COMMUNICATION METEOROLOGY—INTERDISCIPLINARY MINOR

A minor in the area of meteorological communication is available to students who wish to become informed interpreters and communicators of weather information to mass audiences via electronic and print media. The minor consists of 19 or more credits selected from courses in the Departments of Communication and the Earth Sciences and elsewhere as appropriate to individual goals.

Courses will be selected, by advisement, in various combinations depending on the individual’s background and major program.

For more information, contact Gustavo Pereira, Department of the Earth Sciences, (585) 395-2636.

DEPARTMENT OF COMPUTATIONAL SCIENCE

129 Smith Hall
(585) 395-2021
www.brockport.edu/cps/

Associate Professor and Chair: Robert E. Tuzun, PhD, University of Illinois/Urbana-Champaign; Empire Innovation Professor: Osman Yasar, PhD, University of Wisconsin/Madison; Associate Professor: Leigh J. Little, PhD, Arizona State University; Assistant Professor: Wensheng Shen, PhD, University of Kentucky, and PhD, Tennessee Technological University.

- Requirements
- Combined BS/MS Program
- Courses

Along with traditional experimental and theoretical methodologies, advanced work in all areas of science and engineering has come to rely critically on computation. Computer modeling combined with visualization represents a new paradigm for scientific exploration and technological research and development. It permits a new approach to problems that were previously inaccessible. The goal of the computational science program is to enable students to perform computational modeling in problems of technological and societal relevance. To this end, students learn a core set of skills in mathematics, computer programming, visualization, and simulation/modeling. Students may then apply these skills to application areas of interest to them.

Nearly all areas of science and engineering now use computers for modeling and problem solving. The aerospace industry uses this approach to design safe and economical aircraft. The automobile industry uses similar techniques to design better engines and safer vehicles. Computational technology is used in the medical and pharmaceutical industries to develop new drugs, interpret and construct visual images of medical data such as MRI, and to assist in medical procedures. Meteorologists use computational techniques to predict the weather and long-term climate changes. Ecologists and biologists use computer models to study the environment, population dynamics, and the influence of pollutants on the body, the air and the ocean. Economists use computers to predict future behavior of many financial systems, including the stock market. Computer modeling enables the study and performance testing of systems before they are put into production. This approach has saved billions of dollars and years of development time.

The Department of Computational Science has received equipment support from Sun, Intel and Silicon Graphics and works closely with local industry. The program is flexible so as to allow students to follow their particular interests and continue, if desired, with advanced degrees. Our
recent graduates have found employment in industrial, governmental, and educational settings such as Lockheed Martin, Boeing, Google, Paychex, General Electric, Ricoh, the United States Navy, and the Rochester City School District.

The Department of Computational Science has received equipment support from Intel and Silicon Graphics and works closely with local industry, particularly Xerox Corporation and Eastman Kodak Company. The program is flexible so as to allow students to follow their particular interests and continue, if desired, with advanced degrees. Graduates can expect employment in industry, government, business, academia, and at major research and development laboratories.

**Major in Computational Science**

The computational science undergraduate major requires 41 credits of the following courses from the Departments of Computational Science, Computer Science, and Mathematics and from the department of an application area of interest. Six additional credits of elective courses are required.

(a) **Required Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MTH 203</td>
<td>Calculus III</td>
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<tr>
<td>MTH 255</td>
<td>Ordinary Differential Equations</td>
</tr>
<tr>
<td>MTH 324</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>MTH 346</td>
<td>Probability and Statistics I</td>
</tr>
<tr>
<td>CPS 203</td>
<td>Fundamentals of Computer Science I</td>
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<tr>
<td>CPS 201</td>
<td>Computational Tools I</td>
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<tr>
<td>CPS 202</td>
<td>Computational Tools II</td>
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<tr>
<td>CPS 303</td>
<td>High Performance Computing</td>
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<td>Simulation and Modeling</td>
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<td>CPS 333</td>
<td>Scientific Computing</td>
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<tr>
<td>CPS 404</td>
<td>Applied and Computational Mathematics I</td>
</tr>
<tr>
<td>CPS 405</td>
<td>Applied and Computational Mathematics II</td>
</tr>
<tr>
<td>CPS 433</td>
<td>Scientific Visualization</td>
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</table>

(b) **Elective Courses**

Upper division CPS or non-CPS electives chosen under advisement 6

Total Credits (including electives): 47

(c) **Prerequisites**

Calculus I and II (MTH 201 and 202—8 credits)
Discrete Mathematics I (MTH 281—3 credits)
Introduction to Computer Science (CSC 120—3 credits)

**Minor in Computational Science**

(a) **Required Courses**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>CPS 201</td>
<td>Computational Tools I</td>
</tr>
<tr>
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</tr>
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<td>CPS 303</td>
<td>High Performance Computing</td>
</tr>
<tr>
<td>CPS 304</td>
<td>Simulation and Modeling</td>
</tr>
</tbody>
</table>

