

# 2008-2010 GRADUATE CATALOG ONLINE

## Computer and Information Sciences (Ph.D., M.S.)

Degree Offered: Ph.D., M.S.  
Director: *Dr. John K. Johnstone*  
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### **Faculty**

**Purushotham V. Bangalore**, Assistant Professor (Computer and Information Sciences); Grid Computing, High Performance Computing

**Barrett R. Bryant**, Professor and Associate Chair (Computer and Information Sciences); Programming Languages, Compiler Design, Object-Oriented Technology

**Jeffrey G. Gray**, Associate Professor (Computer and Information Sciences); Software Engineering, Model-Driven Engineering, Aspect-Oriented Software Development, Generative Programming

**Robert M. Hyatt**, Associate Professor (Computer and Information Sciences); Computer Chess, Parallel Architectures and Software

**John K. Johnstone**, Associate Professor and Graduate Program Director (Computer and Information Sciences); Shape Modeling, Computer Graphics

**Anthony Skjellum**, Professor and Chair (Computer and Information Sciences); Parallel and High Performance Computing, Bioinformatics

**Kenneth R. Sloan**, Associate Professor (Computer and Information Sciences); Computer Graphics, Anatomy of the Retina

**Thamar Solorio**, Assistant Professor (Computer and Information Sciences); Natural Language Processing, Artificial Intelligence

**Alan P. Sprague**, Associate Professor (Computer and Information Sciences); Data Mining, Graph Algorithms, Bioinformatics

**Chengcui Zhang**, Assistant Professor (Computer and Information Sciences); Databases, Data Mining

### **Program Information**

The field of computer and information sciences deals with theory and methods for processing of information. Graduate programs leading to the M.S. and Ph.D. degrees are designed to prepare individuals for professional and research-level careers in industry, government, and

academia. Prospective students should have substantial background in computer science and mathematics.

## **M.S. Program**

The M.S. program requires 30 semester hours of coursework and a thesis (Plan I) or 36 semester hours of coursework (Plan II). Specializations are available in bioinformatics, computer graphics, distributed computing and software engineering.

## **Ph.D. Program**

The Ph.D. program consists of three phases (with some overlap between phases). The first phase of the program is devoted primarily to formal coursework and preparation for the qualifying examination. The second phase consists of coursework and research in preparation for the comprehensive examination. This examination requires presentation of a dissertation research proposal. Successful completion of this phase leads to admission to candidacy. The final phase is the completion of the dissertation research and its defense. Ph.D. student progress will be reviewed annually.

## ***Additional Information***

Deadline for Entry Term(s):	February 1 for Fall; September 1 for Spring.
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## ***Contact Information***

For detailed information, after first visiting the website below for basic information including application guidelines and prerequisites, contact Dr. Tony Skjellum, Professor and Chair, UAB Department of Computer and Information Sciences, Campbell Hall, Room 115-A, 1300 University Boulevard, Birmingham, Alabama 35294-1170.

Telephone 205-934-2213

E-mail [tony@cis.uab.edu](mailto:tony@cis.uab.edu)

Web [www.cis.uab.edu/graduate](http://www.cis.uab.edu/graduate)

## ***Course Descriptions***

### **Computer and Information Sciences (CS)**

All courses require permission of the student's academic advisor. All 500-level and 600-level courses carry 3 semester hours of credit, unless otherwise specified. All 700-level courses carry 2 or 3 hours of credit, unless otherwise specified.

**501. Programming Languages.** Formal syntax and semantics; compilers and interpreters; virtual machines; representation of data types; sequence and data control; type checking; run-time storage management; functional, logic, and object-oriented programming

paradigms; concurrency and multi-threading. BB. Prerequisites: CS303 and CS350 (with grades of C or better). 3 hours.

**510. Database Management Systems.** Relational model of databases, structured query language, normalized structure of database management systems based on relational model, and security and integrity of databases. BB. Prerequisite: CS 303 (with grade of C or better). 3 hours.

**520. Software Engineering.** Design and implementation of large-scale software systems, software development life cycle, software requirements and specifications, software design and implementation, verification and validation, project management, and team-oriented software development. JG. Prerequisite: CS 303 (with grade of C or better). 3 hours.

