INFORMATION SYSTEMS

SPS Certificate website: https://sps.northwestern.edu/program-search/certificates.php

Database & Internet Technologies, Advanced Graduate Certificate

The Database and Internet Technologies (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/database-internet-technologies-advance-graduate-certificate/) certificate addresses the growing demand for professionals with technical skills to analyze, design, implement, and manage software applications and digital media for the enterprise and IoT (Internet-of-Things). The certificate emphasizes experimentation and application of theoretical concepts to real-world scenarios with the goal of creating business value. Students should walk away with the ability to integrate data science concepts and machine learning algorithms to solve business problems. Throughout the course of study, students will acquire knowledge and skills in data modeling and database design, implementation, and programming skills, using both Relational Database Management Systems and NoSQL technologies. Students will also study design and development of distributed software systems that adhere to sound design principles and best practices, including scalable data services architecture and robust security.

Information Systems Management, Advanced Graduate Certificate

Information Technology is a fast-growing field with new subspecialties emerging on a regular basis. Every business is or will be leveraging technology to deliver or enhance their products and services. Leaders are needed who know how to manage and lead IT organizations in delivering these capabilities. The certificate in Information Systems Management (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-management-advance-graduate-certificate/) introduces students to key information system management best practices, IT strategy development, project management methods, information security and technology management techniques that apply to the entire system life cycle. The certificate emphasizes management techniques and methods used to ensure the successful implementation and ongoing operations of information technology capabilities that produce value for the business. Students will learn various approaches to develop IT strategies, evaluate emerging technologies, keep information secure, manage technology project implementations, and develop frameworks to apply to the ongoing management and operation of application and information technology portfolios.

Information Systems Security & IT, Advanced Graduate Certificate

With the proliferation of internet-enabled devices, social media use and software-dependent organizations, securing and safeguarding data, information and business processes is an ever-increasing urgent concern, especially in a post-9/11 world. The Information Systems Security (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-security-advance-graduate-certificate/) certificate focuses on timely and distinctive skills that allow students to design secured information systems and make recommendations for the protection of sensitive corporate data in accordance with commerce and privacy regulations. Students learn how to plan, budget for, and implement secure network systems (LAN, WAN, wireless, mobile, IoT, AR) and lead organizational staff in the secure exchange of digital information across a variety of platforms. Topics include: VPN, firewalls, intrusion detection systems and defensive strategies, cryptography, social engineering, phishing, anti-virus, anti-spam, ethical hacking, ransomware attacks and application security techniques. Students also learn the managerial and administrative aspects of information security such as risk analysis, vulnerability analysis and remediation, network security architectures, policy development and enforcement, legal/regulatory compliance issues, risk management, business continuity planning, and disaster recovery preparation and execution.

Database & Internet Technologies, Graduate Certificate

The Database and Internet Technologies (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/database-internet-technologies-graduate-certificate/) certificate addresses the growing demand for professionals with technical skills to analyze, design, implement, and manage software applications and digital media for the enterprise and IoT (Internet-of-Things). The certificate emphasizes experimentation and application of theoretical concepts to real-world scenarios with the goal of creating business value. Students should walk away with the ability to integrate data science concepts and machine learning algorithms to solve business problems. Throughout the course of study, students will acquire knowledge and skills in data modeling and database design, implementation, and programming skills, using both Relational Database Management Systems and NoSQL technologies. Students will also study design and development of distributed software systems that adhere to sound design principles and best practices, including scalable data services architecture and robust security.

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Information Technology is a fast-growing field with new subspecialties emerging on a regular basis. Every business is or will be leveraging technology to deliver or enhance their products and services. Leaders are needed who know how to manage and lead IT organizations in delivering these capabilities. The certificate in Information Systems Management (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-management-graduate-certificate/) introduces students to key information system management best practices, IT strategy development, project management methods, information security and technology management techniques that apply to the entire system life cycle. The certificate emphasizes management techniques and methods used to ensure the successful implementation and ongoing operations of information technology capabilities that produce value for the business. Students will learn various approaches to develop IT strategies, evaluate emerging technologies, keep information secure, manage technology project implementations, and develop frameworks to apply to the ongoing management and operation of application and information technology portfolios.

