Equation Editor Applet with TeX Output for the Web

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Equation Editor Applet with TeX Output for the Web

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Abstract

In this project we develop a portable tool to compose algebraic expressions in TeX using a java applet to implement a WYSIWYG application for commonly available web browsers.
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Chapter 1

Introduction

1.1 Problem and goal

A growing number of universities offer a select set of on-line courses and academic degree programs via the Internet. While some programs require students to attend campus classes, others are completely on-line. Communications technology created the Internet, email, discussion forums and collaborative software. This enables both the learners and the teachers to communicate with each other. With the development of on-line education resources, an increasing number of engineering courses run into the problem of writing algebraic expressions in a web browser. Because of the large number of mathematical symbols, notations and rules, writing formulas is an arduous task for the browsers. One way to solve this problem is to make a picture of a formula (or part of it) and display it on the web. This requires some effort and is not well suited for dynamical material that appears e.g. in forum discussions. \( \text{T}_{\text{E}}\text{X} \) is a widely accepted format in the scientific world format to publish books and articles. One advantage of the \( \text{T}_{\text{E}}\text{X} \) system is its flexibility, which allows to produce professionally formatted papers that can be easily be reproduced with the same appearance independently on time, place and equipment. Ready made compilers do exist to translate \( \text{T}_{\text{E}}\text{X} \) into other formats such as HTML. Nevertheless, \( \text{T}_{\text{E}}\text{X} \) needs some time to be learnt which can be an unnecessary burden for undergraduate students. To simplify their task, this project aims to develop a WYSIWYG (What You See Is What You Get) equation editor to display a formula in a browser and at the same time create a \( \text{T}_{\text{E}}\text{X} \) version to be saved locally or used elsewhere.

1.2 Outline of the Thesis

The thesis is organized as follows. Chapter 2 describes the implementation of the applet and explains some of the features. Examples showing the Equation Editor applet in use are provided in Chapter 3. Conclusions are in Chapter 4. Appendix A contains a more detailed documentation on how to use the Equation Editor applet.
in a format that is shared with the students in courses on-line.\footnote{For an example, check http://www.lifelong-learners.com/opt/nu/SRC/ee.html}
Chapter 2

The Equation editor applet

2.1 Implementation

Since, our application is being developed for a wide range of e-learning students, the main requirement is portability across a wide range of platforms / operating systems. For the web, this means ability to work in the most of the modern web-browsers. We found that Java applets meet these requirements. An applet is a small program that can be included in an HTML page, using plug-in software that is commonly installed or readily available. The Java programming language is a powerful programming language, but quite heavy to use. On the other hand, Python is a simple, easy and efficient scripting language that can be used to generate Java source code. Jython is the technology that is capable of merging the two languages; it allows to use Python to call Java classes (increasing the power of Python) and execute Python code inside Java applications.

Finally, Unicode is necessary in order to display mathematical symbols in a manner that is platform independent. Last versions of Unicode contain almost all the symbols that are needed.

2.2 Constructing a formula

2.2.1 Getting started

The Equation Editor applet requires the Java Virtual Machine (JVM 1.1 or higher) to be installed in the browser to work correctly. In addition, the Unicode fonts encoding mathematical symbols need also to be installed.

The applet consists of three parts. At the top, a rectangular box is the input area where the formula can be edited as it looks. Below are a number of buttons with symbols, with different sets that can be selected such as Greek letters, Arrows, Relations etc. The output is shown at the bottom, with a \( \text{T}_{\LaTeX} \) string corresponding to the formula displayed in the top window. Of course, this text area is not editable and its outlook can slightly vary from browser to browser. With Window/Explorer
for instance, the text area can be used to copy the content by clicking with the right mouse button and choosing "copy" in the pop-menu; under Linux/Firefox this text field can be copied by typing “Ctrl+C”. Finally, there are a few additional buttons to create more complicated structures than just one symbol, such as the "frac","sqrt" buttons to create fractions and square-roots.

