

# MASTER OF SCIENCE IN CYBERSECURITY

Over the last several years, individuals and industry have grown to rely on critical infrastructure to counter cyber-attacks. The Master of Science in Cybersecurity program prepares students for rewarding career paths protecting personal and proprietary data for businesses, governments, and individuals. Cybersecurity protects all categories of data from theft and damage. This includes sensitive corporate data, health information, personal information, intellectual property, proprietary data, and governmental and industry information systems. Every organization must have cybersecurity protection to defend itself against data breach campaigns.

The risk of cyber-attacks is growing enormously and so is the need for cybersecurity professionals. The Bureau of Labor statistics Occupational Outlook Handbook indicates that the employment of information security analysts is projected to grow 33 percent from 2020 to 2030, much faster than the average for all occupations. The median annual wage for information security analysts is greater than \$100,000. There is a shortage of cybersecurity professionals and experts in the industry, therefore, it is a wonderful time for you to learn cybersecurity skills and enter the market.

The Master of Science in Cybersecurity emphasizes the need for practical knowledge and understanding of computer systems. Courses examine interface with the web, databases, networks and a diverse number of techniques used to fingerprint, map networks, websites and systems, evaluate weaknesses, attack strategies and methodologies, and perform remediation techniques.

The online cybersecurity master's degree provides you the opportunity to recognize best practices, to learn and master the fundamentals of cybersecurity, including threats and vulnerabilities as well as the tools, technologies, and strategies used to manage it.

## Coursework in this program is focused on preparing you to:

- Identify threats to cybersecurity.
- Define strategies to identify and remediate vulnerabilities in information assets.
- Analyze a complex cybersecurity computing problem.
- Design, implement, and evaluate cybersecurity solutions.
- Function effectively as a member or leader of a cybersecurity team.
- Apply security principles and practices to maintain operations in the presence of risks and threats.

A career in cybersecurity provides you with the potential to increase your learning and career opportunities. Students may transition from an existing IT career or change their careers in mid-life.

## Transition From a General IT career to Cybersecurity

Students with a computer science background may enter the Master of Science in Cybersecurity without the need for taking bridge course work.

## Transition to a career in Cybersecurity

Students may enter the Master of Science in Cybersecurity program from any background. Motivated students who wish to expand their skill set and transition into Cybersecurity are welcome to enroll in the program. Change is an option. Career changers may expect to close their

knowledge gaps by enrolling in as many as 9 credits of work to catch up in the field. These bridge courses will be determined on an individual basis. Contact the department chair or program director to discuss your specific needs.

## Program

To earn a Master of Science in Cybersecurity, students complete the following:

Code	Title	Credits
SWEG 5530	Introduction to Information Security	3
SWEG 6404	Network Security	3
SWEG 6530	Applications and Data Security	3
SWEG 6599	Ethical Hacking	3
<b>Concentration Courses</b>		
Select two courses in one of the following concentration areas:		6
<b>Management Concentration</b>		
SWEG 5417	Security Management	
SWEG 5440	Vulnerability Management	
SWEG 6448	Server Management	
<b>Technical Concentration</b>		
SWEG 5349	Cloud Computing	
SWEG 5420	Systems Security	
SWEG 5335	Digital Forensics	
<b>Elective Courses</b>		
Select two elective courses from the following: <sup>1</sup>		6
SWEG 5301	Software Engineering Methods	
SWEG 5302	Software Design Methods	
SWEG 5322	Visual Analytics	
SWEG 5355	Artificial Intelligence	
SWEG 5360	Machine Learning	
SWEG 5521	Information Visualization	
SWEG 6461	Pattern Recognition	
SWEG 6518	Data Mining and Business Intelligence	
SWEG 6596	Network Routing and Switching	
<b>Capstone Sequence</b>		
SWEG 6961	Capstone Professional Project I	3
SWEG 6962	Capstone Professional Project II	3
<b>Total Credits</b>		<b>30</b>

<sup>1</sup> Electives may be chosen from the courses listed, SWEG 5990 Independent Study, or any other graduate-level course from a concentration or another area, under advisement of the department chair or academic advisor.

## Courses

### **SWEG 5301 Software Engineering Methods** **3 Credits**

This course explores the requirements gathering, system analysis, software design methods and prototyping of software application following the software processes required for the production of high quality software. Techniques for creating documentation and using software development tools will be presented. Students will gain experience in software project management; requirements, analysis, and design; procedural maturity; social, ethical, cultural, and safety issues in software development; interpersonal skills for management and team membership; and the software engineering discernment of systems architecture. Undergraduate equivalent: SWEG 3301. Previously SW 0400.

### **SWEG 5302 Software Design Methods** **3 Credits**

This course is designed to introduce fundamental concepts of object orientation techniques. Through the use of case studies and project work that has the student gradually building a large design specification, students will achieve an understanding of how complex applications are designed and built. Undergraduate equivalent: SWEG 3302. Previously SW 0401.