Information Systems Security, Graduate Certificate

With the proliferation of internet-enabled devices, social media use and software-dependent organizations, securing and safeguarding
data, information and business processes is an ever-increasing urgent concern, especially in a post-9/11 world. The Information Systems Security (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/security-graduate-certificate/) certificate focuses on timely and distinctive skills that allow students to design secure information systems and make recommendations for the protection of sensitive corporate data in accordance with commerce and privacy regulations. Students learn how to plan, budget for, and implement secure network systems (LAN, WAN, wireless, mobile, IoT, AR) and lead organizational staff in the secure exchange of digital information across a variety of platforms. Topics include: VPN, firewalls, intrusion detection systems and defensive strategies, cryptography, social engineering, phishing, anti-virus, anti-spam, ethical hacking, ransomware attacks and application security techniques. Students also learn the managerial and administrative aspects of information security such as risk analysis, vulnerability analysis and remediation, network security architectures, policy development and enforcement, legal/regulatory compliance issues, risk management, business continuity planning, and disaster recovery preparation and execution.

### Project Management, Graduate Certificate

The graduate certificate in Project Management (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/project-management-graduate-certificate/) is designed for IT professionals who want to acquire the skills and competencies for IT project management. The project management certificate provides the students with the managerial and technical skills that are applicable to information systems software development lifecycle (SDLC) including requirements, analysis/design, implementation, and testing. The student applies the fundamental concepts and techniques of project management like schedule and budget estimation, resource allocation, progress monitoring, risk mitigation and contingency planning to IT projects in the software industry. The student acquires hands-on experience with traditional project management methodologies and modern project management methodologies like Agile project management. Standards for quality assurance and quality control, like ISO 9000 family of standards, will be discussed and explained to assess the maturity of the development organizations and the development processes for the IT projects. Business Communication and IT budgeting moves projects and innovation forward, focusing on application to real-world initiatives.

### Certificates Offered

- Database & Internet Technologies, Advanced Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/database-internet-technologies-advance-graduate-certificate/)
- Database & Internet Technologies, Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/database-internet-technologies-graduate-certificate/)
- Information Systems Management, Advanced Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-management-advance-graduate-certificate/)
- Information Systems Management, Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-management-graduate-certificate/)
- Information Systems Security, Advanced Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-security-advance-graduate-certificate/)
- Information Systems Security, Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/information-systems-security-graduate-certificate/)
- Project Management, Graduate Certificate (https://catalogs.northwestern.edu/sps/certificates/graduate/information-systems/project-management-graduate-certificate/)

### Information Systems Courses

**CIS 212-0 Introduction to Programming (1 Unit)**

This course introduces core elements of object-oriented programming and teaches how to transfer those concepts into Java language. First, the basics of the Java language are given an overview: variable, conditionals, looping and user-defined methods. Classes/objects, data hiding/encapsulation, inheritance and aggregation as principles of object-oriented programming will be introduced through interactive lectures and labs. Note: Enrollment restricted to students who have completed CIS 110-CN. Instructor consent (permission number) is required for all other students.

**CIS 350-0 Strategic Information Systems (1 Unit)**

This course examines current issues, themes, and research related to the strategic use of information systems in organizations at a high level. It focuses on the use of information and information technology for competitive advantage in businesses, organizations, and nonprofits. May not be audited or taken P/N.

**CIS 413-0 Telecommunication Networks (1 Unit)**

This course provides an overview of telecommunications and data communications. Course work includes local area network (LAN) and wide area network (WAN) components such as switches, routers, telecommunication circuits, and protocols. Advanced topics such as information security, information assurance, advanced networking technologies, and others will be overviewed as well.

**CIS 413-DL Telecommunications Networks (1 Unit)**

This course provides an overview of telecommunications and data communications. Course work includes local area network (LAN) and wide area network (WAN) components such as switches, routers, telecommunication circuits, and protocols. Advanced topics such as information security, information assurance, advanced networking technologies, and others will be overviewed as well.

**CIS 414-0 Object-Oriented Programming (1 Unit)**

This course focuses on developing complex programs using an object-oriented language. Students write programs that utilize functions and methods for code modularization and arrays for solving problems. Information hiding, encapsulation, inheritance, polymorphism, exception handling, and other principles of object-oriented programming will be introduced.

