SOUTHERN UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE

GRADUATE PROGRAM

2017-2020

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The Department of Computer Science

The Department seeks to improve the scientific literacy of all students, by providing a liberal education in the sciences through course offerings to majors and non-majors.

The Department of Computer Science promotes academic excellence through counseling and scholarly activities that encompass courses of study that provide the foundation necessary for graduate work, professional training and advancement, and a successful career as a scientist. Courses of study enable future teachers to provide basic instruction in areas of science and other educational programs. Graduates of the college receive an education that prepares them to apply theoretical and practical solutions to societal problems.

We strive to instill in students an appreciation for science as an area of human experience used in exploring and understanding the universe; research and cooperative work experience for students form an integral part of its educational programs.

History

The Department of Computer Science was established as a distinct instructional unit in the College of Sciences at Southern University in 1968. Over the last 40 plus years over 3,000 degrees, both Bachelors and Masters were awarded. Our students have pursued careers in various businesses and educational enterprises.

Currently our programs serve well over 400 majors. In addition, the Department offers a variety of service courses to over 500 non-majors who seek practical experience in the application of information technology. The Department offers two programs, BS and MS. The undergraduate program offers students four concentrations: Cybersecurity, Information Systems, Data Analytic & Sciences and Mobile Application, all leading to the Bachelor of Science Degree. This program and its concentrations are accredited by the Computing Accreditation Commission of ABET (http://www.abet.org)

The Department has a foundation of quality in education and research instituted by its founders. Our Bachelor of Science degree program has a long history, however; it was established during a time when computer science was just becoming recognized as a major discipline in universities across the country. The Department built on its strong foundation in computer science to add additional programs over the years.

Graduate Program

The objective of the program leading to the Master of Science in Computer Science is designed to foster independent study and research. Graduates of the program may aspire to pursue a doctoral degree, teach computer science, or pursue careers in business, industry, and government.

Admission Requirements

Applicants must meet all Southern University Graduate School entrance requirements. Admission is on a competitive basis with GRE (Graduate Record Examination) scores and undergraduate records. A preferred minimum grade point average of 2.7 on all undergraduate work, or 3.0 on all graduate work completed, based on a 4.0 scale, and recommendations used to determine those students who are accepted. For international students, a minimum score of 77 (123 on computer based test) on the Test of English as a Foreign Language (TOEFL), as evidence of proficiency in English and an Affidavit of Support (U.S. Department of Justice form I-134). If student fail to meet the minimum TOEFL require, students who score between 69-77 will be accepted but must take English course during the first semester.

Assistantships

Limited numbers of assistantships are available on a competitive basis. For more information, contact the Department of Computer Science at (225) 771.2060.

Academic Advisement

Once the student has been admitted into the Department, an advisor will be assigned to the student by the Department's chairperson. The most important thing to remember is that proper advisement is the key to student's success. Hence, the student should do the following.

- ► Schedule an appointment with the advisor in order to develop a progressive study plan
- ► Periodically update records and study plan with your advisor
- ► Seek advisor's approval before adding or dropping a class

Degree/Option Requirements

A. In order to be a candidate for the Master of Science degree program, a student must successfully complete the core requirements and select one of the five areas of emphasis:
    1. Operating Systems and Architecture
    2. Computational Science
    3. Programming Languages/Software Engineering
    4. Digital Data Communications
    5. Data Analytic and Data Mining
B. The master's degree may include a thesis or project option. Students must complete and successfully defend the thesis or the special project. For students who have demonstrated research capability through previous experience, a coursework option is also available.
C. The Department's Graduate Comprehensive Examination is a requirement for non-thesis option students. The comprehensive examination will be compiled from the content of the four core courses. The student who selects the non-thesis option must pass a comprehensive examination. Students may take the comprehensive examination after successfully completing all four core courses or after the two core courses; if the student is enrolled in the other two core courses. The examination is given once during the spring and fall semesters. The student who fails the first attempt must retake the entire examination. There is no limit on the number of retakes.

The following policies apply for the comprehensive exams:

1. There will be 25 multiple-choice questions from each one of the four core courses - making 100 questions in total.
2. Each question will be of equal points/values.
3. Non-thesis students must pass the comprehensive examination.
4. There is no limit on the number of retake.

Credit Transfer Policy

1. Graduate credits may be transferred only from a regionally accredited university or college (a recognized university, if international) and in a course where a student has earned a grade of "B" or better. Transfer credits must not be more than seven years old at the time of graduation (date on which degree is awarded).

2. Graduate credits may be transferred only when they can be reconciled with the area of emphasis or elective courses of our program. No credit replacement for core courses.
3. A maximum of 3 semester hours of courses whose age will not exceed seven years at the time of graduation may be transferred.
4. 4.Only graduate level courses (500 level and above) may be transferred.
5. 5.Credits that were previously used toward a degree cannot be applied toward another degree.
6. A transfer of credit application form, with approvals by a departmental advisor and chairperson, official transcripts, and a plan of study must be submitted to the Graduate School for approval not later than the end of the first semester of enrollment in a graduate degree program.

Thesis or Project Option

A student may choose to write the Master's thesis or project report. The student who selects the non-thesis option must pass a comprehensive examination of the major field of study. A minimum of six hours CMPS 598/599 Special Project or CMPS 598/600 thesis must be used to satisfy the M. S. requirements.

