

**Thesis Portfolio**

**Open Source Software Practices in CS2**  
(Technical Report)

**Ethics Education for Responsible Computer Scientists**  
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree  
Bachelor of Science, School of Engineering

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## **Sociotechnical Synthesis**

Computer science (CS) is a versatile discipline with the potential to revolutionize every other domain of knowledge. However, while computer scientists have the power to bring visionary technology from science fiction closer to reality, they may also spawn dystopian nightmares where privacy is relinquished for security or malicious artificial intelligence programs wreak havoc. Therefore, to ensure a more optimistic future, higher education institutions must empower engineers to solve challenging problems while reflecting on the ethical implications of their work and upholding moral responsibilities to the public. In order to realize this goal, the technical research proposes several curricula for introductory CS courses to better engage and inspire students with meaningful assignments through open source software projects. The STS research discusses a broader reform of CS education where ethics courses and contextual teaching can prepare future generations of socially conscious engineers.

## **Technical Research**

Introductory courses must be engaging and captivating as students are starting to determine whether CS is the right path of study for them and evaluate its value in the real world and in other disciplines. Instead of trivial assignments and toy projects without much practical utility, instructors can integrate pragmatic and meaningful contexts in lessons with open source software (OSS) projects. OSS is specially licensed programs with publicly available source code that anybody can further develop. Through such projects, students will implement theoretical concepts and gain valuable insight into the professional software development process. The technical research paper discusses four strategies of incorporating OSS development principles,

practices, and tools: direct contributions to OSS, custom plug-ins for existing OSS, simulated open source communities within classrooms, and code snippets as real-life examples of textbook concepts. Depending on the number of students, prior experience in software engineering, and course objectives, choosing the most appropriate model will best ensure classroom success.

### **STS Research**

With the growing influence of technology on society, computer scientists are best equipped with the technical knowledge to reflect on the consequences of their work. Therefore, the CS curriculum must emphasize consideration for moral responsibilities alongside technical knowledge and accomplishments. In order to achieve this goal, instructors must encourage students to independently reflect on difficult ethical issues and consider trade-offs. For example, ethics education can be embedded throughout the curriculum to expand perspectives and lead discussions on real-life challenges faced by computer scientists. Students can also learn how theoretical concepts can be applied to solve real-world problems with meaningful assignments involving an ethical dimension. Projects, such as OSS, that impact a wider community or assignments with pragmatic contexts can provide an accessible approach to understanding course materials and how they can be applied to similar real-world challenges. As a result, the reformed CS curriculum will inspire students to serve and improve the world as responsible engineers.

### **Conclusion**

While the technical research discusses several possible curricula to implement contextual teaching in introductory CS classrooms, the STS research addresses a broader topic of how the curriculum can better train socially conscious computer scientists. Together, they explore how to

improve CS education and why a reformation is necessary. As a result, students will be able to connect with the wider world as they discover their potential to make a positive impact as responsible engineers.

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