**CIS 414-DL Object Oriented Programming (1 Unit)**

This course focuses on developing complex programs using an object-oriented language. Students write programs that utilize functions and methods for code modularization and arrays for solving problems. Information hiding, encapsulation, inheritance, polymorphism, exception handling, and other principles of object-oriented programming will be introduced.

**CIS 417-0 Database Systems Design & Implementation (1 Unit)**

This course covers the fundamentals of database design and management. Topics include the principles and methodologies of database design, database application development, normalization,
referential integrity, security, relational database models, and database languages. Principles are applied by performing written assignments and a project using an SQL database system.

CIS 417-DL Database Systems Design & Implementation (1 Unit)
This course covers the fundamentals of database design and management. Topics include the principles and methodologies of database design, database application development, normalization, referential integrity, security, relational database models, and database languages. Principles are applied by performing written assignments and a project using an SQL database system.

CIS 419-0 Web Application Development (1 Unit)
This course focuses on the design and development of object-oriented web applications. The client-server model and 3-tier architecture are discussed and analyzed. Topics covered include object-oriented methodology, enterprise software application architecture, design patterns, Enterprise JavaBeans, database connectivity, and web and application server development and technologies such as servlets, JSP, XML, HTML, security, JDBC, RMI, and multithreading. (Required: CIS 414-0 or CIS 414-DL and CIS 417-0 or CIS 417-DL.)

CIS 419-DL Web Application Development (1 Unit)
This course focuses on the design and development of object-oriented web applications. The client-server model and 3-tier architecture are discussed and analyzed. Topics covered include object-oriented methodology, enterprise software application architecture, design patterns, Enterprise JavaBeans, database connectivity, and web and application server development and technologies such as servlets, JSP, XML, HTML, security, JDBC, RMI, and multithreading. (Required: CIS 414-0 or CIS 414-DL and CIS 417-0 or CIS 417-DL.)

CIS 431-0 Database Administration (1 Unit)
Provides students with advanced database administration and management concepts that are needed to perform the duties of a Database Administrator (DBA) in organizations that use relational database systems. Topics include: database organization and architecture, industry DBMS standards, system objects management, user roles and profiles, server installation and maintenance, backup/recovery techniques, network configuration, and security management. (Required: CIS 417-0 or CIS 417-DL.)

CIS 431-DL Database Administration (1 Unit)
Provides students with advanced database administration and management concepts that are needed to perform the duties of a Database Administrator (DBA) in organizations that use relational database systems. Topics include: database organization and architecture, industry DBMS standards, system objects management, user roles and profiles, server installation and maintenance, backup/recovery techniques, network configuration, and security management. (Required: CIS 417-0 or CIS 417-DL.)

CIS 435-0 Practical Data Science Using Machine Learning (1 Unit)
This course provides an overview of machine learning concepts, techniques, and tools with a practical emphasis on understanding large, complex datasets and building intelligent systems. Insights gleaned from data mining and machine learning can be used to optimize operational processes, identify new business opportunities, and support evidence-based decision making and digital marketing with applications in industries such as finance, retail, and healthcare. (Required: CIS 417-0 or CIS 417-DL and MSDS 430-DL.)

CIS 435-DL Practical Data Science Using Machine Learning (1 Unit)
This course provides an overview of machine learning concepts, techniques, and tools with a practical emphasis on understanding large, complex datasets and building intelligent systems. Insights gleaned from data mining and machine learning can be used to optimize operational processes, identify new business opportunities, and support evidence-based decision making and digital marketing with applications in industries such as finance, retail, and healthcare. (Required: CIS 417-0 or CIS 417-DL and MSDS 430-DL.)

CIS 436-DL Big Data Management and Analytics (1 Unit)
This course reviews concepts behind both centralized and distributed database systems, and relational and not-only-relational database systems. Discussion of open source and commercial solutions, with special attention being paid to large distributed database systems and data warehousing. The course introduces technologies and modeling methods for large-scale, distributed analytics. (Required: CIS 417-0 or CIS 417-DL. Recommended: CIS 435-0 or CIS 435-DL.)

