Using Moodle for Algorithmic Grading of Homework Assignments

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Abstract

This paper will explore the use of Moodle to grade numerical based homework assignments. Particular interest will be paid to Moodle's ability to supply a different set of numerical parameters for every student in the course. In addition, Moodle's ability to adaptively grade the homework makes it particularly attractive to faculty interested in reaching an online audience. Implementations in a typical fluid mechanics course will be explored in detail.

Moodle is a learning management system used for online or mixed technology type courses. It is freely available as a open source software and is licensed under the GNU General Public License. It is available for download at the web site http://moodle.org/. Of particular interest in this paper is its ability to construct php based algorithmic quizzes and homework's. These quizzes are useful because each student will see a different set of numbers for each question. In addition, these quizzes can be set up as adaptively graded. Adaptive grading is the deduction of a certain percentage for each answer attempt. Below, is an example of a question from both the faculty as well as student's perspective.

Faculty Perspective

Figure 1 shows an example taken from my fluids course for Spring 2012. The picture and problem statement was adapted from the "Fundamentals of Fluid Mechanics" by Munson, Young, Okiishi, and Huebsch. However, upon closer observation the problem statement contains variables enclosed in brackets. These bracketed variables are recognized by the Moodle system as variables. Figure 2 shows the php based formula for the problem statement. Notice the existence of the bracketed variables in the "*Correct Answer Formula*" box. In addition, a tolerance level is available to the faculty member to set. If the tolerance level is set too low, round off will render the entire grading process wrong as we shall see shortly. Moving to the next page, Figure 3, we notice Moodle has identified the variables in out question and answer. Notice two sets of variables were identified. Mandatory variables are those variables that exist in the answer block in Figure 2. In this particular example, the variable {A} had no bearing on the solution and was not entered in the answer block in Figure 2. As a result, Moodle identified this variable as a possible wild card, present only in the question text.

A {D} diameter jet of water is deflected by a homogeneous rectangular -block ({B} meter by 0.2 meter by {A} meter) that weighs {W} N as shown in Below. Determine the minimum volume flowrate needed to tip the block?

NOTE:

- A = {A} meters
- B = {B} meters
- C = {C} meters in diameter
- D = {D} meters in diameter
- E = {E} meters
- F = {F} meters
- density of the fluids is = 999 kg / meter^3

Figure 1. Problem Setup

Figure 2. Problem Answer

Figure 3. Dataset Properties

Moving on to the next page we see Moodle is ready for us to add data to our database. As we can see from Figure 4, we may now set the range for each of our variables. We may also set the Decimal places shown to the students and the distribution type, Uniform or Lognormal.

Figure 4. Datasets

After generating a set of data from these distributions, Moodle will list every incidence in the dataset. Figure 5 shows the 102 incidence in the database. Notice the variables listed show the appropriate decimal places as well as the Min and Max values based on that particular dataset.

Figure 5. 102 Item in the Database

If the data did not allow enough decimal places the correct answer may not have fallen with the range and the text would have been listed in red giving the faculty member quick notification to go back and look at his/her decimal places. Once the dataset is full the faculty member may save the problem for the student's to work on.

Student Perspective

From the Students Perspective, he/she only see the problem as presented by the Moodle server, Figure 6. Notice the numbers are all placed in the problem statement and the problem appears as though it would in any normal textbook.

1 ✎

Marks: --/33

A 0.03110 diameter jet of water is deflected by a homogeneous rectangular -block (0.01168 meter by 0.2 meter by 1.06 meter) that weighs 8.01 N as shown in Below. Determine the minimum volume flowrate needed to tip the block?

NOTE:

- A = 1.06 meters
- B = 0.01168 meters
- C = 0.01394 meters in diameter
- D = 0.03110 meters in diameter
- E = 0.66718 meters
- F = 0.9406 meters
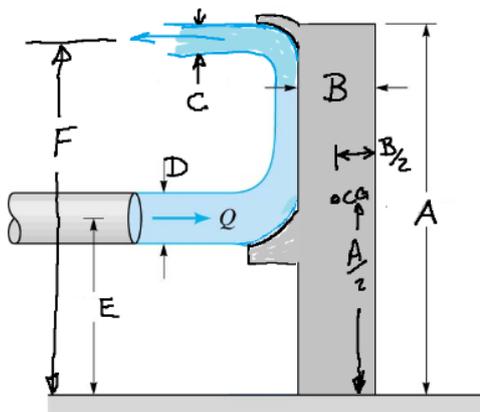- density of the fluids is = 999 kg / meter^3

<div align="center">

Figure 6. Problem Statement

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The only difference occurs when the student enters a number and submits and answer Moodle will grade the problem for that particular set of numbers. If the student enters an incorrect number, Figure 7, the system will deduct a percent from the student and allow them to continue entering numbers until they have the right answer. Notice in Figure 7 a 10% deduction was placed on the incorrect submission. This means the student *must* be able to enter the correct answer eventually to receive any credit. As a result, the student earns partial credit instead of bargaining with the professor for partial credit.
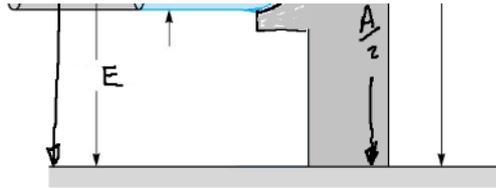
Figure 7. Incorrect Answer

Practical Usage

Through three semesters of usage I have found a slow acceptance from the students. In fact the better students tend to excel using this homework system. Where those students in need of help are immediately exposed to the faculty and some type of remediation can begin. I have found the best approach for my class is to allow every student two attempts at each problem. When the student gives up or exhausts their tries on the first attempt the correct answer is show, with any notes the faculty member my wish to give. Once the student begins his/her second attempt the numbers are completely different. Since Moodle uses a mathematical algorithm to assign an answer, his/her knowledge from their first attempt will translate to their second attempt. I have found that appropriate usage of these attempts in grading can affect a student's score. For example, I make a stipulation that if a student completes 50% of their problems on the first try, they receive 15 point bonus on their final. There are a number of ways Moodle can grade each problem, such as highest grade or average. I generally select the highest grade from their submissions. This will allow a student to go through a learning phase on attempt one, and an execution phase on their final attempt. Currently I am gathering data on this approaches effectiveness. Since our class size is limited to 30 students it should take some time to correlate this approach with learning outcome, at least to some level of statistical significance.

References

http://moodle.org/

http://atu.5thn.com/

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