Creating documents containing mathematical notation

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Introduction[1]

Students with disabilities may have problems correctly reading mathematical notation. Some students rely on screen readers to read the content of an electronic document out loud. Because of this, content should in general be created in a way that best allows screen readers to read the content. From our understanding there is currently no perfect way to do this when it comes to documents containing mathematical notation.

Even though no perfect solution is known, instructors should still be able to share documents containing mathematical notation with students. This document provides recommendations for how to stay compliant with federal laws and how to best

1. create documents containing mathematical notation, and
2. create webpages containing mathematical notation.

In the following we will call an electronic document accessible when it in general is readable using a screen reader.

General recommendation

In general a document should be created so that it is as accessible as possible. Creating accessible documents that only contain text is easily done with, for example, Microsoft Word.

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[1] The recommendations in these notes are largely based on *Accessible Content Creation in Mathematics* by Chris Hughes Scot Leavitt found here: http://www.pcc.edu/resources/instructional-support/access/documents/math-accessibilityreport.pdf. Also, conversations with Screen Reader Specialist Brandon Werner from University of Michigan have been helpful.

As a general practice, the instructor should always be willing to share the source file for a document with a student. If, for example, a PDF document is created using Microsoft Word, then the original word file should be made available to students if requested. This opens up the possibility for the student and instructor together with the Disability Services to convert the document to a format that can be read by the student.

It cannot be emphasized enough that the instructor should expect to work with each student to find a method that works.

Disability Services

A student with disabilities will in general register with the Disability Services on campus. The instructor should then in general be made aware of any students needing special accommodations. The instructor should meet with any student to determine whether the student requires documents in special formats. Together with the Disability Services the student and instructor should determine what formats work best for the student.

Electronic documents vs. printed documents

The requirement that a document be available in an accessible format applies to both printed and electronic documents. Because of this, it is strongly recommended that all documents be created electronically since this in general will make a conversion process easier. Paper handouts in class should have an accessible electronic counterpart.

Creating documents

Documents containing mathematical notation is commonly created using the typesetting system LaTeX[2]. PDF files created using LaTeX are not currently accessible. However, the source code can be useful to the student because (1) the student might be able to read the LaTeX code, (2) the LaTeX file can possibly be converted into other formats like (Nemeth) braille. Because of this, using LaTeX to create documents containing mathematical notation is recommended. This does, of course, presuppose that the original LaTeX file is available to the student who might need it.

There are several ways to use LaTeX. Many have a strong personal preference for a specific method. Two general ways are:

A) Traditionally documents have been created by manually entering the code in a text editor and then compiling the code. This requires the author to know what code does what.
B) For people not familiar with LaTeX one can use Microsoft Office with the MathType plugin. This requires MathType to be installed on the computer. Here one creates the document using, for example, Word and when mathematical notation is needed one uses the MathType equation editor. This document can then be exported as a webpage that is accessible. This webpage can then be sent to students as a document, posted on Blackboard, or displayed as a webpage

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[2] There are other versions of TeX.

online. One can also use LibreOffice with the built-in equation editor and export the document as webpages.

In general one should use as few packages as possible when using LaTeX. One should limit the use of \newcommand to define new commands. When writing the code, keep in mind a student who will possibly be reading the code using a screen reader.

Furthermore, please use the appropriate methods for creating accessible Word documents. The university offers training in working with Microsoft Word.

Creating webpages

To display mathematical notation on a webpage one should use MathML or the JavaScript library MathJax. The MathML code is cumbersome and should not be entered by hand. Various online converters exist that will produce the MathML code. The MathJax code is very similar to LaTeX code and is the preferred way.

The webpage created should also be as accessible as possible. One way to find some accessibility issues on a webpage is using the online web accessibility evaluation tool WAVE (http://wave.webaim.org/). Three ways to create a webpage containing MathJax code:

A) The webpage can be created manually using a preferred editor. This requires the author to know the MathJax code and be able to create an accessible webpage.
B) The document is created using the MathType equation editor and Word. The document is then exported as a webpage.
C) The document is created using LibreOffice with the built-in equation editor and is then exported as a webpage.

Methods not recommended

There are other ways to create documents containing mathematical notation. The following methods are not recommended:

A) Using the built-in equation editor in Microsoft Word. These equations cannot in general be read using a screen reader.
B) Creating webpages where the mathematics is displayed as images (for example PNG images).

Questions

Question: How do I best display images, figures, and graphs?
Answer: This is currently a problem without a good solution. The best approach is to work with the student and the Disability Services to find a method that will work.

Question: Can I use scans of handwritten notes?
Answer: No, this should be avoided if possible.

Question: Can I use a program like Scientific Workplace to create documents?
Answer: Yes, there are many other programs available that will create LaTeX documents. As long as the source file is available. Try, though, to keep the LaTeX code as simple as possible so that a conversion is easier made.

Question: What about Microsoft Power Point?
Answer: According to the report *Accessible Content Creation in Mathematics*[3] MathType does work in Power Point, but there is currently no easy way to convert the slides into accessible webpages.

Question: Where do I get training?
Answer: Please contact HR for a list of training opportunities.

Question: Where can I find more information on accessibility and mathematics?
Answer: The following resources might be helpful:

1. Portland Community College supported a study in accessibility of documents containing mathematical notation. The final report of this study can be found here:
   http://www.pcc.edu/resources/instructional-support/access/documents/math-accessibilityreport.pdf

2. The following article in particular discusses how teaching LaTeX to a blind student has benefits:
   https://nfb.org/images/nfb/publications/fr/fr31/2/fr310212.htm

Question: Who should I contact if I have more questions?
Answer: Please contact the EIT coordinator.

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[3] Found here: http://www.pcc.edu/resources/instructional-support/access/documents/math-accessibilityreport.pdf