**533. Operating Systems.** Internal design and operation of a modern operating system, including interrupt handling, process scheduling, memory management, virtual memory, demand paging, file space allocation, file and directory management, file/user security and file access methods. AB. Prerequisites: Graduate Standing. 3 hours.

**535. Network Programming.** Remote procedure call and client-server mechanisms. Protocol definition and compilation; client and server stubs, application code; transport independence; multiple client and server systems. Applications, e.g., remote database query and update, image filtering and archiving; systems programming, and file systems contexts. RH. Prerequisite: Graduate Standing. 3 hours.

**536. Computer Network Security.** Conventional and public-key cryptography. Message encryption and authentication. Secure communication between computers in a hostile environment, including E-mail (PGP), virtual private networks (IPSec) and the World Wide Web (SSL). Firewalls. Mandatory weekly linux-based lab. RH. Prerequisite: Graduate Standing. 3 hours.

**550. Automata and Formal Language Theory.** Finite-state automata and regular expressions, context-free grammars and pushdown automata, Turing machines, computability and decidability, and complexity classes. AS. Prerequisites: CS 250, CS 302 & MA 125 (with grades of C or better). 3 hours.

**555. Probability and Statistics in Computer Science.** Introduction to probability and statistics with applications in computer science. Counting, permutations and combinations. Probability, conditional probability, Bayes theorem. Standard probability distributions. Measures of central tendency and dispersion. Central Limit Theorem. Regression and correlation. Hypothesis testing. Random number generation. Random algorithms. Estimating probabilities by simulation. Genetic algorithms. 3 hours

**591. Special Topics.** Prerequisites: Permission of Instructor. 1-3 hours.

**594. Special Topics.** Prerequisites: Permission of Instructor. 1-3 hour.

**597. Competitive Programming Techniques.** This course will help students to be more competitive in the ACM programming contest by exploring numerous problem solving techniques and algorithms not covered in the traditional curriculum. JG. Prerequisites: CS 250. 1 hour.

598. **Practical Work Experience.** Credit for Working in the computer science field. Does not count toward M.S. degree BB. Prerequisites: Permission of Instructor. 1-3 hours.

600. **Formal Semantics of Programming Languages.** Context-sensitive and semantic aspects of programming languages, denotational semantics, mathematical foundations. BB. Prerequisite: Graduate Standing. 3 hours.

601. **Program Verification.** Proving properties of programs, termination and correctness, computability and decidability, role of formal methods in software design. BB. Prerequisite: Graduate Standing. 3 hours.

602. **Compiler Design I.** Lexical and syntactical scan, semantics, code generation and optimization, dataflow analysis, parallelizing compilers, automatic compiler generation. BB. Prerequisite: CS 505 or equivalent. 3 hours.

603. **Compiler Design II.** Advanced topics in compiler design. BB. Prerequisite: Graduate Standing. 3 hours.

608. **Programming Languages Seminar.** Pass/Fail. BB. Prerequisite: Permission of Instructor. 1 hour.

610. **Database Systems I.** This course offers an introduction to the advanced topics of database management systems. The following topics are addressed: System and file structure, efficient data manipulation using indexing and hashing, query processing, crash recovery, concurrency control, transaction processing, database security and integrity, distributed databases. CZ. Prerequisites; CS 510 or equivalent. 3 hours.

611. **Database Systems II.** Relational, hierarchical, and network models; object-oriented databases, knowledge-based systems; security issues, concurrency control and distributed databases, query optimization; advanced topics. CZ. Prerequisites; CS 610 or equivalent. 3 hours.

612. **Knowledge-Base Systems.** Logic model for deductive databases, top-down and bottom-up evaluation, conjunctive and disjunctive queries, recursion, query optimization, universal relation model. CZ. Prerequisites: CS 610 or equivalent. 3 hours.

613. **Object-Oriented Database Systems.** Object data model, object-oriented query languages and database architecture, schema evolution, integration with non-object-oriented models, query optimization. CZ. Prerequisites: CS 610 or equivalent. 3 hours.

614. **Distributed Database Systems.** Distributed DBMS architecture, query decomposition and data localization, distributed query optimization, transaction management, concurrency control, multidatabase systems. CZ. Prerequisites: CS 610 or equivalent. 3 hours.

