**Satori: A Course Management System**
(Technical Topic)

**How Can a More Accessible Mode of Office Hours Benefit Students' Learning**
(STS Topic)

A Thesis Prospectus
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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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# Prospectus

## Introduction

The average cost of tuition for college in the US is rapidly increasing with each passing year. Private schools have an average of $39,723 for tuition, public schools have an average cost of $22,953 and $10,423 for out-of-state and in-state students respectively ("See the Average College Tuition in 2022-2023", 2022). Despite these exorbinate prices, many students still don't take full advantages of the amenities which they've paid for through tuition. What I've identified as one of the largest culprits of underutilized student resources is Office Hours. The benefits of going to Office Hours are numerous. For example, it can help professors identify their middiest points, reinforce concepts, facilitate peer instruction, encourage a growth mindset and more ("Office Hours—An Often Underused Key to Student Success", 2019). These are the times where students can both get to know their instructors and get help with any content which they may be struggling to understand (Limberg, 2007). Office hours have been shown to have a positive effect on the students who show up when in need of help. A study done at Harvard has shown that after implementing a web-based system for hosting office hours, average attendance increased to four times the previous average (MacWilliam, 2013). According to a paper regarding Integrated Media Platform-based Virtual Office Hours, using these sort of systems can both improve students' online presence and test scores. In this article it was shown that the degree of students' benefit could be linked to the mode of interaction being used for office hours (Chen, 2021). When a website lacks sufficient interactivity and a professional looking design, users will often be inable to access what they're looking for in a timely manner or sometimes even at all (Cosgrove, 2018). The current course management system being used in CS 2150 at the University of Virginia (UVA) is insufficient. The website being used to host the current

office hours queue is messy, inefficient, and unwelcoming to users. As previously shown, these problems could be affecting the students' confidence in the website or even dissuade them from even attending office hours. It has been shown that bad website design can prevent users from easily navigating it, cause it to be slow, make you seem untrustworthy, overcomplicate functionality, etc. (Laws). The goal is for our updated system is to create something which is easier for the user to navigate, more efficient in term of handling the load of students, and more aesthetically pleasing. With these accessibility updates, the hope is that students will be more inclined to visit office hours and get help when they get caught up in a homework problem. By updating the course management website, instructors for CS 2150 (and hopefully eventually other courses as well) will have a reliable and accessible solution to office hour queueing which will be easy to use and subject to future improvements upon the groundwork already laid out.

**Technical Topic**

CS 2150: Program and Data Representation, currently hosts the third largest number of computer science students at the University of Virginia (393 students in the Spring 2022 semester) but lacks a modern course tool to enhance student's learning experiences. This technical report outlines the work done to create a modern web application to better assist with students seeking help with the course work. The web application was written using the Django framework and hosts a multitude of features that allows for less waiting for the students and less stress for the Teaching Assistants who lead office hours. The current web application has proven useful for handling the workload of CS 2150.

The previously used system, 'Course Tools' has become increasingly insufficient and dated. Specifically for office hours where students must enter an outdated online queue in order to be helped by a teaching assistant, this results in long queue times for students waiting for help.

Course Tools used to handle assignment submission and grades, but now that these are dealt with through Gradescope, there's much less of a need for the system. In a post-Gradescope CS 2150, the only tools supplied which are actually of use are support request tickets (which are used to ask for additional help from instructors) and an office hours queue (which is the system used to decide which student will be picked next to get help in office hours). In addition, Course Tools would often get overwhelmed by the large amounts of traffic coming through the website during office hours. It had long response times, data consistency glitches, and frequent hangs which rendered it useless for long periods of time. Another drawback of the old system is that it was developed in PHP, a coding language which (although it does what it's supposed to in production) is falling out of the mainstream and being taught less and less frequently. This haults any sort of development of the system itself since most people are unfamiliar with its infrastructure.

We have developed a new system to replace the outdated Course Tools. The new system, which has been dubbed, 'Satori' is being developed in Python, a common and widely used programming language. This new system is also built on top of a relatively new web development framework for Python, called Django. With the added functionality of the Django framework, we should be able to replicate and potentially improve upon the functionality provided by Course Tools. In addition, because of frontend frameworks such as bootstrap, it will be significantly easier to design the site in a more visually appealing way compared to the old system. The hope is that by making the use of Satori more appealing and enjoyable to the users, they will have more incentive to utilize office hours.

Some of the main challenges in this technical solution come from recreating the website from the ground up, creating something which improves the experience of students rather than

hindering them, avoiding web development pitfalls, and designing something that looks nice. This is a difficult task because the development team is only three undergraduate Computer Science students from UVA.

**STS Topic**

My research is concerned with students' ability to learn. The question I pose is this: How can a more accessible course management system help to improve students' learning?