### **SWEG 5322 Visual Analytics** **3 Credits**

In this course, students investigate visual analytics tools and techniques used to synthesize information and derive insight from massive, dynamic, ambiguous, and often conflicting data and to communicate the findings effectively for decision-making. Extensive use of case studies based on real-world events will be used to illustrate course concepts. Students will apply visual analytics techniques toward a focused research problem in a real-world application or a domain of interest. Undergraduate equivalent: CPSC 4322. Previously SW 0422.

### **SWEG 5335 Digital Forensics** **3 Credits**

In this course students will be given the basic notions and theory of digital forensics. For file systems and operating systems, the class covers investigative techniques and legal and technical considerations that the examiner should make. They will learn concepts, challenges, and tools in applying digital forensics examinations. The course includes, but not limited to, topics in the suggested curriculum of CDFE certification. The course will use lectures, reading assignments, and interactive lab exercises to reinforce the concepts that are introduced. Undergraduate equivalent: CPSC 4335.

### **SWEG 5349 Cloud Computing** **3 Credits**

This course will introduce the foundations of cloud computing, and familiarize students with the core concepts needed to build, deploy and manage applications in a cloud. Besides the theoretical underpinnings, emphasis will be put on practical experience of using cloud resources and services. Concepts like microservices and containers will be discussed in depth, as well as best practices for building successful cloud native applications and implications for development and operational processes. The course will be a combination of lectures and hands-on experience of a public cloud. Undergraduate equivalent: CPSC 3349. Previously SW 0449.

### **SWEG 5355 Artificial Intelligence** **3 Credits**

This course, which examines computational and theoretical accounts of human intelligence, includes knowledge representation, commonsense reasoning, planning, natural language understanding, machine learning, and deep learning. Undergraduate equivalent: CPSC 4355. Previously SW 0455.

### **SWEG 5360 Machine Learning** **3 Credits**

This course will provide a practical introduction to machine learning applications such as face recognition, clinical diagnosis, speech recognition, natural language processing, or image classification. Topics such as regression, classification, neural networks, deep learning, and ensemble methods will be discussed. Emphasis will be on how to choose appropriate machine learning and deep learning models and how to evaluate their performance. The class will be a combination of lecture and computer lab. Undergraduate equivalent: CPSC 4360.

### **SWEG 5417 Security Management** **3 Credits**

This course will introduce the foundations of security program management and familiarize students with the core concepts needed to build, deploy, and manage security controls and policy to protect against today's cyber threats and regulations. Besides the theoretical underpinnings, emphasis will be put on practical experience of using security governance resources. Concepts like security policy/standards, governance, risk management, and program management will be key to ensuring effective security program management. The course will be a combination of lectures and hands-on collaborative working experience in building a security program.

### **SWEG 5420 Systems Security** **3 Credits**

This course will introduce the core concepts of detective and preventative security and the venues that threat agents use to compromise and breach systems. Students will learn to evaluate their environment for potential attacker entry points physical, virtual, and electronic, and come up with solutions to deploy to prevent intrusions. Emphasis will be placed on theoretical occurrences, but will also include practical experience of using prevention applications. Additionally, research on methodologies used by attackers will be required from outside resources (internet) which will be shared with the class as a whole. The course provides a current status of what is prevalent in the evolving cybersecurity domain.

### **SWEG 5440 Vulnerability Management** **3 Credits**

This course will introduce the foundations of vulnerability program management and familiarize students with the core concepts needed to build, deploy, and manage vulnerability management controls that help identify risk and help prioritize remediation and determine risk to protect against today's cyber threats. Besides the theoretical underpinnings, emphasis will be put on practical vulnerability management experience. Concepts like vulnerability discovery, reporting and assessing risk, threat modeling, and security testing are key to managing a vulnerability management program's risk posture. The course will be a combination of lectures and hands-on a collaborative working experience in building a vulnerability management program.

### **SWEG 5521 Information Visualization** **3 Credits**

Topics covered include graphics programming, information visualization general principles, visualization techniques for one-dimensional, two-dimensional, and N-dimensional information, graph visualization, information visualization lifecycle: representation, presentation, interaction, perception, and interpretation, as well as theories behind information visualization, and focus+context techniques. This course also includes the implementation of techniques presented in lecture. Students are encouraged to devise new techniques, implement them, and determine their effectiveness. Students will be required to complete in-depth assignments, read, summarize, and present recent journal papers from the information visualization literature, and prepare term papers with regard to an information visualization research topic. Students will also be required to specify, design, implement, and document a semester-long software project related to information visualization. Undergraduate equivalent: CPSC 4521. Previously SW 0521.

