UMA: Universal Mathematics Accessibility

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One of the primary difficulties encountered by a visually impaired student in pursuing studies in Science, Mathematics, Engineering or Technology (SMET) is how to read and write Mathematics. The six dot Braille notation only permits 64 different combinations of dots which is not enough to represent Mathematical equations. With respect to using specialized 6 dot Braille-based notations such as Nemeth Math code and Marburg code, many problems still remain

1. Most sighted people are not conversant with these Braille based Math notations, thus communication between sighted and visually impaired students and colleagues is difficult.

2. There are different notations that are in use in different countries, thus, visually impaired students/researchers/scientists cannot effectively communicate with their visually impaired colleagues in other countries.

3. Very rudimentary tools are available for editing or aurally outputting mathematics texts written in such Braille based Math notation; those that are available are specific to one notation and cannot be used with others.

In this project we aim to develop tools and techniques that will allow one to freely interconvert one Braille based Math notation to another (e.g., Nemeth Math to Marburg code and vice versa) as well as interconvert between Braille based notation and those used by sighted individuals such as LaTeX or MathML. Thus, our tools will also allow one to freely interconvert between math markup notation used by the sighted world (such as MathML and LaTex) to Braille based Math notation (such as Nemeth Math notation and Marburg Math notation). Our approach will be based on (i) developing a common intermediate format for representing Mathematics and (ii) designing easy-to-use GUI-based tools that will facilitate the translation of a given Math notation (whether for visually impaired or for sighted) to this intermediate format, back and forth. We will use modern formal language technology developed in the field of computer science, based on *denotational semantics* and *logic programming*, for developing this translator.

We will also develop a general audio browser for understanding mathematics based on this common intermediate format that will allow blind users to “browse" mathematics text using an auditory browser. Techniques based on repetitive navigation and abstraction will be developed to communicate the structure of mathematical expressions. A Domain Specific Language will be developed and implemented so as to allow the (sighted) author of a mathematical expression (or a third party such as a course instructor) to specify how the various expressions should be ``navigated" by the audio browser so as to communicate the structure and content of the expressions to the blind reader in the best possible way.

Reference: N. Annamalai, D. Gopal, G. Gupta, A. Karshmer, H. Guo. INSIGHT: A Comprehensive System for Translating Braille based Mathematical Documents to LaTeX. In Proc. 2003 International Conf. on Human Computer Interaction (HCI'03). pp. 1245-1249.