615. **Multimedia Databases.** This course introduces the principles of multimedia databases including multimedia information processing, modeling, and retrieval. The media to be considered include text, image, audio and video. At the conclusion of this course, the students should understand what multimedia data retrieval is, the principles, which allow the location of relevant information from amongst a large corpus of multimedia data, and the applications of multimedia information retrieval. The students should also have the expertise

and competence to design and implement retrieval software for multimedia data. CZ. Prerequisites: CS 510. 3 hours.

618. **Database System Seminar.** Pass/Fail. CZ. Prerequisites: CS 610 or equivalent. 1 hour.

620. **Software Development I.** Advanced topics in software design, including: Software modularization, design patterns, formal methods, and software testing. JG. Prerequisites: CS 520 or equivalent. 3 hours.

621. **Software Development II.** Design techniques for large-scale systems, portability, life-cycle cost considerations, maintenance, software design methodologies. JG. Prerequisites: Graduate Standing. 3 hours.

622. **Reflective and Adaptive Systems.** This course examines the principles of compile-time and run-time adaptation in several contexts, including: reflection, metaprogramming, aspect-oriented software development, and metamodeling (applied to model-driven engineering). JG. Prerequisites: CS 303. 3 hours.

624. **Formal Specification of Software Systems.** Formal methods for software requirements specification, including VDM, Z, and object-oriented extensions; the relationship among formal requirements, design, and implementation. BB. Prerequisites: CS 505. 3 hours.

625. **Metrics and Performance.** Metrics in systems analysis, development, and performance evaluation; querying models; capacity planning for Web system; computation via spreadsheets, discrete simulation, etc. KR. Prerequisites: Graduate Standing. 3 hours.

628. **Software Development Seminar.** This is a special topics class that meets once a week to study new research ideas emerging in the area of software engineering. Pass/Fail. JG. Prerequisites: CS 520. 1 hour.

629. **Software Engineering Research Project.** This is a project-based experimental research course affiliated with the Masters Specialization in Software Engineering. Can only be taken as part of a specialization in Software Engineering. JG. Prerequisites: Permission of Instructor. 1-3 hours.

630. **Computer Systems.** Introduction to computer architecture, including memory subsystems, direct-mapped and set-associative cache and multi-level cache subsystems, direct-access devices including RAID and SCSI disk drives, processor pipelining including super-scalar and vector machines, parallel architectures including SMP, NUMA and distributed memory systems, Interrupt mechanisms, and future microprocessor design issues. RH. Prerequisites: CS 303& 330 with a grade of C or better. 3 hours.

631. **Distributed Computing.** Object-oriented distributed systems design, distributed software architecture, data and resource access, communication, client-server computing, web technologies, enterprise technologies. PB. Prerequisites: CS 330 with a grade of C or better. 3 hours.

632. **Parallel Computing.** Overview of parallel computing hardware, architectures, & programming paradigms; parallel programming using MPI, Pthreads, and OpenMP; design,

development, and analysis of parallel algorithms for matrix computations, FFTs, and Sorting. PB. Prerequisites: CS 304 & CS 330 with a grade of C or better or MA 360. 3 hours.

633. **Grid Computing.** Motivation for developing and using Grid Computing, the evolution of Grid Computing, and relationship between Grid Computing and other types of computing such as Cluster Computing, Distributed Computing, Internet Computing, and Peer-to-Peer Computing. Study technologies and architectures used to develop Grids. PB. Prerequisites: CS 361 & CS 362. 3 hours.

636. **Computer Security.** Study of computer security including assurance, authorization, authentication, key distribution, encryption, threats including phishing and key logging, and related distributed computing issues. Theory and practical applications. TS. Prerequisite: Graduate Standing. 3 hours.

638A. **Computer Systems Seminar.** Lectures & discussion on advanced topics in Computer Systems. PB. Prerequisite: Permission of Instructor/ 1 hour.

638B. **Computer Systems Seminar.** Lectures & discussion on advanced topics in Computer Systems. PB. Prerequisite: Permission of Instructor/ 1 hour.

639. **Distributed Computing Research Project.** Project based course using distributed parallel computing techniques. Can only be taken as part of a specialization in Distributed Computing. PB. 1-3 hours.