Thesis Option (24 hours' coursework plus 6 hours Thesis research)

Core Courses	12 credits
Area of Emphasis	9 credits
Research Techniques	3 credits
Supervised Research	3 credits
Thesis	3 credits
Total	30 credits

Special Project Option (30 hours course work plus 6 hours' project design)

Core Courses	12 credits
Area of Emphasis	12 credits
Electives	3 credits
Research Techniques	3 credits
Supervised Research	3 credits
Special Project	3 credits
Total	36 credits

Electives may be selected from other graduate computer science courses or graduate courses in other areas with the approval of the student's graduate advisor.

CORE COURSES

CMPS 500	Operating Systems
CMPS 501	Programming Languages
CMPS 502	Computer Organization
CMPS 512	Theory of Computing

AREAS OF EMPHASIS/ COURSE SELECTIONS

OPERATING SYSTEMS AND ARCHITECTURE

CMPS 511	Design & Analysis of Algorithms
CMPS 514	Compiler Theory
CMPS 532	Distributed Processing
CMPS 535	Neural Networks
CMPS 537	Autonomous Robotics
CMPS 580	Artificial Intelligence
CMPS 587	Object Oriented Design Pattern
CMPS 592	Advanced Topics in Computer Science

COMPUTATIONAL SCIENCE

CMPS 507	Scientific Computing
CMPS 511	Design & Analysis of Algorithms
CMPS 520	Database Management Systems
CMPS 555	Introductions to Data Mining
CMPS 558	Modeling and Simulation
CMPS 559	Introduction to Computational Science and Application
CMPS 560	Big Data
CMPS 592	Advanced Topics in Computer Science

PROGRAMMING LANGUAGES/ SOFTWARE ENGINEERING

CMPS 511	Design & Analysis of Algorithms
CMPS 525	Software Engineering: Development
CMPS 526	Software Engineering: Control
CMPS 527	Software Engineering: Management
CMPS 555	Introductions to Data Mining
CMPS 587	Object Oriented Design Pattern
CMPS 592	Advanced Topics in Computer Science

DATA ANALYTIC AND DATA MINING

CMPS 511	Design & Analysis of Algorithms
CMPS 520	Database Management Systems
CMPS 525	Software Engineering: Development
CMPS 535	Neural Networks
CMPS 555	Introductions to Data Mining
CMPS 560	Big Data
CMPS 587	Object Oriented Design Pattern
CMPS 592	Advanced Topics in Computer Science

RESEARCH COURSES

CMPS 574	Research Techniques
CMPS 598	Supervised Research
CMPS 599	Special Project
CMPS 600	Thesis

DIGITAL DATA COMMUNICATIONS

CMPS 507	Scientific Computing
CMPS 516	Graph Theory and Networks
CMPS 532	Distributed Processing
CMPS 533	Telecommunications
CMPS 534	Digital Data Networks
CMPS 535	Neural Networks
CMPS 536	Information and Coding Theory
CMPS 592	Advanced Topics in Computer Science

The Department of Computer Science has ten (10) graduate faculty members with various interests in the areas of Telecommunications, Networking, Sensor Networks, Neural Networks, Software Engineering, Object-Oriented Programming, Multimedia Design, Web Programming, Game Programming, Computer Ethics, Robotics, Machine Learning, and Artificial Intelligence.

Dr. Ebrahim Khosravi, **Professor and Chair**, Research Interest: Network, Electronics, Theoretical Computer Science, and Robotics

Dr. Shuju Bai, **Professor**, Research Interest: Bioinformatics, Image Processing, Indexing for XML, Data Mining, and Database Management

Dr. Yaser Banadaki, **Assistant Professor**, Research Interest: Internet of Things, Big Data Science, Computer Security, Computational Science and Parallel Systems, Nano electronic and Information Systems, Artificial Intelligence and Neural Networks, Embedded and Real-Time Systems, Smart Health Care Technology.

Dr. Nigel Gwee, **Professor and Faculty Senate President**, Research Interest: Machine Learning, Algorithmic Complexity, and Ubiquitous Computing

Dr. Osman Kandara, **Associate Professor**, Research Interest: Software Engineering, Data Mining, Robotics, Internet Security, and Algorithmic Development

Dr. Mathieu Kourouma, **Associate Professor**, Research Interest: Wireless Communications, Computer Architecture and Networking

Dr. Md Abdus Salam, **Professor and Graduate Coordinator**, Research Interest: Wireless Sensor Networks, Internet of Things, Wireless Communications, Coding Theory, and Networking.

Dr. Oleg Starovoytov, **Assistant Professor**, Research Interest: Quantum Computing, Molecular Dynamic Simulation, and Big data analysis.

Dr. Sudhir Trivedi, **Professor**, Research Interest: Neural Networks and Distributed Processing

Dr. Shizhong Yang, **Assistant Professor**, Research Interest: High Performance Computation Algorithm, Software Design, 3D Visualization of Scientific Data, Digital Signaling Processing, Data Mining Application in Material Science and Bioinformatics.

In addition to fulfilling the department's educational mission, faculty engage in research and professional development that allows them to remain current in their fields to provide technological leadership to the university, community and the region. The department makes a conscious effort to evaluate and incorporate new areas and technologies into its programs.

