College of Computing, Engineering & Construction
Computing Course Descriptions

**CAP5605: Introduction to Artificial Intelligence** 3
Prerequisite: COP 3530 or COP 3540. For beginning graduate students. Heuristic techniques for problem solving and decision making, control and search strategies, knowledge representation, logic, AI languages and tools. Applications such as expert systems, natural language understanding, planning, and computer vision. Students will extend course topics via library assignments or other instructor-assigned requirements.

**CAP5661C: Introduction to AI Robotics** 4
Prerequisites: COP 3530, COP 3601, graduate standing. This course focuses on models and methods for the design and development of robotic devices whose function is to accomplish prescribed tasks with minimal human intervention. Basic robotics elements are addressed: simple mechanics (moving, turning, lifting), sensing the environment (light, contact, proximity), monitoring internal state (time, position, orientation). Autonomous and semi-autonomous robots are designed, constructed, and programmed by combining basic reactive behaviors to support higher levels of cognition. Laboratory exercises are incorporated throughout the course, with a term objective of implementing a working robot to address a performance/survival specification. Students will extend course topics via library assignments or other instructor-assigned requirements. (A material fee of $25 will be assessed).

**CAP5715: Computer Graphics** 3
Prerequisites: MAS 3105 and COP 3530. For beginning graduate students. Point-plotting techniques, line drawings, two- and three-dimensional transformations, clipping and windowing, data and file structures, interactive techniques, raster systems, perspective, hidden surface removal, shading. Students will extend course topics via library assignments or other instructor-assigned requirements.

**CAP5771: Data Mining** 3
Prerequisite: COP 5716 or equivalent. Students will study concepts and techniques of data mining, including Characterizing and Comparison, Association Rules Mining, Classification and Prediction, Cluster Analysis, and Mining Complex Types of Data. Students will also examine Applications and Trends in Data Mining.
**CAP5805: Discrete Systems Modeling and Simulation**
Prerequisites: (STA 4321 or STA 2023) and (COP 3530 or COP 3540). For beginning graduate students. Model building; queuing models; design of experiments; simulation techniques; utilization of probability density functions; pseudo-random number generation; simulation tools such as GPSS, SIMSCRIPT, and SLAM; interpretation of results; simulation animation; continuous simulation. Students will extend course topics via library assignments or other instructor-assigned requirements.

**CAP6100: Interface Design and Implementation**
Prerequisite: CEN 6016 or equivalent. This course covers issues associated with the design, implementation, and evaluation of human/computer interfaces including interface devices, metaphors, and interaction styles. Topics covered include task analysis; dialog models and examples; user centered design including naive and expert user interfaces; interface development methodologies and implementation tools; interface testing and quality assessment.

**CAP6400: Graphics Image Recognition and Manipulation**
Prerequisite: CAP 5715. For advanced graduate students. Pattern recognition: edge following, thinning, feature extraction, pattern matching, syntactic pattern recognition. Image processing: image data representation, file formats, data compression, point and area processing, histogram equalization, adaptive histogram equalization, frequency domain, FFT, filters, noise handling, edge detection, color images.

**CAP6671: Intelligent Systems**
Prerequisite: Permission of the instructor. The course may be repeated for credit with the consent of the Department. Each course offering examines an area concerned with intelligent systems chosen from among artificial intelligence, logic programming, language translation, vision, robotics, simulation, neural networks.

**CDA5106: Introduction to Computer Architecture**
Prerequisite: CDA 3101. Corequisite: CDA 5106L. For beginning graduate students. Computer taxonomy, description languages, conventional computer architecture, microprogramming, instruction sets, I/O techniques, memory, survey of non-conventional architectures. Software interface. Students will extend course topics via library assignments or other instructor assigned requirements.

