Iteration of Curriculum: Comparison of Old and New Computer Science Program at the University of Virginia

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Eizaku Asai
Computer Science
The University of Virginia
School of Engineering and Applied Science
Charlottesville, Virginia USA
vmr4ku@virginia.edu

ABSTRACT

The Computer Science (CS) curriculum at the University of Virginia (UVA) was reworked, leading to many changes in the difficulty and type of coursework. One of the prominent problems with the new CS curriculum is the apathy towards the coursework and grading schemes that make passing the course easy. Despite these problems, this curriculum was developed to address issues caused by its predecessors, including reducing redundant material and creating courses that scale better with enrollment. My proposal provides thorough comparisons of the new and old curriculum and advantages and disadvantages with each. To further address these issues, continued analysis of students in the new curriculum can be conducted, as the new curriculum is still relatively fresh. Through iterative development, it can be improved to address evolving needs.

1. INTRODUCTION

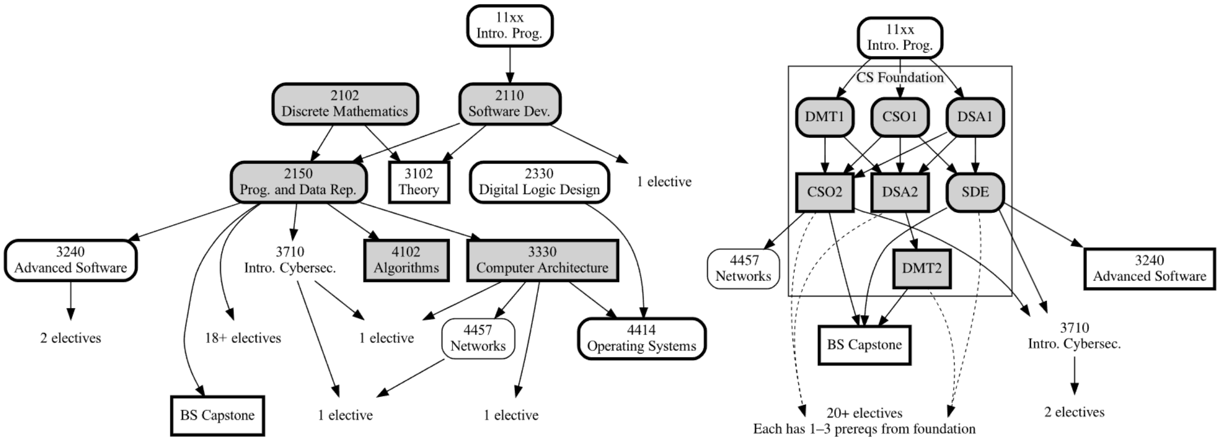
In 2021, the UVA CS department introduced a new curriculum that had undergone rigorous development over the course of several years, designed to reorganize coursework to meet new demands. With increasing popularity in CS as a major, courses need to be able to scale better and formatted in such a way to support three different major types, Bachelor of Arts in Computer Science (BACS), Bachelor of Science in Computer Science (BSCS), and Bachelor of Science in Computer Engineering (BSCPE). Each of these majors has varying requirements within the CS department, and by redistributing topics in a more sensible way, students are able to focus on the subjects important to each of those degrees. Some courses were also considered too difficult or scattered in the subjects covered such as Program and Data Representation, which was often called a "weed out" course. Because of the major shift in the CS curriculum and courses being offered in person following the aftermath of the coronavirus, it is important to analyze the benefits and drawbacks that exist between the new and old systems.

My personal experience was going through either the first or second iteration of each of the classes in the new curriculum, meaning they were only assessed through pilot courses and had yet to be formatted appropriately for larger class sizes and general students. This means grading schemes underwent changes and certain aspects of the course may have already undergone improvements. I supplement my own experiences by referring to the newest versions of the course as well as the latest available data on students who have taken each of these courses to make fair comparisons to the old coursework.

2. RELATED WORKS

Tychonievich and Sherriff (2022) led the effort to redesign the CS curriculum. In this

Figure 1: Old Curriculum (left) and New Curriculum (right) by Tychonievich and Sherriff (2022)



process, they highlighted some of the main issues of the old curriculum, including the increasing size of the student body, the various degrees that utilize coursework in the CS department, the new CS education standards published by the Special Interest Group on CS Education (SIGCSE) and courses that were not transfer-friendly. When redesigning the curriculum, they adopted a tiered system in which introductory courses were at the 1000 level, the first set of foundational courses at the 2000 level, and the second set of foundational courses at the 3000 level. This enabled a streamlined education experience in which the core requirements for the CS degree could be completed in two to three years.

UVA Institutional Research and Analytics (2025) provides grade distribution data on grade percent average (GPA) for old and new course performance. Using this resource, further analysis can be performed to assess and compare student performance in both curricula and how prepared they are for higher levels courses in the curriculum.

Thapa (2024) critiques the new curriculum for its software development focus. They home in on the lack of low-level coding focus with classes such as CS2130 Computer Systems and Organization 1 for only shallowly covering logic gates and hardware design. They recommend increasing the focus low level to high level computing and programming coverage to better prepare students for embedded and hardware design jobs.

3. DESIGN ANALYSIS

This section dives deeper into the considerations of designing the new curriculum and compares the student performance in the old and new curriculum.

