Bridging the gap in interdisciplinary engineering studies

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ABSTRACT

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"Interdisciplinary studies", it rings well right? But how do you teach people two subjects at the same time? How do you bridge the gap in knowledge and basic understanding that exists between two fundamentally different technical fields? The field of bioinformatics, the fusion of biology and computer science, as well as input from the diverse disciplines of mathematics and statistics, physics and chemistry, and medicine and pharmacology, has long struggled with this challenge (Altman 1998, Goodman 2014, Machluf 2017, Pevzner 2009) in its attempt to educate people in these very different topics. The course described here aims to bridge this gap given a specific profile of students and time restrictions. At time of writing this course is planned to run in January 2017 but the effectiveness of the planning is yet to be evaluated.

The overall learning objectives for the course are to enable the students to design and perform a data driven experiment from biological data and write the experimental into a small scientific paper. Here, I will present a course designed for Master's level students in biotechnology who wish to start working with bioinformatics. Biotechnology, being the study of microorganisms in the context of industrial application, is traditionally a field involving complex laboratory skills, such as cloning and feature screening. The difference in biological knowledge between between biotechnology and bioinformatics is minor while the gap in technical skills is wast as bioinformatics requires the work with data analysis and programming, techniques that are not traditionally part of biotechnology (Tan 2009, Welch 2014, Wind 2008). This type of students has often shown signs of discomfort, insecurity and lack of overview when getting into this topic, as it is so far from their normal knowledge fields (Libeskind-Hadas 2013, Machluf 2017). The course uses flipped classroom and case based learning to help the students gain confidence in their abilities in a new field while showing them the context in which the knowledge is used.

The course is designed as an intensive 3 week course (8 hours per day, five days a week, 5 ECTS points) with lessons every day and a total of 4 classic lectures (45 minutes each). A flipped classroom approach is used twice (session of 5 hours each) to let the students investigate online data and analysis resource. These are supplemented with hands on technical assignments (3-4 hours each) and short fast paced projects in groups (6-8 hours per project, one project per week). The projects are case based, the students are asked to read a specific journal article, analyze the content and design their analysis inspired by it. The fast pace and short deadlines serve as a way to eliminate the student’s opportunities to question themselves and lose focus. The students will work on 3 projects and will be changing groups for each, again, forcing people to deal with the project assignment more and each other less. The projects will be of increasing technical and analytical difficulty and will build on skills acquired in previous projects. The two first projects will be concluded with a presentation (15-20 slides, 15 minutes and analysis code/method) while the last

project will be finalized by a scientific article style report and presentation (3 pages, 20-30 slides, 20 minutes and analysis code/method)

Formal assessment is performed based on the 3 projects (oral presentations, code, hand in of slides and written report, the written report is only for the final project) as well as handing in of code and notes from technical exercises. The students are given a chance to assess their own learning through peer assessment during class discussions of results and discussions between groups at the end of each project. Lastly, days of technical tutorials and discussions are ended with a small test which is then discussed the next day. The tests are largely based on the learning objectives stated for the day as well as for the technical exercises. This allows the teacher to stay on top of what is not sticking and gives the students the opportunity to evaluate their own progress.

The teaching format described here is in strong contrast to how this topic is generally taught, with heavy focus on teaching complicated technical skills in long and hard tutorial sessions. It is the intention that this new format will result in students with a higher sense of accomplishment and desire to learn more. This is crucial if biotechnology graduates are to take their place in the new world of microbiology and biotechnology, which relies on both biology and informatics students to engage and remain curious as to how these two fields can grow together (Machluf 2017, Pevzner 2009).

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