### 2.2.2 Input

The input is taken from both the keyboard and the mouse by clicking on any of the symbols in the middle of the applet. To start, move the mouse within applets area and choose the symbol you want to insert into the formula.

### 2.2.3 Editing

If the user does a miss-print, he can use button "Backspace" to delete this last symbol and continue by typing a correct one. If the miss-print occurred somewhere before the cursor position, then the user has to click approximately where mistake occurred to edit the object that has been used to construct this part of the formula. This object appears with a rectangular box. After activation the user can delete or edit every attribute and correct the mistake. When adding or removing some part of the formula, all the other components are shifting so as to preserve the natural
2.2. CONSTRUCTING A FORMULA

look of formula. Of course, all the changes automatically appear in the TeX output window on the bottom.
Figure 2.2. Composing a series
2.2. CONSTRUCTING A FORMULA

2.2.4 Getting the result

A TeX version of the formula (in the form of a string of ASCII characters) can be read directly from the text area and can be copied into the browser clipboard, as shown in fig. 2.3.

Figure 2.3. Copy to the clipboard
Chapter 3

A few examples

What you can do with the Equation Editor applet.

<table>
<thead>
<tr>
<th>Relational symbols</th>
<th>$a \neq b, a \equiv b, a \geq b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derivatives</td>
<td>$f', \frac{df}{dx}$</td>
</tr>
<tr>
<td>Arrow symbols</td>
<td>$2H_2 + O_2 \to 2H_2O$</td>
</tr>
<tr>
<td>Theory symbols</td>
<td>$(1, 2, 3) \cup (4, 5, 6)$</td>
</tr>
<tr>
<td>Greek characters</td>
<td>$\alpha + \beta = \gamma$</td>
</tr>
<tr>
<td>Superscript</td>
<td>$c^2 = a^2 + b^2$</td>
</tr>
<tr>
<td>Subscript</td>
<td>$a_1 + a_2 = a_3$</td>
</tr>
<tr>
<td>Fractions</td>
<td>$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$</td>
</tr>
<tr>
<td>Miscellaneous symbols</td>
<td>$\theta, \infty, \clubsuit$</td>
</tr>
<tr>
<td>Integrals</td>
<td>$\int_a^b f(x)dx \approx (b - a)\frac{f(a) + f(b)}{2}$</td>
</tr>
</tbody>
</table>
A web application has been developed in the form of an applet written in the Jython programming language. The applet renders algebraic expressions that can be edited in all of the most common web browsers to produce the corresponding TeX string version of it. A great variety of formulae can be achieved using Greek characters, arrows, relational and other symbols, in normal, super- and subscript! The tool is now ready to be tested in the E-learning courses offered at NADA.
Bibliography


Appendix A

A.1 Applet requirements

The Equation Editor applet needs Java Virtual Machine (JVM) version 1.1 or higher to work properly. To test your browser for Java Virtual Machine support, visit: http://www.java.com/en/download/help/testvm.xml. If it necessary, download and install it.

A.2 Using the Equation Editor applet

A.2.1 Introduction

After the applet has been loaded you will see the Equation Editor applet appear in your browser. The Equation Editor applet contains the following major elements.
1. A workspace in which formula is constructed.
2. A set of symbols.
3. A set of buttons for superscripts, subscripts, etc.
4. A number of buttons to switch between different sets of symbols.
5. An output area showing the result in \text{\LaTeX}.
Figure A.1. The Equation Editor applet

