

# “Enhancing the Preparation of Next-generation Cyber Professionals”

ONR Project N00014-19-S-F009

Jorge Crichigno

August 31, 2021

# USC Team

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



Jodi Salter  
(ROTC, Walker Institute)



1LT Ebony Penton  
(ROTC Command)

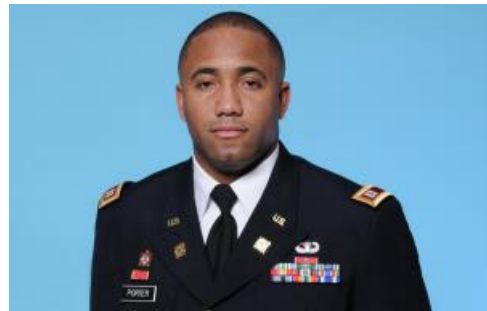


MAJ Christina Knight  
(Former ROTC  
Command, Co-PI)

MAJ Kala Brady  
(ROTC Command)



Dr. Robert Cox  
(Faculty, Cyber Intelligence)



MAJ Jason Porter  
(Former ROTC Command)



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



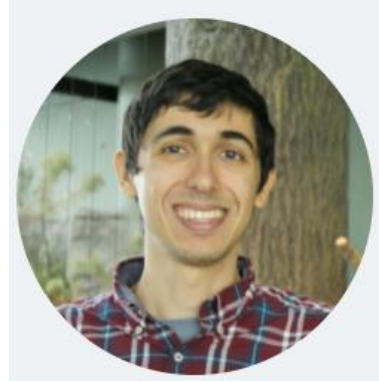
Anthony Dillon  
(Internships)

# USC Team

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Elie Kfoury  
(Graduate Student)



Jose Gomez  
(Graduate Student)



Ali AlSabeH  
(Graduate Student)

# Project Overview

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- **Project title:** “Enhancing the Preparation of Next-generation Cyber Professionals through a Hands-on Academic Program, Undergraduate Research Experiences, and Community Partnerships”
- **Period:** July 22, 2020 – May 31, 2022

# Project Overview

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- **Goals:**

1. Develop a cybersecurity concentration within an academic minor in Information Technology.
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 the 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 cybersecurity concentration within an academic minor in Information Technology.  
Status: Minor in Cybersecurity Operations is now offered, starting Fall 2021.

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

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

# Project Overview

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- **Goals:**

1. Develop a cybersecurity concentration within an academic minor in Information Technology.

Status: Major in Cyber Intelligence is now offered, starting Fall 2021. Major includes the 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 and supports between 10-12 students per semester.

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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- **Goals:**

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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

# Project Overview

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Chris Ngo



Jack Sadle



Brendan  
Curran



Ryan Tallent



ROTC cadets  
and veterans

Matt Driver



Christian  
Tsirlis



# Project Overview

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Dakota  
McDaniels



Keegan  
Sprankle



Brian  
Nelson



CS and IT  
(STEM  
students)

Brad Wilson



Bryson  
Livingston



Ty Love-  
Baker



# Project Overview

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Josue  
Hernandez



Zach  
Fowler



Nate  
Bohmer



CS and IT  
(STEM  
students)

Nathan  
Long



Kyle  
Radzak



Lauren  
Waddell



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Jack Sadle, 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.

Name	Position
Ty Love-Baker	2nd Lt. at United States Marine Corps, DC
Dakota McDaniel	Information Security Analyst at Lowe's
Lauren Waddell	IT Specialist, SC Department of Insurance
Josue Hernandez	Technical Solution Specialist at IBM
Kyle Radzak	IT Specialist at Lowe's Companies
Nathan Bohmer	Project Coordinator at Black Box Networks
Brad Wilson	IT Intern Savannah River National Lab
Zach Fowler	IT Intern at Blue Cross Blue Shield
Nathan Long	Technology Analyst at AIG

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Brad Wilson, 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.

Name	Position
Ty Love-Baker	2nd Lt. at United States Marine Corps, DC
Dakota McDaniel	Information Security Analyst at Lowe's
Lauren Waddell	IT Specialist, SC Department of Insurance
Josue Hernandez	Technical Solution Specialist at IBM
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**Savannah River NUCLEAR SOLUTIONS™**  
FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

