Department of Computer Science

Missouri University of Science and Technology

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http://cs.mst.edu/

For information purposes only
Consult the Missouri S&T graduate catalog for official information

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# Table of Contents

Region and Campus ............................................................................................................................................ 3

The University ..................................................................................................................................................... 3
   Library
   Missouri S&T Information Technology
   Counseling and Academic Support Programs
   Music and Fine Arts
   Career Opportunities Center
   Recreation/Sport Facilities

Honors Programs .................................................................................................................................................. 6
   Chancellor’s Fellowship
   DOD IASP Fellowship

Computer Science at Missouri S&T ................................................................................................................... 7

History of Computer Science at Missouri S&T ................................................................................................. 7

Programs and Facilities ..................................................................................................................................... 7

Research .............................................................................................................................................................. 7

Computer Facilities and Technology ................................................................................................................... 8

Job Outlook for Computer Science ................................................................................................................... 8

Departmental Contributors ................................................................................................................................. 9

Faculty and Staff in Computer Science ............................................................................................................ 10

Graduate School in Computer Science ............................................................................................................ 26

Masters in Computer Science ............................................................................................................................. 26

Financial Aid ...................................................................................................................................................... 28

Graduate Certificate Program ............................................................................................................................. 28

Ph.D. in Computer Science .................................................................................................................................. 31

Courses in Computer Science ............................................................................................................................. 32

Center of Academic Excellence in Information Assurance Education ............................................................... 36

Professional & Honor Societies .......................................................................................................................... 37

Computer Science Academy ............................................................................................................................... 39

Computer Science Advisory Board .................................................................................................................... 40
Missouri University of Science and Technology is located in Rolla, Missouri, a town of about 20,000 in the wooded rolling hills of the Missouri Ozarks. In Rolla, you’ll find a friendly, small-town atmosphere within 100 miles of the St. Louis and Springfield metropolitan areas. It is also about a one hour drive from the state capital, Jefferson City, and the Lake of the Ozarks.

Many recreational activities, particularly canoeing, hiking, swimming, fishing, and spelunking can be enjoyed within a short distance of Rolla. The combination of easy access to outdoor activities and major metropolitan areas makes Rolla an attractive place to live. Living costs, particularly housing and services, tend to be less than in larger urban areas.

Missouri S&T has an enrollment of about 8,000 students, including about 2,000 graduate students. Approximately 95% of these students major in science and engineering.

The bachelor’s degree programs (B.S., B.A.) along with the master of science (M.S.), doctor of philosophy (Ph.D.), doctor of engineering, and professional development degrees are offered.

The Missouri S&T campus encompasses about 284 acres and combines both old and new architecture. Many new buildings have recently enhanced the campus. Missouri S&T is large enough to provide the specialized equipment necessary for state-of-the-art experimentation yet small enough to allow close interaction between students and faculty.

Wilson Library
Wilson Library serves as a gateway to an ever-expanding world of information. A growing collection of books, periodicals, audiovisual materials and computer-based resources supports research and learning and provides entertainment as well. Most electronic resources are available 24/7 from any computer on campus, at home or in the dormitories. Students find the library a pleasant place to study, a central meeting place for study groups and sometimes just a comfortable place to socialize and relax!

The Missouri S&T library houses more than 450,000 volumes and currently subscribes to over 850 periodical titles.

These print resources are supplemented by a variety of other materials, including electronic journals, CDs, and videos. The collection is augmented by the existence of a shared catalog that allows users to request items from other Missouri colleges and by an active inter-library loan department that is able to borrow or obtain copies of most materials needed by Missouri S&T students and faculty.

Many library resources are accessible over the Internet. The library web page provides access to the catalog and a number of databases, including IEEE and ACM Digital Libraries. Workshops on library resources are offered on a regular basis, and librarians are available by appointment for specialized assistance. For more information, people are encouraged to explore the library home page at [http://library.mst.edu](http://library.mst.edu).

Missouri S&T Information Technology

**Getting Started**

Information Technology (IT) provides a variety of computing tools and resources to assist with academic and administrative work done at Missouri S&T.

Most faculty, staff and students use computers daily to help with tasks such as these: to register for classes, communicate with friends using e-mail, collaborate on group projects and research, publish web pages, write reports and find course schedules just to name a few.

Computer accounts are assigned to students and are used to access various resources at Missouri S&T, such as the computing network and the computers and software in Technology Classrooms (TC). Most Missouri S&T IT services require an authorized computer account (userid and password) to gain access. The following services are available through IT computer accounts:

- E-mail
- Network file storage
RESPoNSIbILITIES

Academically priced software for personal use.

Software to those wishing to purchase for

recommendations for supported hardware and

Missouri S&T Bookstore provides recom-

endings across disciplines (both wired and wireless) and cables may be purchased through the Missouri S&T Bookstore which is located in the Havener Center.

GETTING HELP

The Missouri S&T IT Solutions Center is available to assist the students, faculty and staff of

Missouri S&T in using the different computing systems on campus.

Help is available on a wide range of items from the Windows-based PCs, Macintoshes and Linux workstations to the supported software on these systems.

Members of the campus community may call 573-341-HELP (4357) or access the online Help Request system at help.mst.edu. Hours of operation are available by visiting help.mst.edu.

INTERNET RESOURCES

• Online Help Request - http://help.mst.edu
• Missouri S&T - http://www.mst.edu
• Solution Center - http://it.mst.edu/
• IT - http://it.mst.edu
• IT Security - http://it.mst.edu/
• Campus Library - http://library.mst.edu
• Joe’sSS - http://joess.mst.edu

Counseling and Academic Support Programs

Academic Support Programs http://learns.mst.edu. Academic Support Programs offers a wide variety of resources available to enhance your academic success.

The staff of Academic Support Programs provide professional consultation and assistance regarding academic motivation, attitude, and approach to the learning process. Call to make an appointment any time of the year.

The Student Learning Center (204 Norwood) is adjacent to the Academic Support Programs office. It is a place to study and where you’ll have access to a computer learning center, LEAD (Learning Enhancement Across Disciplines) peer tutoring, and much more.

Resource Learning Center is located at Thomas Jefferson Hall, Room G-7, (as well as in 204 Norwood) and is a great study place where you can access old course

Systems and Software

Missouri S&T IT provides a wide variety of computing and networking facilities and support. These facilities include, but are not limited to the following:

• PCs
• Mac’s
• Linux systems

Technology Classrooms

Computer Learning Center (CLCs) are computing sites provided to support academic computing and teaching methodologies. 27 CLCs are located in various build-

ings around campus. Use of computers in these locations is restricted to Missouri S&T faculty, staff and students. A list of TC locations, hours of operation and equip-

ment is available at https://edtech.mst.edu/clc.

Privileges and Responsibilities

Missouri S&T IT provides access to computing, networking and infor-

mation resources in support of teaching, research and other official duties of the university.

Access to the computing resources and facilities is a privilege, not a right. The “Missouri S&T Computing and Network Facilities Acceptable Use Policy” describes the ethical and legal responsibilities regarding computing resources.

Other computing policies and procedures, including the University of Missouri policies, can be found at: http://it.mst.edu/policies/index.html.

Individually Owned Computers

Missouri S&T IT in conjunction with the Missouri S&T Bookstore provides recommenda-

ations for supported hardware and software to those wishing to purchase for personal use.

Academically priced software for person-

ally owned computers may be purchased at the Missouri S&T Bookstore. Software on university owned machines is provided through licensing agreements with various vendors. Missouri S&T IT provides Microsoft Outlook to students free of charge on the “Get Connected CD” (available from the IT Walk-In Center, see Getting Help) and McAfee Anti-virus is available for free download at: http://it.mst.edu/.

Please visit http://www.mstbookstore.com and click on the “MiNERTECH” logo for more information on supported technology and recommended systems.

Connecting to the Network

Computers in campus residence halls and fraternities or sororities connect to the network through an Ethernet connection or via wireless connection. Wireless coverage currently extends to over 70% of the campus (including the Residential College); providing great flexibility and convenience for members of the campus community.

To register a machine on the campus network, simply plug-in to an available Ethernet jack and open a web browser, an online registration page will load, complete the online form and you are ready to access the network. Detailed instructions on connecting to the network, using either wired or wireless Ethernet, are available at http://it.mst.edu/. Virtual Private Network (VPN) connections are available allowing members of the campus community to connect to the network while away from campus or traveling.

Special usage policies apply to network connections; see the “Policies and Procedures” web page at http://it.mst.edu/policies/index.html. In addition, Ethernet cards (both wired and wireless) and cables may be purchased through the Missouri S&T Bookstore which is located in the Havener Center.

Internet Resources

• Online Help Request - http://help.mst.edu
• Missouri S&T - http://www.mst.edu
• Solution Center - http://it.mst.edu/
• IT - http://it.mst.edu
• IT Security - http://it.mst.edu/
• Campus Library - http://library.mst.edu
• Joe’sSS - http://joess.mst.edu

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Academic Support Programs http://learns.mst.edu. Academic Support Programs offers a wide variety of resources available to enhance your academic success.

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Resource Learning Center is located at Thomas Jefferson Hall, Room G-7, (as well as in 204 Norwood) and is a great study place where you can access old course
files, a resource library, a copy machine, and computers. The convenient location is great for residents. Who said you can’t study in your PJ’s!

What you’ll find at Academic Support Programs office and the Student Learning Center, 203 & 204 Norwood Hall:

- Great atmosphere for studying and working with others
- LEAD peer tutoring (see schedule at http://lead.mst.edu)
- Computer Learning Center
- Academic Support Resource Library
- Free coffee and a friendly staff
- Old student course files to use as study tools
- Study techniques and test taking strategies
- Learning consultation to discover your most effective learning style

You will find a virtual academic support center at our website too!

Academic Support Programs operates Disability Support Services, which provides academic accommodations for qualified students. These services are designed to provide students with equal educational opportunities. Services available to qualified students can include classroom adaptation, alternative testing environment, books on tape, and assistance in overall access on campus. If you have a disability or are limited in some way, contact Disability Support Services to request accommodations. University policy and procedures can be found at http://dss.mst.edu or call for an appointment, 341-4211.

The Testing Center, also operated by Academic Support Programs, administers national tests like the CLEP test, GRE, Miller’s Analogies Test, CBASE and PRAXIS. Correspondence course testing service is also available. A range of personality, interest, and skills assessment instruments are available to assist the Counseling Center clients with personal, academic and career concerns. Students desiring to test out of courses, take a test for correspondence courses, or having any other testing needs can contact the Testing Center at 341-4222. Visit our website for more information: http://testcenter.mst.edu.

Music and Fine Arts

Music and fine arts abound at Missouri S&T. The Student Union Board sponsors plays, lectures, films, dances, and concerts. The campus also benefits from the Campus Performing Arts Series and the Missouri S&T Film Series.

Leach Theater is a modern theater with computerized lighting and sound systems. The equipment allows the facility to support such groups as The St. Louis Symphony, Broadway Productions, Alvin Ailey Dance Ensemble and The Chinese Magic Revue. Performances also are available locally through the Ozark Actors Theatre and the Regional Opera Company.