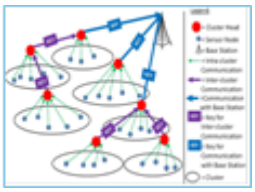
LONI

The Department is currently supporting the projects of the Louisiana Optical Network Initiative, or LONI, in Computational Materials Science and Computational Biomedical research. Our projects are funded by NASA, DOE, NSF, NIH, and Louisiana BoR. We have robotics, computational biomedical, and high performance computing (HPC) labs to facilitate our students and faculty to perform the state-of-the-art computational science study.

ROBOTICS

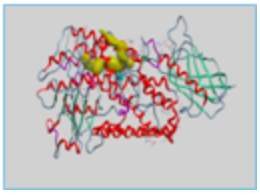
The robotics program is partially funded by Raytheon at the present time. Our robotics program involves one faculty members along with many graduate and undergraduate students. Students engage in research, programming, testing and working hand-on with other Robotics Clubs. The Robotics laboratory is equipped with standard robots and robotic supporting facilities necessary to provide robotics training. The current research is to make an autonomous Humanoid Robot with face and voice recognition abilities.

SENSOR NETWORK



Research is concentrated on the trustworthiness and reliably in distributed sensor networks using elliptic curve cryptography. We are focusing on the development of optimization algorithm for number of cluster in a sensor networks and trust model for distributed systems.

BIOINFORMATICS



Our research focuses on modeling interactions between ligand and protein in lipoxygenase family using computational approaches. We also develop and implement algorithms to improve molecular dynamics simulation. The long term goal of our research is to develop drugs for target proteins, which is important in biomedical research.

SOFTWARE ENGINEERING

Software Engineering lies at the heart of computer science. It integrates the diverse disciplines of theoretical computer science, problem-solving, and programming into a unique and highly rewarding branch of engineering. The department's program equips students with the ability to build realistic large-scale software systems, using the most advanced techniques and tools currently available.

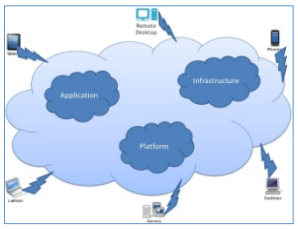
HIGH PERFORMANCE COMPUTING (HPC)

In our Computational Material Science research, we are using state-of-the-art software packages along with our own molecular dynamics codes to design novel materials for high temperature, corrosive and oxidation environment applications, mainly modern turbines and engines. The screened candidates will be validated by experiments in Southern, LSU, and national labs. Recent studies include Cr-based alloys,

Nb-based alloys, oxide dispersion-strengthened alloys (ODS), and high entropy alloys.

In our high performance computing (HPC) research, we are developing new molecular dynamics codes to simulate and design the real materials both efficiently and accurately. Students will have great opportunities to use HPC facilities in LONI to perform simulation.

CLOUD COMPUTING



The Department currently conducts research in Cloud computing. Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). Research includes evaluation of various hypervisors such and KVM and VMWare. We are also implementing virtual machines and creating a Virtual Computing Lab using Apache VCL. The Cloud Computing program was funded by generous grant from IBM.

GAME PROGRAMMING

The Gaming program is a new area of research supported by the Computer Science Department. The area of gaming has grown rapidly over the past few years. We focus on both game playing strategies and game development. Our gaming program is currently headed by on faculty, involves several students and also includes a Gaming Club. We currently offer a Gaming Class and will also offer a concentration in gaming.

The Computer Science Department has excellent computing facilities. Located within the department are ten laboratories associated with instruction and research. In addition, these major labs provide computer science major and faculty access to the Internet and the World Wide Web.

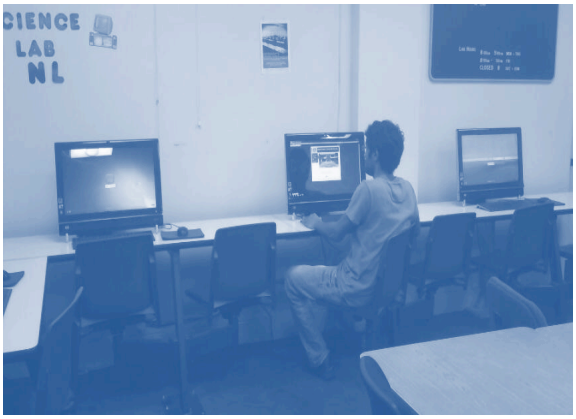
Computer Literacy Laboratory

There are twenty-nine (29) HP TouchSmart all-in-one computers with 4 GB of RAM in this laboratory. The computers provide enhanced multi-application performance. All computers are networked and have internet access. One computer is for instructor which is connected to projector.

Microsoft Windows 7 professional is the operating system with Microsoft Office 2010 as the main packages.

This laboratory is used for courses CMPS 105 (Computer Literacy) and CMPS 290 (Microcomputer Applications in Business). The seating capacity for this laboratory is 30. These courses provide knowledge of the capabilities, limitations and implications of computer technology as well as an overview of the historical development of microcomputers in business. The focus is on application and use of operating system commands, word processing, spreadsheets, database managers, graphics, desktop publishing and presentation managers for business.