**Savannah River National Laboratory™**  
OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

Home Search openings Search results Job details

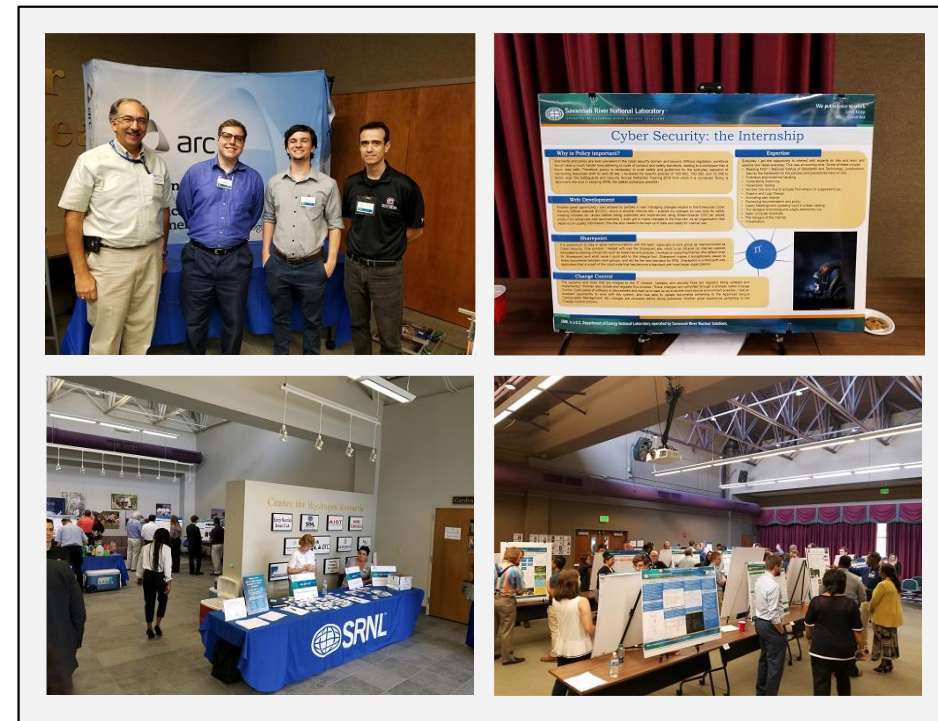
**Job details**

Job 1 of 1

Submit to job Send to friend Save to cart View similar jobs

Auto req ID: 4471BR  
Job Abbreviation Title: SRNL Industrial Control Systems Security Intern  
Job Description: Savannah River National Laboratory (SRNL) is a multi-program laboratory applying state of the art science and practical, high-Department of Energy's (DOE) Savannah River Site (SRS), the laboratory develops and deploys innovative technologies to ad  
Intern will participate in the development of a virtual network which simulates known environments to research vulnerabilities of through scanning and patching industrial controllers and generating documentation to ensure each system meets SRS cyber s environments and robotics systems.  
Major: Computer Science  
Other Major: Other  
Other Major: Cyber Security, Industrial Systems, Virtual Reality, Industrial Controls/Robotics  
Basic Qualifications (Quantifiable; e.g. Three Years Experience, Bachelors Degree): Junior or Senior  
Knowledge and skill in basic computer applications and coding.  
Pursuing degree in Computer Science, Cyber Security, Industrial Systems, Virtual Reality, Industrial Controls/Robotics or relate  
Minimum overall GPA of 2.5 on a 4.0 GPA scale  
Preferred courses:  
Introduction to Computer Networks  
Advanced Computer Networks  
IT Security  
Removal Date: 22-May-2019

