

“Enhancing the Preparation of Next-generation Cyber Professionals”

Jorge Crichigno
Department of Integrated Information Technology
College of Engineering and Computing
University of South Carolina

Cyber Talent Management Workshop and Discussion
October 26, 2021 - Columbia, SC

USC Team



Dr. Jorge Crichigno
(College of Engr. and Comp.
Principal Investigator)



Jodi Salter
(ROTC, Walker Institute
Main Project Coordinator)



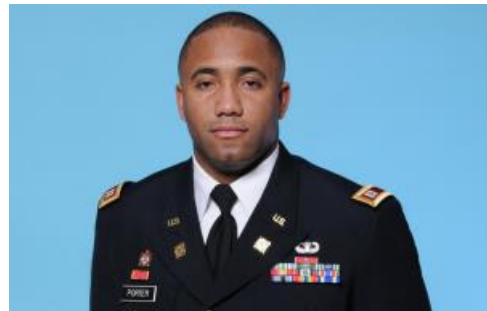
1LT Ebony Penton
(ROTC Command)



MAJ Christina Knight
(Former ROTC
Command, Co-PI)



Dr. Robert Cox
(Faculty, Cyber Intelligence)



MAJ Jason Porter
(Former ROTC Command)



Dr. John Gerdes
(College of Engr. and Comp.)

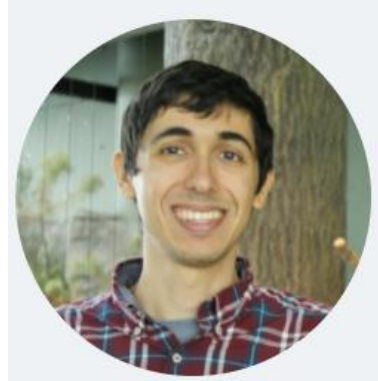


Anthony Dillon
(Internships)

USC Team



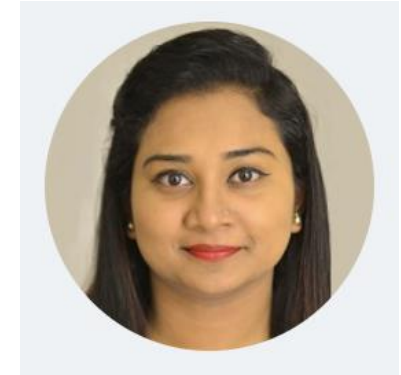
Elie Kfoury
(Graduate Student)



Jose Gomez
(Graduate Student)



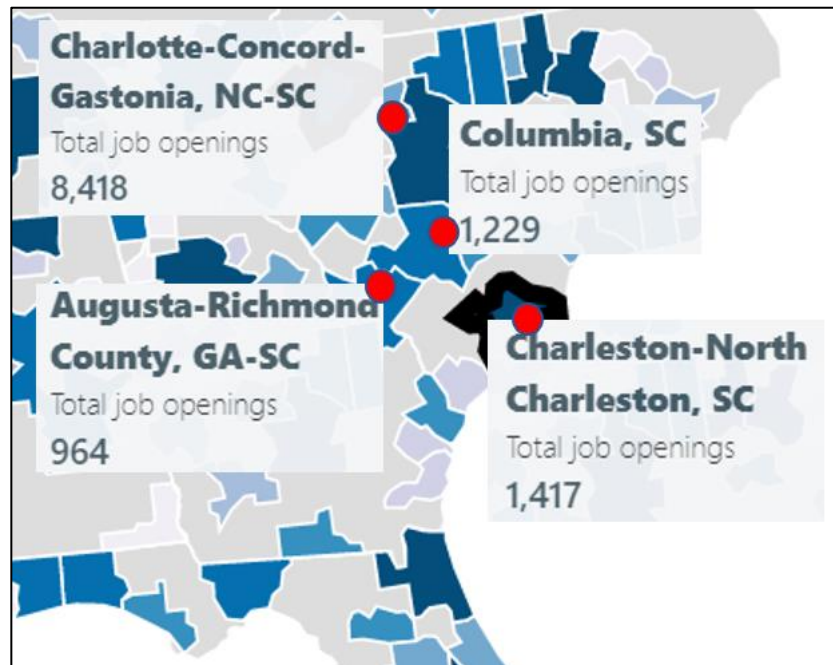
Ali AlSabeH
(Graduate Student)