**SWEG 5530 Introduction to Information Security 3 Credits**

This course gives students a fundamental understanding of current social engineering methods in the information security arena. Deception and human behavior is exploited to gain valuable information, which is very relevant to today's growing security concerns. This course is another key class in the information security track within the software engineering program, and builds upon the weaknesses in the human factor. Areas of discussion will be methods, current trends, and most of all countermeasures. Instruction includes lectures and discussion assignments which involve analyzing current work places and social gatherings coupled with scenarios of exploitation. Previously SW 0530.

**SWEG 6404 Network Security 3 Credits**

This course is intended for individuals who need an understanding of the client-server environment, with any emphasis on network security. The OSI Model, network concepts and network architecture are discussed. The components that make up a network, including cabling, wiring hubs, file servers, bridges, switches, routers, network interface cards, network operating systems, and network software and hardware configurations are discussed. Network architectural concepts, wide area networks, remote access, and segmentation are discussed. Operating systems will be discussed and demonstrated. Featured is the seven-layer OSI model, the foundation of today's communication protocols. Students will work with various security protocols and configure routers and switches with security methods. Previously SW 0404.

**SWEG 6448 Server Management 3 Credits**

This is a course designed to provide the student with the tools necessary to manage Windows servers. The topics include user management, installation and configuration of web servers, mail servers, FTP servers, LDAP and backup, and other routine systems and network administration. Previously SW 0448.

**SWEG 6461 Pattern Recognition 3 Credits**

This course introduces the student to the techniques used and capabilities of modern pattern recognition systems with an emphasis on those that can learn and improve their performance as they are used. After a short review of some necessary mathematical concepts (probability, stochastic processes, and vector spaces), the student is introduced to the problem of representing real-world problems to a system. Selected real world applications are used to show examples of some valid representations (e.g. speech and handwriting) to provide insight and experience in the application of recognition systems. Several important recognition engines are then described and analyzed for their effectiveness in recognition/synthesis/learning systems. The use of additional knowledge bases dealing with the problem environment is then introduced to increase system performance and overall recognition system structures are discussed. Previously SW 0461.

**SWEG 6518 Data Mining and Business Intelligence 3 Credits**

This course examines business intelligence concepts, methods and processes used to improve data-centric business decision support solutions with a particular focus on data mining techniques. Students will first examine the principles and practices of gathering and retrieving large volumes of data for analysis and synthesis. Next, students will examine analytical techniques for extracting information from large data sets. In particular, the course examines the following data mining techniques: classification, estimation, prediction, and clustering. During the course, students will also discuss knowledge management, how organizations manage and use the knowledge that they acquire, and presentation of data. Previously SW 0518.

**SWEG 6530 Applications and Data Security 3 Credits**

This course is structured around enterprise and web applications and the data security associated with these applications. It encompasses the encryption schemes of transmission to execution of code and complete flight of an execution. Common countermeasure and best business practices that help ensure a solid security understanding are the objectives of the course. Previously SW 0531.

**SWEG 6596 Network Routing and Switching 3 Credits**

This course presents concepts and develops skills needed in designing, implementing, and troubleshooting local and wide area networks. Students design and configure LAN and WAN using routers and switches, learn the components of wireless networks, and how to configure and troubleshoot a network and optimize its performance. The course also provides numerous lab opportunities to configure and troubleshoot networks with Cisco routers and switches. Previously SW 0596.

**SWEG 6599 Ethical Hacking 3 Credits**

This course covers current information security practices and countermeasures put in place to safeguard against security breaches. The course reviews internet infrastructures such as firewalls, IDS systems, and honey pots. Additional areas include risk analysis, computer-use policies, physical security, internet/intranet security, malware, firewall infrastructure, and current information security issues. Previously SW 0599.

**SWEG 6961 Capstone Professional Project I 3 Credits**

**Prerequisite:** MATH 5417 or SWEG 5301 or SWEG 5322 or SWEG 5530 or SWEG 6518.

In this two-semester capstone sequence, students form teams, perform a technical study, and design software systems based on either their customer's requirements, develop, test, and deploy software systems. The results of these projects provide a library of case studies, designs, and software development techniques, and project management skills that are of general interest to local information technology professionals. A capstone prospectus, approved by your advisor, must be submitted to and accepted by the director of the program prior to starting the capstone sequence. Previously SW 0550.

**SWEG 6962 Capstone Professional Project II 3 Credits**

**Prerequisite:** SWEG 6961.

In this two-semester capstone sequence, students form teams, perform a technical study, and design software systems based on either their customer's requirements, develop, test, and deploy software systems. The results of these projects provide a library of case studies, designs, and software development techniques, and project management skills that are of general interest to local information technology professionals. A capstone prospectus, approved by your advisor, must be submitted to and accepted by the director of the program prior to starting the capstone sequence. Previously SW 0551.

**SWEG 5990 Independent Study 3 Credits**

This course is an individualized study under the supervision of the faculty member. The course emphasizes individual creativity. Students work with a faculty mentor in studying and investigating topics of current interest in software engineering. Enrollment by permission only. Previously SW 0483.