CS Systems Group Internship

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CYSE368 (Spring 2025)

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April 19, 2025

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Introduction

According to Computer-Science-Schools.com, Old Dominion University is among the top ten percent of Computer Science schools nationally. Additionally, Old Dominion University's Computer Science department is ranked within the top twenty-five percent of research and development expenditures of universities across the United States (Old Dominion University, n.d.). There are over 2,446 computer science students at Old Dominion University, and consequently, many resources and manpower are required to ensure the continuous delivery and success of the Computer Science department.

The Division of Digital Transformation and Technology at ODU, also known as Information Technology Services, manages the technology services of every department except Computer Science. To create opportunities for students to gain hands-on experience with computer science infrastructure, the university allowed the creation of the CS Systems Group to manage the information technology infrastructure within the Computer Science department.

Since the third grade, I've been interested in computer science, cybersecurity, and information technology. Throughout my career in education, I've done my best to take full advantage of every opportunity available to me so I could grow as an individual and a student. I decided to work as a Consultant for the CS Systems Group for a few reasons. First, to become a good administrator, I wanted to gain experience with production tools such as Ansible, Grafana, Kubernetes, and Linux. Secondly, I aimed to enhance my interpersonal skills, particularly in interactions with professors and researchers, as this skill is valuable in the workforce. Finally, I wanted to use the internship to learn about various parts of the industry and determine what cybersecurity branch I wanted to pursue after graduation. These goals have guided me

throughout my internship, and the Systems Group has provided me with lifelong skills that I will always retain.

Organization Overview & Internship Context

Although I work for CS Systems Group, they are not my employer; the company I am interning for is Old Dominion University, a university in Norfolk, Virginia. Old Dominion University was founded in 1930 as the Norfolk Division of the College of William and Mary, the second oldest college in the United States. At this point, Old Dominion was only a two-year school. Since then, it has developed into a four-year independent institution. Old Dominion University was originally named Old Dominion College in 1962 before becoming a university in 1969 after incredible growth and the introduction of graduate programs. Now, as an established university, Old Dominion University is comprised of six colleges with hundreds of bachelor's, master's, and doctorate degree programs available. Furthermore, Old Dominion University is designated as a research institution with "high research activity" by the Carnegie Foundation for the Advancement of Teaching (Old Dominion University, n.d.). In addition to this designation, Old Dominion also has a variety of Division 1 athletic facilities, further adding to its prestige as a national university.

The demographics and customer base of Old Dominion University are similar to that of any other higher education institution. The majority of students at Old Dominion University are in their late teens to mid-twenties (Old Dominion University, n.d.). Since this age boundary borders that of the American high school age range, one can infer that most students at the University are attending to seek higher education after graduating from high school. Some students may study at the university to gain more employment opportunities, while others study to find their life devotion. Competitors of Old Dominion University include other public Virginia

schools such as Virginia Polytechnic Institute, James Madison University, and George Mason University.

In my introductory remarks, I expressed my strong desire to join the Systems Group and capitalize on its numerous benefits. According to its website, the CS Systems Group is staffed by "some of the most brilliant students in the Hampton Roads area" who maintain a sophisticated network of workstations, servers, and advanced technologies. Before joining the group, my primary passion was website design and development, as well as user interface and user experience design. Therefore, I was particularly captivated by the section claiming the Systems Group actively develops and implements "new and exciting projects" for students, staff, and sometimes the community at large to utilize (CS Systems Group, n.d.). I was correct in assuming that most of these projects would be web-based, which I plan to delve deeper into later in this paper. In light of this, I figured this group would help immensely in achieving my goals, so I joined immediately on the first day of the semester.

Before joining Systems Group as a Consultant, I communicated with Dakota Dunn, a CS Systems Engineer. The interview process required me to complete an introductory Linux lab to ensure I had the foundational knowledge and skills necessary for success in the group. The lab required me to set up an Ubuntu server. I needed to configure a static IP address, set up a firewall using iptables, install Apache2 and MySQL servers, and create various groups, users, and directories. After completing the project, I met Dakota at the Engineering and Computational Science building, where he quizzed me on various workstation and server management topics. This lab-quiz dynamic establishes the basis for all learning projects within the Systems Group. After passing the project with flying colors, I was given a tour of the Computer Science facilities, including the server room, several offices, and the computer labs. From there, I met the other two

systems engineers, Izaak Hagy and Rahul Malik, as well as some of the system administrators.
Afterwards, Dakota and I walked to Dragas Hall, where he gave me a tour of the facilities there
and showed me the office where I would be working. My initial impression of CS Systems
Group was quite positive; I worked with people my age who were as passionate about
technology as I was. Engaging in a productive technical conversation with another professional
is always rewarding, as it allows for discussions about shared passions that might not occur with
a non-technical person. Additionally, since CS Systems Group has existed for a long time, it was
interesting to look through the list of the many alumni who have worked for the group over the
years. The most recent graduates from the group that I know of have since gone on to get jobs at
large and incredibly successful companies like Instructure (the company behind Canvas), as well
as NASA, OpenSUSE, and other striking organizations.