Architecture and Simulations Laboratory



This laboratory contains nine (9) HP TouchSmart all-in-one computers with 4GB of RAM and one IBM Laser Printer

Microsoft Windows 7 professional is the operating system. There is some software available in this laboratory such as Microsoft office 2010(Word, Excel, Access and Power Point), Dev C++, NetBeans IDE, WinSCP and putty (to access Linux/Unix system).

This laboratory is opened for all students (both graduate and undergraduate) to do some research and their class work

Solaris Laboratory

This laboratory consists of new twenty-six (26) Sun Ray clients which are ideal for displaying server-hosted virtual desktops. The desktops in this laboratory are networked and have internet access by way of two (2) Dell PowerConnect 2024 switches.

Graduate and undergraduate classes are held in this laboratory. Students write programs in C, C++, JAVA, and FORTRAN. This laboratory is used for instructional and programming purposes

Computer Programming Laboratory

This laboratory contains twenty-seven (27) HP TouchSmart all-in-one computers with 4GB of RAM. One PC is an instructional computer connected to projector.

Microsoft Windows 7 professional is the operating system. There is some software available in this laboratory such as Microsoft office 2010(Word, Excel, Access and Power Point), Oracle 11g (for database class), Dev C++, NetBeans IDE, WinSCP and putty (to access Linux/Unix system).

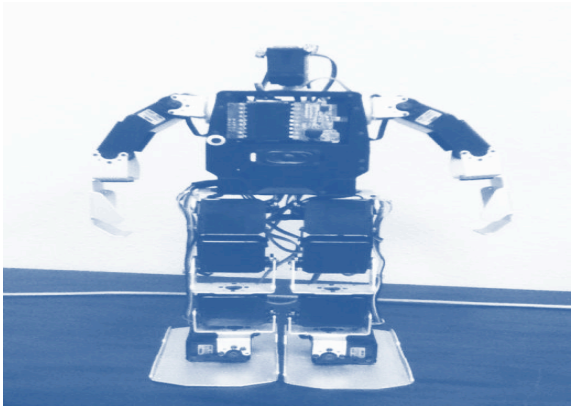
This laboratory will be used for instruction and student use associated with the Software Engineering Option (planned). Both graduate and

undergraduate classes will be held in this laboratory.

Server Network Monitoring Laboratory

This server room consists of one Dell PowerEdge 2400 Server which is a domain controller (Windows 2003), two (2) Sun Ultra 10 Servers (Solaris 9), one (1) for primary DNS Server, the other one is for the secondary DNS server. There is one new Sun Fire Server (Solaris 10) serves all the Sun Ray Clients in the lab 146. There are two (2) Dell Precision 330 Computers which are the departmental firewall. There is one Dell Optiplex GX520 as a Mail Server. There is one Dell PowerEdge 1850 Server (Windows 2003) that is used as a web server. The systems in the laboratory are networked and have internet access by way of two (2) 24 port Nortel 450-24T switches, two (2) Dell PowerConnect 2024 switches, two (2) Linksys SRW224G4 switches and one (1) 3COM 16 port 10/100 hub in this laboratory. This laboratory is used for network monitoring and network maintenance purposes. There are new server and SAN Storage used for faculty research (cron and biomed-storage). Also there is the virtual system that consists of two hosts, two giga-switches and one array storage that will be used for virtual machine servers.

Robotics Lab



It is partially funded by Raytheon and at the present time involves one faculty and several undergraduate students do the research, programming, testing, and works hands on with other Robotics Club students. The Robotics laboratory is equipped with standard robots and robotics supporting facilities necessary to provide robotics training. This laboratory has two QuadCrawler (4-legged) robots (Figure 1), one HexCrawler (6-legged) robot (figure 2) and Humanoid Robot (Human Eye) (figure 3). It is also equipped with a camera, sensors, Laptop, Tablet Pc, personal computers and some instruments.

The main object of this research is to make an autonomous robot which should • be tall enough to reach and perform human activities • be autonomous which means, it should be able to localize itself within a given environment and move autonomously on it, and all the computation and control must be performed onboard the robot. • be able to interact with humans through voice commands • be able to remember the person whom it met earlier using face recognition technology • be able to climb stairs and pull itself up when fallen down • be simple to control and light weighted.

Supercomputing Facilities

The following facilities are available at SU CMPS High Performance Computing (HPC) Lab for faculty and their students to use for the modeling test and mediate size job tests:

1) In the HPC Lab, there are three fast workstations for the modeling and preliminary code testing and a 32 TB JetStor 716F fiber connected storage for large biomedical data processing and saving. There are one HP9400 workstation with 4CPU and 8GB memory, one fast Windows XP workstation with 4 CPU and 64GB memory for fast visual processing and large-scale data communication. One extra SUN X4240 workstation with 8GB (updated to 32 GB) memory can perform fast optical network communications with bandwidth larger than 10GB. The Lab has purchased VASP, MedeA, CHARMM, AMBER, Wien2K, and some data processing packages for modeling and code testing. A HP Proliant 490c G7 blade server with 96 core and 10 GB fiber connection and a 40GB Dell Infiniband connected cluster with 32 nodes and 12 cores in each node are purchasing for high speed network, biomedical, and material modeling and HPC simulation.