Shahrin Sharif
(Graduate Student)

Project Overview

- **Project title:** “Enhancing the Preparation of Next-generation Cyber Professionals”
- **Funding agency:** Office of Naval Research
- **Period:** July 22, 2020 – May 31, 2022



Cybersecurity job openings in four metro areas near Columbia, SC

“U.S. Air Force’s cyber warfare operations is only 46 percent filled”
“The Pentagon is hoping to hire 8,300 cyber positions starting this year (2018)”

J. Lynch, “Inside the Pentagon’s Struggle to Build the Cyber Force,” Oct. 29, 2018. URL: <https://tinyurl.com/yyelqomp>.

Project Overview

- **Goals:**

1. Develop a minor in Cybersecurity Operations, aligned with the Cyber Intelligence program.
2. Establish an Undergraduate Research Program in Applied Cybersecurity.
3. Deploy virtual equipment pods on a virtual platform, accessible over the Internet, to support and facilitate research and teaching activities from anywhere, without compromising hands-on experiences.
4. Establish meetings among industry, government, high schools, and higher-education institutions to enhance cybersecurity preparation.

Project Overview

- **Goals:**

1. Develop a minor in Cybersecurity Operations, aligned with the Cyber Intelligence program.
Status: minor in Cybersecurity Operations is now offered, starting Fall 2021.

Cybersecurity Operations, Minor		
Degree Requirements (18 Hours)		
Course	Title	Credits
Select one of the following:		3
<u>ITEC 101</u>	Thriving in the Tech Age	
<u>ITEC 204</u>	Program Design and Development	
<u>ITEC 552</u>	Linux Programming and Administration	
<u>ITEC 233</u>	Introduction to Computer Hardware and Software	3
<u>ITEC 245</u>	Introduction to Networking	3
<u>ITEC 293</u>	Cybersecurity Operations	3
<u>ITEC 445</u>	Advanced Networking	3
<u>ITEC 493</u>	Information Technology Security for Managers	3
Total Credit Hours		18

<https://tinyurl.com/4mbj3z4k>

Project Overview

- **Goals:**

1. Develop a minor in Cybersecurity Operations, aligned with the Cyber Intelligence program.
Status: Cyber Intelligence major includes courses of the Cybersecurity Operations minor.

Cyber Intelligence Major

Cyber Intelligence expands the cyber world beyond code and technology. Our degree prepares you to master all sides of cybersecurity challenges — political, psychological, and global.

<https://tinyurl.com/4x566mpu>

Project Overview

- **Goals:**

2. Establish an Undergraduate Research Program in Applied Cybersecurity.

Status: the program has been established. It supports between 10-12 students per semester (\$4K).

Cadet	Branch	Name	Semester	Project
1	Navy	Christian S	Spring 2021	Application ID
2	Army	Brendan C	Fall 2020	Protection against Bruteforce Attacks with NGFW
3	Army	Jack S	Fall 2020	Mitigating Routing Hijacking Attacks
4	Army	Matthew D	Fall 2020	Mitigating Routing Hijacking Attacks
5	Army	Chris N	Fall 2020	Protection against Reconnaissance and Scan Attacks
6	Army	Jack S	Spring 2021	Policy-based Forwarding
7	Army	Matthew D	Spring 2021	Policy-based Forwarding
8	None	Keegan S	Fall 2020	An open-source library for computer networks and cybersecurity
9	None	Dakota M	Fall 2020	Distributed Denial of Service (DDoS) Protection with Next Generation Firewalls (NGFWs)
10	None	Lauren W	Fall 2020	Protection against Bruteforce Attacks with NGFW
11	None	Josue H	Fall 2020	Site to site VPN with NGFWs
12	None	Brian N	Fall 2020	Distributed Denial of Service (DDoS) Protection with Next Generation Firewalls (NGFWs)

Project Overview

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2. Establish an Undergraduate Research Program in Applied Cybersecurity.