The Remmers Special Artist/Lecture Series has brought to campus such speakers as former Secretary of State Henry Kissinger, former Prime Minister of Britain Margaret Thatcher, business journalist Louis Rukeyser, Colin Powell, Itzhak Perlman, CBS News correspondent Charles Kuralt, former CIA Director Stansfield Turner, Ralph Nader, former president of Costa Rica Nobel Peace Prize Winner Oscar Arias Sanchez, and former Surgeon General C. Everett Koop.

There are numerous music groups open to student participation, and you are invited to become involved in dramatic productions as a performer or an observer.

Career Opportunities Center

The Career Opportunities Center provides many services to assist Missouri S&T undergraduate students in their professional job search for summer, cooperative training and full-time employment. Services available include:

- Registration and Interview Sign-up
- Resume and Cover Letter Workshops
- Job Search Strategies Workshops
- Interviewing Workshops
- Professional Interview Suites
- Individual Appointments
- On-Campus Interviews
- Company Literature
- Career Fairs
- Resource Library
- Industry Speakers
- Job Listings

Services are also offered to alumni for entry-level and advanced job referrals.

Recreation/Sports Facilities

Campus sports and recreation facilities are available. Most of the facilities are housed in the Student Recreation Center and the Gale Bullman Multi-Purpose Building. These facilities include: basketball courts, a swimming pool, weight rooms, aerobic machines, an indoor jogging track, racquetball courts, a squash court, an aerobics/martial arts room and outdoors tennis courts and intramural fields. In addition, there is also a nine-hole golf course and driving range.

Rolla has 219 acres of park land to enjoy. The 88-acre Ber Juan Park is home to the recently built Centre, SplashZone Water Park, a small lake, a 1.5-mile fitness trail, a skate park, sports fields, playground equipment, a picnic shelter, and acres of natural prairie. Best of all, Ber Juan Park is only blocks from downtown and campus.
Honors Programs

Chancellor's Fellowship

Chancellor's Fellows provide waivers for all required fees and out-of-state fees (if applicable) for the Fall, Spring and Summer Sessions for Chancellor's Fellows maintaining satisfactory progress as Ph.D. candidates and maintaining a 3.50 minimum grade point average.

(The fellowship is awarded, subject to the guidelines below, for as many as six semesters [and intervening summer sessions]. Under exceptional circumstances, the fellowship may be extended to eight semesters [and intervening summer sessions] with the approval of the Chancellor upon the positive recommendations of the Department Chair and the Vice Provost of Graduate Studies.)

Student Guidelines

1. Chancellor's Fellowships are to be awarded to students to encourage them to begin and complete a Ph.D. course of study at Missouri S&T.

2. Chancellor's Fellowships will normally be awarded in the Spring and may be used beginning with the Summer Session, the Fall Semester, or the following Spring) Semester.

3. Chancellor's Fellows must maintain a 3.50 cumulative grade point average each semester; those failing to maintain this average will endanger their continuing as a Chancellor's Fellow.

4. Support continues, subject to the time restrictions above, for a Chancellor's Fellow as long as it is toward the student's approved Ph.D. program (Form VI). (Maximum 36 credit hours for M.S. and 60 credit hours for Ph.D. beyond M.S.)

5. Chancellor's Fellowships are not to be used for students on the Missouri S&T campus, or for continuous registration, or for examination only.

6. Chancellor's Fellows will assess any late registration fees.

7. Chancellor's Fellows dropped for failure to maintain satisfactory progress are not eligible for reappointment as Chancellor's Fellows.

8. Chancellor's Fellows vacated by failure to maintain satisfactory academic status, or by dropping out, are not transferable.

9. Chancellor's Fellows who leave school while in good academic standing may have their Chancellor's Fellowships reactivated on their return to graduate school with the approval of their Department Chair, Vice Provost of Graduate Studies, and the Chancellor.

10. Students holding a fellowship that pays fees or a cost-of-education allowance are not eligible for Chancellor's Fellowships.

11. Chancellor's Fellows not on academic appointment must carry nine hours in each fall/winter semester.

DoD IASP Fellowship Program

S&T Students interested in careers in IA are encouraged to apply for the IASP program which supports undergraduate, graduate, and Ph.D. study. The purpose of the program is to increase the number of qualified students entering the field of Information Assurance (IA) to meet DoD’s increasing dependence on information technology for war fighting and the security of its information infrastructure. The program places interns at various DoD facilities during the summer and provides employment in the IA field upon graduation. For each year of fellowship money received, one year of work for the DoD is required. (The DoD includes the National Security agency for purposes of this program).

Interested students should contact Professor Bruce McMillin for further information or cae.mst.edu.
Computer Science is an exciting, dynamic field with critical demand and is at the core of the modern world. Computer scientists are involved in all the various aspects of computing including the development of algorithms, software development, and hardware/software implementations. As a computer science student at Missouri S&T, you will learn how to deal with the real challenges you will face in the workplace or during your graduate studies. You’ll take courses that provide a sound basis in “classic” computer science, including:

- Algorithms
- Computer Organization/Architecture
- Data Structures
- Database and File Structures
- Discrete Mathematics & Automata
- Object-Oriented Design
- Operating Systems
- Programming Languages

For your advanced work, you can choose to study: distributed/parallel computing/architecture, software engineering, computer security, bio-inspired computing, pervasive/embedded/fault-tolerant computing, artificial/computational intelligence, sensor/wireless/computer networking, computational science, and internet computing.

While instruction and research are on the leading edge of computing, class size is small to facilitate the interactions of students with faculty. Whether you’re solving problems in science, business, industry, engineering, or in the lab, you’ll be prepared with a computer science degree from Missouri S&T.

**Brief History**

The Missouri University of Science and Technology introduced the first Computer Science course in 1957 and added extensive course offerings in Computer Science at both the graduate and undergraduate level before the Master of Science degree in Computer Science was authorized in 1964. The B.S. degree in Computer Science was authorized in 1966 and the Ph.D. degree in Mathematics with emphasis in Computer Science became available in 1967. A separate department of Computer Science was established in January 1969. The Ph.D. degree in Computer Science was approved by the Board of Curators and became effective for Fall 1976.

**Programs and Facilities**

At the M.S. level, the department philosophy is to have the student take a substantial fraction of his/her work in one of the principal areas. The student may choose the thesis or non-thesis option. Our current student population boasts a average GRE quantitative score of 185 and a written score of 4.5.

At the Ph.D. level, the student has the flexibility to build a study plan to suit his/her individual interests. However, there are certain subjects that are common to all areas of emphasis. These courses will form a unifying theme in the study plans.

**Software Lifecycle**

Missouri S&T’s CS program provides a full unified software lifecycle experience over the entire course of the student’s CS education at Missouri S&T. This experience includes software project management in its many roles, ranging from overall project management and process improvement to the management of individual lifecycle components, including software deployment and evolution. Missouri S&T’s software engineering research program specializes in software quality, software testing, hardware/software co-design, and formal methods of software specification and verification, software requirements and software process improvement, automated software engineering, and algorithm theory.

**Critical Infrastructure Protection**

Critical Infrastructure Protection is a multidisciplinary study dedicated to improving the security, reliability, and survivability of the infrastructure that play a vital role in the effective functioning of our nation. Missouri S&T’s specialty focuses on the critical hardware/software integrated systems that make up the nation’s critical infrastructure. Missouri S&T’s CS department focuses on the Software Engineering aspects of Critical Infrastructure Systems, Wireless Computing Technologies, Artificial Intelligence, Distributed Computing, Security, Fault Tolerance, and Visualization. The intention is to improve the quality, survivability, security, and reliability of critical systems using the broadest-based technology possible, to grow a workforce aware of and trained in security (physical and cyber), and to stimulate the economic viability of US corporations and institutions by improving the security, reliability, and survivability of their critical infrastructure.

**Outstanding Research**

Students receive instruction based on the newest developments in computing from department research. Our knowledgeable faculty are able to guide students in their research endeavors. The research funding that our faculty brings in from the federal and state agencies, as well as industry, helps the department to stay at the cutting edge of computer science research and provides financial support for many of our graduate students during their studies.

The Computer Science Department has three areas of excellence in teaching and research, software lifecycle, & critical infrastructure protection.
Computer Facilities & Research Laboratories

In the department, you’ll have access to high-performance computers running Linux and Windows, and a distributed computing cluster for running parallel algorithms as well as computationally expensive sequential tasks. The department supports many programming languages including C, C++, Java, Perl, Python, and packages such as database systems (Oracle). Computer Learning Centers (CLCs) across campus are open 24/7, and high-speed Internet access is available in Missouri S&T residence halls, most Greek houses and in the community.

The Computer Science Department at Missouri S&T makes use of both its own laboratories as well as the University Computer Facilities. The Department maintains the laboratories described next. Additional information for some of these laboratories can be found on the department’s web page at http://cs.mst.edu/.

Web and Wireless Computing (W2C) Laboratory and NSF Industry-University Research Center on Net-Centric Software Systems
Is to design to carry out cutting edge research in different aspects of data management (security, compression, replication, caching, query processing, aggregation, fusion) in wireless networks and cloud computing environment. Our focus is on scientific research to advance the state of art in these areas. The current projects are supported by NSF, DOE, ARL, AFRL, NIST, UM System, etc. The current researchers in the lab are pursuing their PhD/MS degree in different areas of interest to the W2C lab. The lab is well-equipped with over 50 3.2 Ghz PCs, 5 Dell Server, linux machines, laptops etc. The lab also has sensor network test-beds consists of Crossbow sensor motes like Telosb, Mica2 and Missouri S&T motes. Website: http://web.mst.edu/~cswebdb/about.html.

Critical Infrastructure Protection Laboratory
Is to research in advanced methods of security applied within the realm of critical cyber and cyber-physical infrastructures. The focus is on the use of rigorous mathematics through formal methods to create and analyzer fault-tolerant and secure real-time distributed computing systems applied to critical infrastructure protection. The laboratory supports undergraduate, graduate, and faculty researchers. Students in the laboratory participate in the campus Center for Academic Excellence in Information Assurance and Research, the Intelligent Systems Center, and the Energy Research and Development Center. Website: http://filpower.mst.edu

Mcdonnell Douglas Software Engineering Laboratory
Is to perform research on challenging issues of software engineering technology that are critical to support the development, operation and maintenance of modern software-centric systems. Our lab will enhance the competitiveness of member organizations by conducting collaborative research programs, developing joint R&D proposals to compete for state, national, and international funding, and delivering high-quality educational and training programs both on-campus and off-campus. Website: https://sites.google.com/a/mst.edu/software/.

Natural Computation Laboratory
Is to develop novel types of computational problem solving methods inspired by nature which are both more powerful and user-friendlier than the current state-of-the-art, and to apply them to real-world problem solving. Since the lab’s founding in 2002, its computational problem solving method of choice has been Evolutionary Computing. Website: http://web.mst.edu/~taurizd/nc-lab/.

Pervasive and Mobile Computing Laboratory
Is to explore the task of integrating technology into an environment, such that a multitude of computing devices are available to proactively perform services for users, thereby lightening the users’ workload. The emergence of pervasive systems has been

CS room 212/213 Computer lab is used frequently for general access.
characterized as the third wave in computing, after the mainframe era (one computer, many users) and the personal computer era (one computer, one user). Pervasive computing is the next natural step, as a single user is in control of numerous computing elements.