2) Supercomputers: SU CMPS faculties are actively involved in using LONI supercomputers to perform HPC simulation to solve biomedical and materials front-end problems. Specifically, they are using Dell Linux clusters which have 128 nodes with 4 Intel Xeons cores, 10 GB infiniband switch, 1 GB Ethernet connection, with total 4.92 TF capabilities. The most powerful supercomputer, Queen Bee, is the core cluster of LONI (SU is one of the LONI six major research universities) and one of the Top 500 supercomputers in the world with 50.7 teraflops of capability. Queen Bee (queenbee.loni.org), has 668 nodes with 8 Intel Xeons cores @2.33GHz and 8 GB RAM 36 GB hard drive housed at the state's Information Systems Building (ISB) at downtown Baton Rouge. It has 10 GB infiniband switch, 1 GB Ethernet connection, and a 192 TB DDN Lustre storage. These computers are supported by a whole array of peripheral hardware and software including Ethernet connections and all major telecommunication optical networks. With this equipment, we are able to perform large scale calculations that require both large memory and CPU time.

Bio-Informatics Laboratory

There is one server (Dell PowerEdge T410) and four Workstations (3 Dell Vostro 220 and 1 MacPro) in this lab.

The current research focuses on modeling interactions between ligands and proteins, molecular dynamics simulation of enzymes, and algorithm development and improvement for molecular dynamics.

Student: _____ Advisor: _____ Date Entered Program: _____

Admission Status: Regular _____ Conditional _____ Provisional _____

I. Prerequisite Courses Needed

CMPS 190 ___	CMPS 191 ___	CMPS 200 ___	CMPS 201 ___
CMPS 300 ___	CMPS 302 ___	CMPS 334 ___	CMPS 402 ___

Course Number	Courses Title	Semester Completed	Grade
II. Core Courses			
CMPS 500	Operating Systems		
CMPS 501	Programming Languages		
CMPS 502	Computer Organization		
CMPS 512	Theory of Computing		
III. Research			
CMPS 574	Research Techniques		
CMPS 598	Supervised Research		
IV. Area of Emphasis (Need 9 credit hours for thesis and 12 credit hours for project)			
A1. Operating Systems/Architecture – 511, 514, 532, 535, 537, 580, 587, 592			
A2. Computational Science – 507, 511, 520, 555, 558, 559, 560, 592			
A3. Programming Languages/ Software Engineering – 511, 525, 526, 527, 555, 587, 592			
A4. Digital Data Communications – 507, 516, 532, 533, 534, 535, 536, 592			
A5. Data Analytic and Data Mining – 511, 520, 525, 535, 555, 560, 587, 592			
1.			
2.			
3.			
4.			
V. Elective (Need 3 credit hours for project)			
1.			
2.			
VI. Thesis/Project (Prerequisite CMPS 574 and 598)			
CMPS 599	Special Project		
CMPS 600	Thesis		
VII. Comprehensive			
CMPS 610	Graduate Comprehensive Exam		

Student's Signature: _____ Advisor's Signature: _____

Graduate Coordinator: _____Department Chair's Signature: _____

CMPS 500. OPERATING SYSTEMS (Credit, 3 hours). Study of resource management for multiprogramming and time-sharing operating systems, supervisors, scheduling I/O control systems, and interrupt handling will be discussed. Prerequisite: Consent of instructor.

CMPS 501. PROGRAMMING LANGUAGES (Credit, 3 hours**).** Study of various programming languages from conceptual standpoint; topics will include formal language definition, data storage techniques, grammars. Both numeric and string processing languages will be covered. Prerequisite: Consent of instructor.

CMPS 502. COMPUTER ORGANIZATION (Credit, 3 hours). Study of the organization of various modern digital computers including both hardware and software requirements; topics in Boolean algebra, switching circuit design, and total system design will be included. Prerequisite: Knowledge of Discrete Structures and Computer Organization or Computer Architecture.

CMPS 507. SCIENTIFIC COMPUTING (Credit, 3 hours). This course is designed to explore the effectiveness of various advanced techniques and algorithms for the solution of mathematical problems in science and engineering involving the computer. Topics covered will be computational algorithms, error analysis, roots of equations, approximation theory, interpolation and numerical differentiation, numerical integration, solution of system of linear equation, spline functions, numerical solution of ordinary and partial differential equations, method of least squares and smoothing of data, boundary value problems, partial differential equations, minimization of multivariate functions.

CMPS 511. DESIGN AND ANALYSIS OF ALGORITHMS (Credit, 3 hours). This course will cover the design, implementation and analysis of advanced computer algorithms, sets and graphs, sorting, searching, graph theoretic algorithms, matrix multiplication, dynamic programming, NP hard and NP complete problems. Prerequisite: Basic understanding of programming, data structure and discrete structure concepts or consent of the instructor.

CMPS 512. THEORY OF COMPUTING (Credit, 3 hours). The course covers theoretical topics including Turing Machines, algorithmic languages and recursive functions. Coding schemes are used for universal machines and programs, and to show that some problems, including the Halting problem, are unsolvable. Polynomial and exponential time algorithms are discussed. Prerequisite: Knowledge of Discrete Structures.

CMPS 514. COMPILER THEORY (Credit, 3 hours). Time-sharing, real time and virtual systems, review of Backus Normal Form language descriptions and basic parsing concepts, Polish and matrix notation as intermediate forms, and target code representation: topics to be covered include a study of techniques for semantic and syntactic analysis, and allocation of storage areas. Prerequisite: CMPS 500 and CMPS 501.