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Cadet	Branch	Name	Semester	Project
13	None	Kyle R	Fall 2020	Protection against Reconnaissance and Scan Attacks
14	None	Ryan T	Fall 2020	IPsec VPN with Routers
15	None	Nathan B	Fall 2020	Site to site VPN with NGFWs
16	None	Bryson L	Spring 2021	External Dynamic List
17	None	Ryan T	Spring 2021	IPsec VPN with Next Generation Firewalls
18	None	Brad W	Spring 2021	Application ID
19	None	Zach F	Spring 2021	External Dynamic List
20	None	Nathan L	Spring 2021	Geoblocking
21	None	Ty L	Spring 2021	Geoblocking
22	Army	Tucker B	Fall 2021	Preventing Attacks on UDP / UDP abuses
23	None	Collins K	Fall 2021	Preventing Attacks on UDP / UDP abuses

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Cadet	Branch	Name	Semester	Project
24	Air Force	Jeremy G	Fall 2021	Protecting Networks Against BGP Hijacking
25	None	Hannah G	Fall 2021	Protecting Networks Against BGP Hijacking
26	None	Cameron M	Fall 2021	Understanding TCP SYN Attacks
27	None	Jesse L	Fall 2021	Understanding TCP SYN Attacks

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Chris
(ROTC)



Jack
(ROTC)



Brendan
(ROTC)



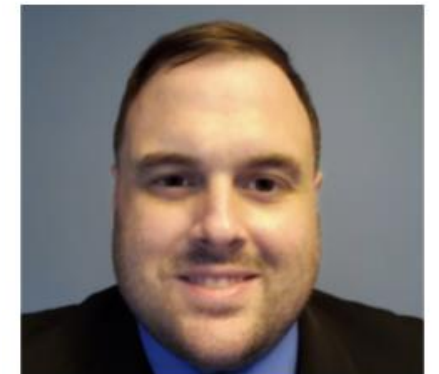
Matt
(ROTC)



Christian
(ROTC)



Ryan
(Navy)



ROTC cadets
and veterans

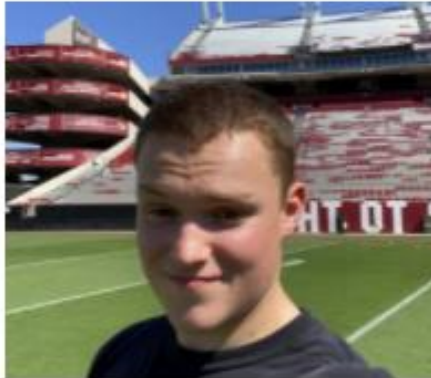
Project Overview

- **Goals:**

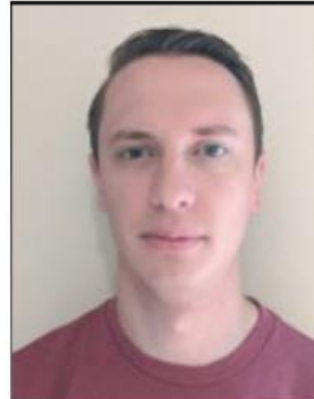
2. Establish an Undergraduate Research Program in Applied Cybersecurity.

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Tucker
(ROTC)



Jeremy (Air
Force)



ROTC cadets
and veterans

Project Overview

- **Goals:**

2. Establish an Undergraduate Research Program in Applied Cybersecurity.

Status: the program has been established. It supports between 10-12 students per semester.

Dakota



Keegan



Brian



CS, IT, CI
students

Brad



Bryson



Ty



Project Overview

- **Goals:**

2. Establish an Undergraduate Research Program in Applied Cybersecurity.

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Josue



CS, IT, CI
students

Zach



Nate



Nathan



Kyle



Lauren



Project Overview

- **Goals:**

2. Establish an Undergraduate Research Program in Applied Cybersecurity.

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Cameron



Jesse



Hannah



CS, IT, CI
students

Collins



Project Overview

- **Goals:**

2. Establish an Undergraduate Research Program in Applied Cybersecurity.

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Jack, ROTC

“During my semesters conducting research under ONR, I **learned many valuable skills that would help me improve my chances at becoming a Cyber Operations Officer in the United States Army.** The skills I learned during this period carried over into **internships with 3rd Special Forces Group Cyber Effects Cell, as well as the Army Cyber Institute at West Point.** Understanding the vulnerabilities with routing protocols greatly improved my value as a member of a research team examining malware and phishing attacks...”