Social Computing Research Laboratory
We are currently designing protocols for tiny embedded wireless sensors to communicate securely in environments of national security like military deployments. The fundamental challenges are large scale operations, low power operation, wireless propagation, ease of physical capture. Our schemes rely on light weight cryptography, exploiting network topology and leveraging collaboration among sensors against adversaries.

Applied Computational Intelligence Laboratory
Students working in the laboratory gain many advantages, including collaboration in a work environment, continued involvement with research, the positive influence of role models and mentors, and, more often than not, an opportunity to publish. (Publishing is required for all graduate students.) The ACIL welcomes small and large business cooperative ventures in intelligent computing. [http://acil.mst.edu/](http://acil.mst.edu/)

Computer Vision and Biomedical Imaging Laboratory
We are interested in computing technologies and systems that are theoretically-sound and practically-applicable in civilian, military, healthcare and multimedia applications. To that end, we are particularly interested in visual perception, sensor fusion, learning methods that can make these technologies as realities. These research activities lead to algorithms and systems capable of understanding object behaviors in biomedical and natural scene images.

Job Outlook for Computer Science
With the advent of computers have come an enormous number of new types of jobs. Some require extensive training but not a college degree (e.g., data entry device operators and computer operators). On the other hand, a large number of business and scientifically oriented computer jobs do require a B.S., M.S., or Ph.D. degree. Computers have found their way into every type of business imaginable; consequently, job opportunities are essentially unlimited.

At the B.S. level, there are opportunities for business and scientific applications programmers, system integrators, and software designers. At the M.S. level, opportunities exist in even more areas. Those completing the Ph.D. degree will have employment opportunities in both industry and academia. The Missouri S&T Career Opportunities Center provides several services aimed at helping students find the “right” job.

Computer Science graduates from Missouri S&T work in a variety of environments not only around the world but also in space. Some work for large companies, others prefer the atmosphere of a smaller company. Many of our graduates have started their own successful businesses. Regardless of company size, Computer Science graduates from Missouri S&T are in high demand as evidenced by the number of companies who specifically recruit our graduates. Average starting salaries for BS graduates in CS from Missouri S&T range upwards from $51,000 (as of 2010-2011 reported figures) at major companies like Boeing, Cerner, Garmin, Microsoft, Accenture, Lockheed Martin, and Union Pacific Railroad, as well as many consulting firms and startup companies with senior level salaries topping $110K.

A Bachelor of Science degree in Computer Science prepares the student for graduate school or industry to work as a software engineer, systems programmer, systems integrator, or as an applications programmer.

Financial Aid
There are many scholarships & fellowships available at Missouri S&T for undergraduate as well as graduate students, and more than 75 percent of admitted students receive some form of merit-based assistance. The computer science department offers several scholarships that are awarded based on need and scholastic standing. Several companies and individuals provide scholarships to undergraduate and graduate students. There are also nationally funded fellowships from the federal government and its agencies. A number of departmental scholarships are available. Application forms can be found on the departments’ web page. Website [http://cs.mst.edu/documents/Assistantship_Application.pdf](http://cs.mst.edu/documents/Assistantship_Application.pdf).

Note: To become eligible for all campus scholarships, new students must have been accepted for admission prior to March 1.
DEPARTMENTAL CONTRIBUTORS

The department is continually seeking support for faculty and student development, including scholarships and fellowships. Recent contributors include:
Selected Publications


Recent Grants

National Science Foundation (NSF) “CAREER: Human Behavior Assessment from Internet Usage: Foundations, Applications and Algorithms” (Feb 13 - Jan 18).

National Science Foundation (NSF) “II-New: Infrastructure to Support Integrated Research and Education in Socially Intelligent Computing at Missouri S&T” - National Science Foundation - (Jun 12 - Jun 14).


Department of Education (DOE) “A Doctoral Program in Security and Privacy in Mobile Social Network Space” (Sep 12 - Sep 15).
Selected Publications

Journals

Conference Proceedings
Maggie X. Cheng, Quanmin Ye, Robert F. Erbacher, “Visualizing Graph Features for Fast Port Scan Detection”, CSIIRW 2013.
Maggie X. Cheng, Quanmin Ye, “Transmission Scheduling Based on a New Conflict Graph Model for Multicast in Multihop Wireless Networks”, IEEE Globecom 2012.

Recent Grants

Areas of Interest
Wireless Networking and Mobile Computing, and Combinatorial optimization with focus on network applications.

I am lucky to work in an area that is related to everyone’s daily experience—computer networks. When the Internet is mature enough to connect every home and office in the world and host millions of e-business, wireless networks that eliminate the hurdle of wiring yet provide convenient connectivity, sensor networks that bridge the physical work to the Internet will become more and more desirable. With the increasing popularity of wireless devices in people’s everyday life, ubiquitous computing is not far from the horizon. It is exciting to live in a world of fully connected devices, so efficient and so convenient to use. Imagine what it would be like to live in a home that is equipped with devices capable of wireless communication. The sensors automatically detect that you are home and communicate to the central control unit that starts lights and your favorite music; when you are away, the sensors and other wireless devices automatically guard your home and report intruding, fire and flooding.
Sajal K. Das
Department Chair & St. Clair Endowed Chair

Meet the Faculty in Computer Science

325B Computer Science Bldg.
(573) 341-7708
sdas@mst.edu


Areas of Interest

We live in an era of cyber-physical-social convergence. Technological advances in wireless mobile communications, sensors and smart devices, embedded and pervasive computing and middleware services have made it possible to design, monitor, analyze and control smart environments and complex cyber-physical systems, such as smart buildings, utility networks (smart grids), transportation (automobiles, aircrafts), critical infrastructures (roads, bridges, harbors, airports), healthcare delivery systems, information technology networks, and so on. Due to the scale, complexity and uncertainty, cyber-physical systems operating with human in the loop pose significant computing and networking challenges including vulnerability, reliability and sustainability issues. My cutting-edge research is inter-disciplinary, spans fundamental theory and practice, and aims at addressing emerging challenges in cyber-physical-social systems.

My Erdős number is 3 and h-index is 56 as per Google Scholar. I have graduated 34 PhD students. To learn more about my research publications, Google “DBLP: Sajal K. Das”. If you are looking for fun-loving yet challenging research projects, please talk to me. My door is always open for the students.

Selected Publications

Journals


Conference Proceedings


Books


Recent Grants


Meet the Faculty in Computer Science

Fikret Ercal
Professor

314 Computer Science Bldg.
(573) 341-4857
ercal@mst.edu
http://web.mst.edu/~ercal


Areas of Interest
Parallel and Distributed Processing, Bioinformatics, Image Processing, Computer Vision, and Neural Networks.

My recent research work is in Bioinformatics, particularly in “Gene Family Identification” which requires close collaboration with colleagues from Biological Sciences. A gene family is a set of genes defined by common ancestry (presumed homology). We are also developing fast automated methods for the identification of functionally significant inverted repeats in whole genomes. The species under consideration are Arabidopsis and Soybean.

My PhD work was in parallel and distributed computing. Therefore, I always prefer to work in areas of science and engineering where high performance computing is critically needed. Bioinformatics, computer vision, and image processing are such areas. I have published many articles in these areas and served on the editorial boards of several journals, on the UM Research Board, and as the co-Program and co-General chair for the annual BioSP3 workshop. I’m a IEEE Golden Core Member, recipient of Meritorious Service Award from IEEE Computer Society in 2001, and recipient of three Faculty Excellence Awards from Missouri S&T and a Best Paper Award.

Selected Publications


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University of Tehran, Iran, B.S., 1970, University of Iowa, M.S., 1978, University of Central Florida, Ph.D., 1980.

Areas of Interest  
Parallel and Distributed Systems, Databases, Multi-Databases, Pervasive and Mobile Computing.

With the advance in technology, the data distribution issue has evolved to data integration from heterogeneous sources. Multidatabases are designed to allow access to heterogeneous and autonomous data sources.

The concept of mobility has introduced additional complexities and restrictions in multidatabase systems: reduced capacity network connection, processing, resource, and power restrictions.

An extended multidatabase system that facilitates “anytime, anywhere” access to information is called a Mobile Data Access System (MDAS).

Within the scope of MDAS, we distinguish three classes of services: Broadcast based services, On-demand based services, and Pervasive based services. Within the scope of broadcasting, we introduce and evaluate algorithms that address: data allocation and retrieval on single and parallel channels, application of indexing on the air channel(s), access conflict and conflict resolution, and power management.

Within the scope of on-demand services with regard to technological limitations, we introduce and analyze solutions that address: query processing, location dependent, location awareness, continuous queries, application of mobile agents, multimedia data processing, transaction processing, power management, ad hoc networking, caching, and security.

Selected Publications  
Books/Book Chapters


Journals


Conference Proceedings


Recent Grants


Meet the Faculty in Computer Science

Wei Jiang
Assistant Professor

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University of Iowa, B.S., 2002, Purdue University, M.S., 2004, Ph.D., 2008

Areas of Interest
Privacy, Security, Data Mining and Databases: Security and Privacy issues raised by data integration and distributed Data Mining techniques; Security issues in Databases and Federated Search; Applied Cryptography and Secure Multi-Party Computation techniques; Document anonymization to prevent the disclosure of sensitive attributes.

Privacy and data utility are often perceived to be at odds. An omniscient data source would have many benefits, particularly in support of data analysis and information retrieval. However, an omniscient data source eases misuse, such as the growing problem of identity theft. What we need is the ability to compute the desired “beneficial outcome” of sharing data for mining or analysis without having to actually share or disclose data. Secure multi-party computation (SMC) has emerged as an answer to this problem. Informally, if a protocol (in a distribute environment) meets the SMC definitions, the participating parties learn merely the final result and whatever can be inferred from the final result and their own inputs.

Based on the concept of SMC, my main research focuses on designing SMC-based computationally efficient protocols and models to facilitate privacy-preserving data analysis and information retrieval tasks.

Selected Publications


Wei Jiang, Mummoorthy Murugesan, Chris Clifton and Luo Si, “Similar Document Detection with Limited Information Disclosure”, the 24th International Conference on Data Engineering (ICDE08), Cancun, Mexico, April 7-12, 2008.


Recent Grants


University of Missouri Research Board (UMRB) “Earthquake Information System Based on Sensors in Mobile Phones”, $38,000, Co-PI, 8/09-7/10.
Meet the Faculty in Computer Science

Jennifer Leopold
Associate Professor
Interim Graduate Coordinator

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Areas of Interest
Qualitative Spatial Reasoning, Programming Languages, Scientific Visualization, Ontologies, Database Accessibility and Analysis.

My research interests range broadly in end-user programming environments, with particular focus on database accessibility and analysis, and scientific visualization. I have pursued those interests through research projects in the field of bioinformatics, wherein the end-users are scientists (untrained as programmers or IT professionals) who need to analyze large quantities of complex data. In particular, I have been interested in developing and studying the use of software tools that will allow such end-users to use powerful information technology to enhance their research, without the need for traditional programming training.

Selected Publications


Recent Grants

Meet the Faculty in Computer Science


Smitha Sundareswaran, Anna Squicciarini, Dan Lin, Shuo Huang, “Ensuring Distributed Accountability for Data Sharing in the Cloud”, in IEEE Transactions on Dependable and Secure Computing (TDSC), 2012.