(b) **Elective Courses**

200-level and higher courses in math and sciences chosen under advisement 8

Total Credits (including electives): 20

(c) **Prerequisites**

Calculus III (MTH 203—4 credits)
Combined BS/MS Program in Computational Science
The combined BS/MS degree is designed for high-parameter students wishing to accelerate the pace of their studies and to receive bachelor’s and master’s degrees in computational science within five years. To be considered for entry into this program requires a GPA of at least 3.25, a written application, and interviews with the departmental undergraduate and graduate directors. In addition to the required courses listed above, the combined program requires undergraduate electives, duplicate requirements (simultaneously satisfying undergraduate elective and graduate core requirements), research experience, and graduate electives.

(a) Elective Courses
Upper level CPS and non-CPS courses chosen under advisement 6
(b) Duplicate Requirements
CPS 533 Scientific Visualization 3
CPS 602 Advanced Software Tools 3
CPS 604 Computational Methods in the Physical Sciences 3
CPS 644 Supercomputing and Applications 3
(c) Research Experience
CPS 698 Graduate Seminar 1
CPS 699* Independent Study 3
CPS 710 Thesis 3
* 3 credits of CPS 699 are required, but up to 9 total may be taken
(d) Elective Courses (chosen through advisement)
Four 600-level or higher graduate courses 12

Note: Information on graduate courses and electives may be found in the The College at Brockport 2009-2011 Graduate Studies Catalog.

Department of Computational Science Courses

CPS 101 Introduction to Computation (A,N).
Prerequisites: MTH 121 or instructor’s approval. An introduction to computation as used in science and engineering. Emphasizes practical applications of formulas to real-life problems and on tools for their solution. Topics include: (1) some basic techniques used in computational modeling (linear regression for data-fitting, determination of areas and volumes, rate of change, and use of graphical calculator), (2) essentials of programming in FORTRAN 90; and (3) essentials of the UNIX operating system (basic commands, editors, file manipulation). 3 Cr.

CPS 201 Computational Tools I (A).
Prerequisites: CSC 120 or CPS 101. A continuation of CPS 201. Emphasizes commonly encountered scientific programming libraries (BLAS, LAPACK, ATLAS). Model problems in numerical linear algebra are prehension. The notion of scalable design allows students to create interactive games first and then move up to educational games as well as more complex simulations and traditional programming practices. 3 Cr. Fall

CPS 202 Computational Tools II (A).
Prerequisite: CPS 201. A continuation of CPS 201. Emphasizes commonly encountered scientific programming libraries (BLAS, LAPACK, ATLAS). Model problems in numerical linear algebra are
heavily utilized. Topics include: advanced topics in Fortran 90 Programming (data structures, overloaded functions, dynamic memory allocation), programming in MATLAB, use of the UNIX operating system, use of the BLAS, LAPACK and ATLAS libraries, optimization of programs (by hand and via compiler optimization), and technical writing. Extensive programming in Fortran 90 and MATLAB required. 3 Cr.

CPS 300 Internet and Technology Ethics (A,I). The Internet has rapidly become a primary source of information, communication and entertainment for society. However, the rapid expansion has resulted in numerous issues that can adversely affect all Internet users. More importantly, new regulations are being passed that can expose users to significant legal risks. Fundamental legal principles that affect all users of the Internet will be discussed and analyzed. 3 Cr.

CPS 301 Issues in Criminal and Forensic Computing (A,I). A discussion of issues related to the use of computers in the criminal justice system. Discussions of growing capabilities in and ramifications of such areas as forensic computing, criminal profiling, fingerprint identification, video image processing, and simulation of crime scenes. In addition, discussions of emerging and future trends in the use of computers as a crime fighting tool. 3 Cr.

CPS 302 Society, Science and Technology (A,I). Discusses ways society and science have affected each other. Introduces a historical perspective of this relation for the past several decades, including the contemporary society. Identifies trends and changes within science and technology in relation to the larger society. Students will attend lectures, discuss issues, and write essays. 3 Cr.

CPS 303 High Performance Computing (A). Prerequisite: CPS 202. An introduction in applied parallel computing, using the Message Passing Interface (MPI) standard for parallel communication. Topics include: parallel architectures, problem decomposition, extracting parallelism from problems, benchmarking and performance of parallel programs, applications to the sciences, and technical writing. Extensive programming in Fortran 90 and/or C/C++ required. 3 Cr.

CPS 304 Simulation and Modeling (A). Prerequisites: CPS 202 and MTH 203; and either MTH 243 or MTH 346. An introduction to stochastic and deterministic methods used to simulate systems of interest in a variety of applications, with emphasis on problem set-up and analysis and programming methods. Part I: discrete event simulation and statistical analysis of results. Part II: other examples of stochastic simulations such as the spread of forest fires. Part III: deterministic methods for particle simulations, with examples from astronomical and molecular simulation. In addition, a brief discussion of the simulation of continuous media. Extensive programming required. 3 Cr.