Currently senior student, employed with UofSC’s IT and at the 359th Theater Tactical Signal Brigade, Headquarters Company.

Brad, IT student

“I learned vital cybersecurity skills, such as creating policies with Application Identification rules, generating traffic to ensure security policies are operating appropriately, and reading logs to understand where traffic is traversing the network. **The skills I learned during my ONR project were very similar to those skills needed to become part of the Networking/Perimeter team at Savanna River National Laboratory (SRNL),** which protects the internal network... My managers [at SRNL internship] were very pleased with my knowledge and experience with next generation firewalls. **As a result of my experience with ONR and previous internship at SRNL I was offered a full-time position contingent upon my graduation in May 2022”.**

Currently senior student.

Project Overview

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Name	Position
Ty	2nd Lt. at U. S. Marine Corps, DC
Dakota	Information Security Analyst at Lowe's
Lauren	IT Specialist, SC Department of Insurance
Josue	Technical Solution Specialist at IBM
Kyle	IT Specialist at Lowe's Companies
Nathan	Project Coordinator at Black Box Networks
Brad	IT Intern Savannah River National Lab
Zach	IT Intern at Blue Cross Blue Shield
Nathan	Technology Analyst at AIG

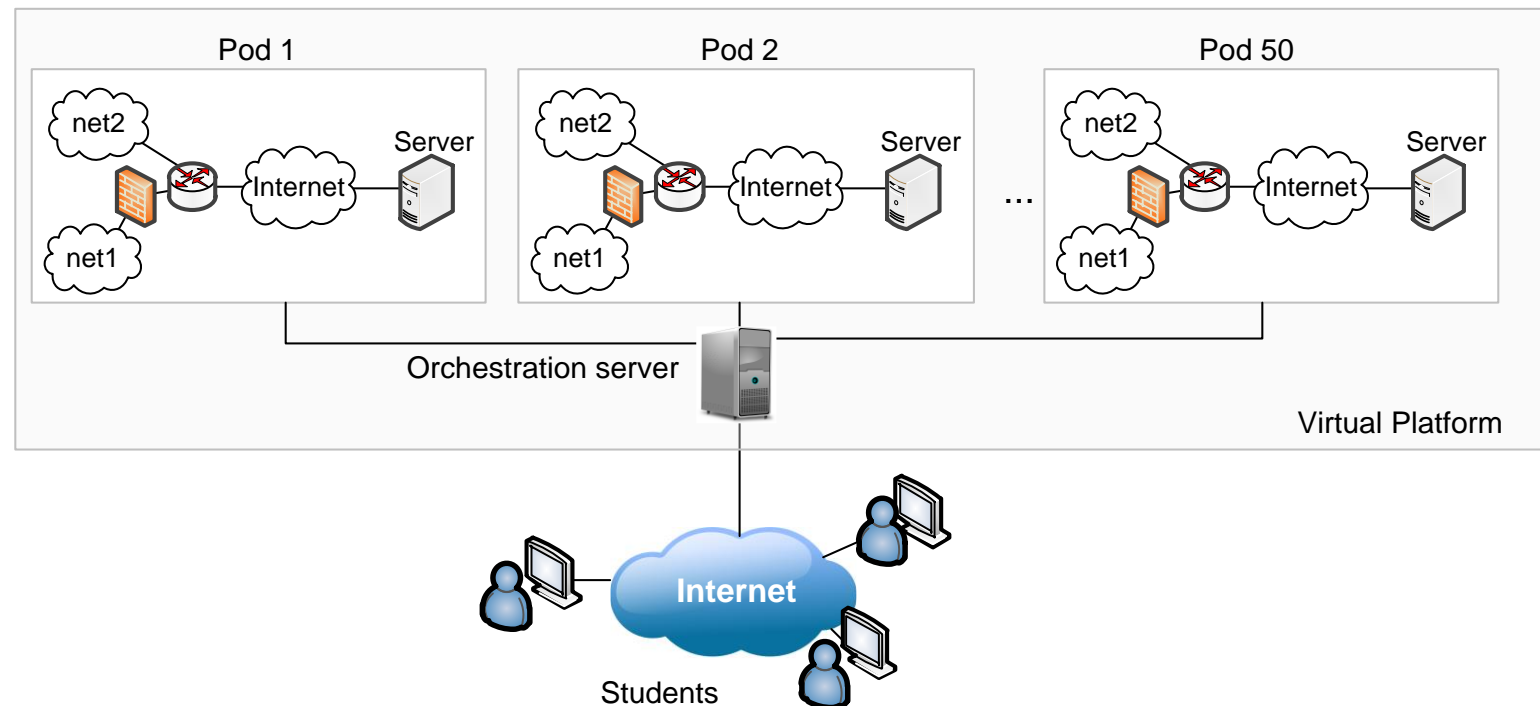
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Project Overview

