COMP-700. Independent Study **Credit 3 (3-0)**

This course can be used for study of advanced topics in computer science pertinent to the student's interest under supervision of a faculty member. Prerequisite: Permission of Instructor

COMP-710. Software Specification, Analysis and Design **Credit 3 (3-0)**

This course examines the formalization of software requirements and the analysis of the flow of data through a proposed large software system. Methodologies covered include Structured Analysis (data flow diagramming), hierarchy charts, entity-relationship data diagrams, procedure specifications, and Information Engineering. Additional methodologies addressed include Jackson Structured Diagrams, Harlan Black Boxes, and Object-Oriented Analysis techniques. Prerequisite: Graduate standing.

COMP-711. Software System Design, Implementation, Verification and Validation Credit 3 (3-0)

This course proceeds from the evaluation of a completed system design for completeness, correctness, information engineering, and functionality. Accepted industry and academic standards for such reviews will be used, for example leveling of data flow diagrams, measures of module cohesion, control structures, and function point estimation. As part of the implementation process, verification and validation methodologies will be studied and practiced. An actual system will be implemented by the end of the semester. Prerequisite: COMP-710.

COMP-712. Software Project Management **Credit 3 (3-0)**

This course examines the nature of data processing projects, definitions of purpose, scope, objectives, deliverable dates, and quality standards. Interpersonal interaction and people-oriented management techniques are studied, along with team member measurement and assessment methods. Project management tools such as PERT (Project Evaluation and Review Technique), and CPM (Critical Path Method) are covered. Managerial styles in motivating, innovating, and organizing will be examined, along with techniques for improving these skills. Equipment and software selection and installation guidelines, and the proper use of outside consulting services will be examined. Prerequisite: Graduate standing.

COMP-713. Social Impacts of Software Systems **Credit 3 (3-0)**

This course examines the increasing importance of computer technology in the functionality of our economy, our government, and our industry. Potential impacts upon personal privacy and autonomy are examined in relation to the public policy and social impacts of computer technology. The role and opportunity for historically under-represented technical professionals will be explored. Interdisciplinary readings, written and oral presentations, and in class debates are required. Outside speakers from related disciplines are invited to participate. Prerequisite: Graduate standing.

COMP-714. CASE, Automated Development and Information Engineering Credit 3 (3-0)

Beginning with the concepts of automated development, various models are reviewed in detail, especially Information Engineering, Methodology assessment approaches are covered, especially the Software Engineering Institute Process Maturity model, and a variety of organizational impacts of technology are examined. Computer Aided Software Engineering (CASE) is covered through tutorial laboratory sessions and a problem assignment. Topics include

fundamentals of data analysis, diagramming tools for data modeling process analysis, presentation architecture, communications architecture, data architecture, process architecture, and application construction. Techniques and tools for defining menu structures, screens and screen dialogues, and user interface management systems are studied, as are the general principles of physical design. Prerequisite: Graduate standing.

COMP-716. Object-Oriented Programming and Software Reuse Credit 3 (3-0)

Introduce software reuse principles and reuse driven software development. Reuse techniques will be addressed that include reuse readiness assessment, corporate reuse plan creation and organizing for reuse. Discuss application package selection, selecting reusable components and identifying candidate reusable components. Teach and use the object-oriented programming language Java, emphasize its object-oriented features and how to use Java to develop reusable components, subsystems and frameworks. Prerequisite: Graduate standing.

COMP-717. Software Fault Tolerance Credit 3 (3-0)

The principles, techniques and current practices in the area of fault tolerant computing with an emphasis on system structure and dependability are examined in this course. Major topics include system models, software/hardware interaction, failure and reliability, fault tolerance principles, redundancy, rollback and recovery strategies, and N-version programming. Redundancy in data structures and the validation of fault tolerant software are studied. Prerequisite: Graduate standing.

COMP-718. Object Oriented Software Engineering Credit 3 (3-0)

This course covers the concept of the "object-oriented life cycle", demonstrating a practical methodology for the application of object oriented methods to large projects. The specific problems and solutions for large software systems are discussed. Object Oriented Requirements Analysis (OORA), Object-Oriented Requirements Specification (OORS), Object Oriented Analysis (OOA), Object Oriented Design (OOD), and Object Oriented Domain Analysis (OODA) are covered. Existing and upcoming object oriented Computer Aided Software Engineering (CASE) tools are examined and object oriented database design issues are discussed with analysis of specific systems currently in practice or under development. Prerequisite: Graduate standing.

