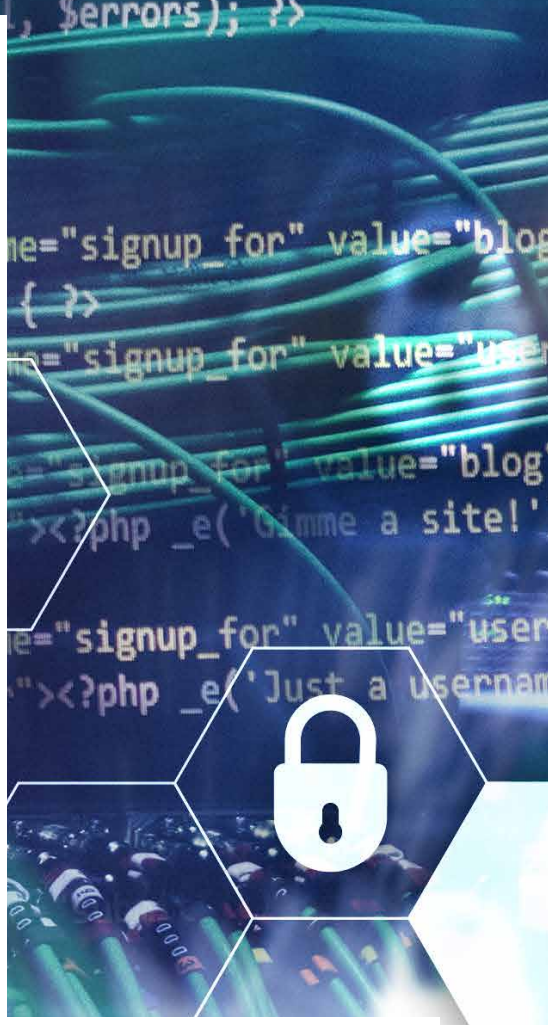
Cultivating a New Generation of Cybersecurity Professionals

Dr Ahmet Mete Kök
Dr Ching-Song (Don) Wei
Dr Mohammad Q. Azhar

Scientia

CULTIVATING A NEW GENERATION OF CYBERSECURITY PROFESSIONALS

Computer systems underpin nearly every aspect of modern life, but they're more vulnerable than many people realise. Threats to cybersecurity can come from anywhere in the world, at any time, and the techniques that malicious agents use are constantly evolving. As such, well-trained cybersecurity technicians are absolutely critical to our modern world, but there is a scarcity of such individuals. Now, **Dr Ahmet Mete Kök** and his colleagues have developed a new online certificate degree program at the Borough of Manhattan Community College, focused on educating and training a new cohort of cybersecurity technicians from diverse backgrounds.



The Vulnerability of the Ubiquitous

Our modern world is built upon computing. The cyberinfrastructure behind this technology is the backbone of communication, healthcare, banking, education, transport, the electrical grid, water, logistics, academic research, and just about every aspect of our daily lives. Maintaining the security of this cyberinfrastructure is therefore critical. However, cybersecurity is unlike any other kind of security, and it requires a cohort of dedicated and well-trained experts to administer.

While breaching physical security systems requires physical access, cyberinfrastructure by its nature is distributed, and attempts to breach cybersecurity can originate from anywhere in the world. While damaging or accessing physical security requires time and effort, algorithmic attacks can target thousands of cybersecurity systems at once, remotely and repeatedly. A security system is only as strong as its weakest point, and so cybersecurity requires cutting-edge knowledge to continually evolve with changing technology.

Unfortunately, the cohort of qualified individuals is small. Jim Gosler, NSA Visiting Scientist and founding director of the CIA's Clandestine Information Technology Office, highlighted the problem, saying: 'There are about 1,000 security people in the US who have the specialised security skills to operate effectively in cyberspace. We need 10,000 to 30,000.'

The Online Cybersecurity Certificate with Stackable Credentials

Dr Ahmet Mete Kök, Dr Ching-Song Wei and Dr Mohammad Q. Azhar have developed a new Online Cybersecurity Certificate program at the Borough of Manhattan Community College (BMCC), which is part of the City University of New York system (CUNY). Their project, entitled 'BMCC-ATE Project: Online

Cybersecurity Certificate with Stackable Credentials' (NSF-DUE 2100225), is designed to address the potentially calamitous shortage of cybersecurity professionals, by providing an inclusive pathway for students to gain crucial skills.

Funded by US National Science Foundation, the BMCC-ATE Project builds upon the successes of a five-year cybersecurity project that started in

2016 called 'Fostering Student Success in Cybersecurity and Information Assurance'. The new project gives participants the opportunity to acquire necessary skills that will prepare them to seek employment in the cybersecurity workforce. If they wish to further their education, the project provides participants with 30 'stackable' credits that count toward an associate degree in Computer Information Systems at the Borough of Manhattan Community College.