3.1 Redesigning the Curriculum

According to Tychonievich and Sherriff (2022), the old CS curriculum was originally designed with only BSCS students in mind. To adjust to learning needs the curriculum experienced changes to coverage in courses that caused disorganization.

Figure 1 above, produced by Tychonievich and Sherriff (2022), shows a flow chart of the courses and their respective prerequisites. From this chart, it is evident that the new curriculum efficiently organizes the courses into a tiered system, compared to the web of courses and prerequisites present in the old curriculum. In addition to distributing topics in a more sensible manner, the new curriculum enabled students to complete elective courses, then progress through and finish the curriculum more quickly. The new curriculum also accommodated BACS and BSCPE students and promotes student diversity and student enrollment.

3.2 GPAs of Old and New Curriculum

When comparing GPA of old and new curriculum courses, a compilation of the most recent data will be used. Courses taught before fall 2021 will not be used because they are during or before COVID-19 and the teaching environment for those courses is vastly different. This data will be retrieved from the University Data Home (2025) that has the grade distribution data for courses taught in the last five years with the latest data from Fall 2024. This can be used to assess whether the new organization of courses better prepares students for subsequent degree requirements.

CS 3240 Advanced Software Development is a course that is present in both the old and new curriculum, so to include it, the instances taught before fall 2023 are part of the old curriculum and those after are used as part of the new curriculum. This is to account for the reasonable amount of time it would take for new curriculum students to be able to take the course.

Table 1. Old Curriculum Course GPAs

Course Number	GPA
2102	3.86
2110	3.58
2150	2.90
2330	3.76
3102	3.63
3330	3.20
4102	3.27
4414	3.26
3240	3.64
Average of Courses	3.46

The GPA for courses in the old curriculum can be seen in Table 1 and can be seen to have classes that are generally above a 3.0 GPA aside from CS2150 Program and Data Representation. In Table 2, the courses in the curriculum can be seen to all have GPAs above 3.0 but can also be seen to have an overall lower average score when combining all the courses.

Table 2. New Curriculum GPAs

Course Number	GPA
2120	3.44
2100	3.62
2130	3.20
3100	3.31
3130	3.27
3120	3.15
3140	3.26
3240	3.81
Average of Courses	3.38

4. RESULTS

The new curriculum has done a good job of meeting the goals set by Tychonievich and Sherriff. The courses seem to be well-structured with well-defined topics that feel relevant both in electives and subsequent courses in the core curriculum. The organization of the new curriculum is also more successful in addressing the growing student body. In my own experience, I was able to complete the required courses for the BSCS degree in four semesters because the tiered system enabled me to take several cores during the same semester. As a double major in BSCPE, I found that courses in the CS and ECE departments complemented each other well. The old curriculum involved using courses in the ECE department as alternative prerequisites in the CS department. The new curriculum on the other hand does not cross courses together and keeps them separate while enhancing the learning experience.

The course GPAs of both curricula are similar and are higher on average in the old curriculum. However, noticeably under the new curriculum there are no courses with students overall performing as poorly as CS2150. The GPA in CS3240, a course present in both curricula, is higher in the new curriculum, indicating better preparedness for the course from the prerequisites mainly being software development (2110 in old curriculum and 3140 in the new curriculum).

Thapa (2024) argues that the new CS curriculum is heavily focused on software development and has a weaker focus on theory and low-level design. However, low-level design can be learned through the BSCPE degree, which requires courses in embedded software development and computer architecture. Despite the low-level design in the CS curriculum being weak, those who want to pursue careers in those fields can opt for BSCPE or take elective courses.

Thapa's concerns encouraged me to reexamine the requirements for the other degrees in the CS department including the minor, BACS and BSCPE. BSCPE and BACS seem to have good coverage as majors; however, the minor can be seen to serve a different purpose. The CS minor requires students to take all the tier 1 courses (CS2100, CS2130, CS2120) and CS3140 software development essentials. The minor mostly serves those who seek to build their software development skills; however, CS2130 does not provide as much substance as the other courses do. I recommend making this requirement interchangeable with another 3000 level or higher elective, so students who want a balanced CS education can achieve that; and those that seek software development experience can accomplish that more easily.

5. CONCLUSION

To recapitulate, the new curriculum was designed to address the disorganization and increasing student body by providing an overall better flow to coursework and content covered. The GPAs of both curricula show that the overall course difficulty did not change much, but CS 3240 Advanced Software Development had students that were better prepared as indicated by the higher GPA. However, the new curriculum introduced its own set of shortcomings. With a weaker basis in lower-level design and theory, students would have to pursue either additional coursework or alternative majors. Additionally, the well-rounded focus of the CS minor does not serve the primary purpose for some of the students pursuing it and should have its requirements adjusted to better meet their needs

6. FUTURE WORK

Overall, the new curriculum is an improvement and proves to be a good step in the iterative design of the UVA CS curriculum. Improvements are always possible and can be addressed in small steps using student feedback without drastic changes like the complete overhaul. One recommendation I have for the CS department is to change the requirements of the CS minor to better serve the needs of those pursuing it for a software development background. Unlike a major, the minor is not accredited by Accreditation Board for Engineering and Technology and its requirements can be adjusted more easily.

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