Jianzhong Qi, Rui Zhang, Lars Kulik, Dan Lin, Yuan Xue, “The Min-dist Location Selection Query”, In International Conference on Data Engineering (ICDE), 2012.


Selected Publications

Dan Lin

Recent Grants

National Science Foundation (NSF) “Brokerage Services for the Next Generation Cloud”, 09/01/2012--08/30/2014.

University of Missouri Research Board (UMRB) “Efficient Processing of Keyword Search in Spatial Databases”, 02/2012-01/2013.

Areas of Interest

My research interests cover many areas in the fields of database systems and information security, especially spatial-temporal databases and access control policy analysis. I have been working on moving object databases for years. Applications related to moving objects (e.g. vehicles, users of wireless devices) have become more and more popular attributed to the advances in positioning technologies such as GPS and rapid developments of wireless communication devices. Such applications contain a large amount of frequently updated moving objects which cannot be well supported by the traditional databases. In order to efficiently manage moving objects, I have proposed several moving object indexing and querying techniques. Recently, I am also interested in the topic of location privacy protection which aims to protect users’ location information from being disclosed to unauthorized parties.

Information security is always a big concern in many applications. My other research interest lies in developing tools for managing and analyzing access control policies in the scenario of distributed applications like grid computing, content distribution networks, and the cloud.

My research in one area has helped me find new research problems in other areas, and inspired new approaches.
Selected Publications


Recent Grants


Selected Publications


Conference Proceedings


Recent Grants


National Science Foundation (NSF), NSF I/UCRC Center Grant on “Net-Centric Software Systems”, $316K, 2012-2017

National Science Foundation (NSF), NSF I/UCRC Center Planning Grant on “Net-Centric Software Systems” (Spring 2012) NSF, $13,000, 2012-2014

Meet the Faculty in Computer Science

Selected Publications


Recent Grants


Selected Publications


Meet the Faculty in Computer Science

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**Areas of Interest**
Computational Intelligence with emphasis on Meta-Heuristic Techniques inspired by nature such as Evolutionary Algorithms with applications in Cyber Security, Critical Infrastructure Protection, and Automated Software Engineering.

Modern society is faced with ever more complex problems that have so many potential solutions that even all the computers on the planet put together cannot exhaustively try them all to determine the best solution. Think of, for example, developing new cancer medications, modeling the stock market, designing super-efficient circuit diagrams, identifying the most critical threats to our critical infrastructures and corresponding defenses, and many more! These problems have in common the extremely large number of potential solutions as well as that we do not need necessarily the theoretically best solution, but would be satisfied with a ‘good enough’ solution. Heuristic search algorithms are a type of algorithm which employs ‘rules of thumb’ to efficiently search for a ‘good enough’ solution; they obtain their efficiency at the expense of losing any guarantee of finding the theoretical best solution. My favorite type of heuristic search algorithm is the Evolutionary Algorithm (EA), because it performs well over a wide variety of really hard types of problems. EAs are stochastic, population-based heuristic search algorithms inspired by neo-Darwinian evolution theory and Mendelian genetics.

**Selected Publications**


**Recent Grants**


**University of La Verne** “Computational Intelligence Techniques for Virtual Facilitation”. (PI, 100% credit), $57,066, 6/1/2011-8/15/2012.

**Sandia National Laboratories (SNL)** “Computational Intelligence Techniques for Malware Classification”, (PI, 100% credit), $39,996, 1/15/2011-8/15/2011, Sandia National Laboratories.

Selected Publications


Recent Grants


Mid-America Transportation Center (MATC), “Develop a Robotic UAV Platform for Automated Bridge Inspection”, 08/13-12/14, Mid-America Transportation Center, $30,000.00

National Science Foundation (NSF), “Infrastructure to Support Integrated Research and Education in Socially Intelligent Computing at Missouri S&T”, $281,680, 06/12-05/14.

Mid-America Transportation Center (MATC), “A Quadcopter with Heterogeneous Sensors for Autonomous Bridge Inspection”, $26,388, 08/12-12/13.


University of Missouri Research Board (UMRB), “Model-driven Microscopy Image Analysis for Stem Cell Discovery”, $36,000, 06/12-12/14.

Areas of Interests

I am interested in software and computing technologies that are theoretically-sound and practically-applicable in civilian, military, healthcare and multimedia applications. To that end, I am particularly interested in perception, sensor fusion, learning methods that can make these technologies as realities. I have been working on single or multi-camera visual information processing for detecting, tracking, and recognizing objects. These research activities lead to algorithms and software capable of understanding object behaviors in biomedical and natural scene images.

Biomedical. The data explosion by recording microscopy images during high-throughput experiments makes the labor-intensive manual analysis prohibitive. I have been working on a large-scale cell tracking system for stem cell engineering and discovery.

Natural scenes. Different types of sensors such as radar and color/thermal/depth cameras allow us to measure 3D scene structures, infer the identity and location of objects, and recognize the dynamic activities and events. An active system with robotic actuators can response to the perception based on the high-level cognition.
David M. Mentis  
Teaching Associate

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Southwest Missouri State University, BS, 1979,  
Missouri S&T, M.S., 1986

Department Service  
• Systems Administrator for Computer Science

Teaching Interests  
• CS 053 : Introduction to Programming with C++  
• CS 074 : Introduction to Programming Methodology  
• CS 078 : Programming Methodology Laboratory  
• CS 128 : Discrete Mathematics for Computer Science  
• CS 228 : Introduction to Numerical Methods  
• CS 238 : File Structures and Introduction to Database Systems  
• CS 253 : Algorithms

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The University of Texas, B.S., 2000, Texas  
Tech University, Ph.D., 2010

Department Service  
• Faculty Advisor for ACM SIG-Competition

Teaching Interests  
• CS 053 : Introduction to Programming with C++  
• CS 153 : Data Structures  
• CS 128 : Discrete Mathematics For Computer Science  
• CS 253 : Algorithms

Research Interest  
Answer Set Programming, Declarative Programming Languages, Knowledge Representation and Formal Program Verification.

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Missouri S&T, BS, 1980, M.S., 1985 & 1990

Department Service  
• Freshman and Transfer Student Advisor  
• Department Chair Assistant  
• CS 53/54 Coordinator

Teaching Interests  
• CS 001 : Introduction to Computer Science  
• CS 053 : Introduction to Programming with C++  
• CS 054 : C++ Programming Lab  
• CS 153 : Data Structures I  
• CS 228 : Introduction to Numerical Analysis  
• CS 328 : Object Oriented Numerical Modeling I

Recent Awards  
• S&T Faculty Achievement Award 2009 and 2012  
• Outstanding Teaching Award 2010-2011
Meet the Joint faculty, Adjunct Faculty and Staff in Computer Science

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Graduate School at Missouri S&T  
Master of Science in Computer Science

The Computer Science faculty at Missouri S&T has an active research programs with a broad range of scholarly interests. These interests include distributed/embedded computing, security, algorithms and complexity, data mining, artificial intelligence, machine learning, software quality, formal methods, internet computing, database systems, graphical user interfaces, parallel computing, and wireless computing. Our current student population boasts a GRE quantitative score of 730 and a written score of 4.5.

Research within the department may be disciplinary or interdisciplinary. Often Missouri S&T Computer Science graduate students work in a large group setting with faculty from many departments examining advanced research problems in Software Engineering and Critical Infrastructure Protection.

Cooperation between students and faculty at this advanced level is a hallmark of Missouri S&T Computer Science research. For the M.S. in Computer Science, the department philosophy is to have the student take a substantial fraction of his or her work in one of the principal areas. The student may choose the thesis or non-thesis option.

Entrance Requirements

Applicants are expected to have the following minimum qualifications before being admitted as a "regular" graduate student:

1. A minimum GRE verbal score of 370 new system 144, effective November, 2011.
3. A minimum GRE WR score >=4.0
4. A minimum TOEFL score of 570 (CBT >=230 OR IBT >=89 OR IELTS 7 or above), for those students not speaking English as their native language
5. An undergraduate GPA of 3.0/4.0 or better over the last 2 years, or successful completion of 12 graduate Hours in Computer Science as a "conditional" graduate student at Missouri S&T with at least a 3.0 GPA.
6. Knowledge of the following:
   1. Strong Math Skills
   2. Competency in a modern programming language
   3. Computer Science Core including
      1. Algorithms & Data Structures
      2. Computer Organization/Architecture
      3. Database & File structures
      4. Discrete Mathematics & Automata
      5. Operating Systems
      6. Software Engineering

*Masters Degree Students are expected to satisfy their 400 level course requirements using Computer Science courses.*

Applying

Refer to the Graduate Catalog for current guidelines.

Thesis Option

The M.S. degree with thesis requires the completion of 25 hours of graduate course work (a minimum of 12 at the 400 level in CS lecture courses and 1 credit hour of CS 410 Seminar), 6-9 hours of research, and the successful completion and defense of a research thesis.
Non-Thesis Option

The M.S. degree without thesis requires the completion of 31 hours of graduate coursework (a minimum of 18 at the 400 level in CS lecture courses and 1 credit hour of CS 410 Seminar).

Required Courses

All M.S. students must enroll in and satisfactorily complete CS 325 - Analysis of Algorithms prior to completing their M.S. program, if not already taken. Seminar CS 410 (1 semester 1 credit hour).

Master's Degree Program in Computer Science:

A student who completes a graduate certificate program in computer science with grades of B or better may be admitted into the master's degree program in computer science at the Missouri University of Science and Technology.

Students may need to complete additional prerequisite requirements before they are classified as "regular" graduate students.

Emphasis Areas

Currently, there are two emphasis areas in the CS Department:

Critical Infrastructure Protection Emphasis Area

Critical Infrastructure Protection is a multi-disciplinary study dedicated to improving the security, reliability, and survivability of the infrastructure that play a vital role in the effective functioning of our nation. Missouri S&T's specialty focuses on the critical hardware/software integrated systems that make up the nation's critical infrastructure. Missouri S&T's CS Department focuses on the Software Engineering aspects of Critical Infrastructure Systems, Wireless Computing Technologies, Artificial Intelligence, Distributed Computing, Security, Fault Tolerance, and Visualization. The intention is to improve the quality, survivability, security, and reliability of critical systems using the broadest-based technology possible, to grow a workforce aware of and trained in security (physical and cyber), and to stimulate the economic viability of US corporations and institutions by improving the security, reliability, and survivability of their critical infrastructure.

To obtain an emphasis in Critical Infrastructure Protection, the student takes at least four out of the following courses as part of their M.S. degree program (two of them must be at 400 level):

- **Software Testing and Quality Assurance (CS 307)**: unit, subsystem, system, object-oriented, and specification, testing, software quality.
- **Object Oriented Analysis and Design (CS 308)**: principles, mechanisms, and methodologies in object-oriented analysis and design.
- **Computer Communications and Networks (CS 365)**: network architecture model, security, and wireless with implementations.
- **Distributed Operating Systems (CS 384)**: algorithms used in the creation of modern (distributed) operating systems.
- **Computer Security (CS 463)**: vulnerabilities and threats to information in cyberspace, principles and techniques for preventing and detecting threats, and recovering from attacks.
- **Mobile and Sensor Data Management (CS 467)**: architectures, Mobile-IP, broadcasting, replication, caching fault tolerance, ad hoc and sensor routing, keys.
- **Distributed Systems Theory and Analysis (CS 484)**: advanced analysis using formal methods.