Submit to job Send to friend Save to cart View similar jobs

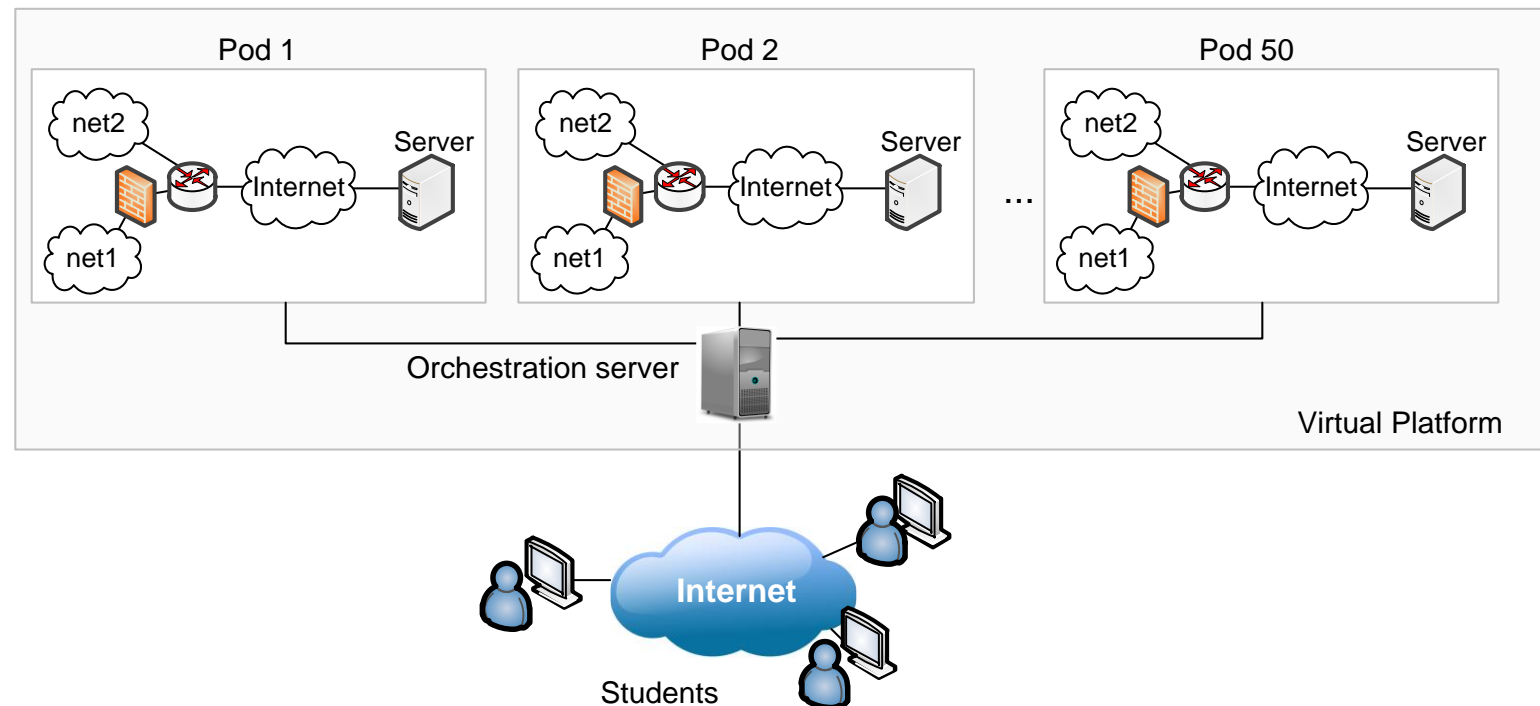


# Project Overview

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





# Project Overview

- **Goals:**

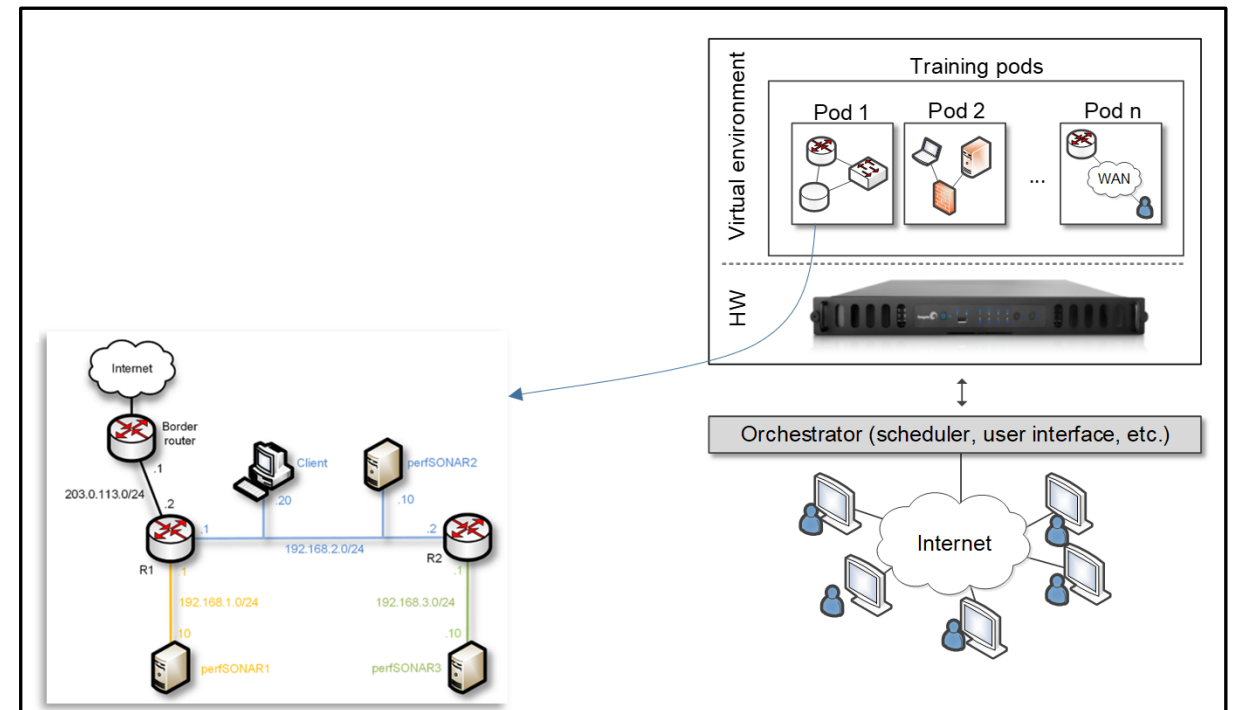
- 3. Deploy virtual equipment pods on a virtual platform, accessible over the Internet, to support and facilitate the research and teaching activities from anywhere, without compromising hands-on.