Although I mentioned learning projects in the previous section, I will now describe them
in detail as they are a necessary part of my training. Consultants complete several learning
projects to enhance their skillset and prepare themselves for future promotion to Systems
Administrator. There are currently four categories of projects to choose from: Windows,
Networking, Linux, and Containerization. Each category has multiple tiers of projects, starting at
Tier 1 and going as high as Tier 5. Before a new consultant is officially considered a consultant,
they must complete the first tier of the Windows, Networking, and Linux projects successfully.
Like the hiring project, each project has a lab, a quiz, and a deadline for completing the lab.
Unfortunately, the new consultants who cannot complete the projects on time are deemed unfit
for Systems Group and are asked to resign. The Linux project is notoriously difficult and is
considered the weed-out project of the three projects, taking two weeks to complete instead of
one. Despite its infamy, the project is regarded as a necessary "stepping stone" by members of

the Systems Group. The consultant must build and compile dozens of programs from scratch and complete other complex administrative tasks on several Linux virtual machines. I will describe the learning projects I have completed in more detail later in this paper.

Management Environment

The CS Systems Group offers a hierarchy of three positions for a consultant to potentially reach. At the bottom of the food chain are Consultants. According to the Systems Group website, Consultants are responsible for assisting users in the computer labs and through the e-mail ticket software. Consultants are given projects in a multitude of topics, namely Windows, Linux, and Networking, to sharpen their skills and help them eventually move up to Systems Administrator (CS Systems Group, n.d.). Generally, consultants spend most of their time working on their assigned learning projects in the consultant office of Dragas Hall. Consultants are scheduled for about four hours each day; during their shift, consultants are expected to respond to any tickets that appear. Consultants must also help the Systems Administrators and System Engineers carry out their duties, usually by taking on some of the labor-intensive aspects of whatever task they are working on. For instance, consultants handle hardware and software installation, inventory management, office furniture assembly, and many other tasks.

After a consultant has proven their technical skills, they have the chance to become a Systems Administrator. This position is very important because these administrators carry out many production tasks on the Computer Science infrastructure that consultants are too inexperienced to perform outside of a lab environment. As stated on the CS Systems Group website, administrators are "responsible for Windows, Linux, or networking infrastructure, handling issues affecting users throughout the department, and working with systems engineers to improve implementation and add services for users" (CS Systems Group, n.d.). One of the

perks of being a Systems Administrator is that you are no longer scheduled but can come in whenever you would like to perform your assigned duties. However, administrators are also responsible for doing project checks and quizzes for consultants, making the position less idealistic than it may seem. Projects are managed on a locally-hosted kanban management system where administrators can monitor consultant progress on their learning projects. The administrators spend most of their time at their office in the Engineering and Computational Sciences Building, along with the highest rank in the CS Systems Group hierarchy known as the Systems Engineer.

Systems Engineers differ from the previous two positions because they are full-time, salaried employees responsible for ensuring the operation of our infrastructure around the clock, even during natural disasters. As active and experienced members of CS Systems Group, the engineers are always looking for ways to improve our infrastructure for users. Systems engineers also carry out human resources or administrative tasks like order approvals, timesheet review, and handling internal and external conflicts with the group. The engineers and administrators of CS Systems Group are required to attend short, periodic meetings (usually once to twice a week) with Dr. Ajay Gupta. Dr. Gupta is the Director of Computer Resources for the Department of Computer Science. In this role, he oversees the department's IT infrastructure, including the management of network services, user accounts, and daily system operations. His role is critical to the proper function and security of the department's technological resources. Therefore, he must be kept knowledgeable of the activities of his engineers, administrators, and consultants.

Regarding general supervision and project management, the environment at my internship is hierarchical, and requests come in either from Ajay Gupta himself or via our ticketing system. Some individuals, such as students, who use the e-mail system may require

professor permission before we can proceed. Once a task is approved to be carried out by our team, it finds its way to the right person via our chain of command. This approach ensures that tasks requiring the expertise of system administrators and engineers are not mistakenly assigned to consultants. Additionally, it allows tasks that do not need to be performed by administrators or engineers to be delegated to consultants, maximizing the effective use of workforce hours. Multiple consultants do some tasks that are too complex for one consultant to handle, and whether or not they need to be supervised or assisted by someone higher in the hierarchy is determined on a case-by-case basis. For example, when consultants are helping users with support tickets, they can work independently without supervision. However, when organizing an inventory closet with a small group of consultants, it is necessary to have at least one administrator or engineer present to ensure the process runs smoothly.