CMPS 516. GRAPH THEORY AND NETWORKS (Credit, 3 hours). This course will develop basic results about graphs, as well as efficient algorithms associated with the solution of many important problems involving graphs in communication systems. Topics to be studied include spanning trees, algorithms, network immunity, heuristic network design algorithms, routing, Warshall's algorithm flows in networks (Ford-Fulkerson Algorithm), capacity

assignment in centralized and distributed networks, matrices associated with a graph, planar and non-planar graphs. Prerequisite: Consent of instructor.

CMPS 520. DATABASE MANAGEMENT SYSTEMS (Credit, 3 hours). This course will discuss data modeling, SQL, database application development, indexing, query optimization, transaction management and database design. Concepts of parallel databases, data warehousing and data mining will be covered. Prerequisite: CMPS 420.

CMPS 525. SOFTWARE ENGINEERING: DEVELOPMENT (Credit, 3 hours.) Introduces the concept of software life-cycle, looks at a number of life-cycle models, then considers in depth the requirements analysis and design phases. Topics covered include systems engineering, Structured Analysis, Warnier-Orr Methodology, Jackson Methodology, object-oriented design, real-time design, and implementation. Prerequisite: Consent of instructor.

CMPS 526. SOFTWARE ENGINEERING: CONTROL (Credit, 3 hours). Non-trivial software systems must be developed using formal methods of control to ensure a correct and quality product. Topics covered include quality assurance, software testing, independent validation and verification, and configuration management. Prerequisite: CMPS 525.

CMPS 527. SOFTWARE ENGINEERING: MANAGE MENT (Credit, 3 hours). Good management is vital to the development of all non-trivial software systems. This course covers the management aspect of planning, organizing, staffing, directing and controlling a software development project. Prerequisite: CMPS 525.

CMPS 532. DISTRIBUTED PROCESSING (Credit, 3 hours). Distribution of data, computation and control in distributed processing systems will be discussed. This course will cover study of a distributed programming language such as ADA. Selected topics include networking, inter-networking, data communication principles, inter-process communication in UNIX, distributed coordination, distributed databases, distributed deadlock detection, recovery, fault tolerance and security issues. Prerequisite: CMPS 500 or permission of the instructor.

CMPS 533. TELECOMMUNICATIONS (Credit, 3 hours). Basic concepts in telecommunications are covered with emphasis on the types of communication links, data transmission, noise and distortion, data errors, and message switching. Selected topics in data communication will be surveyed. Prerequisite: CMPS 500.

CMPS 534. DIGITAL DATA NETWORKS (Credit, 3 hours). An in-depth presentation of the technology and architecture of local, metropolitan and wide area networks. Covers OSI model and related protocols, FDDI, Frame Relay/SMDS/ATM Switching, SONET, and the newer technologies including Broadband ISDN. Prerequisite: CMPS 500.

CMPS 535. NEURAL NETWORKS (Credit, 3 hours). This course will consider design, architecture and implementation of neural networks. Neural networks are becoming increasingly versatile due to their ability to solve difficult nonlinear problems that are not solvable using traditional methods. Inherently parallel design and ability to interact with the environment make neural networks ideal for large applications. Topics include neural networks as emerging technology, perceptions, associative memory networks, radial-basis

networks, spline networks, recurrent networks, neural learning, gradient descent method and back-propagation. Issues related to neuro-computing hardware and neuro-VLSI implementation will be discussed. Neural networks will be examined as problem solving tools as compared with the fuzzy systems and expert systems. Prerequisite: Consent of instructor.

CMPS 536. INFORMATION AND CODING THEORY (Credit, 3 hours). This course is a study of the underlying concepts in digital communications systems. Topics covered are representation of signals and systems, limits in information theory, complete random processes, time-frequency analysis, error-control coding, group codes, burst-error-detecting codes, convolution coding and the Viterbi algorithm, trellis coding, turbo codes, sequential and majority logic decoding, automatic repeat-request strategies, advanced systems. Prerequisite: Consent of instructor.

CMPS 537. AUTONOMOUS ROBOTICS (Credit, 3 hours). Practice in designing robotic systems that, with no human aid, sense and act upon complex environments. Topics include behaviors, deciding what to do next, perception via programmed concepts and via neural nets, social behavior, language emerging from shared concepts and an architecture of nodes.

CMPS 555. IINTRODUCTION TO DATA MINING (Credit, 3 hours). The course will cover an introduction the fundamental concepts of data mining, key data mining techniques such as association rules, neural networks, genetic algorithms, and statistical based mining techniques, efficient high performance mining algorithms, and exposure to applications of data mining in various areas.

CMPS 558. MODELING AND SIMULATION (Credit, 3 hours). Covers the use of computer simulation as a tool to predict system behavior. Topics include statistical models, biomedical system models, computer-based simulation, simulation languages, simulation packages, data analysis, data visualization, and result interpretation. Applications are drawn from diverse areas of science and engineering. Delivery of knowledge incudes textbook, lecture notes, labs, lab assignments and projects. Prerequisite: CMPS500 (with grade C or above)

CMPS 559. INTRODUCTION TO COMPUTATIONAL SCIENCE AND APPLICATION (Credit, 3 hours). Covers the introduction to Distributed Computing, High Performance Computing, and Cloud Computing, which are the broad range of systems. It is a graduate level course that describes computer architectures, network architectures, and scalable and parallel computational algorithms. The focus of this course will be given to the methods that allow reducing computational time implementing Massage Passing Interface and Open Multi-Processing for multicore and many processor machines. There are two major problems that can be solved: a) problem size and b) system size implementing MPI and Open MP. These methods will be discussed and applied to solve practical problems. The examples of the practical problems are sorting, tree searching, linear algebra, numerical integration and other.