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

- 1:** Login page 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:** Lab Reservations table. A reservation for ID 4283 is highlighted with a red box. A red arrow points to the "Enter Lab" button with the text "Enter the lab at the reserved day and time".
- 3:** Network topology diagram showing a client connected to a border router, which is connected to an ISP router and a WAN. A red arrow points to the client with the text "Perform lab (live experiments and traffic)".
- 4:** Terminal window showing network commands and output, including ping statistics and packet transmission results.

**Cyberinfrastructure Lab @ UofSC**



# 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: virtual equipment pods have been deployed on a virtual platform, accessible over the Internet. It allows students to conduct all activities online. Servers are supporting the system.

UNIVERSITY OF SOUTH CAROLINA

Home administrator

Admin > Usage > Class Usage > List

Class Usage Search

Class Name	Community	Reservations Made	Labs Attended	Hours Reserved	Hours Attended
ONR - Fall 2020	default	480	459	1431.76	801.45
ONR Spring 2021	default	187	184	349.05	258.53
Page Total:		667	643	1780.81	1059.98
Table Total:		667	643	1780.81	1059.98

Show All entries Showing 1 to 2 of 2 items

# Project Overview

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- **Goals:**

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

Status: agreement with industry (Cisco, Palo Alto, and VMware, Intel) which provide professional tools and platforms. These, along with open-source tools, were used by students to conduct research.

# 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 credentials<sup>1</sup> 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

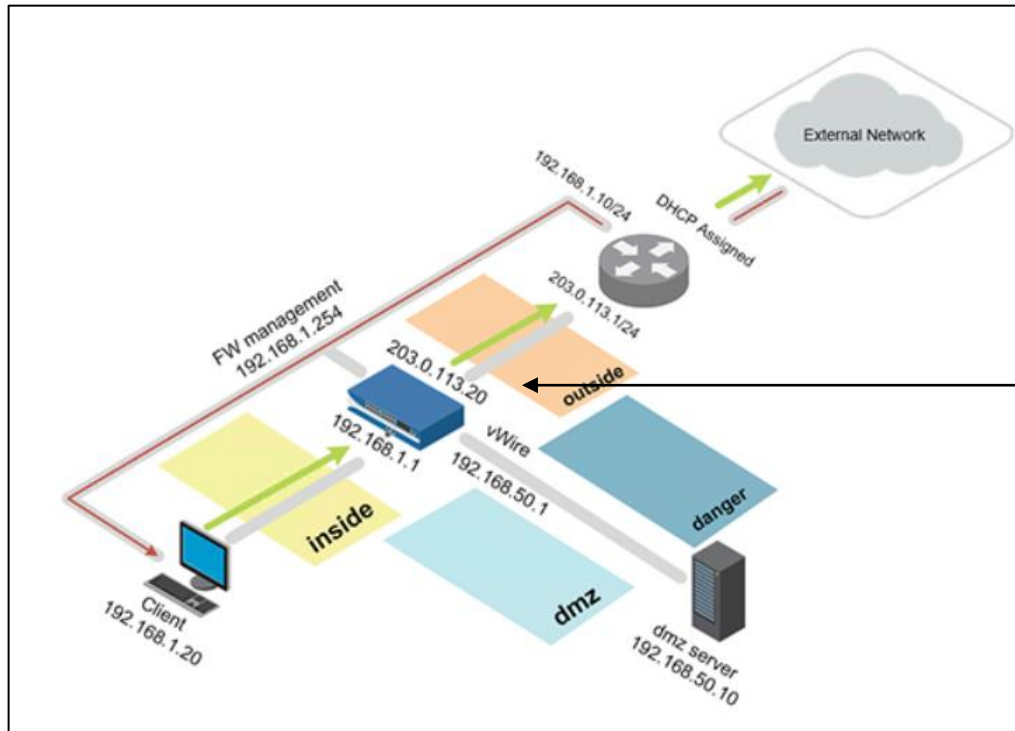
<sup>1</sup>Department of Defense (DoD) Cyber Workforce Management Program Website. <https://tinyurl.com/55t7sdnm>