Supervision is relaxed but productive, which helps me learn to manage my own time. Every week, we have a team meeting (usually without the presence of Dr. Ajay Gupta), to discuss what everyone has been up to and deliver announcements of what is to come in the following weeks. The meeting is about an hour long, from noon to one, and everyone is required to attend. Since the meeting table is ovular, the meeting is organized so all the administrators and engineers are on one side of the table while the consultants are on the other side, making it easy for the system engineers to ask questions and communicate effectively with all of the consultants. Most of the time is spent focusing on the work of the consultants, giving us opportunities to showcase our work and express any concerns or wishes we may have in front of the entire team. We also perform various team bonding activities where possible, including visits to various ODU facilities like the Student Recreation & Well-Being Center, or the semesterly CS Systems Group cookout. During the cookout, we all have a chance to work together, socialize,

and meet new people from the Computer Science department. It's gratifying to serve delicious food to the computer science faculty and students. While most teams utilize tools like Slack or Microsoft Teams for internal communication, we prefer Discord. This choice stems from Discord's popularity among young people, which aligns with the demographic of Old Dominion University. Since Systems Group hires students, using Discord is advantageous because it is the communication platform most preferred by our target demographic. We utilize the genuine connection of in-person communication alongside the effectiveness of virtual communication to create a cohesive environment where collaboration feels natural and communication remains seamless. By deploying effective team-building, communication, and management practices, Systems Group can process hundreds of tickets each semester in a timely, efficient, and orderly manner. Overall, the structure and supervision style allowed for independence while offering support when needed.

Duties and Responsibilities

As a consultant, I have many responsibilities to ensure the Computer Science department can continue to operate smoothly and efficiently. Firstly, I work about four scheduled hours each day or twenty hours each week, and I am expected to be present in the office when my shift begins. Some consultants are assigned to conduct openings and closings of computer labs, while others are assigned to inventory. I am one of the consultants assigned to open and close labs, but I must also help with inventory. Since I have been moved to the Engineering and Computational Science building, I have been tasked with performing the opening and closing duties for the Open Research computer lab on the third floor. To perform opening and closing procedures, I must go through the entire computer lab and check every computer to ensure it is responsive. I return any chairs out of place and ensure all power and ethernet cables are connected and

working correctly. I am also assigned to open and close the conference room, ensuring the two smart displays are working and all four desk-integrated computers are available.

Inventory

Inventory is another task that must be completed to maintain the integrity of the Computer Science department and ensure all equipment is accounted for. The department has a lot of inventory, both at rest and in use, stored in various locations across multiple buildings. This inventory is ready to be picked up by the Facilities Management department. To perform inventory, we must go through all of this equipment and confirm its presence by one of its unique identifiers, such as the p-tag, serial number, asset tag, or service number. We must scan or manually record this number for each device in a spreadsheet and record its new location if it was moved. If we cannot locate the item, we must mark it as not found. Generally, we can recover most of the items in our inventory and rarely have to mark items as lost or unaccounted for. We must conduct inventory at various intervals, usually every six months, to meet department standards and expectations. Although inventory is critical, it is only a tiny part of my job.

Tickets and Support

The most crucial thing consultants do is monitor and respond to tickets via our e-mail help system. While consultants are in the office, they must actively monitor the ticket feed, available on our Discord server or our self-hosted support system, Zammad. Tickets come in for various reasons, but the most common issue involves our Virtual Private Network. Computer Science students must connect to our network using the FortiClient VPN to access our Linux servers and complete various assignments, particularly throughout the Java and Linux courses in the curriculum. Although the software usually works without issues, sometimes it may freeze or

experience other problems that require the user to restart their computer. Most often, the issue arises from simple user error, and we can redirect users to our Systems Wiki page or guide them through the solution if needed. Other common issues involve problems connecting to the Linux servers, problems with printers, or requests for software installation. Unfortunately, professors and researchers cannot install software on the machine, so we must install the software they want for them using our administrator permissions. Other than these common issues, tickets may involve other physical tasks. For instance, one ticket required a group of three consultants (including myself) to move a professor's entire office to another room, which was especially challenging. While a consultant can generally predict what types of problems they will encounter on a day-to-day basis, we will oftentimes get hit with a curveball that completely blows our expectations out of the water. Therefore, consultants must always be adept and ready to conquer any tasks deemed their responsibility by the department, making the ticket system integral to accomplishing this task.