CMPS 560. BIG DATA (Credit, 3 hours). This course covers the knowledge of Big Data science. It serves as a graduate level course for graduate students. The focus will be Big Data storage, processing, analysis, visualization, and applications. State-of-art computational frameworks for Big Data will be introduced to

students. Students will learn the essentials of Big Data management, processing, and system reliability. Delivery of knowledge incudes textbook, lectures, labs, lab assignments, programming projects, and research projects. Prerequisite: CMPS500

CMPS 574. RESEARCH TECHNIQUES (Credit, 3 hours). Students will learn how to conduct literature reviews of articles, journals, white papers using Internet, computerized databases and library resources. Students will learn to develop research questions, hypotheses, research topics, research designs and write research papers in standard format.

CMPS 580. ARTIFICIAL INTELLIGENCE (Credit, 3 hours). Review of attempts to initiate human and animal intelligence and of commercial spin-offs there from. Topics come from such diverse areas as machine perception, game-playing, autonomous robotics and knowledge engineering.

CMPS 583, CMPS 586. INDEPENDENT RESEARCH (583, Credit, 3 hours); (586, Credit, 6 hours.) A three or six-hour course in which the graduate student conducts research on a project with a research advisor or works in industry with supervisors acting as research advisor. Prerequisite: Consent of Advisor. (Not for degree credit).

CMPS 587. OBJECT ORIENTED DESIGN PATTERN (Credit, 3 hours). The concepts behind the patterns approach will be studied, followed by a detailed examination of a selection of the various patterns. Gamma et al. have categorized these patterns under Creational, Structural, and Behavioral. In this introductory course to design patterns, the following patterns will be studied and applied: Creational Patterns: Abstract Factory, Builder, Factory Method, and Singleton; Structural Patterns: Adapter, Composite, Decorator, and Proxy; Behavioral Patterns: Iterator, State, Strategy, and Template Method. Projects consist of software problems whose design and maintenance call for the application of these patterns.

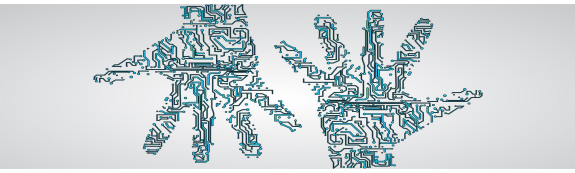
CMPS 592. ADVANCED TOPICS IN COMPUTER SCIENCE (Credit, 3 hours). Current topics in computer science research. Prerequisites: CMPS 525 and/or consent of instructor.

CMPS 598. SUPERVISED RESEARCH (Credit, 3-6 hours). Student selects a chair and research advisors to serve on committee for thesis or special project. Student presents research initiative to the committee for approval prior to midterm. Weekly meetings with chair and monthly meetings with full committee are required. A final grade other than "I" (Incomplete) will be given. Prerequisite: CMPS 574.

CMPS 599. SPECIAL PROJECT (Credit, 3-15 hours). Continuation of research on Special Project. Satisfactory oral defense of topic is required for graduation. (Prerequisite: CMPS 598).

CMPS 600. THESIS (Credit, 3 hours.) Continuation of research on Thesis. Satisfactory oral defense of topic is required for graduation. (Prerequisite: CMPS 598.)

CMPS 610. GRADUATE COMPREHENSIVE. (Credit, 0 hrs. with grade of P/F). Prerequisite: Student must have completed all Computer Science core courses.



Information for Courses CMPS 598, 599, 600:

Unless otherwise noted, the following are the responsibilities of the students:

1. Successfully complete CMPS 574 (Research Techniques)
2. Choose a topic
3. Attend at least two topic approval sessions and two defenses and get signatures from the chair
4. Enroll in CMPS 598 (Supervised Research)
5. Request a graduate faculty advisor and at least two graduate faculty members from the Department of Computer Science to serve on their committee
6. Access forms via Department of Computer Science website to obtain committee members' acceptance to serve on research committee
7. Prepare document for approval by the chair and committee
8. Work closely with chair and committee, prepare proposal, plan document.
9. Schedule a date for topic approval by departments graduate faculty and successfully defend topic

After the proposed topic in CMPS 598 is approved the following steps must be accomplished:

- ☐ Enroll in CMPS 600 for Thesis or CMPS 599 for Special Project
- ☐ Conduct study and report to chair each week on progress. This includes the writing of the document as the study proceeds (Refer to note 1)
- ☐ With approval of the chair and committee, schedule research defense according to published deadlines
- ☐ Defend research
- ☐ Make required corrections
- ☐ Submit to chair and committee for final approval
- ☐ Pay for binding and submit final document to library (Special Project only)
- ☐ Pay for binding and submit final document to Library and Graduate School (Thesis Only)

Note 1: Students should be aware that unless they make a concentrated effort to initiate their study during the time they are enrolled in CMPS 600, it will probably take them more than two semesters to complete the study.