640. **Bioinformatics I.** Introduction to computational methodologies in bioinformatics. TS. Prerequisites: Graduate Standing. 3 hours.

641. **Bioinformatics II.** Introduction to computational methodologies in bioinformatics. TS. Prerequisites: CS 640. 3 hours.

648. **Bioinformatics Seminar.** Pass/Fail. TS. Prerequisites: Permission of Instructor. 1 hour.

649. **Bioinformatics Research Project.** Can only be taken as part of a specialization in Bioinformatics. Pass/Fail. TS. Prerequisites: Permission of Instructor. 1-3 hours.

650. **Automata, Languages, and Computation.** Formal grammars and automata, Turing machines, computability and decidability, computational complexity, intractability. AS. Prerequisites: Graduate Standing. 3 hours.

651. **Formal Language Theory.** Parsing and translation theory, formal syntax, proof properties and complexity measures. AS. Prerequisites: Graduate Standing. 3 hours.

652. **Design and Analysis of Algorithms.** Algorithms for bioinformatics applications, especially string matching algorithms. Also, traditional algorithmic techniques, such as greedy algorithms, dynamic programming, and branch and bound. AS. Prerequisites: Graduate Standing. 3 hours.

653. **Computational Geometry.** Basic methods and data structures, geometric searching, convex hulls, proximity, intersections. AS. Prerequisites: Graduate Standing. 3 hours.

658. **Theoretical Foundations Seminar.** Pass/Fail. AS. Prerequisites: Permission of Instructor. 1 hour.
660. **Principles of Artificial Intelligence.** Programming methodologies, logic foundations, natural language applications, expert systems. KR. Prerequisites: Graduate Standing. 3 hours.
661. **Expert Systems.** Concepts and architectures, tools, reasoning, evaluations, selected examples. KR. Prerequisites: Graduate Standing. 3 hours.
662. **Natural Language Processing.** Syntax, semantics, ATNs, logic grammars, language and memory. BB. Prerequisites: Graduate Standing. 3 hours.
663. **Knowledge Discovery & Data Mining.** Techniques used in data mining (such as frequent sets and association rules, decision trees, Bayesian networks, classification, clustering), algorithms underlying these techniques, and applications. AS. Prerequisites: Graduate Standing. 3 hours.
664. **Knowledge Representation.** Logic, production systems, semantic nets, frames, multiple representational systems. KR. Prerequisites: Graduate Standing. 3 hours.
665. **Neural Networks.** Theoretical foundations, associative memory, pattern processing, biological neural nets. KR. Prerequisites: Graduate Standing. 3 hours.
668. **Artificial Intelligence Seminar.** Pass/Fail. KR. Prerequisites: Permission of Instructor. 1 hour.
670. **Computer Graphics.** Graphics architectures, geometric transforms, 3-D, object models, shading, intensity, hidden elements, color, advanced topics. JJ. Prerequisites: Graduate Standing or Permission of Instructor. 3 hours.
671. **Shape Design.** Shape design for graphics, game design, bioinformatics and CAD/CAM. Bezier curves and surfaces, B-splines, interpolation, polygonal meshes, subdivision surfaces, implicit curves and surfaces, swept surfaces, boundary representation, contour reconstruction. JJ. Prerequisites: Graduate Standing or Permission of Instructor. 3 hours.
672. **Motion Design.** Motion design for graphics, animation, game design, and robotics. Orientation control, quaternion splines, basics of Bezier curves and surfaces, camera control, motion planning, collision detection, cinematography, visibility analysis. JJ. Prerequisites: Graduate Standing or Permission of Instructor. 3 hours.
673. **Computer Vision Systems.** Image understanding feature extraction, domain-specific knowledge for high-level vision. KS. Prerequisites: Graduate Standing. 3 hours.
675. **Computer Visualization.** Advanced Computer Graphics techniques aimed at "Scientific Visualization" applications. KS. Prerequisites: Graduate Standing. 3 hours.
678. **Graphics and Image Processing Seminar.** Pass/Fail. KS. Prerequisites: Permission of Instructor. 1 hour.