As mentioned previously, we have a wiki website for answering questions and solving the most common problems the computer science community encounters. The page is available to the public at https://systems.cs.odu.edu. A screenshot of the home page is included in the appendix (Appendix A). The wiki has many categories to help users find solutions to common problems quickly; some categories include Windows, Linux, Account Help, Network, and E-Mail services, among many others. This documentation is essential for establishing our group's identity, as it contains a wealth of history and information about Systems Group. For instance, one can see a list of previous staff on the staff page, with recorded membership data as early as the 2000s, although Systems Group has been around for much longer (CS Systems Group, n.d.).

The wiki is essential to our support system, enabling users to find solutions quickly and

efficiently while educating them about our group's goals and objectives.

Learning Projects

Before a consultant can come close to working with production infrastructure, they must

refine their skillset through various challenging real-world learning experiences. As described

earlier, there are multiple categories with different levels of progression. So far, I have completed

the first level of the Windows projects, the first two levels of the networking projects, both

containerization projects, and all four levels of the Linux projects. As you can see, I vastly prefer

Linux and containerization over networking and Windows. Nonetheless, I will briefly overview

each project I've completed and what I think about each one.

The first project I completed was Windows I, where I had to become familiar with

administering a Windows domain controller and use it to manage Active Directory and Group

Policy. Next, I tackled Networking I, where I had to configure a small subnet of five devices

using a Cisco switch and learn about various networking topics like the OSI models, IPv4

addressing, classful vs classless subnetting, fundamentals of LANs, and cabling standards.

Afterwards, I spent two weeks completing Linux 1, the most challenging project of them all; it is

often considered the weed-out project or even hazing by some consultants. To pass the project, I

had to build and install twenty-eight programs and their dependencies from source (i.e., without

a package manager) on an Ubuntu server. Afterwards, I had to set up and secure an NFS server

and mount the share automatically on a client Ubuntu machine. I configured a Syslog server and

expanded the initial LVM group to wrap up the project. The quiz for this project was also

particularly more challenging than the other level one projects, requiring me to be a master in all

topics related to Linux, including permissions bits, init systems, data storage technologies, and

filesystems. After passing this Linux project, I was finally promoted from *New Consultant* to *Consultant*, proving I have what it takes to thrive and survive in Systems Group. After tackling the first level of projects, I moved immediately to the second networking project to get it out of the way. I created three subnets for this project, each on their switch and VLAN, while configuring a VTP domain, an LACP port-channel, and spanning tree convergence.

Afterwards, I focused all my attention on the Linux and containerization projects because they were the most relevant to our infrastructure and my interests. My favorite project was undoubtedly Linux 2, where I had to deploy highly available and load-balanced web servers behind a proxy, one using the LAMP stack and the other a stack of my choosing. For the stack of my choice, I chose SvelteKit because I have the most experience with it, and it is the best web development framework available. Since website development has been a significant hobby of mine since my early days in elementary school, this project appealed to me the most and gave me a chance to let my skills shine through. After completing the containerization projects, I completed Linux 3, which taught me how to use Ansible to configure a system and deploy many services simultaneously using automation. Finally, the latest project I completed is Linux 4, which helped me learn logging by requiring me to deploy a Grafana server and send system information using Loki and Prometheus.

Before being allowed to do Linux 3, I was required to complete the first project in the containerization series, which involved setting up an Ubuntu VM to run a DNS server, reverse proxy, web server, and custom-built image using Docker; I learned both Docker and Docker Compose to complete this project. I recommend that consultants complete the containerization projects as soon as possible to ensure they're well-prepared for the complexities of modern container infrastructure. The last project I completed was the Kubernetes project (i.e., the second

tier of containerization) in just one day, when most consultants take over two weeks to complete it. For this project, I deployed Rancher and the Rancher Kubernetes Engine (RKE) to create a Kubernetes cluster of three nodes. I wrote Kubernetes manifest files to deploy and manage two services on my cluster: a Minecraft server and Navidrome. The Minecraft server provides a customizable multiplayer environment where players can explore, build, and survive in a block-based sandbox world. It's hosted in a dedicated container for easy management and scalability, with support for mods and persistent world data. Navidrome is a lightweight, self-hosted music server that lets me stream my music collection from anywhere. It supports multiple clients and real-time metadata updates.

For each project I've mentioned, I had to complete a quiz afterward. Some of these quizzes are more challenging than others, and if you don't answer most of the questions correctly, you will need to complete "follow-ups." The follow-ups are opportunities to correct your mistakes on the quiz so that you can pass the project. To encourage acing the quiz on the first go around, consultants must wait at least one day before being allowed to do the follow-ups. Furthermore, you do not need to complete every project to be eligible for promotion to System Administrator; however, the projects are paramount for developing the skills necessary to perform the duties of that position.

