The Impact of UVA's Machine Learning Class (CS 4774) on Students:
How its Benefits can be Augmented

Comparing the Perspectives of Students and Professionals on Machine Learning Pedagogy

A Thesis Prospectus
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**Investigating the Pedagogical Implications of UVa's Machine Learning class (CS 4774):
How can CS Education be Better?**

Overview:

I am a student in the CS 4774 class at UVq and I plan to analyze its impacts on different students through interviews. I then want to outline the pedagogical implications of this class and what its strength and weaknesses mean for the world of computer science in academia. I want to answer the question of how exactly this class impacts students and how it can be improved for future students. The readers may gain a broader perspective into the realm of CS knowledge and gain better tools to understand what they would desire from a CS education.

Positionality:

As a daughter of Bangladeshi immigrants, I grew up with the mentality that the way to succeed was to be the best at everything academically. Both of my parents came from humble beginnings and worked so that they could cultivate a better life for themselves and their children. I always felt a fear of disappointing them if I didn't follow suit and make a name for myself. My dad, having a PhD in CS, always ecstatically rambled about his own passions without explicitly telling me which path in life I should take. It wasn't until the senior year of high school when I learned where I wanted to develop my career. In my AP Computer Science Principles class, I programmed for the first time and fell in love with this art, steering me towards the direction of CS.

Throughout college, I became fascinated with artificial intelligence and machine learning. My first experiences with these topics would not come, however, until my third year at UVa. In the first semester of my third year, I took a robotics class and worked a job concentrated in the data science aspect of machine learning. These experiences illuminated this subject and the great

possibilities that it has. While I know now that my parents will be proud of me regardless of what I do, I believe that machine learning shapes our future and that I can make a change through educating myself about this topic. Hence, I decided to take the Machine Learning CS elective to fulfill my Capstone requirement.

Problematization:

CS 4774 can be improved in many ways from the student perspective. Although it is a useful elective, it has some weaknesses that must be addressed. Nevertheless, it also has many strengths that one can take away from the class. The current professors are highly qualified and would benefit from learning how the students, the other main interactors, would enjoy the class more. The past professors have had different approaches, which is why there needs to be data collected on what the best one is and how that can be improved. The 'best' one is not easily quantifiable, but can be characterized by different qualities, such as the knowledge retention of students and their overall ability to be able to teach the knowledge from the course to other students. Not only would this data help improve the experience of CS 4774, but it would also give insight into the current world of pedagogy in computer science.

Guiding Question:

From this project, I want to answer the following question: "How can CS 4774 teach us how to improve pedagogy in computer science?

Projected Outcomes:

My research aims to address the problem of how we can better our classes so that our CS students can earn more out of their major and are more prepared for their jobs in this field. I also want to extend the benefits of this beyond the machine learning classroom into the overall realm

of pedagogy. Throughout my experiences and through the testimonies of my peers, teaching in computer science has a long way to go and an in-depth look at the best classroom practices would help future CS students retain knowledge that earlier generations could not. Of course, future software engineers would benefit from this immensely, but so would the people who are affected by their work. Hence, the benefits will spread through multiple communities.

Technical Project Description:

My project is based on other students' and my experience in the CS 4774 class I took in the spring semester of my third year at UVA. I have some prior expertise on the area of machine learning due to the robotics class I took earlier at UVA in my fall semester. I am interested in this area, so an encompassing review will let me express this interest better. In my technical project, I take student testimonies and other reviews to give a comprehensive perspective on CS 4774 as a class and propose a solution to any of the recurring criticisms that students may have. The STS project also touches on this class, but takes the opportunity to view it from a humanistic perspective to view its applications to overall pedagogy.

Preliminary Literature Review & Findings:

Other engineering students on CourseForum have also discussed their own experiences with this class (theCourseForum). The challenges faced by people on these online forums is that they don't get to talk to the professor face-to-face, and this may mean that the professor may not take these perspectives into account as he works. Moreover, the professors tend to rotate on this class from semester to semester, so a new professor may not know exactly what the old professor did or how to improve upon what the old professor did. Hence, my work should take into

account different people's experiences with professors from different semesters to give an all-encompassing analysis of this class.