The display area (top) is interactive: this means that it is possible to click on some part of the formula and insert or delete what you want. Below this input area (middle) various sets of symbols can be chosen by clicking on the corresponding button to insert the symbol into the formula. There are also buttons for superscripts, subscripts and various accents.
The icons in the Equation Editor are explained by the following table:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>x^</td>
<td>Superscript</td>
<td>$a^2$</td>
</tr>
<tr>
<td>x_</td>
<td>Subscript</td>
<td>$a_2$</td>
</tr>
<tr>
<td>frac</td>
<td>Fraction</td>
<td>$\frac{1}{123}$</td>
</tr>
<tr>
<td>sqrt</td>
<td>Square root</td>
<td>$\sqrt{a+b}$</td>
</tr>
<tr>
<td>hat</td>
<td>Accent hat</td>
<td>$\hat{a}$</td>
</tr>
<tr>
<td>bar</td>
<td>Accent bar</td>
<td>$\bar{a}$</td>
</tr>
<tr>
<td>dot</td>
<td>Accent dot</td>
<td>$\dot{a}$</td>
</tr>
<tr>
<td>vec</td>
<td>Accent vector</td>
<td>$\vec{a}$</td>
</tr>
<tr>
<td>tilde</td>
<td>Accent tilde</td>
<td>$\tilde{a}$</td>
</tr>
</tbody>
</table>

Figure A.2. Applet buttons definition
Different sets of symbols can be chosen by clicking on the corresponding selector: Greek, Arrows etc.

Figure A.3. Greek symbols

Figure A.4. Arrows

Figure A.5. Relations

Figure A.6. Operators

Figure A.7. Miscellaneous
A.2. USING THE EQUATION EDITOR APPLET

The output of your work appears at the bottom of the applet in the form of a $\text{TeX}$ string that can directly be copied to your browser clipboard. In Windows/Explorer: highlight the $\text{TeX}$ string with the mouse, click on the right button and choose “Copy” from the pop-menu. In Linux/Firefox: highlight the $\text{TeX}$ string with the mouse and use “Ctrl+C” combination to copy content to the browser clipboard.

A.2.2 Creating an equation

Input

Input is taken from the keyboard and by clicking with the mouse on the symbols in the applet. To be able to type from the keyboard you need to place a mouse within displaying area to give it the focus.

Insertion

An insertion consist of one or more characters inserted in the editing formula. To insert any symbol in formula, click on the part of the formula that you are going to edit. The rectangular box that appears shows that this part is now editable. Everything that you inserted is appeared at the end of the box.

Deletion

Deletion consist of one or more characters deleted from the rectangular box. To delete any symbol in formula, click on the part that you are going to delete. Deleting is performed starting at the end of the rectangular box defining the active region in the formula.

A.2.3 Getting the result

To get result in form of $\text{TeX}$ file select text in the output text area, click on the mouse and choose “copy” in a pop-menu in Windows, or use “Ctrl+C” to copy to clipboard in other operating systems. After that you can paste it the text area where you are going to use $\text{TeX}$ version of the formula. Do not forget to surround the $\text{TeX}$ string with dollar signs (as in $\sqrt{-1}=i$) To get a picture of your formula and check accuracy of your $\text{TeX}$ version of the formula, there is an excellent tool on the web, which parses a LaTeX math expression and immediately emits the corresponding gif image. Go to: http://www.forkosh.com/mimetex.html
A.2.4 Examples

Here some examples showing series of steps to create a formula with the applet.

Figure A.8. Example 1

\[ a_{i,j} = 1 \]

1. Move the mouse into the display area
2. Type \( a \) using the keyboard
3. Press the \( x \) button
4. Type \( i, j \) using the keyboard
5. Click inside the display area
6. Enter \( = 1 \) using the keyboard
A.2. USING THE EQUATION EDITOR APPLET

Figure A.9. Example 2

\[ a^2 + y \neq a \times y \]

Move the mouse into the display area
Type \( a \) using the keyboard
Press the \( \times \) button
Type \( x \) using the keyboard
Click inside the display area
Type \( +y \)
Press the \textit{Relations} button
Select \( \neq \) using the keyboard
Type \( a \) using the keyboard
Press the \( \times \) button
Type \( x + y \) using the keyboard
Figure A.10. Example 3

\begin{align*}
1 + \frac{1}{2} + \frac{1}{4}
\end{align*}
A.2. USING THE EQUATION EDITOR APPLET

Figure A.11. Example 4

\[ \hat{a} = \hat{c} \]

- Move the mouse into the display area
- Hit the \textit{hat} button
- Type \textit{a} = using the keyboard
- Hit the \textit{hat} button
- Type \textit{c} using the keyboard