Improving graduation rates in advanced master's level courses

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When it comes to graduation rates, the CSE department and its related programs have an inherent challenge. On one hand, the program courses prepare their students well for their professional life. On other hand, it is indeed challenging to keep them motivated throughout their education years, since they can find well-paying jobs even before graduation. Today we do this by offering attractive topic tracks within the programs, encompassing solid introduction courses and challenging advanced courses, which prepare the student for their master's thesis work. This proposal describes how to harmonize the efforts at the CSE master programs, more specifically how our advanced master's level courses could offer the students technically and/or theoretically challenging contents, introducing the students to scientific writing (including literature review), and providing the students with support and examination mechanisms so as to improve the graduation rates in these courses.

This proposal is based on some changes made in one of the advanced courses in MPCSN, EDA421 – Parallel and Distributed Real-Time Systems. To that end, we have made sure that the student (1) becomes active early in the course via homework assignments, (2) has to address challenging technical and scientific problems in these assignments, and (3) feels that the overall examination procedure in the course is fair. It is our belief that these changes have contributed to the fact that EDA421 has a steady inflow of students (20-30 students each year), receives very good reviews (grade > 4,5 for the last three years), and has a high graduation rate (90% or more). We also believe that approaches similar to those used in EDA421 could be implemented in most other advanced courses in our programs.

Project description

1. The motivation: Students should not start working too late into the course, causing them to do poorly, or even fail. We therefore propose that students are required to solve a set of homework assignments (take-home exams) evenly distributed in the study period, starting already in study week 2. The students will then immediately realize if the course is harder than they expected and thus immediately put more time into the course. As a "reward" for the students for their early commitment to the course we propose to use a weighted-sum policy for the final grade in the course, wherein the homework assignments contribute with a larger weight (e.g. 60-75%) to the final course grade while the written exam contributes with a smaller weight. Such a policy has the nice side effect that students who spend their time wisely solving the homework assignments in a timely and good manner will have less pressure on them to excel at the final written exam. The experiences from EDA421 indicate that almost every student that makes a serious attempt to solve the homework assignments also do very well at the written exam (as they have already gained the knowledge required during their work with the assignments).

2. The challenge: In order to attract students to our programs, and to prepare them for their thesis work, we believe that an advanced course must be technically intriguing/challenging and have a strong connection to the state-of-the-art research in the topic. The latter can be

accomplished by requesting that the students read, and write reviews for, scientific papers. We also recommend that "open" (currently-unsolved) problems in the scientific community are presented in the course, and that explanations are given as to why these problems are difficult to solve. In terms of challenges, it is important that the homework assignment problems are of such a nature that it is not possible (or at least very difficult) to look up their complete solutions on the web or in books. Also, the problems should preferably encourage alternative interpretations or solution paths, thereby offering more freedom in the solving of the problems. Our experiences from EDA421 indicate that this approach makes plagiarism virtually non-existent among the students; the problems are so intriguing and challenging that they want to find the solutions by their own doing. Another interesting side effect of the 'alternative interpretations or solution paths' idea is that is keeps the course teaching staff on their toes, as there may occasionally appear new thrilling aspects of a given problem.

3. The examination: In the traditional procedure used for grading exams and assignments it may happen that, if a student had presented a solution which rendered him/her very few (or no) points, there is not much leeway for rectifying this. To avoid this, we propose the concept of 'solution defense meetings' for the homework assignments: that is, immediately after a student have submitted his/her solutions to a homework assignment, a meeting takes place between the student and the course examiner wherein the submitted solutions are presented and orally defended and explained by the student. Based on the technical quality of the solutions and the degree of convincing argumentation made by the student the homework assignment is graded during the meeting, with deduction of points clearly motivated by the examiner. In EDA421 this approach has been received very favorably, mainly because it gives the students a feeling of having their solutions graded in the fairest way possible. Also, in cases when an alternative interpretation of, or solution to, a problem is proposed by the student there is less risk that it will be graded as erroneous by the examiner. This approach also saves time in the examination since the examiner does not have to sit and try to understand an unclear solution before being able to grade it; instead, any unclear issues can be raised during the meeting thereby saving valuable time for the examiner.

Estimated costs

We will suggest changes (as described above) in the following courses[1] over a 4-year period

- During the first two years: EDA491 (Network Security), TDA297 (Distributed Systems, advanced course), EDA282 (Parallel Computer Organization and Design), and DAT147 (Technical Writing in Computer Systems and Networks).
- In the third year, we will extend the ideas to the MPALG program. Advanced courses of primary interest are DAT280 (Parallel Functional Programming) and TDA230 (Algorithms for Machine Learning and Inference).

We estimate that the project will affect at least 120 students from the D program (as well as 20 more from other programs). We estimate that each course will take two iterations before the work completes. The first iteration will define homework assignment problems with the desired properties, and test/evaluate them locally at the department (e.g. by doctoral students or senior staff). We estimate that the first iteration requires 80 hours per course. The second iteration is for establishing a framework for the execution (schedule, consultation sessions) and examination (grading guidelines) of the homework assignments. We estimate that the second iteration requires 20 hours per course.

The total cost is 600 hours for six courses, which is about 700 kSEK[2]. The cost per year will be as follows: 2014: 280 kSEK *(1st iteration for 3 out of 4 courses)*, 2015: 165 kSEK, 2016: 210 kSEK *(1st iteration for 2 courses + 2nd iteration for 1 course)*, 2017: 45 kSEK.

[1] These courses are chosen because they are program 'exit points' before the thesis work. The courses have a long chain of prerequisites and they are not in the prerequisite list of any other course.

[2] Assuming that ca 2/3 of the teachers are professors, we use an average 65 kSEK monthly salary.