Software Engineering Emphasis Area

Missouri S&T's Computer Science program provides a full unified software lifecycle experience over the entire course of the student's CS education at Missouri S&T. This experience includes software project management in its many roles, ranging from overall project management and process improvement to the management of individual lifecycle components, including software deployment and evolution. Missouri S&T's software engineering research program specializes in software quality, software testing, hardware/software co-design, and formal methods of software specification and verification, software requirements engineering and software process improvement, and algorithm theory.
To obtain an emphasis in Software Engineering, the student takes the following courses as part of their M.S. degree program:

**Software Testing and Quality Assurance (CS 307):** unit, subsystem, system, object-oriented, and specification, testing, software quality.

**Object Oriented Analysis and Design (CS 308):** principles, mechanisms, and methodologies in object-oriented analysis and design.

**Software Engineering II (CS 406):** software metric used in the life cycle.

**Software Requirements Engineering, (CS 409):** elicitation of software requirements.

**Departmental Seminars**

The Computer Science Department sponsors seminars presented by a combination of departmental faculty members, graduate students, and external speakers. Regular attendance is required by all graduate students. Specifically, M.S. students are required to take the graduate seminar course once in their graduate studies.

**Financial Aid**

A limited amount of financial assistance is available to graduate students at Missouri S&T in the form of assistantships and fellowships. Half-time assistants devote approximately 20 hours per week to laboratory supervision or other departmental duties, including research, and/or teaching, and receive a stipend of $14,500 per academic year for the 2002-2003 school year. Applications for these assistantships may be obtained here. They should be returned before March 1 or November 1, with notification of acceptance or rejection by approximately June 1 or January 1, for the Fall or Spring Semesters, respectively.

All applicants for a Graduate Teaching Assistantship (GTA) MUST satisfactorily complete a five-day Instructional Communication Workshop during the week prior to registration week. One aspect of this workshop is the assessment period at the end of the workshop. Each individual will demonstrate the ability to communicate by presenting a brief introduction to a subject in the appropriate discipline. A panel of four individuals, one from the workshop faculty, two students, and one faculty member from the potential teaching assistants' department, will evaluate the candidates' performance at the end of the workshop. A GTA may be granted to the individual only if this assessment period is judged satisfactory.

**Graduate Certificate Programs In Computer Science**

**What is a Graduate Certificate Program?**

Graduate Certificate programs give students the opportunity to increase their knowledge in specific areas of interest. These courses provide students with the latest knowledge and skills in strategic areas of computing and are presented by Missouri University of Science and Technology instructors that are experts in their fields. Most of the courses will be offered through distance education over the internet. Distance education courses use streaming internet video for course delivery. In this setting, students actively participate in classes through viewing the class on their computer while being interactively connected with the class by telephone. Lectures are archived so they may be reviewed at any time during the semester. Instructors are available outside of class time by e-mail and telephone. Where there is sufficient interest, some courses may be taught by traditional instruction methods at Missouri S&T off site locations such as Ft. Leonard Wood, St. Louis, and Springfield, MO.

The Software Design and Development Certificate provides an attractive option for the working professional to expand their experience in Software Engineering. The core of four classes gives a treatment of software project management in its many roles, from overall project management and process improvement to the management of individual lifecycle components, including software deployment and evolution. Specialized coursework gives depth in advanced object-oriented design, software quality and testing theory and practice, and an advanced treatment of software metric.
The Information Systems & Cloud Computing certificate is tailored to the working professional who wants to expand their knowledge of advanced data management technologies. Object-oriented database structure, data mining, multimedia storage and retrieval techniques form the core of the study.

The Wireless Networks and Mobile Systems Certificate is designed to provide students an intensive treatment in wireless systems and applications. Program coverage includes network architecture and protocols, computer communication and networking basics, principles of network security, and techniques for preventing, detecting and recovering from attacks, as well as advanced topics that address the specific issues and challenges in the wireless and mobile environment, including wireless network provisioning and deployment, location and mobility management, security and privacy, attacks and counter measures, mobile computing applications, and data management in networked sensor systems. There is a high industrial appeal in these timely topics making this certificate extremely attractive from a distance and continuing education standpoint.

Entrance Requirements & Course Descriptions:

The only entrance requirements for students entering a Graduate Certificate Program are that they satisfy the prerequisites for any course they take in the program. Complete course descriptions are provided online at http://catalog.mst.edu/graduate/.

Course Descriptions:

**Software Design & Development**

- **Software Testing and Quality Assurance (CS 307):** unit, subsystem, system, object-oriented, and specification, testing, software quality
- **Object Oriented Analysis and Design (CS 308):** principles, mechanisms, and methodologies in object-oriented analysis and design
- **Software Engineering II (CS 406):** software metric used in the life cycle
- **Software Requirements Engineering (CS 409):** covers all the activities involved in discovering, analyzing, specifying, and managing software requirements for software system from multiple perspectives

**Wireless Networks and Mobile Systems**

- **Computer Communications and Networks (CS 365):** network architecture model, security, and wireless with implementations
- **Heterogeneous and Mobile Databases (CS 438):** Extensively discusses multidatabase systems (MDBS) and mobile data access systems (MDAS), moreover it will study traditional distributed database issues within the framework of MDBSs and MDASs.
- **Privacy Preserving Data Integration and Analysis (CS 461):** Covers basic tools, in statistics and cryptography, commonly used to design privacy-preserving and secure protocols in a distributed environment as well as recent advances in the field of privacy-preserving data analysis, data sanitization and information retrieval. Students are expected to complete a course project on a relevant topic of their choosing.
- **Computer Security (CS 463):** vulnerabilities and threats to information in cyberspace, principles and techniques for preventing and detecting threats, and recovering from attacks
- **Mobile and Sensor Data Management (CS 467):** architectures, Mobile-IP, broadcasting, replication, caching fault tolerance, ad hoc and sensor routing, key
- **Advanced Network Security (468)** Covered include network security issues such as authentication, anonymity, traceback, denial of service, confidentiality, forensics, etc. in wired and wireless networks

**Information Systems & Cloud Computing**

- **Introduction to Data Mining (CS 301):** This course provides an introduction to classical data mining methods which can be used to predict unknown or future values of variables, or to find human-interpretable patterns that describe data. Topics will include classification, clustering, association rule discovery, sequential pattern discovery, regression, and deviation/anomaly detection.
- **Cloud Computing (CS 401):** Cloud computing architecture, data management and indexing in cloud computing, security and privacy issues in cloud computing, scheduling and cost analysis, sensor and mobile cloud, Ajax/mapreduce and EC3 cloud. Prerequisite: Instructor’s permission and knowledge of operating systems, databases, distributed computing, and a programming language.
- **Heterogeneous and Mobile Databases (CS 438):** This course extensively discusses multidatabase systems (MDBS) and mobile data access systems (MDAS), moreover it will study traditional distributed database issues within the framework of MDBSs and MDASs.

Students choose one of the following:

- **Database Systems (CS 338):** This course introduces the advanced database concepts of normalization and functional dependencies, transaction models, concurrency and locking, timestamping, serializability, recovery techniques, and query planning and optimi-
zation. Students will participate in programming projects. This course assumes students have an introductory course in database systems.

**Data Mining & Knowledge Discovery (CS 444)** Data mining and knowledge discovery utilizes both classical and new algorithms, such as machine learning and neural networks, to discover previously unknown relationships in data. Key data mining issues to be addressed include knowledge representation and knowledge acquisition (automated learning).

**Privacy Preserving Data Integration and Analysis (CS 461)** This course covers basic tools, in statistics and cryptography, commonly used to design privacy-preserving and secure protocols in a distributed environment as well as recent advances in the field of privacy-preserving data analysis, data sanitization and information retrieval. Students are expected to complete a course project on a relevant topic of their choosing.

**Information Assurance & Security Officer Essentials**
Protecting information systems is key to protecting the nation’s critical infrastructures. Only through diligence and a well-trained workforce will we be able to adequately defend the nation’s vital information resources. Missouri S&T is Certified by the National Security Agency (NSA) Committee on National Security Systems (CNSS) for National Standards 4011 (National Training Standard for Information Systems Security (INFOSEC) Professionals) and 4014E (Information Assurance Training Standard for Information Systems Security Officers (ISSO)).

The certificate will be awarded in the department of the student’s choice (Computer Science or Computer Engineering) by completing four three-credit courses from the following list:

- **Intellectual Property for Computer Scientists (CS 317):** A presentation of the relationship between the law of intellectual property and computer science.
- **Security Operations & Program Management (CS 362):** An overview of information security operations.
- **Trustworthy, Survivable Computer Networks (CpE 349):** Basic issues in network management, testing, and security.
- **Network-Centric Systems Reliability & Security (CpE 449/ SE 449):** Network-centric systems comprise a diverse category of large and complex systems whose primary purpose is to provide distributed, network-type services.
- **Advanced Network Security (CS 468):** network security issues such as authentication, anonymity, traceback, denial of service, confidentiality, forensics, etc. in wired and wireless networks.

**Computational Intelligence**
Recent advances in information technology and the increased level of interconnectivity that society has achieved through Internet and broadband communication technology created systems that are very much different. The world is facing an increasing level of systems integration leading towards Systems of Systems (SoS) that adapt to changing environmental conditions. The number of connections between components, the diversity of the components and the way the components are organized can lead to different emergent system behavior. Computational Intelligence tools are an integral part of these systems in enabling adaptive capability in their design and operation.

This graduate certificate program provides practicing engineers the opportunity to develop the necessary skills in the use and development of computational intelligence algorithms based on evolutionary computation, neural networks, fuzzy logic, and complex systems theory. Engineers can also learn how to integrate common sense reasoning with computational intelligence elective courses such as data mining and knowledge discovery.

**Core Course**

- **Computational Intelligence (CpE 358/ EE367/ SysEng 367):** Introduction to Computational Intelligence (CI), Biological and Artificial Neuron, Neural Networks, Evolutionary Computing, Swarm Intelligence, Artificial Immune Systems, Fuzzy Systems, and Hybrid Systems.

And select one of the following:

- **Introduction to Artificial Intelligence (CS 347):** A modern introduction to AI, covering important topics of current interest such as search algorithms
- **Evolutionary Computing (CS 348):** Introduces evolutionary algorithms, a class of stochastic, population-based algorithms inspired by natural evolution theory
- **Introduction to Neural networks and Applications (SysEng 378/ CS 378/ EE 368):** Introduction to artificial neural network architectures, adaline, madaline, back propagation, BAM, and Hopfield memory, counter propagation networks,
Elective Courses (Select two courses not taken as a core course):

- Evolvable Hardware (EE/CpE/Sys Eng 301)
- Neural Networks for Control (EE 337)
- Introduction to Artificial Intelligence (CS 347)
- Evolutionary Computing (CS 348)
- Introduction to Neural networks and Applications (SysEng 378/CS 378/EE 368)
- Data Mining and Knowledge Discovery (SysEng 404/CpE 404/CS 444)
- Advanced Topics in Artificial Intelligence (CS 447)
- Advanced Evolutionary Computing (CS 448)
- Markov Decision Processes (CpE/SysEng/EE 457)
- Adaptive Critic Designs (SysEng/CpE/EE 458)
- Advanced Neural Networks (SysEng 478)

**Systems and Software Architecture Certificate**

The systems and software architect fills a critical role in today’s development process, transforming market inputs into the requirements and architecture specification of a product that independent (often remote) development teams can implement. Requests from industrial partners have led to a focused graduate certificate training program on Systems and Software Architecture containing coursework as follows:

**Object-Oriented Analysis and Design (CmpSci 308, LEC 3.0):** This course will explore principles, mechanisms, and methodologies in object-oriented analysis and design. An object-oriented programming language will be used as the vehicle for the exploration. Offered via distance and on-campus.

