satisfactory for in-line mathematics, since there is no way currently for the browser to communicate to the plug-in where the base line of the current text line is.

MacKichan Software is a corporate member of the MathML standard committee, and is committed to supporting XML and MathML. With Version 4.0 of our products, you can export a document to HTML format with the mathematics rendered as graphics or as MathML. As MathML rendering software becomes available, it may become the preferred method for displaying mathematics on the web.

All of the currently available methods of displaying mathematics on the web have disadvantages and advantages. This white paper discusses and compares the alternatives.

Some solutions for displaying mathematics on the web

We list here some of the possible solutions for displaying mathematics on the web. Since displaying mathematics in HTML is generally impossible, each of these solutions requires some special software for the author of the web, and/or some special software for the readers of the web. Each of these solutions has advantages and disadvantages.

Scientific Viewer

Our recommended solution for displaying mathematics on the web is for the author to use one of our mathematical word processors, and for the readers to use our free Scientific Viewer software. All CDs for Scientific Notebook and for Version 3.0 or later of Scientific WorkPlace and Scientific Word contain a directory named \Viewer. The directory contains a version of Scientific Notebook that does not allow saving documents but does allow printing read-only documents. It is, in effect, a web browser for the files (with extension .tex) produced by any of our products.

The free Scientific Viewer is also available for download from our website, at <http://www.mackichan.com/products/freedwnld.html>. Also, it is available on the Comprehensive Tex Archives Network (CTAN). The Scientific Viewer may be freely distributed.

With any of our products, an author can create a complete web that displays mathematics correctly and cleanly. The documents on the web can include graphics and hyperlinks; together, they can together create a rich and beautiful web.

An example of such a web is the WebMath project at Texas A&M University. To view this web, run Version 3.0 or later of Scientific WorkPlace or Scientific Word, or run Scientific Notebook or Scientific Viewer. From the File menu, choose Open Location and enter this URL: <http://www.math.tamu.edu/~webcalc/mindex.tex>.

Advantages of using Scientific Viewer

1. *There are no limits to the mathematics you can display.* You can display any mathematics that you can enter with the premier tools for publishing mathematical papers and books.
2. *The files will be small and will download quickly.* The files are created in TeX, a mathematical typesetting language that consists of compact ASCII codes for mathematical objects. Contrast this with other solutions that replace mathematical text with graphics.
3. *Your users can print high quality documents from your web.* Since the mathematics in your web pages has not

been converted to bitmap graphics, it will not appear dotted or grainy when it is printed.

4. *This solution is inexpensive for the author and the readers.* The writing tool can be Scientific Notebook (\$199.00), and the reading tool, Scientific Viewer, is free.

5. *Links to HTML files and links to TEX files can be intermixed.* Readers can access both kinds of files.

Disadvantages of using Scientific Viewer

1. *The readers must download the free viewer before browsing your web.* The size of the viewer download file is about 5 megabytes.

2. *The viewer is currently available for Windows® platforms only.*

HTML exported from a MacKichan Software product

Beginning with version 4.0, Scientific WorkPlace, Scientific Word, and Scientific Notebook support exporting any document as an HTML document (or more precisely, XHTML). The mathematics can be rendered as MathML or as graphics in these graphics formats: .bmp, .dib, .emf, .gif, .jpg, .png, or .wmf.

Advantages of using HTML export

1. *The HTML output filter creates an accurate HTML version of your document.*

2. *Readers can view your documents on many computer platforms* with recent versions of the most popular browsers.

3. *The author can further manipulate the HTML files with other web authoring tools.*

4. *The HTML filter interprets any HTML commands in the document.* The author can insert HTML commands in special HTML fields.

Disadvantages of using HTML export

1. *The files download relatively slowly.* However, downloading is faster than MathML.

2. *The mathematics is not live.* Your readers cannot perform computations on the mathematics in downloaded files.

Adobe Acrobat

If you have the Adobe Acrobat writer (Distiller) installed, you have a printer driver called Distiller Assistant. When you print a file from Scientific WorkPlace, Scientific Word, or Scientific Notebook using this printer driver, it creates a file with the extension .pdf. Using Acrobat Exchange, you can insert hyperlinks into the file, and you can post the file on the web. This will create a web of PDF files. You must set the parameters for the Distiller correctly, so that all fonts are embedded in the file, and so that graphics are not severely compressed. Otherwise, your document will not display correctly on computers that do not have Scientific WorkPlace, Scientific Word, or Scientific Notebook installed.

Advantages of using PDF files

1. *There are no limits to the mathematics you can display.* The PDF files are an accurate representation of the files that you create with Scientific WorkPlace, Scientific Word, or Scientific Notebook.

