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Math e-Learning System STACK2.2 and a Prototype of Question Authoring Tool

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Abstract: STACK, System for Teaching and Assessment using a Computer algebra Kernel, is a system of a computer aided assessment package for mathematics. STACK can provide questions for an on-line test that inquires an answer as a mathematical expression and assess the answer algebraically. We have been developing Japanese version of STACK as a part of work of internationalization. Recently version 2.2 of STACK was released and it increased processing speed. However, one of the difficulties of STACK is to author questions because the interface is inconvenient. In order to overcome the problem, we have developed a prototype of question authoring tool by the use of VBA of Excel. A question can be written on Excel interface and XML file is produced that can be imported to STACK question bank. Compared to authoring questions on the existing web interface of STACK, it is expected that time spent on authoring questions can be reduced.

Keywords: Mathematics, e-Learning, Computer Algebra System

Introduction

In recent years, infrastructures of information and communication technology (ICT) have been improved in schools. Some schools have computer suites for students to have practical work experience and some schools deploy Wi-Fi network for students to access Internet by their own laptop computers. Portable digital devices such as a smartphone and personal digital assistance (PDA) have been becoming popular and ubiquitous education environment are opened to students nowadays. On the basis of the ICT environment, e-Learning have been becoming popular. One of the most important functions of e-learning system is an on-line test. The level of students' comprehension can be evaluated by the online test. Students enter answers into the online form and the answers are automatically assessed by e-learning system. However, most forms of entering answers on existing on-line tests are only true or false questions test, single- or multiple-choice test, input of numerical value and simple description, and only a few e-learning system can assess true or false of mathematical expression algebraically. Maple T.A.[1] and STACK [2,3] are examples of the few systems. Maple T.A. can be accessed from a wide range of Learning Management System (LMS) such as Blackbord, Moodle and so on and STACK is integrated with Moodle. Maple T.A. is commercial software, whereas STACK is open source software.

Since we have been using Moodle as LMS, we adopted STACK in order to provide on-line test of mathematical expressions in science and math subjects. However there are some problems in STACK. Firstly since it takes times to display questions and assess the students' answer, rhythm of learning might be lost. Secondly, STACK can reply effective feedback to wide variety of students answer, but in order to realize the function, authoring questions is very complicated. First problem is solved by new version of STACK 2.2 with

cash mechanism. In order to overcome the second problem, we would like to suggest a question-authoring tool for STACK in this paper.

1. Brief Review of STACK

STACK, System for Teaching and Assessment using a Computer algebra Kernel, is a system of a computer aided assessment package for mathematics that is developed by Sangwin at the University of Birmingham, UK. Since version 2, STACK is fully integrated with Moodle. Students provide answers as mathematical expressions, for example polynomial and matrix expressions and STACK manipulate students' answer and generates outcomes such as not only true or false result but also some feedbacks. STACK is written by PHP and use Maxima, a computer algebra system, in order to manipulate mathematical expressions provided by students.

Figure 1 is an example of a question of solving a simple differential equation that was provided to students in January 2010 as an online test in our class. The question is quite simple but there are two elements that we should check in order to confirm the students' level of understanding; one is whether or not students make miscalculation and the other is whether or not an arbitrary constant is included. Although the correct answer of the question is C*exp(-2*x), there are two typical incorrect answers. One is C*exp(2*x) that is an example of miscalculation and the other is an answer exp(-2*x) that does not have an arbitrary constant. We can design questions that can provide a feedback "Incorrect answer. Your answer should satisfy the ODE, but does not." for the first type of incorrect answer and a feedback "Your answer is partially correct. The solution should contain a constant but your answer does not." for the second type of incorrect answer (see Figure 2).

If we design a question carefully in order to give a feedback like the above, we can produce significant educational benefit. As we see later, however, it is complicated work to author STACK questions because of the inconvenient authoring interface.