**CDA5106L: Introduction to Computer Architecture Laboratory**
Prerequisite: CDA 3101. Corequisite: CDA 5106. Laboratory exercises to accompany CDA 5106 emphasizing computer architecture, microprocessing, instruction sets, I/O techniques and memory using software interfaces. 3 hours of laboratory. (A lab fee of $30 will be assessed)

**CDA6011: Web Engineering**
Prerequisite: CEN 6016 or equivalent. In this course, topics covered include the application of software engineering principles and techniques to the development, deployment, and maintenance of high quality Web-based systems and applications; markup languages, distributed objects, hypermedia and Web integration; architecture and security issues; client side and server side technologies; distributed technologies; data integration across heterogeneous Web sources.
CEN6016: Engineering of Software I
Prerequisite: COP 3540 or COP 4534 or equivalent. Topics covered in this course include: methods, techniques, and practices associated with software development that go from elicitation or requirements to the analysis of both the problem and solution domains; formal methods, executable specifications, classical and object-oriented approaches; support tools, and quality assurance practices; team-oriented project using methods, techniques and practices learned.

CEN6017: Engineering of Software II
Prerequisite: CEN 6016. Topics covered in this course include: the design of a software system using classical and object-oriented approaches; software architectures, frameworks, functional and object-oriented decomposition, prototyping, design and implementation of reviews and walkthroughs, GUI design and implementation, interoperability, support tools, and quality assurance practices; team-oriented project used methods, techniques and practices learned.

CEN6070: Software Quality Assurance and Testing
Prerequisite: CEN 6016. Topics covered in this course include: the quality of the software product; techniques with the stages of verification and validation; reliability; correctness, testing methods, coverage measures, testing specialized applications, formal verification, testing management techniques and support tools; team-oriented project used methods, techniques and practices learned.

CEN6940: Software Engineering Practicum
Prerequisites: Software Engineering core: CIS 6101, CEN 6016, CEN 6017, and CEN 6070. This course involves a supervised team project, including field experience with real customers, to address a major software development effort that employs methods, techniques, and practices covered in the Software Engineering core.

CIS5105: Systems Performance and Evaluation
Prerequisites: CDA 3100 and COP 3540. For beginning graduate students. Tools and techniques used in the evaluation of the performance of computing systems, empirical modeling, methods, simulation models, deterministic and stochastic methods. Students will extend course topics via library assignments or other instructor assigned requirements.

CIS5865: Spatial Information Systems Administration
Prerequisite: CIS 5871C Advanced Spatial Information Systems This course will provide the participants with the advanced knowledge of the professional practices needed to be able to administer enterprise-scale Spatial Information Systems (SIS) and to manage the development and implementation of specialized applications that utilize SIS technology as a component. The course will utilize guest lectures by SIS professionals to present case studies of professional practices. Participants will work in groups to execute a series of peer-reviewed assignments in which each group develops the requirements for development of a SIS application, a competitive professional proposal, and a SIS business plan. Participants will also be required to conduct an individual research project and make a professional presentation.

CIS5870C: Introduction to Spatial Information Systems
An introduction to Spatial Information Systems (SIS): the technology of acquiring,
managing, analyzing, and displaying information in a spatial context. The course focuses on the unique technical and institutional issues associated with designing and implementing a spatially-enabled Information Technology infrastructure in a public or private enterprise. The participants will get hands-on experience with industry-standard technology including: Geographic Information System and Global Positioning System hardware and software. Practical exercises provide a pathway to understanding how fundamental spatial theory and principles become relevant in the context of developing practical applications using these technologies. Students will be required to conduct an individual research project and make a professional presentation.

CIS5871C: Advanced Spatial Information Systems 3
Prerequisite: CIS 5870C This course will provide participants with advanced knowledge of spatial principles and professional practices related to enterprise-scale Spatial Information Systems (SIS) and specialized applications that utilize SIS technology. The course will explore how SIS technology can be integrated with other technologies to create new business process models. The laboratory component will provide participants with the advanced technical skills needed to design and implement a SIS and develop applications that utilize SIS technology. The course will give participants a "hands on" opportunity to explore how SIS technology can be integrated other technologies such as mobile computing, the web, and wireless communications. Participants will be required to conduct an individual research project and make a professional presentation.