Note 2: CMPS 583 and CMPS 586 are not for degree credit.

Components of a Supervised Research (CMPS 598) Document

1. INTRODUCTION
    - 1.1. Background
    - 1.2. Significance
    - 1.3. Statement of Problem
    - 1.4. Hypothesis /Null Hypothesis (Thesis)
    - 1.5. Research Question
    - 1.6. Objectives
    - 1.7. Delimitations
2. REVIEW OF RELATED LITERATURE
3. METHODOLOGY
    - 3.1. Design
    - 3.2. Resources
    - 3.3. Timeline

REFERENCES

APPENDIX – DEFINITION OF TERMS

Components of a Special Project (CMPS 599) Document

1. INTRODUCTION
    - 1.1. Background
    - 1.2. Significance
    - 1.3. Statement of Problem
    - 1.4. Research Questions
    - 1.5. Objectives
    - 1.6. Delimitations

2. REVIEW OF RELATED LITERATURE
3. METHODOLOGY
    3.1. Design
    3.2. Implementation
    3.3. Resources
4. CONCLUSION
    4.1. Research Outcomes
    4.2. Summary/ Conclusion
    4.3. Future Work
REFERENCES
APPENDIX– DEFINITION OF TERMS

Components of a Thesis (CMPS 600) Document

1. INTRODUCTION
    1.1. Background
    1.2. Significance
    1.3. Statement of Problem
    1.4. Hypothesis / Null Hypothesis
    1.5. Research Questions
    1.6. Objectives
    1.7. Delimitations
2. REVIEW OF RELATED LITERATURE
3. METHODOLOGY
    3.1. Design
    3.2. Implementation
    3.3. Resources
4. DATA ANALYSIS
5. CONCLUSION
    5.1. Research Outcomes
    5.2. Summary/ Conclusion
    5.3. Future Work
REFERENCES
APPENDIX– DEFINITION OF TERMS

Note: Pick up copy of thesis guidelines from office of Graduate Studies

Preparation for Graduation

By the completion of the semester immediately preceding the final semester of study, students must apply for graduation within the guidelines established by the Graduate School.

It is the student's responsibility to ensure that all requirements have been met and that every deadline is observed.

The Graduate School, college, or department publishes all deadlines in the University's Calendar. Students should obtain copies of Thesis Guidelines from the Graduate School and review them carefully prior to putting the thesis into its final form.

The following is a summary of critical items required for graduation:

Candidates must complete and file an Application for Graduation with the Graduate School during the semester preceding the semester in which graduation is anticipated, within the deadline established by the Graduate School.

The Candidate's graduation application must be signed by the advisor and chairperson of the department and must be accompanied by a completed and approved "Plan of Study."

Candidates must inscribe his or her name on the application as he or she wants it to appear on the degree and in the commencement program.

Candidates whose applications are approved must officially "check out" of the University, i.e., satisfy all financial responsibilities and obtain clearance from the appropriate offices/divisions on campus.

Candidates must pay a non-refundable graduation fee.

Candidates who apply but fail to graduate must reapply and reregister for graduation during a subsequent semester or summer, after correcting any and all deficiencies.

Immediately upon entrance into the Computer Science Graduate Program, the student must contact his/her academic advisor.

- A plan of study must be completed and approved by the end of the completion of the student's first semester in the program.
- The Chairman of the Department of Computer Science, along with the student's academic advisor is responsible for ensuring that the student's curriculum is of the highest scholastic excellence. However, the student is responsible for his/her own progress through the program. The student's academic advisor is assigned by the Department.
- By the end of the second semester of enrollment, each student selects a committee of at least three Computer Science graduate faculty members. The thesis or project topic must be specified in writing by the student and approved by the committee chair, committee members and the Chair of the Department of Computer Science. The student's thesis/project chair will supervise the thesis or project's progress. The student may also request additional members to serve on his/her committee as research advisors. These individuals must be members of the graduate faculty from a science-related area
- CMPS 574, Research Techniques, can be taken when two (2) cores and two (2) areas of emphasis courses have been completed.
- Student must attend at least two topic approval sessions and two defenses.
- The document for CMPS 598, Supervised Research, must need to be submitted to all committee members at least one week prior to the defense date.
- Thesis defense must be publicly announced.
- Thesis and project documents must be given to all committee members two weeks prior to the defense; otherwise the defense will not be scheduled. NO EXCEPTIONS.
- Student must submit a copy of the document for CMPS 598.
- Student must submit soft copy of documents and presentations for CMPS 599 and CMPS 600.
- Student must submit one copy of project document and three copies of thesis document to the Department of Computer Science along with receipt for binding (bound copies must be on 100% cotton paper).
- The comprehensive examination will be compiled from the contents of the core courses. The student who selects the non-thesis option must pass a comprehensive examination on the major field of study. Students may take the comprehensive examination after successfully completing all four core courses or after three core courses if the student is enrolled in the fourth. The examination is given once during the spring and fall semesters. The student who fails the first at-tempt must retake the entire examination during the following semester.

For additional information, please feel free to contact:

Graduate Coordinator
Department of Computer Science
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Fax: 225.771.4223
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