While the 2016 project focused exclusively on recruiting existing college students and new college students from high schools, the current BMCC-ATE Project is also open to IT workers who wish to upgrade their skills and advance their careers. The new project is more inclusive, as the course content has been adapted to be delivered online, allowing IT workers to participate in the certificate program around their work schedules. The BMCC-ATE Project is also specifically designed to support students who are typically underrepresented in STEM fields, improving their access to cybersecurity education through flexible online study and by fostering support networks.

The project started in September of 2021 and will run until August of 2024. In this time, the project will have trained at least 130 participants, preparing them to apply their new expertise to enter into the critical field of cybersecurity.

Teaching a Rapidly Evolving Subject

The challenge with cybersecurity is the constant arms race that experts face, due to emerging and rapidly evolving threats. Maintaining secure systems requires both a deep understanding of the fundamentals of cybersecurity, and an up-to-date understanding of the constantly evolving threats that are developed by malicious actors.

With their decades of combined experience in both education and cybersecurity, Dr Kök, Dr Wei and Dr Azhar are well suited for this challenge. Dr Kök has crafted curricula for Multimedia, Health Informatics, and now Cybersecurity. He also spearheaded the formation of the Virtual Cybersecurity Lab at the Borough of Manhattan Community College during lockdown, with a focus on accessibility to ensure equity and inclusion of disadvantaged students.

Dr Wei, Professor and the Chairperson of the Computer Information Systems Department at the College, serves as the Internship Coordinator of the project. his background covers both PhD research into Computer Science, and extensive experience in industry, providing a non-academic perspective on the curriculum. He has developed new courses, established articulation agreements, and has placed students in mentorships, internships, and apprenticeships to bolster their success.

Dr Azhar, Associate Professor of Computer Information Systems, joined the team as a Recruitment Coordinator, supporting the project's goal to improve access for previously underrepresented communities. During the height of the COVID-19 pandemic, Dr Azhar developed the first virtual hackathon at the Borough of Manhattan Community College, which was focused on equity and social justice. He also draws on the experience of many academic and industry projects, such as the Cybersecurity Workforce Development project funded by the NSF's Advanced Technical Education project.

The team aims to share the online curricular materials that they have developed for the certificate program with the cybersecurity community, which will contribute to a global, collaborative goal of technological education.

For such a rapidly evolving field, the team understood that it would be vital to focus on the professional development of the College's teaching staff. As such, the project includes several objectives for developing a diverse and intellectually vigorous faculty, including training instructors to deliver content online effectively and establishing a cohort of new tutors, trained specifically in cybersecurity.

Further, the team also plans to embed the Borough of Manhattan Community College and its staff in the global research community, conducting workshops as part of the Cybersecurity Professional Learning Community and presenting at international conferences.

The team established a new, state-of-the-art virtual cybersecurity laboratory for teaching the certificate courses, as well as an extra-curricular Cybersecurity Club for students to engage socially with like-minded individuals. Outreach programs were launched, such as High School Cybersecurity Awareness Workshops and Tech Talk presentations from industry partners to inspire and prepare students for careers in cybersecurity. They also established additional programs such as industry certification workshops and internships with industry partners, which will continue to provide opportunities for graduates of the new certificate program.

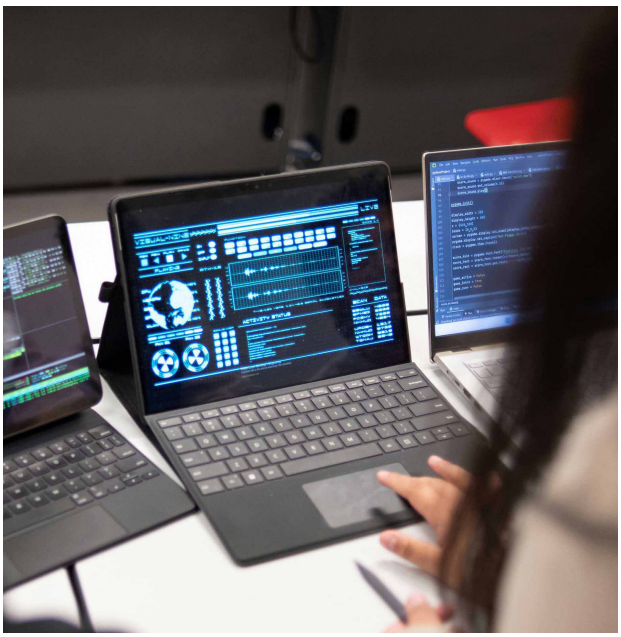
Improving Access for Underserved Communities

This project has a unique focus on improving the access of underserved groups to cybersecurity education. The Borough of Manhattan Community College itself is a predominantly Hispanic-serving institution, in which 75% of students are from communities that are underrepresented in the cybersecurity field, and in STEM more broadly.

This means that the project provides new opportunities to traditionally underserved communities, opening doors to high-paying and rewarding careers. In addition, the field of cybersecurity is currently constrained by a dire scarcity of well-trained professionals. As such, providing opportunities for underserved students to pursue cybersecurity careers will lead to a cohort of new talent entering the workforce at this critical time.