2. *The files will be moderately sized, and will download moderately quickly.* The PDF files created will be significantly smaller than graphics files, but significantly larger than TeX files.

3. *Your readers can print high-quality documents from your web.* Since the mathematics in your web pages has not been converted to bitmap graphics, it will not appear dotted or grainy when it is printed.

4. *This solution is inexpensive for the readers, and only moderately expensive for the author.* The writing tool costs about \$150 in addition to the program that writes the mathematics, such as Scientific Notebook. Adobe

Reader is freely available from Adobe's website.

5. *Links to HTML files and links to PDF files can be intermixed.* The Adobe Reader is available as a plug-in, so the PDF file can be read within the browser.

Disadvantages of using PDF files

1. *The readers must download the free viewer before browsing your web.* The size of the Acrobat Reader download file is about 1 megabyte. This disadvantage is mitigated by the fact that the Adobe Reader is so common that many readers may have downloaded it already.
2. *The author must manually add hyperlinks into the file.* Web development becomes more time-consuming when manual processes are involved.

Latex2Html

All files produced by Scientific WorkPlace, Scientific Word, and Scientific Notebook are LaTeX files. LaTeX is a mathematical typesetting language. Latex2Html is a freeware program that converts LaTeX files to HTML. Since HTML is not able to display mathematics directly, Latex2Html converts mathematics to graphics (GIF) files.

Advantages of using Latex2Html

1. *The results will display, with some problems, in any browser since all browsers support the combination of HTML and graphics that is produced.*
2. *This solution is inexpensive for the author and the readers.* The author's program is freely available on the web, and the readers do not need anything in addition to their current browsers.

Disadvantages of using Latex2Html

The conversion of mathematics to graphics causes several problems:

1. *The file sizes grow quickly when a document contains much mathematics in the document.* Large documents slow the browsing of your web. If your web consists of more than 30 or 40 pages, your readers will save time in the long run by downloading Scientific Viewer.
2. *The graphics files are compressed bitmaps.* They will look acceptable on the screen, but when they are printed they will look "dotty" and grainy.
3. *The mathematics graphics files will match only one size of text.* Web browsers allow users to select the magnification of the text. However, because the graphics files will match only a single text size, they may look small compared to the text size chosen by one user and large compared to the text size chosen by another user.
4. *Visually impaired users will be unable to magnify the mathematics graphics files.*
5. *The baselines of text lines and mathematics in the graphics files will not always line up.*

Hevea

Hevea is a freeware program that converts LaTeX files to HTML, without using graphics. It uses characters from the Symbol font to represent some mathematics; however, because many common mathematical symbols are not in the Symbol font, they will not appear.

Advantages of using Hevea

1. *Some simple mathematics is converted to true HTML.* Depending on your requirements, this may be adequate.
2. *The resulting files are small and download quickly.*
3. *This solution is inexpensive for both the author and the readers.* The author's program is freely available on the

web, and the readers do not need anything in addition to their browsers.

Disadvantages of using Hevea

1. *The variety of mathematics that can be converted successfully is limited.* Mathematical symbols that are not in the Symbol font will not be represented.
2. *The display of the mathematics is relatively crude.* Gaps exist in integral signs and limited sub- and superscripts.

IBM TechExplorer

IBM TechExplorer, a free program developed by IBM, displays a subset of LaTeX in a browser plug-in. A professional version is available for sale.

Advantages of using IBM TechExplorer

1. *The plug-in integrates well with browsers.*
2. *The display of mathematics looks good on the screen and prints well.* Since IBM TechExplorer does not convert the mathematics to graphics, the mathematics will print as sharp as other text.
3. *The files are compact and download quickly.* The file sizes are comparable to those of Scientific Notebook.
4. *Scientific WorkPlace and Scientific Word are good authoring tool for IBM TechExplorer files.* Some LaTeX typesetting specifications for Scientific WorkPlace and Scientific Word are optimized for use with TechExplorer. (Since authoring for IBM TechExplorer requires control over the LaTeX that is produced, Scientific Notebook is not a good choice for an authoring tool.)
5. *Links in Scientific WorkPlace and Scientific Word documents are preserved* if the author uses the correct LaTeX typesetting specifications with Scientific Word.

Disadvantages of using IBM TechExplorer

1. *IBM TechExplorer displays only a subset of LaTeX, so not all mathematics will display properly.* It does much better than Hevea, but not as well as Scientific Viewer.
2. *Readers need to download free software* of about two megabytes before they can view your files.
3. *The author has limited control over the format and appearance of the pages.* IBM TechExplorer uses a single set of LaTeX typesetting specifications, which cannot be changed by the author.
4. *The Macintosh platform is not supported.* Windows and Linux versions are available.