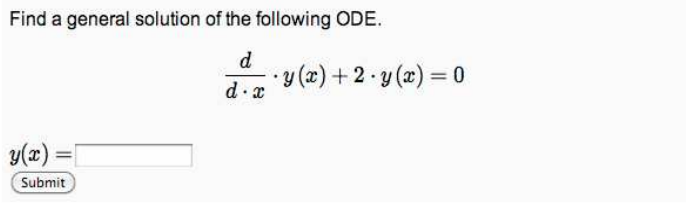

Figure 1. A question of solving a simple differential equation

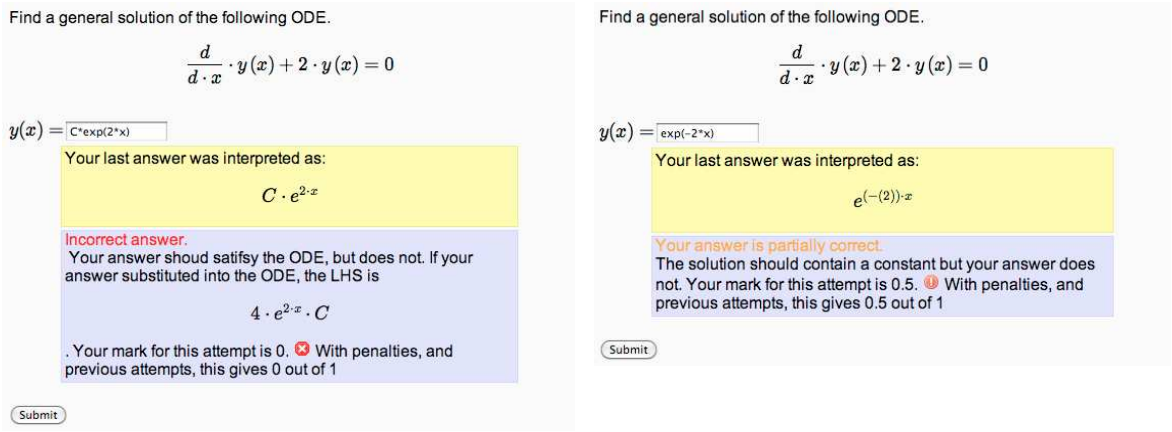

Figure 2. Examples of feedback to incorrect answers.

2. Question Authoring Tool for STACK

As we mentioned above, STACK can provide effective feedbacks to the students' answer and this function is one of the most important one of STACK. However the interface of authoring questions is not convenient. For example, the authoring web page is vertically long, network connection is inevitably required and so on. In order to reduce the stress in authoring questions, we have developed a prototype of question authoring tool for STACK by the use of VBA of Excel (Figure 3).

Although every function is not implemented to our tool, the interface is quite simple and authoring questions can be carried out without network connection. Questions authored by our tool can be exported as XML file with UTF-8 coding. Then the XML file can be imported to STACK question bank.

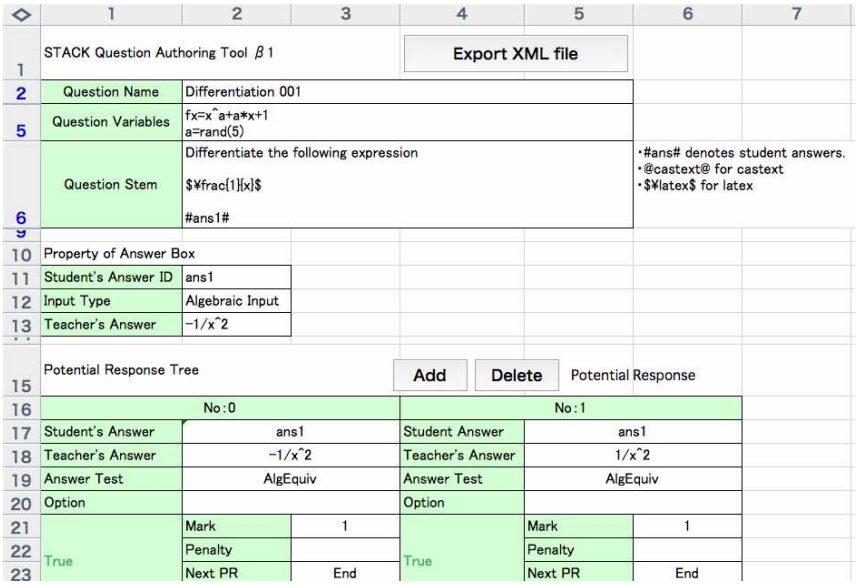

Figure 3. Snapshot of question authoring tool for STACK developed by VBA of Excel.

3. Conclusion

We have developed a prototype of question authoring tool for STACK in order to reduce the stress in authoring questions for STACK. Although every function is not implemented to our tool, the interface is quite simple and authoring questions can be carried out without network connection.

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