COMP 722 E-Commerce Credit 3 (3-0)

This course covers the computer science and technology that enable e-commerce and the business concepts needed to understand e-commerce. Topics reviewed include HTML and CSS as well as client-side scripting. Topics introduced include e-commerce features, business models, and marketing concepts. Topics emphasized include the HTTP protocol, server-side scripting, the XML family of specifications, web services, the Semantic Web, and security in an e-commerce context.

COMP-723. Intrusion Detection Credit 3 (3-0)

This course introduces the concepts, techniques, tools, and the state of the art in the area of network intrusion detection systems. Topics to be covered include: network and computer system security fundamentals, network security models and approaches, attack classification and analysis, intrusions detection techniques and tools (vulnerability scanners, network sniffer, system monitoring and logging, etc), firewall, as well as the tools and techniques for intrusion signature analysis, such as TCPdump and Snort, etc. Prerequisite: Graduate standing.

COMP-732. Advanced Software Tools **Credit 3 (3-0)**

The software tools utilized in the high performance and massively parallel computing environments are indispensable to the practicing computer scientist. Message passing, profiling, languages, compilers, porting, system library usage, cache optimization, and in-lining are the topics of this course. Prerequisite: Graduate standing.

COMP-733. Parallel Computing Applications **Credit 3 (3-0)**

Many problems in computing can be solved more efficiently on a parallel computer. The parallel computing paradigm is the main focus of this course. The applicability of Amdahl's law, PRAM models, matrix by vector transforms, matrix by matrix graphics and visualization computations will be discussed. Prerequisite: Graduate standing.

COMP-740. Advanced Artificial Intelligence **Credit 3 (3-0)**

This course is a further study of artificial intelligence principles, with a focus on knowledge-based systems. The course examines planning, belief revision, control, and system evaluation and implementation. Advanced topics include automated theorem proving, learning and robotics, neural nets, and the adequacy of existing theoretical treatments. Prerequisite: COMP-645.

COMP-741. Knowledge Representation and Acquisition **Credit 3 (3-0)**

The representation formalisms used in artificial intelligence are explained, along with representation selection and implementation in common Artificial Intelligence languages and shells. Formalisms include first order logic and its extensions, semantic nets, frames and scripts, and KL-ONE-like languages. Knowledge acquisition is introduced as eliciting knowledge, interpreting elicited data within a conceptual framework, and the formalizing of conceptualizations prior to software implementation. Knowledge acquisition techniques such as protocol analysis, repertory grids, and laddering are examined. Prerequisite: Graduate standing.

COMP-742. Automated Reasoning **Credit 3 (3-0)**

This course studies the computational aspects of logic via propositional and predicate calculi, as well as the theory underlying their automation through logic programming languages. Various forms of resolution and their soundness and completeness are examined along with unification and its properties. Proof procedures and their search characteristics, term rewriting, and techniques such as narrowing are researched as a means of theory resolution. The relationship of formal specification techniques such as cut elimination, efficiency, and implementation issues are addressed. Prerequisite: COMP-645.

COMP-745. Computational Linguistics **Credit 3 (3-0)**

A presentation of computational linguistics theory and practice. Advanced readings that emphasize theories of dialogue and research methodologies are examined. Technical writing for journals and conferences is stressed as a goal of research output. Prerequisite: COMP-645.

COMP-747. Computer Vision Methodologies **Credit 3 (3-0)**

This course researches techniques for image understanding, both low-level and high-level image processing, mathematical morphology, neighborhood operators, labeling and segmentation. Vision methods covered include perspective transformation, motion, the consistent-labeling problem, matching, object models, and knowledge-based vision. Prerequisite: COMP-645.

COMP-749. Intelligent Robots **Credit 3 (3-0)**

This course examines intelligent robot systems as inclusive of knowledge representations, path finders, inference systems of rules and logic, and image understanding and spatial reasoning systems. Problems of navigation, algorithm development, robot programming languages and multiple robot co-operation are explored. Prerequisite: Graduate standing.