# Project Overview

- **Goals:**

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

Status: industry partners allow us to use their tools and platforms



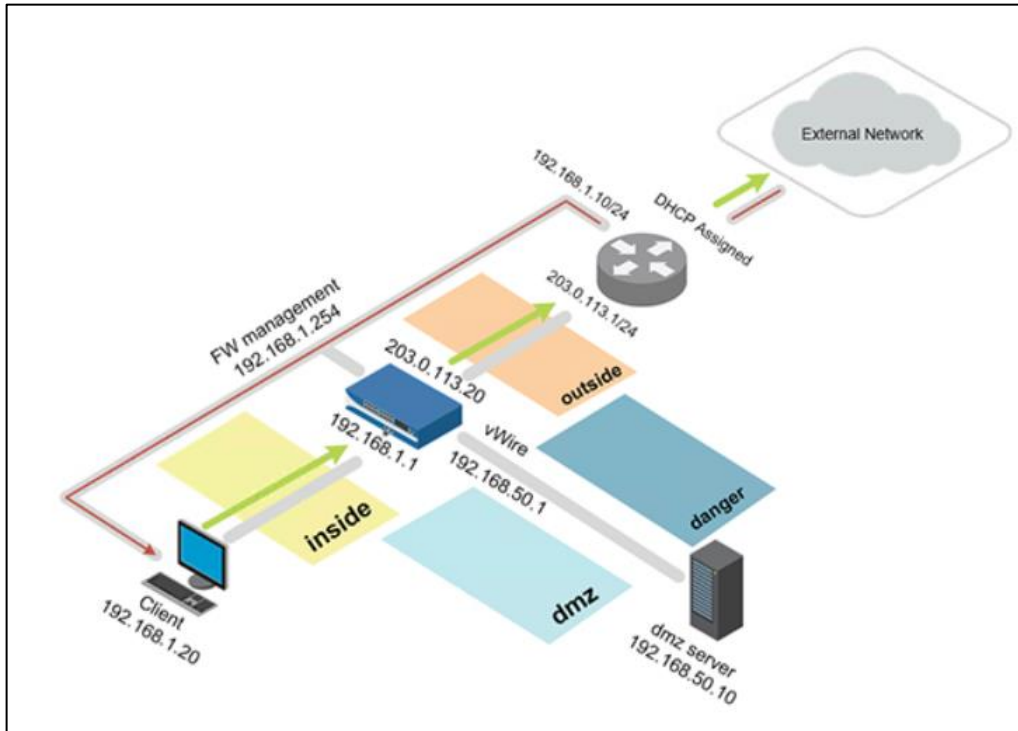
**Next-generation** Firewall Virtual Machine + licenses

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The screenshot shows a CareerBuilder job search page. The search criteria are 'Firewall in US', resulting in '1,214 Jobs Found'. The top job listing is 'Cybersecurity Systems Engineer - Palo Alto Firewall' by Base-2 Solutions, LLC in Washington, DC, Full-Time. The job details include a required security clearance of 'Top Secret/SCI' and a specific requirement: '8570 Category Requirement: IAT Level II'. Other job listings include 'IT Project Manager' by ComTec and 'Senior Network Engineer' by Blackstone Technology Group, Inc.

