IMPROVING CS EDUCATION AT THE UNIVERSITY OF VIRGINIA BY INTEGRATING ELECTIVES

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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ABSTRACT

Engineering computer science students at the University of Virginia can have a hard time fully incorporating into their work all the knowledge they have gained during their study. Integrating computer science electives would allow students to better understand how to incorporate their computer science knowledge. I propose integrating different CS fields such as machine learning and mobile app development by adding to the curriculum different electives than those currently offered. The effects of these integrated electives on students can be studied in the future if UVA implements the recommended changes. One of the advantages of the proposed approach is that students would have a better understanding of computer science and thus better preparation for the workforce. Future work would need to be done to evaluate the effectiveness of these classes.

1. INTRODUCTION

There are a lot of gaps between what is required of a software engineer and the education of computer science majors. This can lead to many graduates lacking necessary skills when entering the workforce [3]. The University of Virginia currently has a curriculum for the BS major in computer science that attempts to give students the best education and workforce preparation possible. There are many issues with this curriculum, especially with computer science electives as students must take five CS electives [8].

The problem with this is that these electives could be very enriching for students but do not connect with other CS material students have learned. The solution to this problem would be to offer new electives that still branch off to these CS subtopics but also integrate with other electives, tying them together with the general CS material students are required to learn.

2. RELATED WORK

There have been many efforts to improve undergraduate computer science curriculum. Hadfield, et. al. (2019) suggests increasing the number of required CS classes and ensuring that these classes have strong ties with software engineering in order to better prepare CS students for the workforce [7]. By contrast, my study focuses on improving electives to better prepare students.

Hollingsworth and Powell (2011) focused on requiring a class that incorporated both cloud computing and mobile computing, skills needed to better prepare future software engineers [4]. They created a UVA class with two current electives combined into one and they show how it would be beneficial to integrate the two classes. This study expands on their idea as it seeks to integrate more electives with other electives along with the general CS material to better prepare

engineering computer science students at UVA.

3. Proposed Curriculum

In contrast to the current curriculum, the curriculum I propose would seek to integrate electives. The goal would be to create UVA graduates more ready for the workforce. For example, some of the electives currently offered in the spring semester of 2023 are cloud computing, database systems, machine learning and introduction to cybersecurity [1]. The proposed new electives would be classes such as combining the mobile app development elective that has been offered in previous semesters and cloud computing, a class that Hollingsworth and Powell (2011) proposed because of the benefits to the student [4].
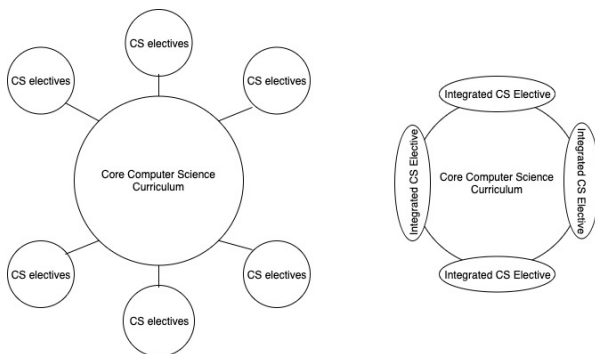

Figure 1: A comparison between the current CS curriculum and the proposed CS curriculum

The proposed integrated electives also would closely relate to the core computer science curriculum, as seen in Figure 1. This would be beneficial to the students as it would give them a better basis of understanding of the new elective topic and how it relates to general CS knowledge. Furthermore, the student would also see how the general CS knowledge is applied to more real applications in these integrated electives. Overall, instead of the usual five electives, students would take five of the proposed integrated electives.

3.1 Example Class—Machine Learning in Mobile App Development

One integrated elective that could be offered would be combining machine learning and mobile app development. Many of the top apps used today such as Snapchat and Facebook use machine learning [2]. Therefore, learning how to utilize both skills at once could be very beneficial to future software engineers who are likely to work with these types of apps.

Currently, the objective for machine learning is the student learning the fundamental concepts of machine learning and how to apply it to various problems [5]. The objective for the current mobile application development class is to introduce to students how to build apps for mobile devices [6]. The objective of the proposed class would be to introduce both topics to the students and allow them to build an app utilizing machine learning. Instead of going into deep detail about all the different types of learning techniques in machine learning and all the different platforms and technologies needed to build mobile apps, the proposed class would focus on how to build an app and use machine learning within it.

Furthermore, the proposed class would tie the topics together using the core CS curriculum to give the students a basis from which to work. Algorithms and advanced software development techniques are both required courses for BSCS students to take and these classes would heavily relate to the content of the class [8]. This is because developing a mobile app is like what was done in advanced software development techniques and machine learning has strong ties to algorithms. Having a strong basis from their core CS curriculum would allow students to better understand this

class and help them become better future software engineers.

4. Anticipated Outcomes
The outcome expected for students would be better preparation for software development post-graduation. This is because classes like the class proposed above have a greater emphasis on building on a student's current CS knowledge, which would allow them to fully incorporate all the knowledge they have gained throughout their study. Instead of having deep knowledge of a certain subject such as cloud computing, a student would be able to relate cloud computing to their core CS knowledge, giving them a better basis from which to operate in the workforce.

5. Conclusion
The proposed curriculum is important to implement as it will allow CS graduates at UVA to be ready for the workforce. This is a contrast to the current curriculum in which the electives do not allow students to fully build on their CS knowledge. The implementation of this curriculum would allow students to build on their current CS knowledge through the proposed integrated electives which ultimately make them more ready for the workforce. Overall, integrating electives can be very beneficial to CS students at UVA as the electives will allow students to fully incorporate all their knowledge into their work.

6. Future Work
Since the proposed integrated electives have not been implemented, those classes would need to be offered in order to see if there are benefits to integrated electives. Classes should be evaluated to determine the benefits, if any, and the nature and extent of the benefit, if so. Furthermore, different integrated electives that combine CS topics can also be explored to see

if they help students build their knowledge base.

7. UVA Evaluation
The University of Virginia has a very good CS program. However, the electives are lacking, which led to this proposal of integrating the electives topics to be more beneficial to the student. The core classes in the CS program are very good; therefore, implementing electives that are more closely related to these core classes would be very beneficial.

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