Production Projects

Consultants who demonstrate particular skill and interest in one area may be allowed to complete a production project. These are tremendous opportunities to present one's value to CS Systems Group by creating something meaningful on our production infrastructure. Production projects resemble creative works in many ways, with system engineers serving as the critics, evaluating quality, design, and effectiveness. During my time as a consultant, I've had the

opportunity to complete several of these projects, which I will describe in detail in the following section.

As the system engineers recognized by web development prowess, my first production product was the ChatCS web interface. On this website, users can interact with an AI assistant created by the ODU CS Systems Group. This project is available at https://ai.cs.odu.edu and is accessible to everyone. A screenshot is also included in the appendix (Appendix B). I used SvelteKit once again for this website because of its versatility, although the application itself is very simple. When a user submits the chat form, it sends their request to the backend, which proxies it to the ChatCS API endpoint and returns the response to the user. The API endpoint handles everything involving the LLM, while the website sends the chat and history to the model. I've also had the opportunity to work on several other minor web projects, like redesigning our Keycloak login and account management theme, which can be previewed in the appendix (Appendix C).

The largest and by far my favorite project so far has been the mirror project. I proposed the idea and was later entrusted with setting up the ODU CS mirror server. A mirror server offers a local and dependable source for open-source software distributions to users in the surrounding region. Intending to serve the entire southeastern United States, this server aims to provide a faster and more accessible path to popular software and essential updates, eliminating the need for users to rely on distant overseas servers. This involved provisioning a new machine using Ansible to configure rsync and HTTP services, set up regular sync jobs with upstream mirrors, and deploy local policies such as user accounts and firewall rules. While a network restructuring has delayed my release of the mirror to the public, I hope to officially publish this service soon. In the meantime, a screenshot of the webpage is available in the appendix (Appendix D).

Use of Cybersecurity Skills

Despite working for the Computer Science department, my position leverages more cybersecurity skills than pure computer science skills. Although I write quite a bit of code for CS Systems Group, which some may argue is more in computer science, I use hard and soft cybersecurity skills to perform my duties as a consultant. As a freshman, it's reasonable to assume that my interest in cybersecurity has been developing since before I started at Old Dominion University. I graduated from Landstown High School's Governor's STEM Academy, where I developed foundational skills in cybersecurity and had numerous opportunities to expand my knowledge by participating in extracurricular competitive cybersecurity events. One major disadvantage of taking the internship class as a freshman is the difficulty in connecting many of the cybersecurity curriculum topics, as I have not yet taken numerous courses. However, despite not formally taking the classes yet, I believe I already have most of the hard skills taught in these classes to match the needs of the CS Systems Group. Before joining Systems Group, I was fairly well-versed in Linux server administration, virtualization, programming, and general computer troubleshooting. Since joining the group, my skill set has significantly expanded due to the projects I have completed. I am now proficient in various areas, including Windows administration, networking, container management, automation with Ansible, and monitoring using the Grafana suite of tools. In addition to developing my technical skills, I have also strengthened a range of soft skills. For example, I have learned how to effectively communicate with teammates and provide friendly customer service to professors and students in diverse contexts and environments. Consequently, I can confidently say that my on-the-job experience has thoroughly prepared me for a career in cybersecurity after I graduate.

Leveraging the ODU Curriculum

As mentioned in the last section, my ability to reflect on the ODU curriculum is limited because I am a freshman. However, I've learned quite a bit about cybersecurity over the past two semesters from the curriculum. For example, in my Linux System for Cybersecurity class (CYSE 270), I refined my understanding of GNU/Linux systems and tools, particularly through developing hard skills. I can attest to my ability to apply these core concepts to my function in CS Systems Group, as most of our infrastructure is built on Linux. The Cybersecurity, Technology, and Society class (CYSE 200T) enhanced my soft skills and gave me a deeper understanding of how cybersecurity is connected to various disciplines, such as business, education, politics, and cultural studies; a nuanced perspective is essential for effectively carrying out responsibilities in the field. Besides the Cybersecurity curriculum, I've also leveraged what I have learned in my Computer Science minor. Almost all of my projects required some programming experience and experience with git. I was confident in my programming skills before matriculating at the university. However, taking the Programming with Java (CS 252) and Programming with C++ (CS 150) courses furthered my understanding and ability to use these programming languages effectively. In many classes, such as Object-Oriented Design and Programming (CS 330) and Introduction to Unix for Programmers (CS 252), I had to learn the Git version control system to submit my projects correctly. So, although I am only a freshman, I leveraged the few classes I have taken at Old Dominion University every day of my internship. While my internship has taught me more through hands-on experience than the cybersecurity curriculum has, I am excited to learn more about cybersecurity as I progress through the curriculum over the next few years.