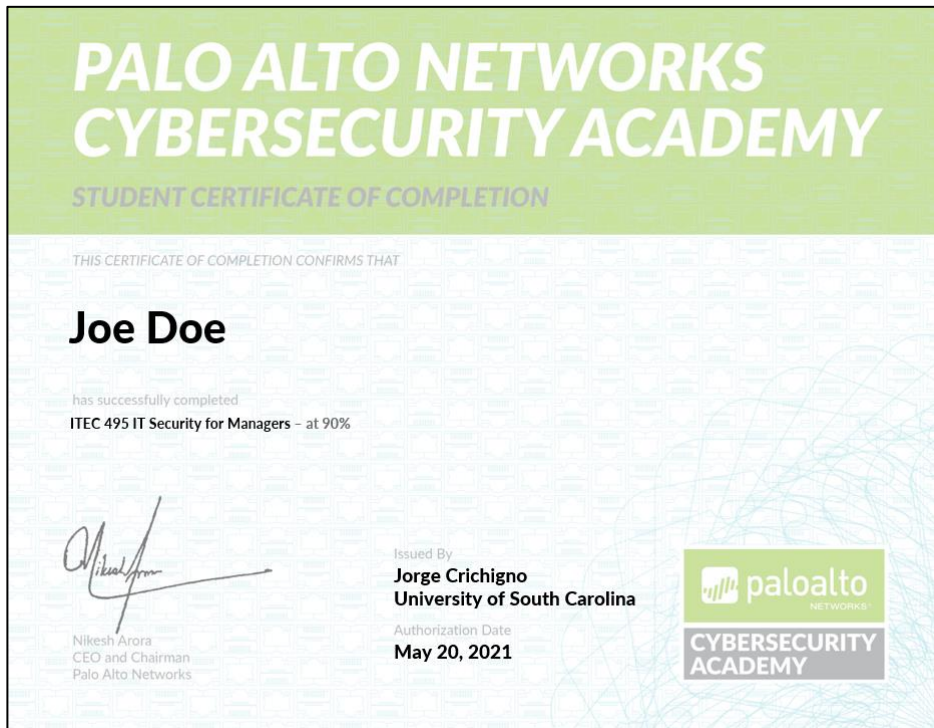
Job search

# Project Overview

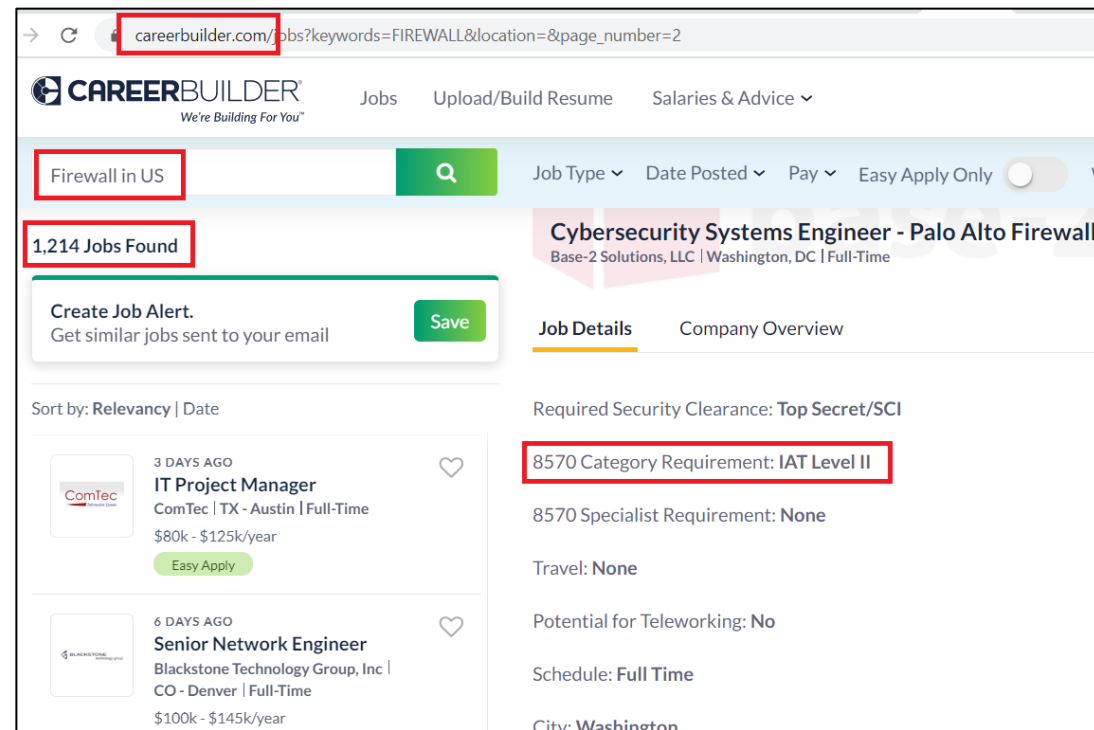
- **Goals:**

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Additional credentials



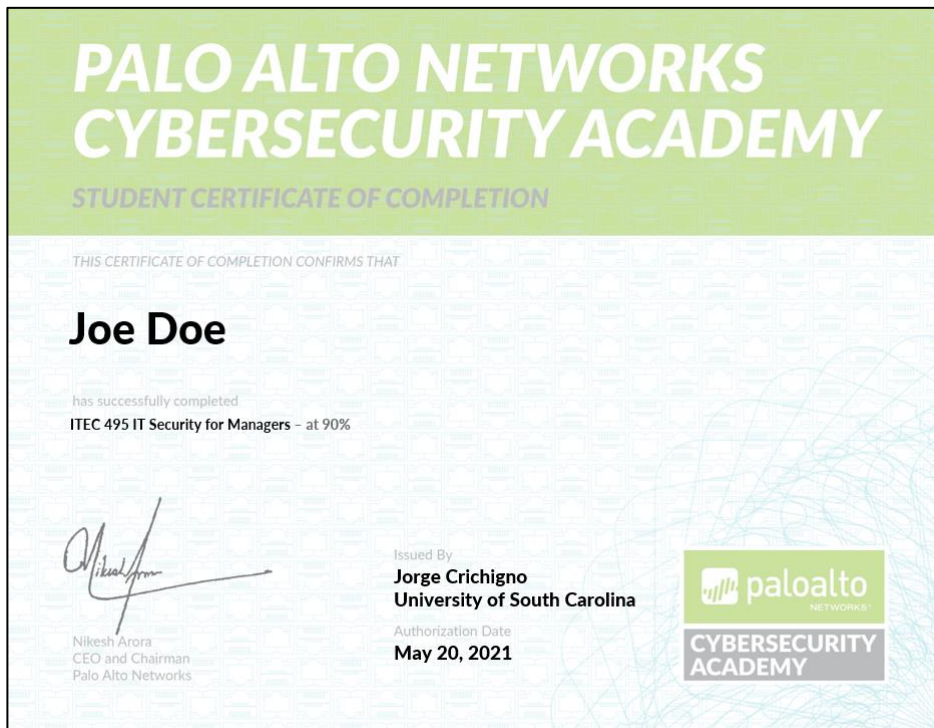
Job search

# Project Overview

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Additional credentials



USC's ROTC



# Project Overview

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- **Goals:**

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

Status: workshops open to the public

Two workshops: one in the Spring (Spring 2021) (~80 people) and another in the Fall (December 2020) (> 100 people). These events enabled students to showcase the research work. The presentations and videos of the work presented during the workshops can be found online at:

- Workshop Fall 2020: [http://ce.sc.edu/cyberinfra/onr\\_workshop.html](http://ce.sc.edu/cyberinfra/onr_workshop.html)
- Workshop Spring 2021: [http://ce.sc.edu/cyberinfra/onr\\_workshop\\_spring\\_2021.html](http://ce.sc.edu/cyberinfra/onr_workshop_spring_2021.html)

# Project Overview

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- **Goals:**

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

Status: we have made the platform available to other institutions, establishing agreements with government, high schools, and other higher-education institutions.

- Berkeley National Lab
- SANS institute (“girlsgocyber”)
- Multiple higher-ed institutions
- International Networks at Indiana
- Fort Gordon (2 cyber courses)