CIS5930: Special Topics in Computer and Information Sciences v. 1-4
For beginning graduate students and advanced undergraduates. Topics are reflective of current faculty interests and advances in state-of-the-art computing not adequately addressed in current course offerings. May be repeated up to 12 credits.

CIS5935: Seminar v. 1-3
Prerequisite: Permission of the Department of Computer and Information Sciences. Topics reflect broader interests than covered in a standard course. Students will be expected to make presentations of material extracted from current trade publications. May be repeated up to 12 credits.

CIS5949: Experiential Studies in Computing v. 1-3
Prerequisites: Acceptance to the Graduate Program in Computer and Information Sciences and for the cooperative education program Students will participate in supervised work experiences related to computing. Students may receive repeat credit for this course. Up to 3 credits may be applied to the elective category for the Master of Science in Computer and Information Sciences

CIS6101: Software Processes and Metrics 3
Prerequisite: CEN 6016. Topics covered in this course include: software life cycle and process models; software metrics, software estimation, software standards, configuration management, version control, planning, scheduling, tracking, risk management, maintenance and reengineering; capability measures such as CMM; process approaches such as PSP, extreme programming, and TSP; ethical and professional issues; support tools; team-oriented project used methods, techniques and practices learned.

CIS6302: Distributed and Internet Systems 3
Prerequisite: CNT 5505 or equivalent. This course covers topics in distributed and Internet systems from among design issues; mobile and wireless systems; resource
allocation; load balancing; security; reliability; file systems; performance evaluation and architectural enhancements to improve performance. Case studies such as the distributed object architectures of CORBA and RMI are used to illustrate topics.

**CIS6516: Managing Software Projects and Personnel**
Prerequisite: CEN 6016 or equivalent. For advanced graduate students. Principles of management as they apply to information technology enterprises. Emphasis on the unique requirements of software projects and the personnel involved in them examined in the context of the current information technology workplace.

**CIS6900: Directed Individual Study**
For advanced graduate students, topic supportive of the student's overall program. May be repeated with permission.

**CIS6910: Project**
Prerequisite: Permission of Director of Graduate Studies for Computer and Information Sciences. This graduate project is for advanced graduate students nearing completion of the degree. It requires completed proposal and approval prior to the semester of intended enrollment.

**CIS6930: Special Topics in Computer and Information Sciences**
For advanced graduate students, topics reflective of current faculty research interests. May be repeated up to 27 credits.

**CIS6935: Seminar**
Topics reflect broader interests than covered in a standard course. Students will be expected to make presentations of material extracted from current trade publications. May be repeated up to 27 credits.

**CIS6970: Thesis**
For advanced graduate students nearing completion of the Masters degree. May be repeated up to 6 credits.

**CNT5505: Computer Networks and Distributed Processing**
Prerequisites: CEN 4510 or COP 3530 or COP 3540. For beginning graduate students. Network architecture and protocols in computer communication networks, network elements and topology, switching and routing, data management and security in a distributed environment. Students will extend course topics via library assignments or other instructor assigned requirements.

**CNT6707: Network Architecture and Client/Server Computing**
Prerequisite: CNT 5505 or equivalent. Topics covered in this course include: the technology and architecture of high-speed WANs and LANs including ATM, ATM-LANE,
FDDI, fast and gigabit Ethernets; design and performance issues in high-speed networks; traffic analysis and queuing; resource allocation and congestion control; QoS parameters; RSVP and differentiated services; network security; wireless networks.

COP5615: Operating Systems
Prerequisites: STA 4321, COP 3601. For beginning graduate students. Process management, memory management, file management, input/output device management, distributed systems issues. Students will extend course topics via library assignments or other instructor-assigned requirements.

COP5625: Construction of Language Translators
Prerequisites: COT 3210 and COP 3601. For beginning graduate students. Grammars, languages, parsing, precedence, runtime storage organization, semantic routines, error recovery, optimization, intermediate code representations, scope, symbol tables, compiler-compilers. Students will extend course topics via library assignments or other instructor-assigned requirements.