**Software Requirements Engineering (CmpSci 409, LEC 3.0):** Software Requirements Engineering covers all the activities involved in discovering, analyzing, specifying and managing software requirements for a software system from multiple perspectives. Students will study how to elicit, analyze, specify, validate, and manage software requirements using advanced software requirements engineering methods. Offered via distance and on-campus.

**Software Intensive Systems Architecting (SysEng 470, LEC 3.0):** Provides the basic tools and concepts of architecting complex software intensive systems. The following topics are covered under four main sections: Architecting Process, Architecting Heuristics, Architecting Patterns and Frameworks, and Architecture Assessment. Offered via distance and on-campus.

**Model Based Systems Engineering (SysEng 435/CmpSci 405, LEC 3.0):** Provides the student with an understanding of the use of models to represent systems and the underlying system elements, components, etc. The student will gain proficiency in using a systems modeling language and how it can be used to shift systems engineering from a document centric paradigm to one that is model centric. Offered via distance and on-campus.

For more information on the Graduate Certificate Programs see the DCE information page [http://dce.mst.edu/](http://dce.mst.edu/).
Admission Requirements

Application is made to the Missouri S&T admissions office along with the required transcripts, etc. Applicants who do not have a graduate degree will normally request admission to the M.S. program first. Applicants must submit a letter outlining tentative research interests and career goals along with GRE verbal, quantitative and analytical writing test scores. Admission into the Ph.D. program in Computer Science is granted by majority vote of the Computer Science Graduate Faculty, demonstration of supervisory interest by a faculty member, and approval of the Vice Provost of Graduate Studies.

A student with only a B.S. interested in Ph.D. study may be admitted, at the discretion of the faculty, directly into the Ph.D. program. The student will be expected to meet all requirements for the M.S. and Ph.D. programs. Examination schedules for the Ph.D. program will apply. Thus, the student must pass the Ph.D. academic programs/qualifier within the three semesters of admission, and continue to following all Ph.D. timelines. All M.S. minimums must apply for admission and a faculty member must demonstrate interest in admitting the candidate to the Ph.D. program.

Required Courses

All Ph.D. students must enroll in and satisfactorily complete CS 325 -Analysis of Algorithms prior to completing their Ph.D. program, if not already taken. Seminar CS 410 (3 semester 1 credit hour per semester).

Qualifying Examination

To pass the Ph.D. qualifying examination, a student must pass both a written and oral examination. The written and oral portions of the qualifying examination may each be taken no more than twice.

The Ph.D. Qualifier consists of 3 parts:

- Required: Algorithms (CS 325 content)

Choose two of the following:

- Software Engineering (CS 406 content)
- Architecture (CS 388 content)
- Database Systems (CS 338 content)
- Artificial Intelligence (CS 347 content)
- Distributed Operating Systems (CS 384 content) or Computer Networks (CS 365 content) not both

If a student fails an exam from an elective area, they can re-take in the same area or choose a different area.

Given the fundamental nature of the exam areas, all chosen areas must be taken during the same exam administration - individual area examinations are not allowed. All Ph.D. students are required to take the first attempt of the written portion of the Ph.D. qualifier examination within one year of starting the program. If students fail the exam on the first attempt, they are required to retake it the following semester. If students pass any subjects, they will not need to take the same subjects again. The examination is scheduled regularly at the start of Fall and Spring Semesters.

The Ph.D. research readiness exam should be finished in two years after Ph.D. admission. A Ph.D. student has two options of taking it: (1) A Ph.D. student submits a referred paper (published or accepted for publication) and a summary of his/her research activities, including his/her contribution to the paper, with his/her advisor’s approval, to the graduate committee for evaluation. (2) The student will select a topic of personal interest in Computer Science and review recent literature on the subject. Under the guidance of the advisor, an in-depth comparative paper will be prepared and presented to the departmental Graduate Policies and Procedures Committee. The student may be questioned on the paper and other closely related topics. It is not necessary that the subject have any bearing on the students proposed research, however, in the interest of efficiency, relevance is desired.

Ph.D. Advisory Committee

The Ph.D. advisory committee must be appointed and meet to outline the candidate's plan of study before the end of the next semester after the candidate passes the qualifying examination. If this is not done, the candidate will not be permitted to register the following semester. There will be a committee chair and a research advisor on the committee; this is normally the same person. The plan of study must follow all university guidelines. Additionally, the student's program of study must include at least 15 hours of 400 level computer science lecture courses.

Ph.D. Comprehensive Examination

The student's Ph.D. advisory committee will conduct the written and oral comprehensive examination. The subject matter, conduct of the examination, and certification of success or failure are entirely under the authority of the student's Advisory Committee, subject to the rules of the Graduate School. Refer to the Missouri S&T Graduate Bulletin for more information.

Research Proposal

The candidate must present and receive approval of his or her research proposal before beginning research for the dissertation. An appropriate time for the presentation would be during the oral portion of the comprehensive exam.

Residence Requirement

Refer to the Graduate Catalog for information.
COMP SCI 301 Special Problems (IND 0.0-6.0) Problems or readings on specific subjects or projects in the department. Consent of instructor required.

COMP SCI 302 Agile Software Development (LEC 3.0) Understand principles of agile software development and contrast them with prescriptive processes. Specifically: Eliciting, organizing, and prioritizing requirements; Design processes; Understand how a particular process promotes quality; Estimate costs and measure project progress and productivity. Prerequisite: A “C” or better grade in COMP SCI 206.

COMP SCI 307 Software Testing And Quality Assurance (LEC 3.0) It covers unit testing, subsystem testing, system testing, object-oriented testing, testing specification, test case management, software quality factors and criteria, software quality requirement analysis and specification, software process improvement, and software total quality management. Prerequisite: A “C” or better grade in COMP SCI 253.

COMP SCI 308 Object-Oriented Analysis And Design (LEC 3.0) This course will explore principles, mechanisms, and methodologies in object-oriented analysis and design. An object-oriented programming language will be used as the vehicle for the exploration. Prerequisite: A “C” or better grade in COMP SCI 253.

COMP SCI 310 Seminar (IND 0.0-6.0) Discussion of current topics. Prerequisite: Senior standing.

COMP SCI 317 Intellectual Property For Computer Scientists (LEC 3.0) A presentation of the relationship between the law of intellectual property and computer science. Topics include the application of copyright principles to computer programs, protection of computer programs through patents and trade secret law, and the effect of various agreements which are frequently encountered by the computer scientist. Prerequisite: Senior or graduate standing.

COMP SCI 325 Analysis Of Algorithms (LEC 3.0) The purpose of this course is to teach the techniques needed to analyze algorithms. The focus of the presentation is on the practical application of these techniques to such as sorting, backtracking, and graph algorithms. Prerequisite: A “C” or better grade in COMP SCI 253.

COMP SCI 328 Object-Oriented Numerical Modeling I (LEC 3.0) A study of object-oriented modeling of the scientific domain. Techniques and methodologies will be developed enabling the student to build a class library of reusable software appropriate for scientific application. Applications will be drawn from mechanics, finance, and engineering. Prerequisites: A “C” or better grade in both COMP SCI 228 and COMP SCI 153; a “C” or better grade in one of MATH 208, 203, 229.

COMP SCI 329 Object-Oriented Numerical Modeling II (LEC 3.0) A continued study of object-oriented modeling of the scientific domain. Advanced applications include models posed as balance laws, integral equations, and stochastic simulations. Prerequisite: A “C” or better grade in COMP SCI 328.

COMP SCI 338 Database Systems (LEC 3.0) This course introduces the advanced database concepts of normalization and functional dependencies, transaction models, concurrency and locking, timestamping, serializability, recovery techniques, and query planning and optimization. Students will participate in programming projects. Prerequisite: A “C” or better grade in both COMP SCI 128 and COMP SCI 238.


COMP SCI 345 Introduction to Robotics (LEC 3.0) This course provides an introduction to robotics, covering robot hardware, fundamental kinematics, trajectories, differential motion, robotic decision making, and an overview of current topics in robotics. Prerequisite: A “C” or better in both MATH 208 and COMP SCI 153. (Co-listed with COMP ENG 388 and ELEC ENG 388).

COMP SCI 346 Introduction to Computer Vision (LEC 3.0) This course introduces foundational theories and analysis methods in computer vision. Topics will include camera model and geometry, description of visual features, shape analysis, stereo reconstruction, motion and video processing, and visual object recognition. Prerequisites: A “C” or better grade in both Comp Sci 253 and Math 208.

COMP SCI 347 Introduction To Artificial Intelligence (LEC 3.0) A modern introduction to AI, covering important topics of current interest such as search algorithms, heuristics, game trees, knowledge representation, reasoning, computational intelligence, and machine learning. Students will implement course concepts covering selected AI topics. Prerequisite: A “C” or better grade in COMP SCI 253.

COMP SCI 348 Evolutionary Computing (LEC 3.0) Introduces evolutionary algorithms, a class of stochastic, population-based algorithms inspired by natural evolution theory (e.g., genetic algorithms), capable of solving complex problems for which other techniques fail. Students will implement course concepts, tackling science, engineering and/or business problems. Prerequisite: A “C” or better grade in both COMP SCI 253 and in a Statistics course.

COMP SCI 353 Multimedia Systems (LEC 3.0) This course introduces the concepts and components of Multimedia information systems. Topics include: Introduction to Multimedia Data, Multimedia Date Compression, Techniques and Standards, Indexing and Retrieval, Data Storage Organization, Communication and Synchronization, Applications-Media-OnDemand Systems, Video Conferencing, Digital Libraries. Prerequisite: A “C” or better grade in COMP SCI 153.

COMP SCI 354 Mathematical Logic I (LEC 3.0) A mathematical introduction to logic with some applications. Functional and relational languages, satisfaction, soundness and completeness theorems, compactness theorems. Examples from Mathematics, Philosophy, Computer Science, and/or Computer Engineering. Prerequisite: PHILOS 15 with junior standing or MATH 305 or COMP SCI 253 or COMP ENG 111. (Co-listed with MATH 354, PHILOS 354 and COMP ENG 354.).

COMP SCI 356 The Structure of a Compiler (LEC 3.0) Review of Backus normal form language descriptors and basic parsing concepts. Polish and matrix notation as intermediate forms, and target code representation. Introduction to the basic building blocks of a compiler: syntax scanning, expression translation, symbol table manipulation, code generation, local optimization, and storage allocation. Prerequisite: A “C” or better grade in both COMP SCI 256 and COMP SCI 253.
COMP SCI 358 Interactive Computer Graphics (LEC 3.0) Applications and functional capabilities of current computer graphics systems. Interactive graphics programming including windowing, clipping, segmentation, mathematical modeling, two and three dimensional transformations, data structures, perspective views, antialiasing and software design. Prerequisite: A “C” or better grade in both COMP SCI 228 and COMP SCI 253.