- Texas’ Lonestart Education and Research
- U.S. Army Cyber Center of Excellence (CCoE) (Signal School)

# Project Overview

- **Goals:**

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

Status: increased relation with agencies and industries, internships. We are organizing a pre-internship course, hosting speakers from industry

	DATE	NAME	COMPANY
1	28-Aug-20	Ron Scherba	Google
2	31-Aug-20	Angie Greenwood	Blue Cross / Blue Shield
3	4-Sep-20	Jeff Ruble	Richland Co. Economic Development
4	9-Sep-20	Kaitlyn Flake	Capgemini
5	11-Sep-20	Lewann Belton	Savannah River Site - SRS
6	14-Sep-20	Lucio Bicalho	Electrolux
7	16-Sep-20	Stephen Lariviere	SPAWAR / NIWC
8	18-Sep-20	David Nance	Amarok
9	21-Sep-20	Willis Cantey	Cantey Tech
10	23-Sep-20	Neil Stanley	Microsoft
11	25-Sep-20	Lari Young	Crowd Strike
12	28-Sep-20	Doug Foster	USC - DoIT
13	30-Sep-20	Chris Reeder	ACS Technologies

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	DATE	NAME	COMPANY
13	30-Sep-20	Chris Reeder	ACS Technologies
14	2-Oct-20	Elvin Boone	Blackboard
15	5-Oct-20	David Ulmer	SC DHHS
16	7-Oct-20	Aubrey Hawes	Oracle
17	12-Oct-20	Abby Blackwell	Scansource
18	14-Oct-20	Roberto Dominguez	Hilti
19	16-Oct-20	TJ Rich / Phillip Cockrell	SC Department of Administration
20	19-Oct-20	Lola Jordan	Companion Data Services
21	21-Oct-20	Caitlin Deltgen / Presley Pender	Gartner
22	23-Oct-20	Jill Menhart	VC3
23	26-Oct-20	Malik Walker	US Patent Office
24	28-Oct-20	Amy Beekley	Lowes
25	30-Oct-20	Tim Hutto	Fort Gordon / OSC Edge
26	2-Nov-20	Elizabeth Gibbs	American Specialty Health