CIS 452-0 Cybersecurity Attacks and Counter Measures (1 Unit)
With increased dependence by organizations and individuals on secure information technology, this course provides a hands-on approach to security issues and techniques throughout various areas of cyberspace. Technical topics will be explored including security controls and technologies, cybersecurity law, auditing and cybersecurity programs, risk assessment, and mitigation. Tools and topics used to both control and compromise these systems and networks, and how to assure these attacks, will be demonstrated. This course will provide learners with insight into defining problems in the field along with an understanding of the negative effects already experienced throughout the history of internet-available data, and those predicted for the future. (Required: CIS 413-0 or CIS 413-DL.)

CIS 452-DL Cybersecurity Attacks and Counter Measures (1 Unit)
Fundamentals of Network Security helps students develop an understanding of computer network security and survivability principles. Course work includes the study of survivability, availability, threats, risk, and policy in a multi-user network. Additionally, students study technical solutions necessary to understanding and securing network information and communications; these include cryptography, firewalls, intrusion, anti-virus, anti-spam, wireless, VPN, host systems, network services, and network infrastructure. (Required: CIS 413-0 or CIS 413-DL.)

CIS 453-0 Enterprise Security Strategy (1 Unit)
Enterprise Security Strategy helps students develop an understanding of the core components of a holistic information security program. Coursework includes the study of industry standard frameworks for risk management, organizational structures, budgeting, executive communication, and overall program development. In addition, students will examine effective policy strategies, privacy program development and understand how security programs are managed in real organizations. (Required: CIS 413-0 or CIS 413-DL.)

CIS 453-DL Enterprise Security Strategy (1 Unit)
Enterprise Security Strategy helps students develop an understanding of the core components of a holistic information security program. Coursework includes the study of industry standard frameworks for risk management, organizational structures, budgeting, executive communication, and overall program development. In addition, students will examine effective policy strategies, privacy program development and understand how security programs are managed in real organizations. (Required: CIS 413-0 or CIS 413-DL.)

CIS 455-0 Business Continuity and Disaster Recovery (1 Unit)
Provides an in-depth study of the technical solutions necessary to support disaster recovery and business continuity in an enterprise networking environment. Course work includes the study of Risk and Business Impact Assessment (BIA), responding to a disaster, disaster recovery strategies, business continuity planning, and creating a recovery plan. Additional discussions will focus on designing a disaster recovery plan.
solution and surveying appropriate and current technologies and techniques, including RAID, SAN, clustering, backup solutions, LAN/WAN designs, and environmental impact. (Required: CIS 413-0 or CIS 413-DL. Recommended: CIS 452-0 or CIS 452-DL.)

CIS 455-DL Disaster Recovery and Continuity (1 Unit)
Provides an in-depth study of the technical solutions necessary to support disaster recovery and business continuity in an enterprise networking environment. Course work includes the study of Risk and Business Impact Assessment (BIA), responding to a disaster, disaster recovery strategies, business continuity planning, and creating a recovery plan. Additional discussions will focus on designing a disaster recovery solution and surveying appropriate and current technologies and techniques, including RAID, SAN, clustering, backup solutions, LAN/WAN designs, and environmental impact. (Required: CIS 413-0 or CIS 413-DL. Recommended: CIS 452-0 or CIS 452-DL.)

CIS 457-0 Management of Information Security (1 Unit)
This course emphasizes the need for information technology security and control and provides reasonable working knowledge required to manage information technology security and risk. This is accomplished through a comprehensive survey of security threats, risk analysis, control techniques, and managerial issues associated with establishing and maintaining an information technology security plan. (Required: CIS 413-0 or CIS 413-DL. Recommended: CIS 452-0 or CIS 452-DL and CIS 455-0 or CIS 455-DL.)

CIS 457-DL Management of Information Security (1 Unit)
This course introduces students to the key challenges and responsibilities of managing information technology and an information technology organization. Students gain knowledge of the various facets of managing information technology including how to develop an IT strategy aligned with business strategy. Topics covered include the IT solution lifecycle, IT service management, IT supplier management and sourcing, ongoing IT technology operations, governance, business continuity, budgeting, benchmarking, and industry standard management frameworks such as ITIL and COBIT. (Required: CIS 413-0 or CIS 413-DL. Recommended CIS 452-0 or CIS 452-DL, 455-0 or CIS 455-DL, and CIS 457-0 or CIS 457-DL.)

