Free Software Packages Available to Develop Online Courseware In Mathematical Education

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Abstract : We present a few simple working examples based on some well-known free software packages. These examples could be used as a model to build an elaborate educational online system managing courseware involving lots of special mathematical symbols used in science, technology and engineering.

1. Background

1.1 The feasibility of mathematical education online involving many special mathematical symbols has been confirmed independently in [3] and [4] since 1997. Our online exercises [2] in the form of multiple-choice were managed in 1997 with a PDF-file created by plain-Tex to display mathematical contents and with an htm-form to collect answers. By early 2004, Javascript, navigation buttons and hyper-references were embedded in our lecture notes [5], in screen formats using PDFscreen [6] and Acrotex [7], with Latex. In late 2004, a sample [2] of randomized exercises with instantaneous report were updated with Python. In early 2005, we constructed another sample of embedding audio and video segments into PDF produced by Latex. Our current online service in 2006 is shown in [8].

1.2 On the other hand, MathML [9], XML [10], OpenXM [11] and JavaMath [12] were preferred by the intensive activities surrounding ATCM in the last few years as partly indicated by the references from [13] to [20]. Examples of similar but more elaborate systems include those from [21] to [24]. In addition, AiM [25] and MacQTex [26] claim that they offer open sources.

1.3 We want to find a suitable way to deliver the contents online in physics, chemistry, engineering and technology. This method must be easy enough for tens of thousands of school teachers and university staff to produce their teaching material. It must also be readable and acceptable by tens of thousands of students to study the subjects. To achieve this purpose, there are many free packages such as TexPoint [27], Beamer [28], Prosper [29] and Pdfmark [30] but we chose Texpower [31], Movie15 [32], Hyperref [33], PHP [34] and Python [35]. Information about commercial products is beyond the scope of this seminar.

2. Demonstration of Feasibility

2.1 We download the package, twmaACTM6.rar, from [36]. After unzip it, there should be only one file with tex as extension. We modify this file and compile it twice with Latex-PDF in front of the audiences. Our friends should be able to reproduce our experiment at home and probably adapt it as their own teaching tool. The demonstration includes the following standard well-known features.

(a) Typesetting documents with lots of mathematical symbols is easy nowadays.

(b) Corrections and maintenance are simple after a courseware is computerized.

(c) Beautiful colorful screen format for presentations in classrooms and in conferences.

(d) Internal and external hyper-references are inserted into the document in the form of buttons and hyperlinks.

(e) Problems and solutions are prepared in one file but they are separated into two files by a simple program.

(f) JavaScripts are inserted as part of the document although we do not recommend them because it appears to be unstable according to our experience.

(g) Audio and video clips are embedded although we do not recommend them because it appears to be too slow according to our experience.

2.2 The feasibility of online exercises based on Latex is also well-known. At the last page of the screen from the above experiment, there should be a link to start the second part of our demonstration and if it fails then we may use [2]. We present an online exercise involving mathematical expressions and a chemical equation. The demonstration includes the following standard well-known features.

(a) Displaying mathematical symbols online is easy nowadays.

(b) The parameters vary every time.

(c) Results are available as soon as the student submits the exercise.

(d) Data are collected from the screen and manipulated. They can be recorded if necessary although we skip this part in our demonstration.

(e) The chemical equation justifies the application beyond mathematics. We collect strings in addition to numbers.

2.3 Because we are able to collect strings, it is merely a matter of programming to include mathematical expressions analyzed either by computer algebra [37], [38] or

by pushdown automata with control of acceptable error. We believe that it can be done although it is not part of our demonstration.

3. Your Conclusion

3.1 All my source files are free to download [1]. Techniques involved in this presentation have been in the public domain for many years. Any school teacher can easily develop something similar to ours [8] for his/her classes. The students would be able to learn at their own pace within their own physical environment in addition to their normal style through personal contact with their teaching staff in classrooms.

3.2 In a larger scale, similar projects have been developing in many places as quoted in our references. Do we want to use the collective strength to establish a new achieve of teaching material in science, technology and engineering? Or should we integrate ourselves under some existing umbrella? Or will we miss this opportunity all together?

4. References

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