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	DATE	NAME	COMPANY
27	4-Nov-20	Erika Fosu	Vanguard
28	6-Nov-20	Jeff McBride	AFL Global
29	9-Nov-20	Jim Morris	SC Economics
30	11-Nov-20	Cassius Rhue	SIOS
31	13-Nov-20	Tracy Newkirk	ICAP Solutions
32	16-Nov-20	Rachel Kehoe	Blackbaud
33	18-Nov-20	Robert Cameron	Dell
34	20-Nov-20	Amanda Mason	Global Lending Services
35	13-Jan-21	Angie Greenwood	Blue Cross / Blue Shield
36	22-Jan-21	Malik Walker / John Lau	US Patent Office
37	25-Jan-21	Bethany LeClair	Thomson Construction
38	27-Jan-21	Amy Beekley	Lowes
39	29-Jan-21	Rachel Kehoe	Blackbaud

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	DATE	NAME	COMPANY
40	1-Feb-21	Jason Gibbs	Extra Hop
41	3-Feb-21	Doug Foster	USC - DoIT
42	8-Feb-21	Abby Blackwell	Scan Source
43	12-Feb-21	Lide Winburn	Soft Docs
44	17-Feb-21	Bob Kenney / Zane Reed	Fluor
45	19-Feb-21	Phillip Cockrell / Thomas Rich	SC Department of Administration
46	22-Feb-21	Lola Jordan	Companion Data Services
47	24-Feb-21	Brianna Berry / Victoria Turner	Synnex
48	26-Feb-21	Traci Newkirk	ICAP Solutions
49	1-Mar-21	Willis Cantey	Cantey Tech
50	3-Mar-21	John Webster	ACST
51	5-Mar-21	Joe Smith	Verizon
52	10-Mar-21	Tim Hutto	OSC Edge

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53	15-Mar-21	Ron Scherba	Google
54	17-Mar-21	Byron Doyle	DISA
55	19-Mar-21	Jeff Ruble	Richland Co. Government
56	22-Mar-21	Elizabeth Gibbs / David Cristinzio	American Specialty Health
57	24-Mar-21	Paige O'Brien	Dell
58	26-Mar-21	Cassius Rhue / Sajid Shaikh / Takofumi Noso	SIOS
59	29-Mar-21	Ron Harvey	Global Core Strategies
60	2-Apr-21	Jackie Chen / Robert Willm	Nephron Pharmaceuticals
61	5-Apr-21	Jim Morris	SC Economics
62	7-Apr-21	Aubrey Hawes	Oracle
63	9-Apr-21	Jeff McBride	AFL Global
64	12-Apr-21	Kaitlyn White	Capgemini
65	14-Apr-21	Erica Fosu	Vanguard
66	16-Apr-21	Randall Hugee	TIAA
67	19-Apr-21	Juan DeFillippis	IBM

# Project Overview – Future Plans

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- Promote Cyber Intelligence Major, Cybersecurity Operation Minor
- Support the military, ROTC, National Labs, Internet2, training centers
- Engage with industry, agencies
- Expand, scale the virtual platform nationally (now serving thousands of learners)
- Increase, disseminate training material



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	Workshop Title	Format	Dates	URL	Att.
1	LEARN Hands-on Workshops for Network Engineers	Online	Sep 22-23, 2020	<a href="http://ce.sc.edu/cyberinfra/workshop_2020_3.html">http://ce.sc.edu/cyberinfra/workshop_2020_3.html</a>	30
2	2020 Midwest Academy Conference	Online	Sep 24-25, 2020		19
3	WAST 2021 Winter Education Conference	Online	Jan 7-8, 2021	<a href="https://www.wastc.org/events/wastc-2021-winter-ict-educators-conference">https://www.wastc.org/events/wastc-2021-winter-ict-educators-conference</a>	305
4	Academic Support Center Conferences	Online	April 6, 13, 20, 27		80
5	NSF CC* Workshop	Online	Apr. 8, Apr. 15, 2021	<a href="http://ce.sc.edu/cyberinfra/nsf_cc_workshop.html">http://ce.sc.edu/cyberinfra/nsf_cc_workshop.html</a>	194
6	Advanced Networking Topics: BGP, BGP Hijacking, MPLS,	Online	June 14-18, 2021	<a href="http://ce.sc.edu/cyberinfra/workshop_2021_wast.html">http://ce.sc.edu/cyberinfra/workshop_2021_wast.html</a>	20
7	Hands-on Workshop on Open vSwitch and SDN	Online	June 21-25, 2021	<a href="http://ce.sc.edu/cyberinfra/workshop_2021_wast_2.html">http://ce.sc.edu/cyberinfra/workshop_2021_wast_2.html</a>	20
				TOTAL	668