180 Introduction to Data Science
Fall, Spring. 4(4-0) Interdepartmental with Statistics and Probability. Administered by Computational Mathematics, Science, & Engineering. P: (MTH 124 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently) Not open to students with credit in STT 301. Pervasiveness and utility of data in modern society. Obtaining and managing data. Summarizing and visualizing data. Ethical issues in data science. Communication with data. Fundamentals of probability and statistics.

201 Introduction to Computational Modeling and Data Analysis
Fall, 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, Spring. 4(4-0) P: CMSE 201 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.

314 Matrix Algebra with Computational Applications
Fall, Spring, Summer. 3(3-0) Interdepartmental with Mathematics. Administered by Mathematics. P: (MTH 133 or MTH 153H or LB 119) and (CMSE 201 or CSE 231) R: Not open to students in the Actuarial Science Major or in the Bachelor of Arts in Computational Mathematics or in the Bachelor of Science in Computational Mathematics or in the Bachelor of Arts in Mathematics, Advanced or in the Bachelor of Arts in Mathematics, Advanced or in the Mathematics Minor or in the Mathematics-Elementary Disciplinary Teaching Minor or in the Mathematics-Secondary Disciplinary Teaching Minor. Numerical methods in linear algebra with applications to systems of equations and eigenvalue problems, and geometry.
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, & 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. 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.