CPS 333 Scientific Computing (A). A survey of programming methods and the use of UNIX for practical scientific computation: (1) Advanced features of Fortran 90/95 such as modules and operator and function overloading, and practical strategies for their use; (2) Bookkeeping; (3) Shell scripting and other methods for automating scientific computations; (4) Numerical linear algebra libraries (BLAS and LAPACK) and their use, and construction of libraries; (5) Advanced features of MATLAB and other scientific computing packages. 3 Cr. Fall.

CPS 404 Applied and Computational Mathematics (A). Prerequisites: CPS 304 and MTH 203; and either MTH 243 or MTH 346. A survey of scientific computing methods, emphasizing programming methods, interpretation of numerical results, and checks for numerical sensibility and self-consistency. The course is divided into several modules, including: (1) representation of floating point data, truncation and rounding error, and basic considerations for accurate numerical computation; (2) iterative numerical methods; (3) numerical differentiation and integration; (4) numerical interpolation; (5) random number generation; (6) the Fast Fourier Transform; and (7) numerical solution of ordinary differential equations. Extensive programming required. 3 Cr.

CPS 405 Applied and Computational Mathematics II (A). A continuation of Applied and Computational Mathematics I. Topics include: iterative methods in numerical linear algebra, least squares methods, the Fast Fourier Transform, special functions and their computation, numerical solution of ordinary equations. Extensive programming required. 3 Cr. Spring.

CPS 417 Introduction to Computational Chemistry (A). Cross-listed as CHM 417. An introduction to classical and quantum simulation methods as applied to chemistry-related problems and computational chemistry software packages. Part I: introductory material, potential energy surfaces, vibrational and electronic properties of molecules, and capabilities/limitations of computational chemistry. Part II: classical molecular simulation methods, molecular dynamics, molecular mechanics, Monte Carlo calculations, normal coordinate analysis, computer “measurement” of materials properties. Part III: the Schrödinger equation, common electronic structure methods, basic sets, geometric optimization, and molecular properties. 3 Cr.
CPS 433 Scientific Visualization (A). Prerequisites: MTH 424 and either CSC 203 or CPS 202.
Examination of scientific visualization as a critical portion of the analysis and interpretation of numerical simulations, and an introduction to a wide variety of methods used for scientific visualization. Topics include: basic 2 and 3 dimensional graph types, visualization of 3D data, interpretation of simulation results, grid generation and visualization, problem solution via graphical techniques, image processing, rendering and animation. Extensive programming in MATLAB required. 3 Cr. Spring.

DEPARTMENT OF COMPUTER SCIENCE

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Chairperson and Professor: Kadathur B. Lakshmanan, PhD, Ohio State University; Professors: Joan M. Lucas, PhD, Princeton University; Kulathur S. Rajasethupathy, PhD, Tata Institute; Thambrahalli M. Rao, PhD, Indian Institute of Science; Associate Professors: Vishal Anand, PhD, University at Buffalo; Sandeep R. Mitra, PhD, Binghamton University; Anthony Scime, DA, George Mason University; Assistant Professors: Joyram Chakraborty, PhD, University of Maryland, Baltimore County; Mehruz Kamal, PhD, University of Nebraska, Omaha; Lecturer: Daniel F. Rogers, MS, Syracuse University.

Computer science is the study of the theory and practice of computation. A computer scientist creates new hardware and software that is more efficient, effective, and reliable. Computer information systems, on the other hand, is the study of the use of computers for systematic organization of data that supports efficient and accurate collection, processing, analysis and retrieval of information. An information system specialist applies existing technology to solve real world problems. Both incorporate aspects of several other fields: mathematics, to analyze the properties of algorithms and data structures; engineering, to design and construct practical programs and machines; the experimental sciences, both to investigate the behavior of programs running on real machines and to use programs for modeling scientific phenomena; the cognitive sciences, to develop “intelligent” programs and to study computation in relation to human intelligence; and business administration, to identify information needs of organizations.

Computer science and information systems are young and rapidly developing fields. Presently their chief areas, reflected in regular course offerings at The College at Brockport, are: design and analysis of algorithms, programming languages, systems analysis, software engineering, project management, database systems, e-commerce, computer architecture, operating systems, computer security, artificial intelligence, decision support and expert systems, networking, multimedia, etc. Other areas are covered in independent study and topics courses. In addition, students can gain valuable job experience through internship programs and Brockport Career Exploration Courses (BCEC).

The programs offered by the department provide students with an excellent basis for a variety of careers and for graduate study. Possible careers include programming, system analysis and design, maintenance, management, and user support of software in areas such as business, sci-