# COMPLEX SYSTEMS AND DATA SCIENCE AMP

All students must meet the Requirements for the Accelerated Master's Degree Programs

## OVERVIEW

The Vermont Complex Systems Center's Accelerated MS in CSDS is a five year degree coupled with a relevant bachelor's degree with optional disciplinary tracks. Our central goal is to help students become protean data scientists with eminently transferable skills. We provide students with a broad training in computational and theoretical techniques for (1) describing and understanding complex natural and sociotechnical systems, enabling them to then, as possible, (2) predict, control, manage, and create such systems. Students will be trained in: Industry standard methods of data acquisition, storage, manipulation, and curation; Visualization techniques, with a focus on building high quality web-based applications; Finding complex patterns and correlations through, for example, machine learning and data mining; Powerful ways of hypothesizing, searching for, and extracting explanatory, mechanistic stories underlying complex systems—not just how to use black box techniques; Combining the formulation of mechanistic models (e.g., toy physics models) with genetic programming.

## SPECIFIC REQUIREMENTS

### REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE FOR ACCELERATED STUDENTS

To be eligible for the Accelerated Master's Program, a student must be a declared computer science, mathematics, or statistics B.S. major, and have identified a Complex Systems faculty sponsor. Students need to apply early (before the second semseter of their junior year) to have time to plan two graduate level courses that can be used toward both their bachelor's and graduate (MS) degree. These credits must be taken after formal admission to the graduate program. Other requirements include a GPA typically higher than 3.0 overall. There is no GRE requirement for the AMP degree. All students must meet the Graduate college requirements for the Accelerated Master's Degree Programs.

### MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

A total of thirty credits, distributed as shown below:

| Common Core (4 courses) | | 12 |
|---|---|---|
| CSYS 300 | Principles of Complex Systems (Include individual and/or team projects) | |
| or MATH 300 | Principles of Complex Systems | |
| CSYS 302 | Modeling Complex Systems (Include individual and/or team projects) | |
| or CS 302 | Modeling Complex Systems | |
| STAT 287 | Data Science I (Include individual and/or team projects) | |
| STAT 387 | Data Science II (Include individual and/or team projects) | |
| Students who receive a grade of A- or above will not be required to take oral exams. Those who fall below this mark will have oral exams involving three faculty | | |
| **Electives** | | 9 |
| Six credits of Complex Systems and/or Data Science Electives | | |
| Three credits of an advisor approved course | | |
| **Track Specific** | | 9 |
| Nine credits in a concentration track (Enery Systems, Policy Systems, Biomedical Systems, Evolutionary Robotics, Environmental Systems, Distributed Systems Track, Self-designed track) | | |

A Policy Systems Elective is recommended for students in the Energy Systems Track.

CS 124: Data Structure is required and is approved for graduate credit (pending completion of a Permission to take a 100/200 Level Course for Graduate Credit Form) for those without a formal CS background unless candidates can establish competency in this area.

Threaded throughout their courses, a desired central outcome of each Master's student's training will be their development of a data-intensive, high design portfolio of interactive online visualizations. Students will have many opportunities to work with faculty, researchers, institutions, and corporations, on meaningful, important real-world data sets, drawn from engineering systems, neuroscience, society through the lens of social media, and more. Beyond being a key training mechanism, we envisage these portfolios—in the manner of, for example, a traditional engineering design or artist's set of works—will be instrumental in students achieving outstanding positions in their chosen fields.

### comprehensive exam

Receiving an A- or above in all four core courses meets the comprehensive exam requirement. Students who fall below this mark will have oral exams involving three faculty organized by the Curriculum Committee.

### REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Successful completion of the comprehensive exam and all required coursework.