COMPUTATIONAL MATHEMATICS, SCIENCE, AND ENGINEERING CMSE

Department of Computational Mathematics, Science, and Engineering
College of Natural Science

201 Introduction to Computational Modeling
Spring. 4(4-0) P: MTH 124 or MTH 132 or MTH 152H or LB 118 SA: NSC 204
Computational modeling using a wide variety of applications examples. Algorithmic thinking, dataset manipulation, model building, data visualization, and numerical methods all implemented as programs.

202 Computational Modeling Tools and Techniques
Fall. 4(4-0) P: CMSE 201 or CSE 231 SA: NSC 205
Continuation of introduction to computational modeling focusing on standard methods and tools used for modeling and data analysis. Topics may include statistical analysis, symbolic math, linear algebra, simulation techniques, data mining.

401 Methods for Parallel Computing
Spring of odd years. 4(4-0) P: (CMSE 202 and CSE 232) and (MTH 235 or MTH 340 or MTH 347H)
Core principles, techniques, and use of parallel computation using modern supercomputers. Parallel architectures and programming models. Message-passing and threaded programming. Principles of parallel algorithm design. Performance analysis and optimization.

402 Visualization of Scientific Datasets
Spring of even years. 3(3-0) P: (CMSE 202) and (MTH 234 or MTH 254H or LB 220)
Core principles, methods, and techniques of effective data visualization. Visualization toolkits. Vector and scalar data. Multivariate visualization. Relationship between data analysis and visualization.

491 Selected Topics in Computational Mathematics, Science, and Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.
Topics selected to supplement and enrich existing courses and lead to the development of new courses.

499 Independent Study in Computational Mathematics, Science, and Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Supervised individual research or study in an area of computational or data science.

801 Introduction to Computational Modeling
Fall. 3(3-0) RB: One semester of introductory calculus SA: NSC 801
Introduction to computational modeling using a wide variety of application examples. Algorithmic thinking and model building, data visualization, numerical methods, all implemented as programs. Command line interfaces. Scientific software development techniques including modular programming, testing, and version control.

802 Methods in Computational Modeling
Spring. 3(3-0) RB: (CMSE 801) or equivalent experience SA: NSC 802
Standard computational modeling methods and tools. Programming and code-management techniques.

820 Mathematical Foundations of Data Science
Spring. 3(3-0) RB: CMSE 802 or equivalent experience in programming and numerical methods. Differential equations at the level of (MTH 235 or MTH 255H or (MTH 340 and MTH 442) or (MTH 347H and MTH 442)). Linear algebra at the level of (MTH 309 or MTH 317H). Probability and statistics at the level of STT 231.
Fundamental mathematical principles of data science that underlie the algorithms, processes, and methods of data-centric thinking, and tools based on these principles.

821 Numerical Methods for Differential Equations
Spring. 3(3-0) RB: CMSE 802 or equivalent experience in programming and numerical methods. Differential equations at the level of (MTH 235 or MTH 255H or (MTH 340 and MTH 442) or (MTH 347H and MTH 442)). Linear algebra at the level of (MTH 309 or MTH 317H)
Numerical solution of ordinary and partial differential equations, including hyperbolic, parabolic, and elliptic equations. Explicit and implicit solutions. Numerical stability.

822 Parallel Computing
Fall. 3(3-0) Interdepartmental with Computer Science and Engineering. Administered by Computational Mathematics, Science, and Engineering. RB: Calculus at the level of MTH 133. Ability to program proficiently in C/C++, basic understanding of data structures and algorithms (both at the level of CSE 232). Basic linear algebra and differential equations.
Core principles, techniques, and use of parallel computation using modern supercomputers. Parallel architectures. Parallel programming models. Principles of parallel algorithm design. Performance analysis and optimization.

823 Numerical Linear Algebra
Fall. 3(3-0) RB: (CMSE 802) or equivalent experience in programming and numerical methods. Linear algebra at the level of MTH 309 or MTH 317H.
Methods in modern numerical linear algebra for solving linear systems, least squares problems, and eigenvalue problems. Efficiency and stability of algorithms in numerical linear algebra.

890 Selected Topics in Computational Mathematics, Science, and Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.
Topics selected to supplement and enrich existing courses.

891 Independent Study in Computational Mathematics, Science, and Engineering
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.
Topics selected to supplement and enrich existing courses.

899 Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to master's students in the Department of Computational Mathematics, Science, and Engineering.
Master's thesis research

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open to doctoral students in the Department of Computational Mathematics, Science, and Engineering.
Doctoral dissertation research.