Fulfillment of Goals

In the introduction of this paper, I laid out a set of objectives related to my employment at CS Systems Group that I aimed to achieve by the end of the semester. I wanted to become a good administrator, enhance my interpersonal skills, and learn enough about the industry to determine what field of cybersecurity I wanted to pursue. Looking back at the goals I set at the beginning of my time with the CS Systems Group, I'm proud of the progress I've made. I set out to become more confident with key system administration tools, improve how I interact with others in a professional environment, and gain clarity on which direction I wanted to take within cybersecurity. Over the course of the semester, I've had hands-on experience with technologies like Ansible, Grafana, Kubernetes, and Linux—tools I now feel very comfortable using. I've gained so much experience with these tools thanks to my internship that I could confidently teach a class on each tool. I've also grown more confident in my communication skills, especially through working closely with faculty and researchers to solve real problems. Most importantly, this practicum helped me discover a strong interest in developer operations and web development, which I now see as the path I want to follow after graduation. Overall, it was a valuable experience that helped me grow both technically and professionally.

Motivating Aspects

CS Systems Group offers a dynamic and challenging environment for students to collaborate with peers with similar interests. Every day, there is something to look forward to, even if it takes a lot of work. Additionally, working with a team of people my age makes it much easier for us to communicate thanks to the various centripetal forces holding our demographic together. It's incredibly rewarding to help fellow students solve complex problems and see their understanding grow in real time. At the same time, I'm able to express my creativity and

ingenuity through the various projects I've completed. Each responsibility is an opportunity to innovate, make a meaningful contribution to the department, and have a positive impact on those around me.

Discouraging Aspects

During my internship, I encountered a few discouraging moments. At times, I felt a lack of support from the senior members of our organization while completing tasks. Additionally, some system engineers would make themselves unavailable, often arriving late, leaving early, or simply not being present when we needed assistance. For example, while a few other consultants and I were tasked with installing a smart board in a professor's office, the system engineers chose to go fishing instead of helping us. Furthermore, since our group is predominantly male, I believe some members of the team are not being sensitive enough with their language, which negatively impacts team cohesion. However, I have worked around these setbacks, and I have been thriving in the group so far.

Challenging Aspects

As a consultant, my duties at Systems Group challenged me every day. Some days were physically demanding, while others were more mentally draining. Sometimes, I got unlucky and was physically and mentally exhausted. There were many notable, physically draining tasks. One day, I had to move a bookshelf loaded with books and a large metal cabinet to the back of a professor's office to fit a 70" virtual display on their wall. Installation of the display involved taking multiple measurements, drilling large holes in the wall while avoiding inhalation of debris, and installing the mounting bracket. This entire process took a few hours and was very exhausting. Another physical challenge I faced was moving a professor's desk from one office to another on the other side of Dragas Hall. The desk was cumbersome, and a small team of

consultants with a trolley was required to move it into her new office. Afterwards, we had to reinstall her equipment, including the monitors, computer, and cables. In terms of day-to-day labor, installing equipment and routing cables are the most common physically challenging tasks. In addition to physical exertion, however, I had to face a variety of mentally challenging scenarios. Each learning project requires the consultant to spend most of their time on it to complete it before the deadline. Some projects, like Linux 1, may also require working outside of scheduled hours to finish. Furthermore, some scenarios can be very stressful, such as working in a loud environment or interacting with a hostile professor, student, or even a fellow employee.

Recommendations and Advice

I encourage anyone who believes they can meet the standards of the CS Systems Group and is genuinely interested in making a difference to apply immediately. However, a few words of warning and wisdom are necessary so one knows what they are getting into. First, you should have an innate curiosity about computers before applying to the CS Systems Group, as a substantial amount of determination is sometimes required to handle the stresses that employment with the group may bring. Furthermore, those who do have the curiosity and perseverance to join should brush up on as many cybersecurity skills as possible. System engineers can recognize talent, so one should make themselves as attractive as possible to expedite the hiring process and move up more quickly in the organization. Don't hesitate to volunteer for new projects. I actively sought opportunities to get involved and successfully completed numerous projects. As a result, I earned a position as the sole consultant in the Engineering and Computational Science building, working alongside system engineers and administrators—an honor typically granted to the most exceptional consultants.

Final Thoughts

As I reflect on my internship with Old Dominion University's CS Systems Group, I see how beneficial the experiences and abilities I've acquired have been. It gave me an exceptional opportunity to delve deeper into system administration and advance my career in a motivating yet demanding setting. I honed my technical skills and expanded my knowledge of team problem-solving and project management by collaborating with driven individuals. Throughout the internship, I seized the opportunity to work with cutting-edge technologies like Kubernetes, Ansible, and Grafana, which helped enhance my confidence and competence as an emerging cybersecurity professional. The hands-on projects enabled me to apply concepts in real-world scenarios, bridging the gap between traditional academic learning and practical application.