- **Goals:**

3. Deploy virtual equipment pods on a virtual platform, accessible over the Internet, to support and facilitate the research and teaching activities from anywhere, without compromising hands-on.

Status: private cloud for teaching and research in cyber at UofSC. Live traffic, scalable.



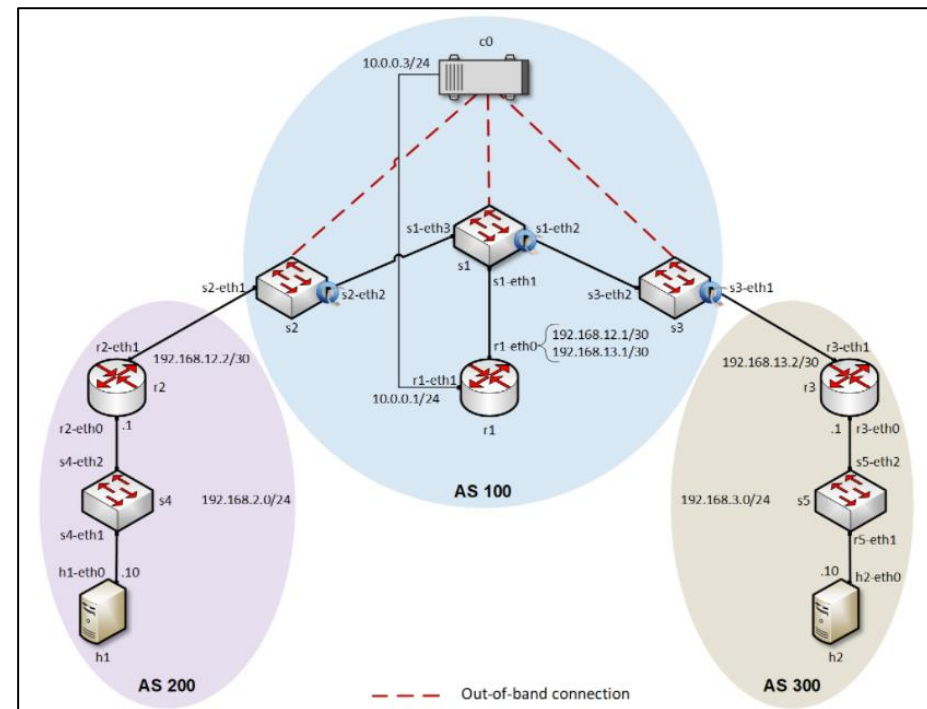
Project Overview

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The image shows four numbered screenshots of the netlab.ccc.sc.edu web interface:

- 1. Login:** A login form with fields for Username (johnsmith) and Password, and a Login button. A red arrow points to the Login button with the text "Login to virtual environment".
- 2. Reservations:** A table of Lab Reservations. One reservation is highlighted with a red box: ID 4283, Date/Time 2019-10-03 16:55 to 2019-10-03 21:00, Description "Class: Cyberinfrastructure Training", and Pod BRO_H1. A red arrow points to the "Enter Lab" button with the text "Enter the lab at the reserved day and time".
- 3. Lab Execution:** A network topology diagram showing a central AS 100 connected to AS 200 and AS 300. A red box highlights the "Enter Lab" button in the reservation table, with a red arrow pointing to this screenshot and the text "Perform lab (live experiments and traffic)".
- 4. Terminal:** A terminal window showing network configuration commands and output, including "ping statistics" and "show ip interface brief".