COP5716: Data Modeling and Performance
Prerequisites: COT 3210 and COP 3601. This course studies dynamic storage management, compression, data abstraction, data models (hierarchical, network, relational), query languages, concurrency and security, grammatical validation and standards. Schema design methodologies and evaluation including object oriented, semantic, functional entity-relationship data models, CASE tools, and SQL engine design are covered. Students will extend course topics via library assignments or other instructor-assigned requirements.

COP5819: Internet Programming
Prerequisites: COP 3530 or COP 3540. This course presents various approaches to building large enterprise systems to be deployed on the World Wide Web (WWW). Examples include, but are not limited to: classical multitiered, client-server, service-oriented, grid computing, utility computing, software as a service, smart clients, and web services. It also presents current development platforms (e.g. J2EE, .NET), development frameworks (e.g. JSP-based, ASP-based), development environments (e.g. Eclipse), and related technologies (e.g. Tomcat JSP Container, Microsoft IIS Server) used to build and deploy such systems. Finally, it also discusses current trends in connection with relevant quality attributes these systems should exhibit, such as (but not limited to) security, privacy, reliability, mobility, and performance. A comprehensive software development project is used to apply covered concepts.

COP6557: Programming Language Design Paradigms
Prerequisites: COP 5615 and COT 3210 or equivalent. Topics covered in this course include: operating system support features required by different programming paradigms; run time symbol tables and semantics; compiling vs. interpreting; binding and execution time requirements; storage management; subprogram control; implementation of inheritance; strong vs. weak data typing.

COP6611: Advanced Operating Systems
Prerequisite: COP 5615 or equivalent. For advanced graduate students. Advanced topics in operating systems such as network operating systems, distributed operating systems, distributed shared memory, object-based systems, distributed file access.
COP6616: Parallel Computing
Prerequisites: COP 5615 and COT 5405, or equivalent. In this course, topics covered include: parallel models and hardware architectures (shared-memory, message-passing, threads); basic communication operations; concurrency and synchronization techniques; parallel algorithms analysis and design; problem partitioning and mapping; parallel programming paradigms and environments; cluster-based computing; performance and scalability issues; parallel simulations; new trends in parallel computing.

COP6711: Database Engineering and Administration
Prerequisites: COP 4720 and CEN 6016 or equivalent. This course covers the application of software engineering approaches in the strategy, analysis, design, implementation, verification, and validation phases of large scaled database design. Design issues and the user's role are studied. Database administration and management responsibilities are examined.

COP6735: Developments in Database Structures
Prerequisite: COP 5716 or equivalent. This course covers traditional and emerging databases with emphasis on advanced areas in development methodologies, object orientation, connectivity, and query language/optimization. Research projects in selected topics, such as distributed, knowledge base, deductive, multimedia, spatial/temporal, data warehousing, and web databases, will be developed.

COT5405: Algorithms and Complexity
Prerequisites: COT 3210, COP 3530. For beginning graduate students. Analysis of various algorithm design strategies, divide-and-conquer, greedy method, backtracking, branch-and-bound, lower bound theory, NP-hard and NP-complete. Students will extend course topics via library assignments or other instructor assigned requirements.

COT5561: Applied Graph Theory
Prerequisites: COT 3100 and COP 3530 or COP 3540 or equivalent. Topics in graph theory including coloring, domination, and flows will be covered as well as applications of graph theory in computing and modeling real-world phenomena, and graph algorithms. Individual research project will be required.

COT6416: Computational Complexity
Prerequisites: COT 3210, COP 4400 or COT 5405. This is a course in structural complexity theory. The focus is on the models of computation and the structure and relationship among the important classes of computational problems such as P, BPP, NP, co-NP, and PSPACE. Results on the hardness of approximating optimization problems which follow from the PCP Theorem and the theory interactive proofs will be presented.