In addition to technical skills, this experience has refined my interpersonal skills, teaching me the importance of effective communication, the value of teamwork, and the nuances of navigating professional environments, particularly in higher education. Every professor agrees that these soft skills are crucial in the cybersecurity field, where collaboration and clear communication are necessary for success. While there were challenges along the way, each obstacle presented a learning opportunity that prepared me for future endeavors. Ultimately, this internship has solidified my career aspirations and laid a strong foundation for my future pursuits. The connections I've made, the skills I've acquired, and the lessons I've learned will undoubtedly guide my journey in the ever-evolving landscape of cybersecurity. I am grateful for this transformative experience and look forward to applying these insights in future roles.

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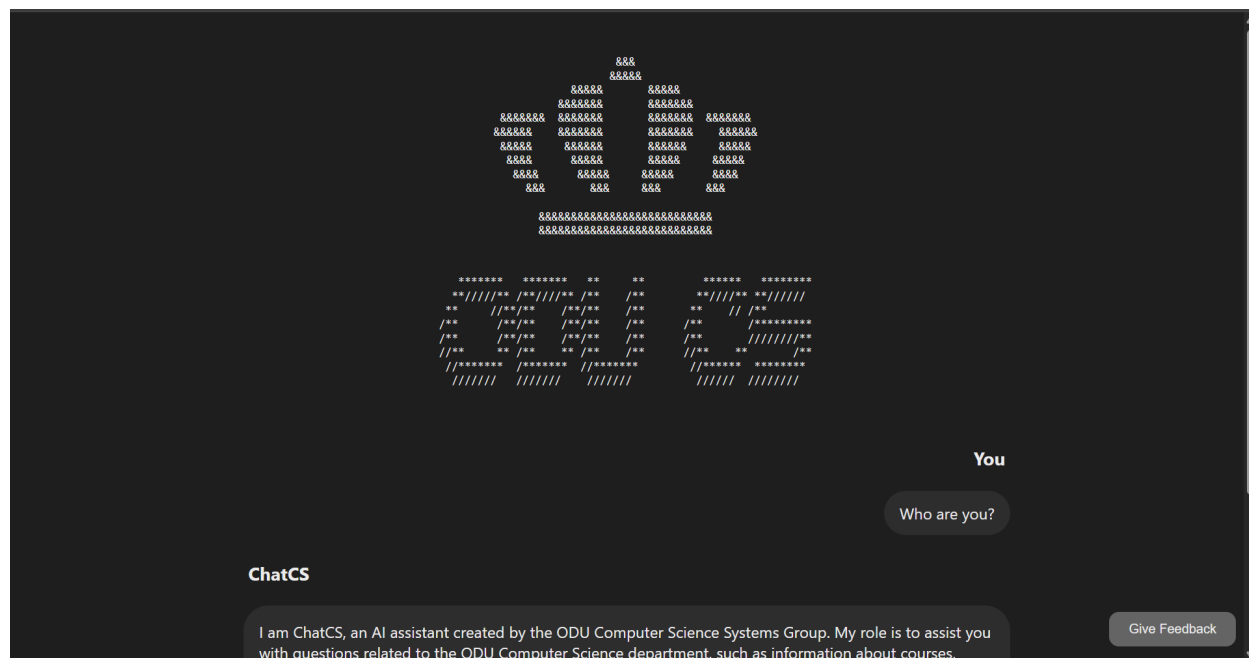Old Dominion University. (n.d.). *University Facts & Figures*. Old Dominion University.