CIS 460-0 Information Technology Strategy (1 Unit)
This course introduces effective frameworks and methods for developing information technology and systems strategies that focus on meeting enterprises business objectives and on leveraging IT to competitively extend business capabilities. Topics covered include business driver identification and business and IT alignment; key technology components of the IT strategy, including enterprise architecture, enterprise systems, SOA and other integration technologies, networks, and data management; portfolio management; sourcing and hosting alternatives; emerging technologies and entrepreneurship. (Required: CIS 413-0 or CIS 413-DL. Recommended CIS 452-0 or CIS 452-DL, 455-0 or CIS 455-DL, 457-0 or CIS 457-DL, and CIS 460-0 or CIS 460-DL.)

CIS 465-DL Disaster Recovery and Continuity (1 Unit)
This course introduces students to the key challenges and responsibilities of managing information technology and an information technology organization. Students gain knowledge of the various facets of managing information technology including how to develop an IT strategy aligned with business strategy. Topics covered include the IT solution lifecycle, IT service management, IT supplier management and sourcing, ongoing IT technology operations, governance, business continuity, budgeting, benchmarking, and industry standard management frameworks such as ITIL and COBIT. (Required: CIS 413-0 or CIS 413-DL. Recommended CIS 452-0 or CIS 452-DL, 455-0 or CIS 455-DL, and CIS 457-0 or CIS 457-DL.)

CIS 465-DL Information Technology Strategy (1 Unit)
This course introduces effective frameworks and methods for developing information technology and systems strategies that focus on meeting enterprises business objectives and on leveraging IT to competitively extend business capabilities. Topics covered include business driver identification and business and IT alignment; key technology components of the IT strategy, including enterprise architecture, enterprise systems, SOA and other integration technologies, networks, and data management; portfolio management; sourcing and hosting alternatives; emerging technologies and entrepreneurship. (Required: CIS 413-0 or CIS 413-DL. Recommended CIS 452-0 or CIS 452-DL, 455-0 or CIS 455-DL, 457-0 or CIS 457-DL, and CIS 460-0 or CIS 460-DL.)

CIS 469-DL Project Management Concepts (1 Unit)
This course introduces effective frameworks and methods for developing information technology and systems strategies that focus on meeting enterprises business objectives and on leveraging IT to competitively extend business capabilities. Topics covered include business driver identification and business and IT alignment; key technology components of the IT strategy, including enterprise architecture, enterprise systems, SOA and other integration technologies, networks, and data management; portfolio management; sourcing and hosting alternatives; emerging technologies and entrepreneurship.

CIS 470-DL, 474-0 Information Technology Management (1 Unit)
This course introduces students to the key challenges and responsibilities of managing information technology and an information technology organization. Students gain knowledge of the various facets of managing information technology including how to develop an IT strategy aligned with business strategy. Topics covered include the IT solution lifecycle, IT service management, IT supplier management and sourcing, ongoing IT technology operations, governance, business continuity, budgeting, benchmarking, and industry standard management frameworks such as ITIL and COBIT. (Required: CIS 413-0 or CIS 413-DL. Recommended CIS 452-0 or CIS 452-DL, 455-0 or CIS 455-DL, and CIS 457-0 or CIS 457-DL.)

CIS 460-DL Information Technology Management (1 Unit)
This course introduces students to the key challenges and responsibilities of managing information technology and an information technology organization. Students gain knowledge of the various facets of managing information technology including how to develop an IT strategy aligned with business strategy. Topics covered include the IT solution lifecycle, IT service management, IT supplier management and sourcing, ongoing IT technology operations, governance, business continuity, budgeting, benchmarking, and industry standard management frameworks such as ITIL and COBIT. (Required: CIS 413-0 or CIS 413-DL. Recommended CIS 452-0 or CIS 452-DL, 455-0 or CIS 455-DL, and CIS 457-0 or CIS 457-DL.)