Project Overview

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UNIVERSITY OF SOUTH CAROLINA

Home administrator

Admin > Usage > Community Usage > List

Community Usage Search

ID	Name	Reservations Made	Labs Attended	Reserved	Hours Attended
1	default	4877	4692	65292.41	23586.63
Page Total:		4877	4692	65292.41	23586.63
Table Total:		4877	4692	65292.41	23586.63

Showing 1 to 1 of 1 items

Use of the virtual platform at the University of South Carolina between Oct. 1, 2020 – Sep. 30, 2021.

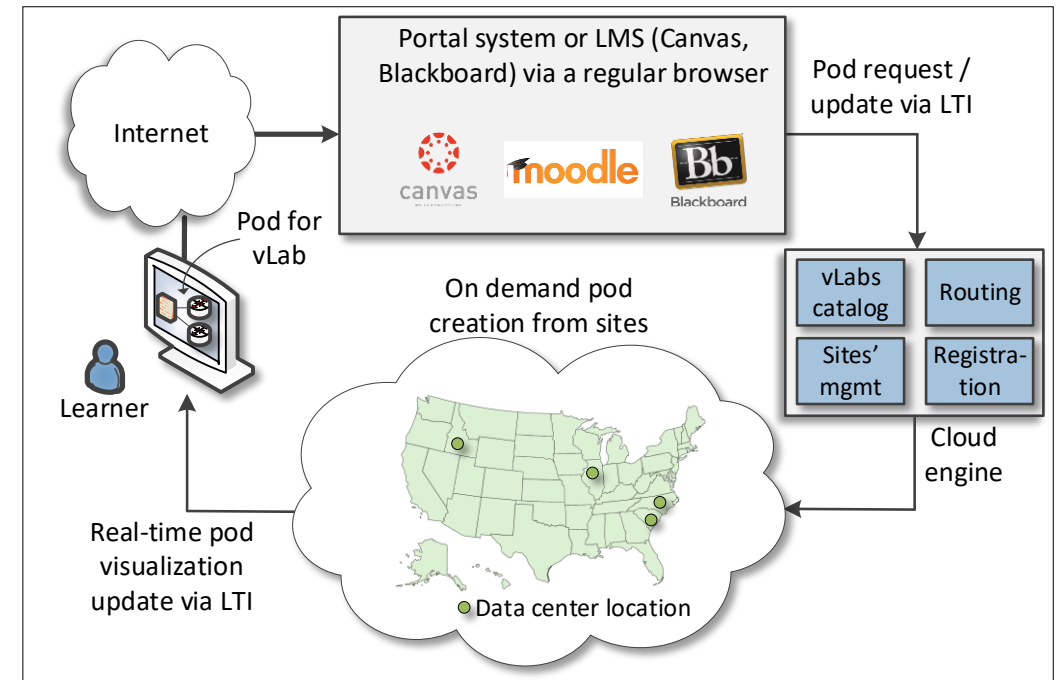
Project Overview

- **Goals:**

3. Deploy virtual equipment pods on a virtual platform, accessible over the Internet, to support and facilitate the research and teaching activities from anywhere, without compromising hands-on.

Status: we **expanded** the platform and made it available to other institutions, establishing agreements with government, high schools, and other higher-education institutions (NSF support ~\$1M).

- Berkeley National Lab
- SANS institute (“girlsgocyber”)
- Multiple higher-ed institutions
- International Networks at Indiana
- Texas’ Lonestart Education and Research
- U.S. Army Cyber Center of Excellence (CCoE)



Project Overview

- **Goals:**

4. Establish meetings among industry, government, high schools, and higher-education institutions to enhance cybersecurity preparation.

Status: agreements with industry partners (Cisco, Palo Alto, VMware, Intel) which provide professional tools and platforms. Also, they provide a pathway to additional certifications.

95% of the more than 345,000 job listings for Information Security Analyst request professional certification.

M. Tannian, W. Coston, “The Role of Professional Certifications in Computer Occupations,” Communications of the ACM, Oct. 2021.

Project Overview

- **Goals:**

4. Establish meetings among industry, government, high schools, and higher-education institutions to enhance cybersecurity preparation.