The team has endeavoured to make the course flexible and compatible for as many applicants as possible. The project's online delivery adds more flexibility, improving access to individuals with travel restrictions and those with family or work commitments.

To ensure that participants can complete the course during their tenure at the College, and to highlight the value of their previous work, stackable credentials such as industry certifications and prior experiences are mapped to credit-bearing college courses.



The certificate program's curriculum consists of 30 college course credits, broken down into 10 individual courses. Participants who complete the program will have the flexibility to enter the workforce directly, or to further their education and specialisation by earning advanced credentials such as a college degree.

The certificate program also includes enrichment activities. Younger participants can enrol in an online course called the 'Summer Bridge Course Program', which offers free tuition and deliberately small classes for more individualised teaching. At the end of the summer, the participants who complete this program will earn credit for a computer science course, which is transferable as an elective in any college within the City University of New York system, or towards the Cybersecurity certificate itself.

Those who are participating in the BMCC-ATE Project also have access to a variety of virtual internships – a relatively new concept that has erupted in popularity since the start of lockdown. Universities across the world are adapting traditional internships for an online delivery system, dramatically reducing the costs that hinder many disadvantaged students. Last summer, the New York financial company Bank of New York Mellon mentored 85 virtual interns. These mentorships coupled with internships introduce students to valuable contacts within the industry and build collaborations between academic and industrial communities.

The Online Cybersecurity Certificate program developed by Dr Kök, Dr Wei and Dr Azhar will undoubtedly advance the field of cybersecurity, building a new and diverse generation of experts who are well-equipped to protect the critical systems underpinning our modern world.

To find out more information about the project please visit http://cis.bmcc.cuny.edu/cybersecurity.

Meet the researchers

Dr Ahmet Mete Kök
Computer Information Systems Department
Borough of Manhattan Community College
New York City
USA

Dr Ahmet Mete Kök received his PhD in Computer Science from the City University of New York Graduate Center in 1994. He is now a Professor in the Computer Information System Department at Borough of Manhattan Community College in New York City. He currently serves as the Principal Investigator of the National Science Foundation's Advanced Technological Education (NSF-ATE) program and the Department of Education Hispanic Serving Institute (HSI-STEM) Articulation funded projects in Cybersecurity articulation and workforce development. Recently, Dr Kok spearheaded the formation of the Virtual Cybersecurity Lab at BMCC during the COVID-19 pandemic. The accessibility of this resource ensured the equity and inclusion of disadvantaged students and promoted student success in cybersecurity. His research interests include computer networking; network modelling and performance evaluation; computer network security and resilience.

CONTACT

E: amkok@bmcc.cuny.edu
W: https://www.bmcc.cuny.edu/faculty/mete-kok

Dr Ching-Song (Don) Wei
Computer Information Systems Department
Borough of Manhattan Community College
New York City
USA

Dr Ching-Song (Don) Wei is a Professor and the Chairperson of the Computer Information Systems (CIS) Department at Borough of Manhattan Community College. He received his Master's in Mechanical/Manufacturing Systems and PhD in Computer Science. As the Chairperson of the CIS Department, Dr Wei has been actively involved in developing new curricula; establishing articulation agreements; and placing students in mentorship, internship, and apprenticeships. He has served as Principal Investigator and Co-PI for numerous projects including the NSF-ATE, HSI-STEM programs in the areas of cybersecurity, geospatial technology, and mobile programming. Dr Wei serves as a co-PI for the Cybersecurity Workforce Development project and was instrumental in institutionalising the Virtual Cybersecurity Lab. Dr Wei has authored and published articles in the areas of Clinical Information systems, Machine Learning, Data Engineering, and Semantic Web Services.

CONTACT

E: cwei@bmcc.cuny.edu
W: https://www.bmcc.cuny.edu/faculty/ching-song-wei/

Dr Mohammad Q. Azhar
Computer Information Systems Department
Borough of Manhattan Community College
New York City
USA

Dr Mohammad Q. Azhar received his PhD in Computer Science from the Graduate Center, The City University of New York (CUNY), in 2015. He is now an Associate Professor of Computer Information Systems at Borough of Manhattan Community College (BMCC). As the faculty advisor of the BMCC Computer Programming Club and ACM-W chapter, he engages students in leadership and co-curricular learning. His research and projects include numerous NSF, DOE, CUNY and Industry projects. Dr Azhar is a co-PI for the NSF-ATE Cybersecurity Workforce Development and HSI-STEM Articulation programs. He was instrumental in the establishment of BMCC's Virtual Cybersecurity Lab. His current research interests include Human-Robot Collaboration, Artificial Intelligence and Assistive Robotics, Computer Science Education and Cyber Security.

CONTACT

E: mazhar@bmcc.cuny.edu
W: https://www.bmcc.cuny.edu/faculty/mohammad-azhar/

FUNDING

National Science Foundation (NSF)
US Department of Education