COMP SCI 362 Security Operations & Program Management (LEC 3.0) An overview of information security operations, access control, risk management, systems and application life cycle management, physical security, business continuity planning, telecommunications security, disaster recovery, software piracy, investigations, ethics and more. There will be extensive reporting, planning and policy writing. Prerequisite: A “C” or better grade in all of: operating systems, computer networking, and a writing emphasized course.

COMP SCI 365 Computer Communications And Networks (LEC 3.0) Network architecture model including physical protocols for data transmission and error detection/correction, data link concepts, LAN protocols, internetworking, reliable end to end service, security, and application services. Students will implement course concepts on an actual computer network. Prerequisite: A “C” or better grade in COMP SCI 284.

COMP SCI 366 Regression Analysis (LEC 3.0) Simple linear regression, multiple regression, regression diagnostics, multicollinearity, measures of influence and leverage, model selection techniques, polynomial models, regression with autocorrelated errors, introduction to non-linear regression. Prerequisites: MATH 22 and one of STAT 211, 213, 215, 217, or 343. (Co-listed with STAT 346).

COMP SCI 381 The Structure Of Operating Systems (LEC 3.0) The hardware and software requirements for operating systems for uniprocessing, multiprogramming, multiprocessing, time sharing, real time and virtual systems. The concepts of supervisors, interrupt handlers, input/output control systems, and memory mapping are discussed in detail. Prerequisite: A “C” or better grade in COMP SCI 284.

COMP SCI 384 Distributed Operating Systems (LEC 3.0) This is a study of modern operating systems, particularly distributed operating systems. Topics include a review of network systems and interprocess communication, causality, distributed state maintenance, failure detection, reconfiguration and recovery, load balancing, distributed file systems, distributed mutual exclusion, and stable property detection including deadlock detection. A group project in Distributed Systems programming will be required. Prerequisite: A “C” or better grade in both COMP SCI 284 and COMP SCI 253.

COMP SCI 387 Introduction to Parallel Programming and Algorithms (LEC 3.0) Parallel and pipelined algorithms, architectures, network topologies, message passing, process scheduling and synchronization. Parallel programming on clusters. Cost, speedup and efficiency analysis. Prerequisite: A “C” or better grade in both COMP SCI 284 and COMP SCI 253.

COMP SCI 388 Introduction to High Performance Computer Architecture (LEC 3.0) Overviews high performance architecture of computing systems and covers various architectural/hardware and software/algorithimic means that enhance performance. Uniprocessor and concurrent systems are investigated. Various computational models are studied and linked to commercial systems. Prerequisite: A “C” or better grade in both COMP SCI 328 and COMP SCI 253.

COMP SCI 390 Undergraduate Research (IND 0.0-6.0) Designed for the undergraduate student who wishes to engage in research. Does not lead to the preparation of a thesis. Not more than six (6) credit hours allowed for graduation credit. Subject and credit to be arranged with the faculty supervisor.

COMP SCI 397 Software Systems Development I (LEC 3.0) Class members will work in small teams to develop a complete software system beginning with end-user interviews and concluding with end-user training. Prerequisite: A “C” or better grade in COMP SCI 206 and 100 credit hours completed.

COMP SCI 398 Software Systems Development II (LEC 3.0) This course is an optional continuation of COMP SCI 397. Those interested in project management should take this course since participants become officers or group leaders in the class “corporation.” This course is especially important for those going straight into industry upon graduation. Students with co-op experience may find this course redundant. Prerequisite: A “C” or better grade in COMP SCI 397.

COMP SCI 400 Special Problems (IND 0.0-6.0) Problems or readings on specific subjects or projects in the department. Consent of instructor required.

COMP SCI 401 Special Topics (LEC 0.0-6.0) This course is designed to give the department an opportunity to test a new course. Variable title.

- Search-Based Software Engineering (LEC 3.0) This course will introduce students to re formulating software engineering problems from the life-cycle, requirements engineering to testing and evolution, as search problems by adapting different meta-heuristic search algorithms. Topics covered during this course include evolutionary testing, cost/effort prediction, multi-objective software management and requirements validation. Prerequisites: Comp Sci 347 or Comp Sci 348 and Comp Sci 206.
- Cryptography (Lec 3.0) Foundations of Cryptography including number theory, private and public key schemes and applications. Prerequisite: Graduate Standing
- Cloud Computing (LEC 3.0) Cloud computing architecture, data management and indexing in cloud computing, security and privacy issues in cloud computing, scheduling and cost analysis, sensor and mobile cloud, Ajax/mapreduce and EC3 cloud. Prerequisite: Instructor’s permission and knowledge of operating systems, databases, distributed computing, and a programming language.
- Network Information Analysis (LEC 3.0) This course covers modeling techniques and analytical methods to study the interaction of information and networks. The two main focuses are (1) models and properties of network structures; (2) diffusion of information over networks. The expected outcomes are systematic inference of information encoded in network structures, and effective methods to disseminate or gather information from networks. Prerequisites: Comp Sci 325 and Comp Sci 365.

COMP SCI 405 Model Based Systems Engineering (LEC 3.0) Provides the student with understanding of the use of models to represent systems and validate system architectures. The student will gain proficiency in using a systems modeling language and shifting systems engineering from a document centric to a model centric paradigm. Prerequisite: A “C” or better grade in both COMP SCI 206 and Sys Eng 433.

COMP SCI 406 Software Engineering II (LEC 3.0) A quantitative approach to measuring costs/productivity in software projects. The material covered will be software metrics used in the life cycle and the student will present topical material. Prerequisite: A “C” or better grade in COMP SCI 206.

COMP SCI 409 Software Requirements Engineering (LEC 3.0) This course will cover advanced methods, processes, and technique for discovering, analyzing, specifying and managing software requirements of a software system from multiple perspectives. It will discuss both functional and non-functional requirements analysis. Prerequisite: A “C” or better grade in COMP SCI 206.

COMP SCI 410 Seminar (RSD 1.0) Discussion of current topics.

COMP SCI 417 Network Performance Analysis (LEC 3.0) Provides an introduction to performance modeling and analysis of computer networks. Topics include stochastic processes; performance measurement and monitoring; quantitative models for network performance, e.g., Markovian models for queues; simulation; and statistical analysis of experiments. Prerequisites: COMP ENG 319 or COMP SCI 365; STAT 217 or 343. (Co-listed with COMP ENG 417).

COMP SCI 425 Algorithmics II (LEC 3.0) Covers selected classical and recent developments in the design and analysis of algorithms, such as sophisticated data structures, amortized complexity, advanced graph theory, and network flow techniques. Prerequisite: A “C” or better grade in COMP SCI 325.
COMP SCI 426 Theory Of Computation (LEC 3.0) Turing machines and other machines. Godel numbering and unsolvability results. Machines with restricted memory access and limited computing time. Recursive functions, computable functionals and the classification of unsolvable problems. Prerequisite: A "C" or better grade in COMP SCI 220.

COMP SCI 431 Pervasive Computing (LEC 3.0) Pervasive computing aims to seamlessly integrate computing with our everyday activities, so that people do not need to be aware of computing artifacts. This course will introduce various techniques needed to realize pervasive computing, such as position tracking and ad-hoc networking. Prerequisite: A "C" or better grade in either COMP SCI 365 or COMP ENG 319.

COMP SCI 437 Web Data Management and XML (LEC 3.0) Management of semi-structured data models and XML, query languages such as Xquery, XML indexing, and mapping of XML data to other data models and vice-versa, XML views and schema management, advanced topics include change-detection, web mining and security of XML data. Prerequisite: A "C" or better grade in COMP SCI 338.

COMP SCI 438 Heterogeneous and Mobile Databases (LEC 3.0) This course extensively discusses multidatabase systems (MDBS) and mobile data access systems (MDAS). Moreover, it will study traditional distributed database issues within the framework of MDBSs and MDASs. Prerequisite: A "C" or better grade in COMP SCI 338.

COMP SCI 439 Object-Oriented Database Systems (LEC 3.0) This course will include a study of the origins of object-oriented database manipulation languages, their evolution, currently available systems, application to the management of data, problem solving using the technology, and future directions. Prerequisite: A "C" or better grade in COMP SCI 308.

COMP SCI 444 Advanced Topics in Data Mining (LEC 3.0) Advanced topics of current interest in the field of data mining. This course involves reading seminal and state-of-the-art papers as well as conducting topical research projects including design, implementation, experimentation, analysis, and written and oral reporting components. Prerequisite: A "C" or better grade in COMP SCI 301 Introduction to Data Mining. (Co-listed with COMP ENG 404 and SYS ENG 404).

COMP SCI 447 Advanced Topics in Artificial Intelligence (LEC 3.0) Advanced topics of current interest in the field of artificial intelligence. This course involves reading seminal and state-of-the-art papers as well as conducting topical research projects including design, implementation, experimentation, analysis, and written and oral reporting components. Prerequisite: A "C" or better grade in one of COMP SCI 347, COMP SCI 348 or COMP ENG 358.

COMP SCI 448 Advanced Evolutionary Computing (LEC 3.0) Advanced topics in evolutionary algorithms, a class of stochastic, population-based algorithms inspired by natural evolution theory, capable of solving complex problems for which other techniques fail. Students will conduct challenging research projects involving advanced concept implementation, empirical studies, statistical analysis, and paper writing. Prerequisite: A "C" or better grade in COMP SCI 348.

COMP SCI 449 Clustering Algorithms (LEC 3.0) An introduction to cluster analysis and clustering algorithms rooted in computational intelligence, computer science and statistics. Clustering in sequential data, massive data and high dimensional data. Students will be evaluated by individual or group research projects and research presentations. Prerequisite: At least one graduate course in statistics, data mining, algorithms, computational intelligence, or neural networks, consistent with student's degree program. (Co-listed with COMP ENG 439, ELEC ENG 439, SYS ENG 439 and STAT 439).

COMP SCI 456 Theory Of Compiling (LEC 3.0) Properties of formal grammars and languages, language-preserving transformations, syntax-directed parsing, classes of parsing methods and the grammars for which they are suited, control flow analysis, and the theoretical framework of local and global program optimization methods. Prerequisite: A "C" or better grade in COMP SCI 356.

COMP SCI 457 Markov Decision Processes (LEC 3.0) Introduction to Markov Decision Processes and Dynamic Programming. Application to Inventory Control and other optimization and control topics. Prerequisite: Graduate standing in background of probability or statistics. (Co-listed with COMP ENG 457, MECH ENG 447, AERO ENG 457 and ENG MGT 457).

COMP SCI 458 Computer Graphics And Realistic Modeling (LEC 3.0) Algorithms, data structures, software design and strategies used to achieve realism in computer graphics of three-dimensional objects. Application of color, shading, texturing, antialiasing, solid modeling, hidden surface removal and image processing techniques. Prerequisite: A "C" or better grade in COMP SCI 358.

COMP SCI 461 Privacy Preserving Data Integration and Analysis (LEC 3.0) This course covers basic tools, in statistics and cryptography, commonly used to design privacy-preserving and secure protocols in a distributed environment as well as recent advances in the field of privacy-preserving data analysis, data sanitization and information retrieval. Prerequisite: A "C" or better grade in both COMP SCI 338 and Comp Sci 262.