Status: the program incorporates preparation for DoD's approved baseline credentials¹ for Information Assurance Technical (IAT) positions, Cybersecurity Service Provider (CSSP) Analyst, and CSSP Incident Responder.

Cybersecurity courses with content for DoD's Approved 8750 baseline certifications

Course	IAT 1-2	CSSP Analyst	CSSP Incident Responder	Security Plus	NICE Framework Objectives
Intro to Computer Security				✓	✓
Cybersecurity Operations		✓	✓		✓
Intro to Networks	✓	✓	✓		✓
IT Security for Managers				✓	✓
Advanced Networks	✓	✓	✓		✓

NICE: National Initiative for Cybersecurity Education

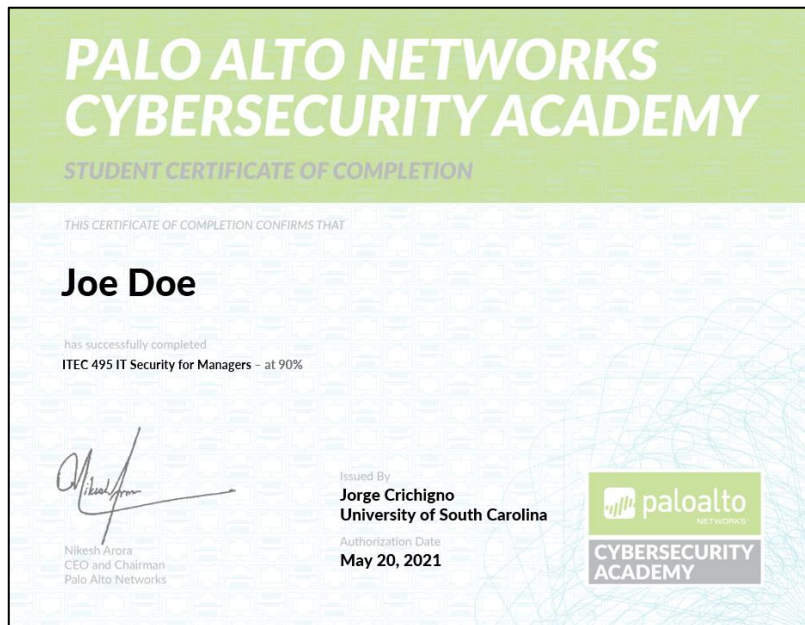
¹Department of Defense (DoD) Cyber Workforce Management Program Website. <https://tinyurl.com/55t7sdnm>