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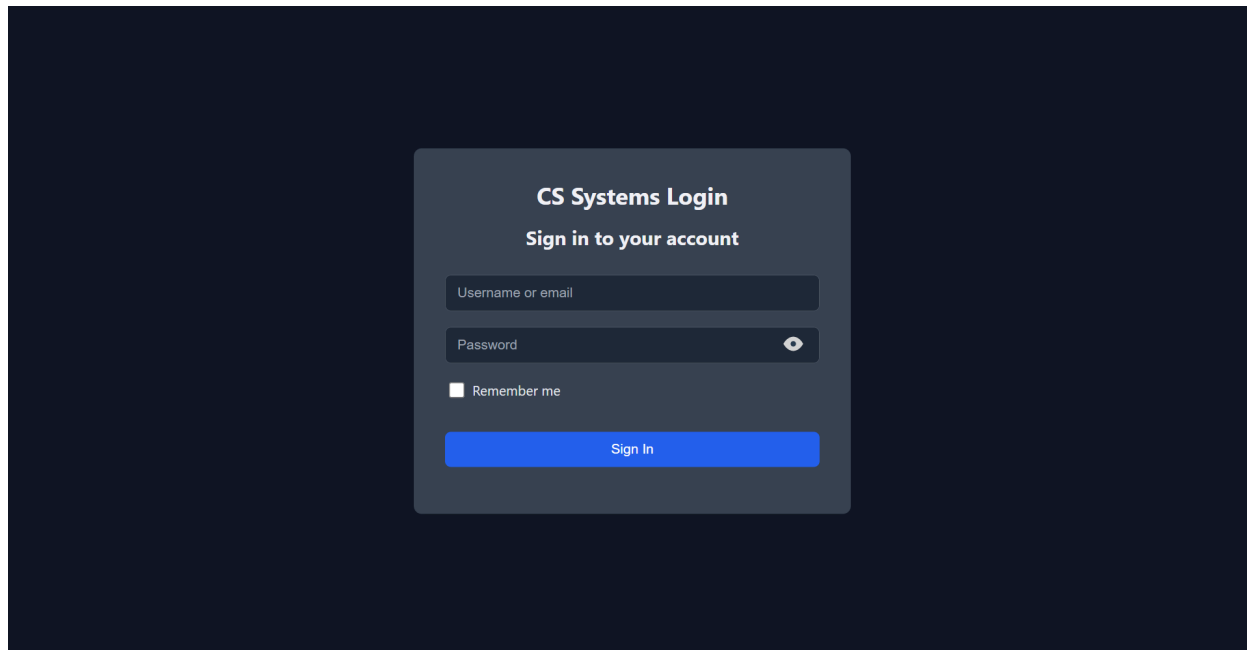
Appendix

Appendix A: CS Systems Group website
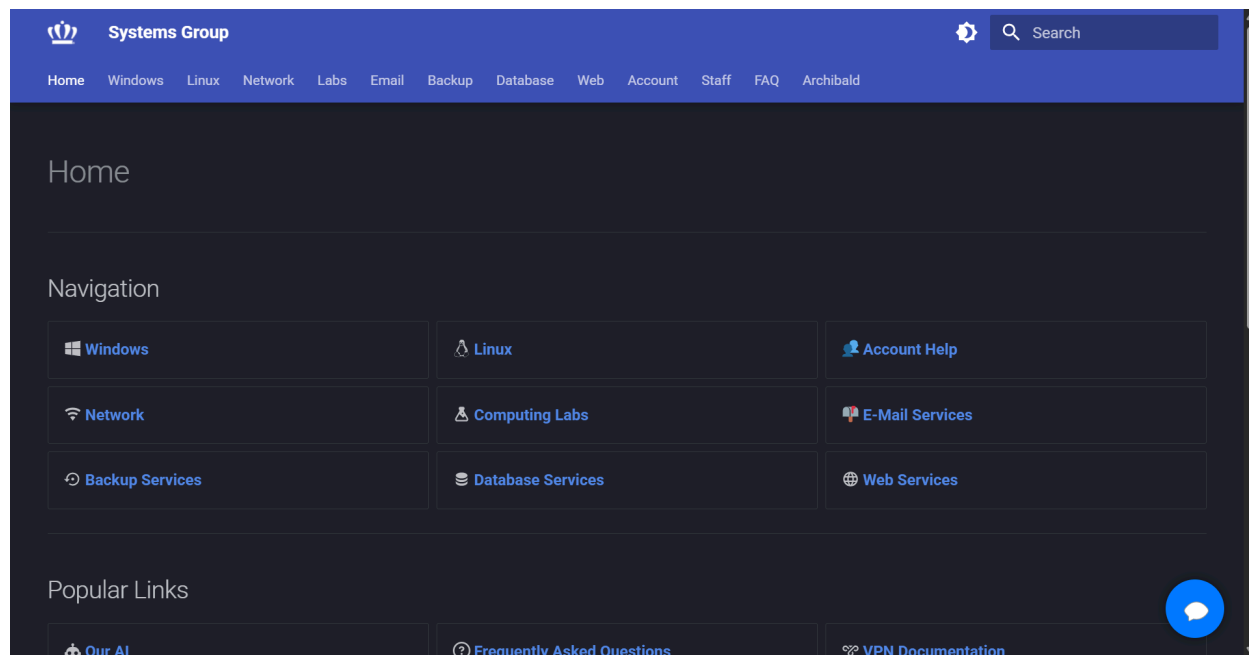
Appendix B: ChatCS webpage

Appendix C: Keycloak Login Page

Appendix D: Computer Science Mirror Webpage