Additionally, reading the syllabi of different machine learning classes at other universities gave perspective on how machine learning is viewed beyond the UVA classroom (Yale University, 2021; Princeton University; NYU Tandon School of Engineering). The bulk of the sources I consulted cover the various teaching methods and pedagogical frameworks used in the context of delivering knowledge. They placed an emphasis on active learning and constructivism (Cho et al., 2021; Arthurs and Kreager, 2017; Attwell and Hughes, 2010). Others promote a non-traditional approach, using methods like electronic textiles or small groups (Bilson, 1986; Fields et al., 2018). These sources are meant to help develop a specific set of classroom values that can better the teaching of computer science overall.

STS Project Proposal:

STS is a study of how engineers can build and invent in a way that takes into account multiple perspectives and ethical viewpoints. A weakness of STEM fields is the fact that they can become highly theoretical and abstract in lecture, causing a disconnect from ethical implications which are highly relevant.

My approach is lining mostly with an ethics and values standpoint. When studying Machine Learning, it is very important to highlight the ethical implications of this discipline. Though many people are already afraid of the capabilities of machines, it is still important for anyone studying this discipline to truly delve into why this is the case. The applications of machine learning extend across multiple disciplines, affecting fields like healthcare. While the approach is still heavily ethics-based, it would be weak to say that other areas do not apply to

this paper. The primary authors I want to use are multidisciplinary. While the authors will still be involved in CS, , I will also use sources from people outside CS who may feel slightly opposed to innovation and the impact that innovation has. It is no secret that the improvement of machine learning will cause a shift in the job market, potentially replacing the labor of many people. This will also lead to more jobs in technology, though. This is one of the primary reasons I chose this ecosystem of knowledge and why I want a multidisciplinary approach in terms of authors.

I want to approach this with a discourse analysis approach, which analyzes based on the context of material given. To then validate the values drawn from this work, I want to use a Focus Group and analyze their results using the value sensitive design approach by Batya Friedman. Approaching machine learning technology with the values of humans not only makes machines that much more useful for humans, but can also help answer the question of the negative impacts of machine learning on humans. I define the value sensitive design approach as designing with humans and human value at the forefront of your mind. Its contributions are most certainly important in the realm of engineering because I find that engineers, though we are builders, tend to lose sight of who we are building for. We also tend to exclude people when we build things, which opens up another world of ethical problems. With this approach, those harmful effects can be mitigated immensely. It will co-produce research that aligns with my understanding of STS because this approach greatly takes into account multiple viewpoints and multiple perspectives. It alleviates the harm from excluding people or excluding everyone altogether.

I plan on accomplishing this through reviewing the current class I am taking, which is CS 4774. The method of collecting data which I plan to do is through first looking at the online syllabi and course forum for discourse analysis. Then, I will be collecting interviews in the form

of focus groups from people who took this class. This method is the anticipated one for me because it will collect in-depth answers from multiple people who will be encouraged to think about their experiences in real time and easily deliver an answer. The face-to-face experience will also encourage them to come up with real answers.

Barriers & Boons

As with anything, there are potential blindspots and limitations to my pursuit of knowledge. My positionality statement has given me the perspective of a woman of color and daughter of immigrant parents, but I know that there are many diverse people in the CS community at UVA, and hence many diverse perspectives on the impact of the machine learning class here. I have some experience with interviewing people if it was an assignment for a class. However, I am not a naturally outgoing person even though I have a desire to interview people outside of my own friend group. To offset the impacts of these limitations, I will make sure to ask all interviewees the same questions in the same manner, regardless of how much I know them. I'll also try to reach out to people in a variety of manners, whether through group chats or posting on my Instagram story to get a diverse range of different people who took the class. I will have to read more about the science of interviewing to know how best to proceed with this method. Moreover, the interviews are not the primary resource to utilize. I am consulting syllabi of other classes to get better insight into how the discipline of machine learning is taught at multiple universities. Moreover, I am reading multiple pedagogical papers that can help examine the discipline of machine learning in relation to mainstream pedagogy.

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