COMP-750. Distributed Systems **Credit 3 (3-0)**

This course examines the operating system concepts necessary for the design and effective use of networked computer systems. Such concepts include communication models and standards, remote procedure calls, name resolution, distributed file systems, security, mutual exclusion, and distributed databases. Students are required to construct an advanced implementation of distributed operating system facilities or a simulation of same. Prerequisite: COMP-755.

COMP-753. Performance Modeling and Evaluation **Credit 3 (3-0)**

Common techniques and current results in the performance evaluation of computer systems are studied in this course. Background material in probability theory, queuing theory, simulation, and discrete mathematics is reviewed so that a performance evaluation of resource management algorithms for operating systems and database management systems in parallel and distributed environments may be developed. Prerequisite: COMP-755.

COMP-755. Advanced Operating Systems **Credit 3 (3-0)**

This course centers on operating systems for multi-processing environments: concurrent processes, mutual exclusion, job scheduling, memory, storage hierarchy, file systems, security, and distributed processing. Also discussed are virtual resource management strategies. A design project involving the construction of operating facilities is produced. Prerequisite: Graduate standing.

COMP-767. Computer Network Architecture **Credit 3 (3-0)**

This is a course in the architecture of computer communication networks and the hardware and software required to implement the protocols that define the architecture. Basic communication theory, transmission technology, private and

common carrier facilities, international standards, satellite communications, and local area networks are examined. Methods of performance analysis and communication network modeling are discussed. Prerequisite: Graduate standing.

COMP-770. Computer Organization and Programming for Scientific Computing Credit 3 (3-0)

Computer programming in the High Performance Computing environment is unlike that of the common workstation or desktop computing platform. Programming parallel computers with regard to data transfer (MPI), data storage and process execution are the main focus of this course. The architecture and organization of various parallel computing platforms are examined. Prerequisite: Graduate standing.

COMP-780. Semantics of Programming Languages Credit 3 (3-0)

This course examines the formal treatment of the specification, meaning, and correctness of programs. Required mathematical results are examined, in areas such as universal algebra and category theory. Major course topics include the lambda calculus, type systems for programming languages, polymorphism, algebraic specification, rewrite systems, and semantic domains. The denotational semantics of programming languages, program logics, and program verification are discussed. Prerequisite: Graduate standing.

COMP-785. Advanced Analysis of Algorithms Credit 3 (3-0)

This course discusses the design and analysis of efficient algorithms and algorithmic paradigms. Applications include sorting, searching dynamic structures, graph algorithms, computationally hard problems, and NP completeness. Prerequisite: Graduate standing.

COMP-786. Multiagent Systems Credit 3 (3-0)

This course primarily addresses multiagent systems, emphasizing collaboration and group attributes. Topics include planning for multiagent tasks and distributed planning, distributed problem solving, agent communication languages (involving speech acts), negotiation, ontologies and knowledge sharing, distributed rational decision making (involving techniques from economics), societal theories (from philosophy), and computational organization theory. Formalisms (including modal logics, process algebras, Petri nets, and Statecharts) are presented and applied to the specification and modeling of multiagent systems. Prerequisite: Graduate standing.

COMP-790. Special Topics in Computer Science Credit 3 (3-0)

This course permits research in advanced topics pertinent to the student's program of study. Prerequisite: Permission of advisor.

COMP-793. Masters Supervised Teaching Credit 3 (3-0)

Students will gain teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment. Prerequisite: Graduate standing.

COMP-796. Masters Project **Credit 3 (3-0)**

The student will conduct advanced research of interest to the student and the instructor. A written proposal, which outlines the nature of the project and the deliverables, must be submitted for approval. This course is only available to project option students. Prerequisite: Graduate standing.

COMP-797. Masters Thesis **Credit 3 (3-0)**

Master of science thesis research will be conducted under the supervision of the thesis committee chairperson leading to the completion of the master's thesis. This course is only available to thesis option students. Prerequisite: Permission of advisor.

COMP-999. Continuation of Research **Credit 1 (1-0)**

Continue incomplete thesis or project work.