The Satori course management system is a key component to CS 2150 Program and Data Representation. The class is a requirement for both CS majors coming from UVA's College of Arts and Sciences as well as the Engineering School so we know that there will be many students who use this website ("Programs", 2020). We want Satori to help cultivate the optimal learning environment during office hours. That being minimal distractions, a clear routine, and a positive atmosphere ("What Makes a Good Learning Environment", 2022). One of the goals set when designing the system is for it to be compatible with multiple classes so professors from other classes could use it as well. With this potential for an incredibly large load, one must consider the scalability of the solution. The old system, being designed in PHP, looks like a website from the early 90s without any sort of graphics on the page. This begs the question of, "What can we do to best improve the overall user experience?" The importance of the user experience cannot be undermined, as shown in Al-Shamaileh's study on user interactivity and how it affects their perception of a website (Al-Shamaileh, 2012). It can be difficult to gain the perspective of an 'outsider' in regards to a project. Aside from the obvious problems with the old system such as the display, the slow speeds, and outdated codebase, it's difficult to determine what needs to be changed. This is why, during development of Satori, we (the developers) allowed the current CS

2150 TAs to beta test the system to both look for bugs and suggest additional features. From a study, *Programmer-focused website accessibility evaluations*, we're told that rather than looking at an end-product website and then considering accessibility, we should focus on education of the programmers creating the website to have the capacity and resources to design an accessible website from the ground up (Law, 2005).

As someone who has built the technology being observed, viewing it in the same naïve manner as one completely unfamiliar with the technology just isn't realistic. This is why we can build our solution to this problem in a way that is aimed towards a particular use by the user (Law, 1991). Given enough users they will surely eventually misuse the technology. Often a problem that can lead to this misuse is catering the solution to a wider scope of users than initially intended ("Why you need to design with misuse in mind", 2021). For now, Satori is designed to be used by University of Virginia students and instructors. One such way to keep our system limited to these groups is by adding authentication and authorization which goes through UVA's netbadge system. This way users must have a virginia.edu email to sign in. To simplify the use of the website and thus improve the user's experience with the website, we've clearly labeled the use for all of the buttons available on any particular page. One way that could help improve the speed and efficiency of the queue would be to update the algorithm being used to select students. We could use something like weighted start-time fair queueing which has been shown to be a fairer algorithm than a basic queue (Allahyar, 2009).

**Methodology**

To show the importance of students attending office hours as well as the potential efficacy of virtual office hours, I will analyze and compare research from multiple different studies and attempt to make sense of their takeaways and drawbacks.

After COVID, many classes have transitioned to a hybrid mode of office hours in which students can come in-person or online (Furman, 2021). From the article, *Who Uses Office Hours? A Comparison of In-Person and Virtual Office Hours Utilization*, it was shown that in-person office hours are often underutilized. They compared the modes of office hours based on performance, interaction time, and the demographics which students represented. A limitation of this study is that the two samples were from Fall of 2019 and Fall of 2020, two very different times in everyone's life with the pandemic going on in 2020 (Gao, 2022). Still, the additional data of demographic information is important to consider as it could have a strong correlation with how comfortable a student is coming to office hours. When looking at problems of equitability we should focus on affordability, accessibility, overall quality, barrier of entry, and ease of use (Reynolds, 2020). Each of these are either a key area of focus in the development of Satori or they don't apply (such as affordability). It has been expressed in Nowak's, *Why I Require Office Hours Visits*, that often first-generation students will feel as if they are intruding on their instructor's time during office hours. The entire point of Office Hours being held, to help the student, can often be misunderstood (Nowak, 2021).

One research paper on *Engaging in Office Hours: A Study of Student-Faculty Interaction and Academic Performance* looks at quantitative data that they've gathered to show a positive correlation between students' office hours attendance and their academic performance (Guerro, 2013). This is limited by the study only being done on Political Science classes. Another paper, *The efficacy of online office hours: and expert report*, has some similar and some differing findings. This study combined data about office hour usage with student' project commit and grade history. Fron the data it could be shown that students' grades improved from individual office hour visits but actually showed a negative correlation with students' final project and the

total number of visits made to office hours (Hall, 2021). It could be surmised that coming to office hours very frequently is an indication of poor understanding of the class material. This study is also limited by the subject it covers (CS).

**Conclusion**

From the work being done on the Satori course management tool, it is expected that office hours will run more smoothly and students will be able to get help easier. Assuming that the research showing a positive correlation between office hours attendance and students' grades is true, the implementation of Satori should lead to overall better performance in classes using it. On Satori, students will be able to see their estimated waittime for being on the queue. It's possible that by improving the look of the website, students will be less intimidated by our system of office hours and will be able to get the help they're in need of. The hope is that Satori can one day be wide spread as a solution to optimize office hours for both the student and the instructors who are using it.

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