Using Student ID Numbers to Create Customized Homework Problems

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Abstract –Academic integrity and misconduct are of great concern in the educational community. One way to combat cheating is to assign each student a unique homework problem. Student ID numbers are unique and can therefore be used to customize assignments. Using examples from a logic-design course and a signal-integrity course, it can be shown how the creative use of ID numbers can create homework problems that are all equally difficult on one hand but unique on the other. Microsoft Excel can "pick apart" the ID numbers to create answers for each student, and zeroes in the student ID number can be dealt with easily.

Keywords: Academic integrity, Student identification number

INTRODUCTION AND SURVEY OF LITERATURE

Academic Misconduct (AMC) is of clear concern to engineering educators. Not only is ethical behavior essential to good engineering practice, but also engineers need to be well-educated which implies that they did not take shortcuts to their education.

Several approaches to reducing cheating and plagiarism have been proposed and tested. These include using advanced pedagogy to create a climate that discourages cheating [1],[2], shuffling and/or customizing test and homework questions randomly [3],[4], automated detection of plagiarism [5],[6], controlling distribution of questions to prevent students giving answers to future students [7], and adding multimedia components so that student identity can be verified [8].

After making the observation that each student has, by definition, a unique ID number, and that the instructor already knows the number, it is clear that the ID number becomes a source of pseudorandom numbers that are unambiguous and that do not introduce any new privacy issues. This is the approach that is described in this paper. It is similar to the approach of customizing test questions [3],[4], except that it actually enables each student, both present and future, to have a homework problems that are unique on one hand and are of roughly equal difficulty on the other. Some have expressed concern about students retaining homework sets for future students to use to unfair advantage [7]. A significant advantage of ID-number-based assignments is that even future students will have customized problems, minimizing the impact of retained homework.

A survey of literature surrounding student ID numbers describes methods for using ID number [9] and reveals methods for keeping ID numbers secure [10], especially if RFID technology is used [11]. Such privacy measures, while important, are outside the scope of this work. Students already routinely place their ID numbers on homework sets and tests and so the method outlined here does not introduce new privacy issues.

EXAMPLES USING STUDENT ID

There are three steps in using student ID numbers in homework sets and on tests. First, suitable problems must be identified. Second, the problem statement must be reformulated to make the use of the ID number clear. Third, there should be a method for creating an answer key for each student.

Identifying Suitable Problems

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Engineering homework sets and tests are, by their nature, problem-oriented. Many homework problems have unique closed-form solutions and involve processing numerical quantities. Most problems in this category (unique closed-form solution involving numerical quantities) are good candidates for ID-number customization. It is clear that incorporating ID numbers can work in both online and traditional courses, although the author has only used them to date in traditional courses.

One example is from a course in logic design, where students are tasked with calculating different clock-cycle times. There are four possible constraints on clock cycle, and each constraint can have several different possible answers. To find the correct answer for each constraint, different "paths" (sums of different series of numbers) are compared and a maximum is selected. Then the maximum of the four constraints is selected. Thus each individual constraint calculation and the selection of a maximum can turn out differently depending on the delays involved and therefore the student ID number. Similar examples include a power-supply design (constrained by four numerical quantities) and delay and capacitance of a logic gate (also constrained by four numerical quantities).

In classes involving programming, ID numbers can be incorporated different ways. For example, in a microprocessors course, a program can be written to blink or display the student ID number or to have the program's behavior be a function of ID number.

Clear Problem Statement

The problem statement (e.g. in the written homework instructions) must clearly explain how the ID number is to be used. It is helpful to create blanks where the student fills in his or her ID number (or the last few digits of the ID number). Then one can add a separate set of blanks to eliminate zeroes since, in many problems, zero is not a physically plausible quantity. One way to eliminate zeroes is to replace them with the last non-zero digit, and another is to replace zeroes with tens.

Once the unique set of numbers has been created, the problem statement can explain how each quantity is to be used in the homework set.

Creating an Answer Key

While it is advantageous, from the standpoint of academic integrity, for each student to have a unique homework problem, it is clearly more difficult to create an answer key. (Indeed, this is arguably the biggest problem with ID-number-based assignments.) Microsoft Excel is extremely useful for this purpose. After creating a column for ID number, one can create a series of columns to break out individual digits and then correct for zero values. Then one can use the closed-form formulas and the ID-number values as inputs and generate answers. If desired, one can use functions like INDIRECT and ADDRESS to pull out a single row of data and display it in a readable format. It is helpful to generate the answer key first, and then generate the problem statement and handouts.

DEPLOYMENT IN COURSES

Two examples, one from logic design and one from signal integrity, are shown below. First, the example from logic design and the accompanying circuit are shown.