CIS 495-DL Enterprise Agility Frameworks (1 Unit)
The course will prepare students to apply Agile ways of working to projects, teams and organizations. Students will begin applying Agile project management techniques at the team or project level. By the end of the course students will be able to initiate, plan and execute an Agile project. A secondary focus of the course will be on those cultural and environment factors that impact the adoption of agile and ultimately successful agile transformation across an enterprise. Students will be able to develop and defend a proposal for enterprise agile transformation. (Required: MSDS 475-DL)

CIS 495-DL Project Management Concepts (1 Unit)
The course will prepare students to apply Agile ways of working to projects, teams and organizations. Students will begin applying Agile project management techniques at the team or project level. By the end of the course students will be able to initiate, plan and execute an Agile project. A secondary focus of the course will be on those cultural and environment factors that impact the adoption of agile and ultimately successful agile transformation across an enterprise. Students will be able to develop and defend a proposal for enterprise agile transformation. (Required: MSDS 475-DL)
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project management techniques at the team or project level. By the end of the course students will be able to initiate, plan and execute an Agile project. A secondary focus of the course will be on those cultural and environment factors that impact the adoption of agile and ultimately successful agile transformation across an enterprise. Students will be able to develop and defend a proposal for enterprise agile transformation. (Required: MSDS 475-DL.)

CIS 496-0 IT Finance & Communication (1 Unit)
This course is designed for those who want to sharpen their writing and communication skills for professional IT environments. Using a case study, students learn to apply measures of excellence in professional writing and communication in business environments, including audience analysis, persuasive writing, verbal and interpersonal communication, and document design and graphics. Writers gain experience writing individually and in collaborative environments, producing multiple drafts and receiving feedback from their peers and the instructor.

CIS 496-DL Information Technology Business Writing and Communication (1 Unit)
This online course is designed for those who want to sharpen their writing and communication skills for professional IT environments. Using a case study, students learn to apply measures of excellence in professional writing and communication in business environments, including audience analysis, persuasive writing, verbal and interpersonal communication, and document design and graphics. Writers gain experience writing individually and in collaborative environments, producing multiple drafts and receiving feedback from their peers and the instructor.

CIS 497-DL Information Technology Finance (1 Unit)
This course focuses on developing and managing an IT project budget as well as looks at the means of conveying information to ensure understanding and gain the cooperation of key partners in initiating positive IT financial initiatives.

CIS 498-0 Computer Information Systems Capstone Project (1 Unit)
This course provides experience in development and delivery of a large-scale software application that solves a real-world problem. This will be accomplished through a managed capstone software project that will cover all aspects of the software development life cycle including (but not limited to): discovery, requirements, design, implementation, testing, technical documentation, and deployment. Students will learn how to research a real-world problem, evaluate industry trends that address the problem, and consequently propose and implement their own solution to the problem. To accomplish this, students will learn how to apply the skills they acquired through the various tracks of the Computer Information System program to deliver the project, which in turn will set them up for success in their professional careers. (Required: CIS 413-0 or CIS 413-DL, CIS 414-0 or CIS 414-DL or MSDS 430-DL, and CIS 417-0 or CIS 417-DL. And must have completed 9 out of 11 units of credit.)

CIS 498-DL Computer Information Systems Capstone Project (1 Unit)
This course provides experience in development and delivery of a large-scale software application that solves a real-world problem. This will be accomplished through a managed capstone software project that will cover all aspects of the software development life cycle including (but not limited to): discovery, requirements, design, implementation, testing, technical documentation, and deployment. Students will learn how to research a real-world problem, evaluate industry trends that address the problem, and consequently propose and implement their own solution to the problem. To accomplish this, students will learn how to apply the skills they acquired through the various tracks of the Computer Information System program to deliver the project, which in turn will set them up for success in their professional careers. (Required: CIS 413-0 or CIS 413-DL, CIS 414-0 or CIS 414-DL or MSDS 430-DL, and CIS 417-0 or CIS 417-DL. And must have completed 9 out of 11 units of credit.)

CIS 499-0 Independent Study (1 Unit)
Independent Study.

CIS 590-0 Capstone Research (1 Unit)
Capstone Research.

CIS 590-DL Capstone Research (1 Unit)
Capstone Research.