679. **Computer Graphics Research Project.** Can only be taken as part of a specialization in Computer Graphics. Pass/Fail. JJ. Prerequisites: Permission of Instructor. 3 hours.

680. **Numerical Computing Foundations.** Matrix computations and matrix analysis, including solution of linear systems, solution of nonlinear systems, spectral analysis, quadrature, and least squares. JJ. Prerequisites: CIS graduate standing and permission of instructor. 3 hours.

681. **Simulation Models and Animations.** Model development using popular simulation languages, e.g., Excel or OpenOffice.org Calc Spreadsheet; interfacing to an animation system such as Proof Animation or Open\_GL. KR. Prerequisites: Graduate Standing. 3 hours.

682. **Simulation Methodology and Applications.** Combined continuous and discrete simulation, simulation theory, modeling environments. KR. Prerequisites: Graduate Standing. 3 hours.

688. **Geometric Modeling Seminar.** JJ. Prerequisites: Permission of Instructor. 1 hour.

690. **Special Topics.** BB. Prerequisites: Permission of Instructor. 1-3 hours.

691. **Special Topics.** BB. Prerequisites: Permission of Instructor. 1-3 hours.

692. **Special Topics.** BB. Prerequisites: Permission of Instructor. 1-3 hours.

693. **Special Topics.** BB. Prerequisites: Permission of Instructor. 1-3 hours.

694. **Special Topics.** BB. Prerequisites: Permission of Instructor. 1-3 hours.

697. **Directed Readings.** JJ. Prerequisites: Permission of Instructor and Graduate Program Director. 1-3, 6 hours.

698. **Masters Plan II.** (Plan II) Pass/Fail. JJ. Prerequisites: Permission of Graduate Program Director. 2, 3, 5, 6, 9 hours.

699. **Masters Thesis Research.** Pass/Fail. JJ. Prerequisite: Admission to candidacy. 1-6 hours.

700. **Topics in Programming Language Semantics.** BB. Prerequisites: Graduate Standing. 2-3 hours.

701. **Topics in Program Verification.** BB. Prerequisites: Graduate Standing. 2-3 hours.

702. **Topics in Compiler Design.** BB. Prerequisites: Graduate Standing. 2-3 hours.

703. **Topics in Compiler Design.** BB. Prerequisites: Graduate Standing. 2-3 hours.

708. **Topics in Programming Languages Seminar.** BB. Prerequisites: Graduate Standing. 2-3 hours.

**710. Topics in Database Systems.** This course offers an introduction to the advanced topics of database management systems. The following topics are addressed: System and file structure, efficient data manipulation using indexing and hashing, query processing, crash recovery, concurrency control, transaction processing, database security and integrity, distributed databases. CZ. Prerequisites: Cs 510 or equivalent. 2-3 hours.