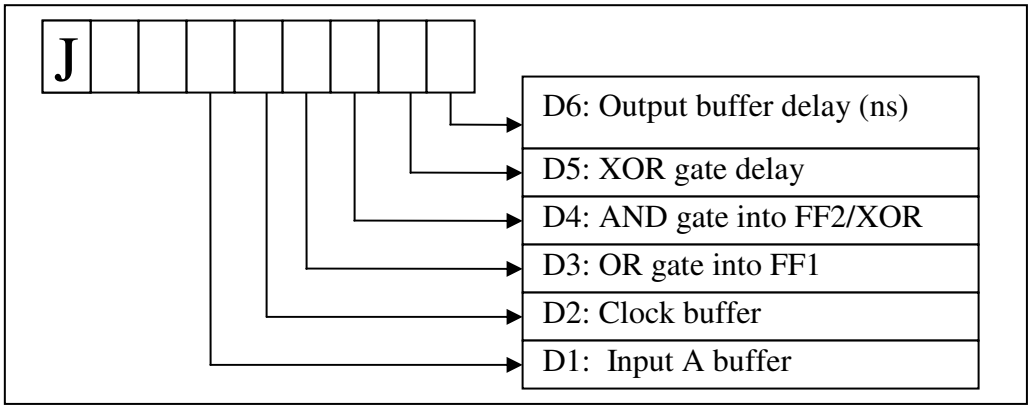

Figure 1: Example of converting ID number to numerical values for homework problems.

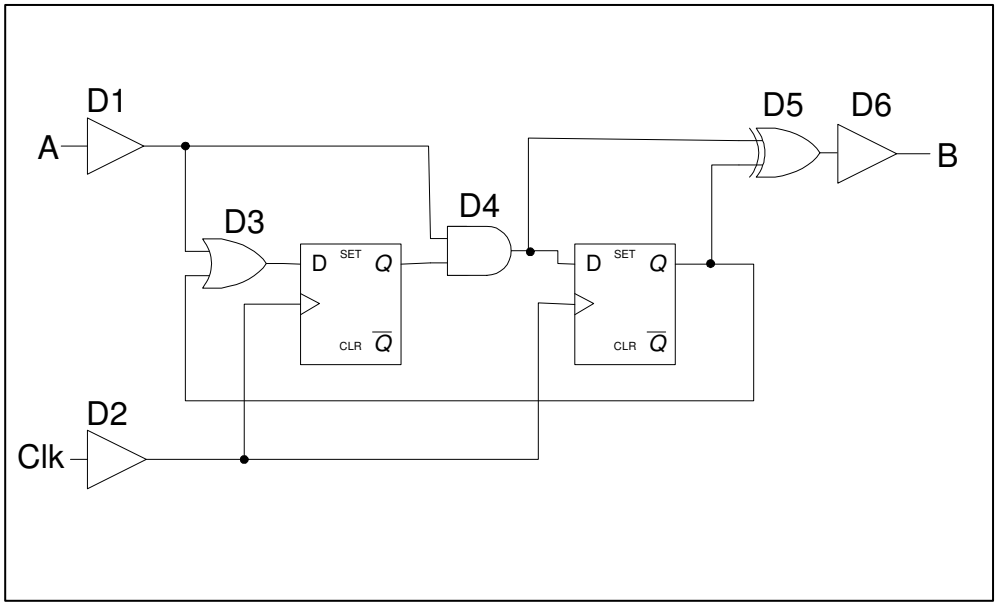

Figure 2: Circuit corresponding to Figure 1 that shows how the "input values" are used. Students use the values to calculate clock cycle times.

Second, the problem statement from the signal-integrity homework set is shown.

1. Construct a power infrastructure for a simple design. The design as a target Xmax of 0.1 Ohms, a rise time of 500 ps, and a power-and-ground-plane capacitance of 1500 pF.
   - Write down the last 4 digits of your J number: _____ _____ _____ _____
   - Replace any instances of '0' with the last non-zero digit in your J number:

     _____ _____ _____ _____

     Digit: A B C D

   - Power-supply inductance is D*25 nH
   - Inductance of bypass cap, Lbyp, is C nH
   - Resistance of bypass cap, Rbyp, is Xmax/2 = 0.05 Ohms
   - Inductance of a single array capacitor, Lcap, is B nH
   - Resistance of a single array capacitor, Rcap, is A/10 Ohms

   a. Compute fpsw, the point at which the power-supply wiring has too much impedance.
   b. Compute Cbyp, the amount of bypass capacitance needed.
   c. Compute fbyp, the point at which the bypass capacitance has too much impedance.
   d. Compute N, the number of array capacitors needed.
   e. Compute Ccap, the capacitance value of each array capacitor.
   f. Compute Rarray and Larray, the resistance and inductance of the entire capacitor array, taking into account that there are N capacitors in parallel.

Figure 3: Another example of an ID-based homework problem from a signal-integrity class.

CONCLUSIONS AND FUTURE WORK

Academic integrity is an important component of engineering education. One way to increase the likelihood that students are conducting their own work is to assign unique homework problems (but of roughly identical difficulty) to each student. Incorporating student ID numbers into the numerical values of an assignment is a practical method for accomplishing this, and one that does not necessarily require programming or web-based tools to work. One interesting advantage is that the uniqueness of the homework assignment persists over time, reducing the advantages conferred by using homework retained from previous semesters.

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