Project Overview

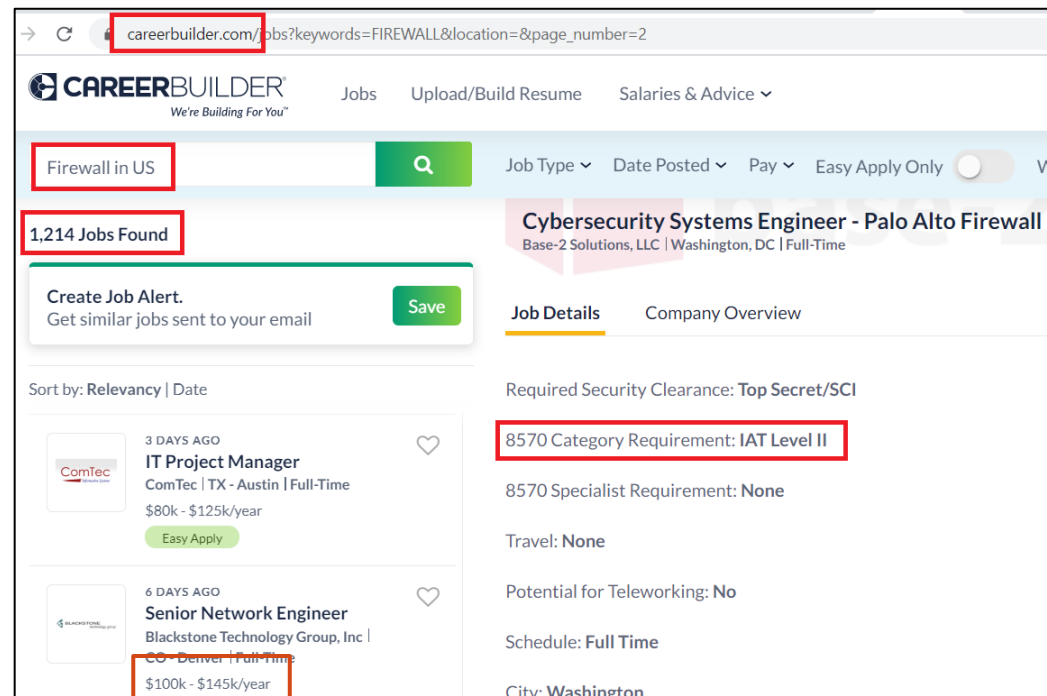
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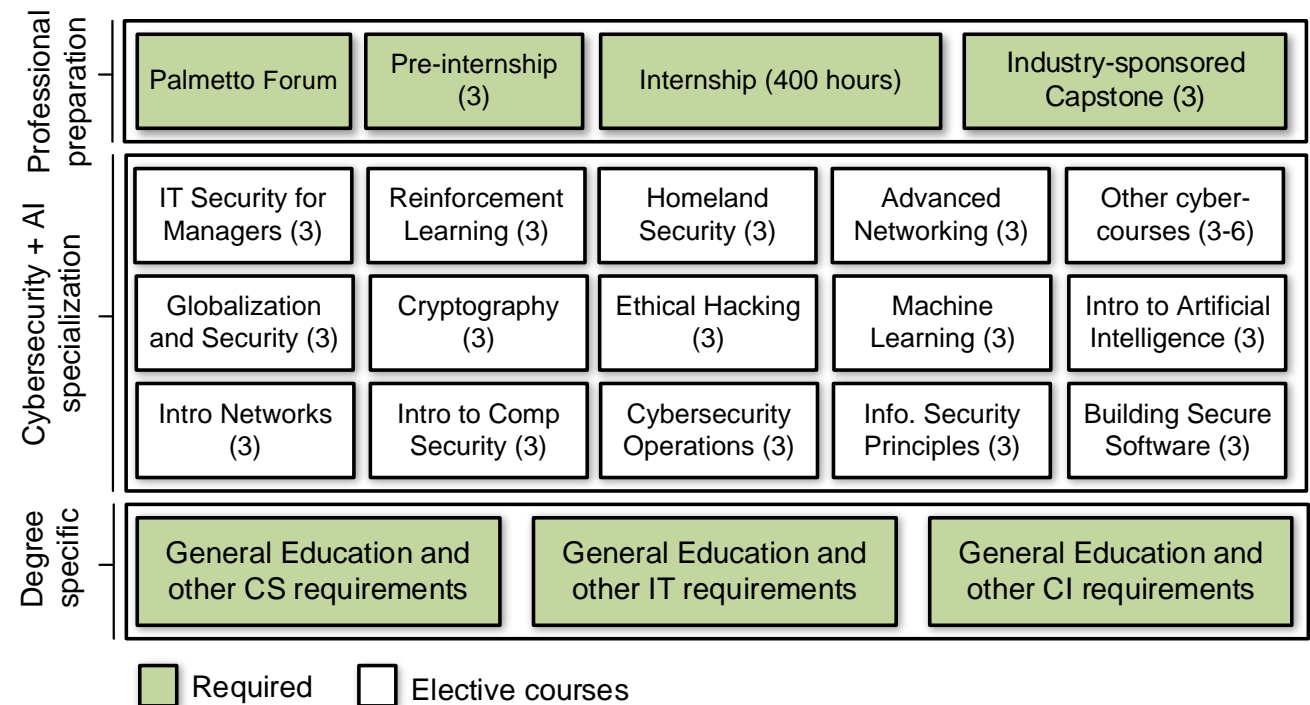
Additional credentials



Job search

Project Overview

- USC's application to NSF Cybersecurity Scholarship Program currently under review
- ~\$3M project
- Activities include internships and industry-sponsored capstone projects for CI, IT, and CS students
- Other organizations
 - ESnet / Berkeley National Lab
 - Savannah River National Lab
 - Idaho National Lab
 - UCAR
 - SC Department of Administration
 - U.S. Army CCOE
 - SC Chamber of Commerce
 - Multiple private companies





South Carolina