**711. Topics in Database Systems.** CZ. Prerequisites: Graduate Standing. 2-3 hours.

**712. Topics in Knowledge-Base Systems.** CZ. Prerequisites: Graduate Standing. 2-3 hours.

**713. Topics in Object-Oriented Database Systems.** CZ. Prerequisites: Graduate Standing. 2-3 hours.

**714. Topics in Distributed Database Systems.** CZ. Prerequisites: Graduate Standing. 2-3 hours.

**715. Topics in Multimedia Database.** CZ. Prerequisites: Graduate Standing. 2-3 hours.

**718. Topics in Database Systems Seminar.** CZ. Prerequisites: Graduate Standing. 2-3 hours.

**720. Topics in Software Development I.** JG. Prerequisites: Graduate Standing. 2-3 Hours.

**721. Topics in Software Development II.** JG. Prerequisites: Graduate Standing. 2-3 Hours.

**722. Topics in Reflective and Adaptive Systems.** JG. Prerequisites: Graduate Standing. 2-3 Hours.

**724. Topics in Formal Specification of Software Systems.** BB Prerequisites: Graduate Standing. 2-3 hours.

**725. Topics in Metrics & Performance.** KR Prerequisites: Graduate Standing. 2-3 hours.

**728. Topics in Software Development Seminar.** JG. Prerequisites: Graduate Standing. 2-3 hours.

**730. Topics in Computer Systems.** RH. Prerequisites: Graduate Standing. 2-3 hours.

**731. Topics in Distributed Computing.** PB. Prerequisites: Graduate Standing. 2-3 hours.

**732. Topics in Parallel Computing.** PB. Prerequisites: Graduate Standing. 2-3 hours.

**733. Topics in Grid Computing.** PB. Prerequisites: Graduate Standing. 2-3 hours.

**736. Topics in Computer Security.** TS. Prerequisites: Graduate Standing. 2-3 hours.

**738A. Topics in Computer Systems Seminar.** PB. Prerequisites: Graduate Standing. 2-3 hours.

738B. **Topics in Computer Systems Seminar.** PB. Prerequisites: Graduate Standing. 2-3 hours.

740. **Topics in Bioinformatics.** TS. Prerequisites: Graduate Standing. 2-3 hours.

741. **Topics in Bioinformatics.** TS. Prerequisites: Graduate Standing. 2-3 hours.

748. **Topics in Bioinformatics Seminar.** TS. Prerequisites: Graduate Standing. 2-3 hours.

750. **Topics in Automata Theory.** AS. Prerequisites: Graduate Standing. 2-3 hours.

751. **Topics in Formal Language Theory.** BB. Prerequisites: Graduate Standing. 2-3 hours.

752. **Topics in Design and Analysis of Algorithms.** AS. Prerequisites: Graduate Standing. 2-3 hours.

753. **Topics in Computational Geometry.** AS. Prerequisites: Graduate Standing. 2-3 hours.

758. **Theoretical Foundations Seminar.** AS. Prerequisites: Graduate Standing. 2-3 hours.

760. **Topics in Artificial Intelligence.** KR. Prerequisites: Graduate Standing. 2-3 hours.

761. **Topics in Expert Systems.** KR. Prerequisites: Graduate Standing. 2-3 hours.

762. **Topics in Natural Language Processing.** BB. Prerequisites: Graduate Standing. 2-3 hours.

763. **Topics in Knowledge Discovery & Data Mining.** AS. Prerequisites: Graduate Standing. 2-3 hours.

764. **Topics in Knowledge Representation.** KR. Prerequisites: Graduate Standing. 2-3 hours.

765. **Topics in Neural Networks.** KR. Prerequisites: Graduate Standing. 2-3 hours.

768. **Artificial Intelligence Seminar.** KR. Prerequisites: Graduate Standing. 2-3 hours.

770. **Topics in Computer Graphics.** JJ. Prerequisites: Graduate Standing. 2-3 hours.

771. **Topics in Shape Design.** JJ. Prerequisites: Graduate Standing. 2-3 hours.

772. **Topics in Motion Design.** JJ. Prerequisites: Graduate Standing. 2-3 hours.

773. **Topics in Computer Vision.** KS. Prerequisites: Graduate Standing. 2-3 hours.

775. **Topics in Computer Visualization.** KS. Prerequisites: Graduate Standing. 2-3 hours.

778. **Graphics and Image Processing Seminar.** KS. Prerequisites: Graduate Standing. 2-3 hours.

780. **Topics in Numerical Computing Foundations.** JJ. Prerequisites: Graduate Standing. 2-3 hours.

781. **Topics in Simulation Models and Animations.** KR. Prerequisites: Graduate Standing. 2-3 hours.

782. **Topics in Simulation, Methodology, and Application.** KR. Prerequisites: Graduate Standing. 2-3 hours.

788. **Topics in Geometric Modeling Seminar.** JJ. Prerequisites: Graduate Standing. 2-3 hours.

790. **Special Topics.** BB. Prerequisites: Graduate Standing. 2-3 hours.

791. **Special Topics.** BB. Prerequisites: Graduate Standing. 2-3 hours.

792. **Special Topics.** BB. Prerequisites: Graduate Standing. 2-3 hours.

793. **Special Topics.** BB. Prerequisites: Graduate Standing. 2-3 hours.

794. **Special Topics.** BB. Prerequisites: Graduate Standing. 2-3 hours.

796. **Directed Readings and Research.** JJ. Prerequisites: Permission of Instructor. 1-6 hours.

799. **Dissertation Research.** Pass/Fail. JJ. Prerequisite: Admission to candidacy. 1-6, 9 hours

Last modified 06/26/09