COMP SCI 463 Computer Security (LEC 3.0) The course presents various vulnerabilities and threats to information in cyberspace and the principles and techniques for preventing and detecting threats, and recovering from attacks. The course deals with various aspects and layers of security: data-level, network-level, system-level, and application-level security. Prerequisite: A "C" or better grade in both COMP SCI 263 and COMP SCI 325.

COMP SCI 465 Advanced Topics in Wireless Networks (LEC 3.0) Introduces the fundamentals and recent advances in wireless networking. Coverage includes cellular networks, wireless and mobile ad hoc networks, wireless mesh networks, sensor networks and wireless LANs with a focus on network operation. Special topics selected from the literature on wireless network security will also be addressed. Prerequisite: A "C" or better grade in COMP SCI 365 or equivalent.

COMP SCI 467 Mobile And Sensor Data Management (LEC 3.0) Architectures of mobile computing systems; Mobile-IP support in mobile computing systems; localization data management, Broadcasting and indexing, replication control, caching, fault tolerance and reliability of mobile systems; adhoc and sensor routing schemes, key management. Prerequisite: COMP SCI 265.

COMP SCI 468 Advanced Network Security (LEC 3.0) Topics covered include network security issues such as authentication, anonymity, traceback, denial of service, confidentiality, forensics, etc. in wired and wireless networks. Students will have a clear, in-depth understanding of state of the art network security attacks and defenses. Prerequisite: A "C" or better grade in either COMP ENG 349 or COMP SCI 365.

COMP SCI 484 Distributed Systems Theory And Analysis (LEC 3.0) Analysis of the problems of state maintenance and correctness in concurrent computing systems using formal methods such as Hoare Logic, Temporal Logic, and Symbolic Model Checking. Prerequisite: A "C" or better grade in COMP SCI 347, COMP SCI 348 or COMP ENG 358.

COMP SCI 487 Topics in Parallel and Distributed Computing (LEC 3.0) Introduction of parallel and distributed computing fundamentals and advanced research topics. Students present research papers selected from the current literature on P&D computing paradigms. A term paper and oral presentation are required. Prerequisite: A "C" or better grade in COMP SCI 387 or equivalent background.

COMP SCI 490 Research (IND 0.0-16) Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

COMP SCI 493 Oral Examination (IND 0.0) After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

COMP SCI 495 Continuous Registration (IND 1.0) Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.
Description

Missouri S&T is the first Missouri university to be designated as a National Center of Academic Excellence in Information Assurance Education (CAEIAE) and is the first Missouri university to be designated as a National Center of Academic Excellence in Information Assurance Research (CAE-R). The website cae.mst.edu contains detailed information about the program. The designation is offered jointly by the U.S. National Security Agency and Department of Homeland Security. Missouri S&T is a member of an elite group of universities that meet the federal government’s criteria for providing educational and research opportunities in cyber-security.

The CAEIAE program is designed to reduce vulnerabilities in the national information infrastructure by promoting the study of “information assurance” in U.S. colleges and universities. The program also is designed to promote information assurance expertise in various disciplines. Missouri S&T offers a unique contribution to the information assurance field with our focus on developing ways to protect the nation’s electric power grid, oil, gas and water distribution systems, and transportation systems from terrorist attack. Much of that research occurs through Missouri S&T’s Center for Critical Infrastructure Protection (http://cs.mst.edu/facultystaffandfacilities/researchlabs/criticalinfrastructureprotectionlaboratory/).

Emphasis in Critical Infrastructure Protection

Critical Infrastructure Protection is a multi-disciplinary study dedicated to improving the security, reliability, and survivability of the infrastructures that play a vital role in the effective functioning of our nation. Missouri S&T’s specialty focuses on the critical hardware/software integrated systems that make up the nation’s critical infrastructures. Missouri S&T’s CS department focuses on the Software Engineering aspects of Critical Infrastructure Systems, Wireless Computing Technologies, Artificial Intelligence, Distributed Computing, Security, Fault Tolerance, and Visualization. The intention is to improve the quality, survivability, security, and reliability of critical systems using the broadest-based technology possible, to grow a workforce aware of and trained in security (physical and cyber), and to stimulate the economic viability of US corporations and institutions by improving the security, reliability, and survivability of their critical infrastructures.

Requirements

To obtain an emphasis in Critical Infrastructure Protection, the student takes at least four out of the following courses as part of their MS degree program (two of them must be at 400 level):

- Distributed Operating Systems (CS 384): algorithms used in the creation of modern (distributed) operating systems
- Distributed Systems Theory and Analysis (CS 484): advanced analysis using formal methods
- Computer Communications and Networks (CS 365): network architecture model, security, and wireless with implementations
- Computer Security (CS 463): vulnerabilities and threats to information in cyberspace, principles and techniques for preventing and detecting threats, and recovering from attacks
- Mobile and Sensor Data Management (CS 467): architectures, Mobile-IP, broadcasting, replication, caching fault tolerance, ad hoc and sensor routing, keys
- Software Testing and Quality Assurance (CS 307): unit, subsystem, system, object-oriented, and specification, testing, software quality
- Object Oriented Analysis and Design (CS 308): principles, mechanisms, and methodologies in object-oriented analysis and design
Professional & Honor Societies

The Association for Computing Machinery (ACM)

The Missouri University of Science and Technology student chapter of the Association for Computing Machinery was organized in 1962 and was the second one in the United States. The purpose of this active student organization is to provide information on the science and art of information processing, including the views of prominent speakers on many different Computer Science oriented topics. Topics of discussion at meetings include the study, design, development, and application of modern technology, computing techniques, and appropriate languages for general information processing, storage, retrieval, transmission/communication, and processing data of all kinds. Membership is available to any student interested in the organization’s activities, becoming involved in numerous campus computing activities, and sponsoring several informal social events each year. In 1981, the Missouri S&T Programming Team placed first in a field of ten teams at the site and first in a field of sixty teams in the Mid-Central Regional Programming Contest.

The Association for Computing Machinery-Women (ACM-W)

ACM-W is the Association for Computing Machinery Committee on Women in Computing. It celebrates, informs and supports women in computing, and works with the ACM-W community of computer scientists, educators, employers and policy makers to improve working and learning environments for women.

The Association for Computing Machinery-Special Interest Group – Security (ACM SIG Sec)

The Missouri S&T Association for Computing Machinery student branch Special Interest Group: Security (ACM SIG Sec) is a student group focused on computer & network security. SIG Sec meetings are bi-weekly, featuring a wide variety of speakers on topics ranging from software vulnerabilities and real-world tools to security projects and research.

The group also works on its own security projects, such as building antennas, (antennas made from soup, coffee or Pringles cans that increase the gain of wireless cards), wireless auditing (mapping open wireless access points so we can inform the owners), security auditing of student computers, and red team vs. blue team competition (controlled environment competition where each team defends their server from the attacks/attempted entry of the other team).
Upsilon Pi Epsilon (UPE)

Upsilon Pi Epsilon is the International Computer Science Honor Society. Missouri S&T has had a chapter since 1973. Each semester outstanding undergraduate and graduate students are invited to join. Members of the student chapter provide instruction for Boy Scout Merit Badge testing. During 1977-1979, the National President of UPE was a Missouri S&T faculty member.

Institute for Electrical and Electronic Engineers Computer Society (IEEE-CS)

The Missouri S&T Computer Society student branch of the IEEE (S&T CSSI) was established in Fall 2009. The primary purpose of the society is to promote and disseminate knowledge of the theory and practices of all aspects of computer science, computer engineering, electrical engineering, allied branches of engineering or the related arts and sciences, as well as the furtherance of the professional development of its members.

Computing Research Association (CRA)

The Computing Research Association (CRA) is an association of more than 200 North American academic departments of computer science, computer engineering, and related fields; laboratories and centers in industry, government, and academia engaging in basic computing research; and affiliated professional societies.
PREAMBLE
The Academy of Computer Science is established for the purpose of recognizing alumni for their outstanding professional achievement and success. It is to be an active organization serving as an advisor to the chair, faculty, and students of computer science.

MISSION
(1) To recognize computer science graduates who have provided outstanding leadership, have attained significant levels of professional achievement and success and who demonstrate high standards of personal and professional integrity.
(2) To provide advisory guidance and counsel at the call of the Dean of the College of Arts and Sciences, Chair of Computer Science, faculty, or students of the department.
(3) To strengthen the dedication and understanding of students to computer science through personal and professional example.
(4) To partner with the Computer Science Department to develop, advance and sponsor key programs of both the Academy and the department by identifying, securing, and providing financial support.

Academy Members

2012 academy inductees
Kent Lynn ‘85-IBM
Charles Marsh ‘76-ESCADA Americas

2011 academy inductees
Pam Leitterman ‘75-Hewlett Packard (retired)
Susan Rothschild ‘74-John T. Straub

2010 academy inductees
Thomas J. DePauw ‘73-Caterpillar Financial Services (retired)
Richard Lenz ‘74-Caterpillar Financial Services
John McNally ‘83-Panduit Corporation
Michael O. Vahle ‘71-Sandia

2009 academy inductees
Cindy Tang ‘85-Insight Industries, Inc.

2008 academy inductees
John R. Hock ‘82-IBM (Secretary/Treasurer)
Randy Kerns ‘74-Prostor Systems
Joan Woodard ‘73-Sandia (Director)

2007 academy inductees
Donald Gaitros ‘66-Baylor University
Herb Krasner ‘73-Krasner Consulting
Marcus Smith ‘76-Pabst Brewing Co.

2006 academy inductees
James Gantt ‘72-Center for Telecommunications System Mgt.
Adonica Randall ‘75-Connection Strategies Enterprises
Daniel A. Reed ‘78-Renaissance Computing Institute

2005 academy inductees
Karen Squires ‘89-Pearson Educational Measurement
(Past President)
Dean O. Swisher ‘70-MedSynergies (President)

2004 academy inductees
Margy A. Beckmeyer ‘73-Westinghouse Savannah River Co.
(Vice President)
Robert C. Feldman ‘80-The Boeing Co.
Ralph Szygenda ‘70-General Motors
Kim Wayne Tracy ‘85-Northeastern Illinois University
(Director)

2003 academy inductees
William A. Eaton ‘70-Intergrated Operations (retired)
Daniel C. Hirschbuehler ‘80-IBM
Jean K. Holley ‘81-Tellabs Center
Michael P. Koclanes ‘79-Creek Path Systems
John R. Lovitt ‘70-Rational Software (retired)
(Director)
Dan G. McNicholl ‘80 & ‘82-General Motors
Richard B. Schuessler ‘72 & ‘74-Washington University
Mark X. Stratman ‘73-Cap Gemini Ernst & Young
Susan E. Watson-Hajjar ‘83-IBM
Missouri S&T Computer Science Advisory Board

The Missouri S&T Computer Science Advisory board provides the following services to the Computer Science department at Missouri S&T:

Consultancy
Provide consultation and input for the Department on ways to improve the quality of the Department, the programs, and the learning environment.

Ambassadorship
Assist the Department by communicating the Department’s goals, programs, needs, and contributions to the community.

Sponsorship
Advance the objectives of the Department by identifying, securing, and providing resources needed for a successful program.

Computer Science Advisory Board Members List

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John Stone- 2003 - University of Illinois
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Computer Science
Students having Fun!!!

2012 Computer Science Picnic