

COMPUTATIONAL SOCIAL SCIENCE (CSS)

600 Level Courses

CSS 600: *Introduction to Computational Social Science*. 3 credits.

Graduate-level introduction to computational concepts, principles, and modeling approaches in social sciences, emphasizing simulations and elements of complexity theory as they apply to social phenomena. Survey includes systems dynamics, cellular automata, and agent-based models. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 605: *Object-Oriented Modeling in Social Science*. 3 credits.

Presents and applies concepts and principles from object-based modeling paradigm. Emphasizes Unified Modeling Language (UML) to render structure and operation of complex social systems and processes. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600 or approval from instructor or program director. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 610: *Agent-based Modeling and Simulation*. 3 credits.

Provides hands-on examination of agent-based models in social sciences by examining and experimenting with variety of social-simulation projects conducted in modeling environments such as Swarm, Repast, Ascape, and MASON (Multi-Agent Simulator of Networks and Neighborhoods). Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600 or permission of instructor. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 620: *Origins of Social Complexity*. 3 credits.

Examines when, where, and how social complexity emerged in human societies, emphasizing long-term analysis and comparative information processing in four civilizations of the ancient world: West Asia, East Asia, Andean Peru, and Mesoamerica. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Registration Restrictions:

Required Prerequisite: CSS 600^{B-}.
^{B-} Requires minimum grade of B-.

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 625: *Complexity Theory in the Social Sciences*. 3 credits.

Examines social phenomena including language, terrorism, the Internet, warfare, and wealth based on power laws and far-from equilibrium nonlinear dynamics. Emphasizes data analysis, and modeling and interpreting complexity-theoretic dynamics. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Registration Restrictions:

Required Prerequisite: CSS 600^{B-}.
^{B-} Requires minimum grade of B-.

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 630: *Comparative Computational Social Science*. 3 credits. Applies comparative method for analyzing different types of computational models in the social sciences. Strong crossdomain and interdisciplinary emphasis akin to comparative economic systems, government, or linguistics. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600 or permission of instructor. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 635: *Cognitive Foundations of Computational Social Science*. 3 credits. Examines cognitive foundations and information processing in computational social agents and compares to human cognitive phenomena, including emotions, trust, and reciprocity. Emphasizes modeling project. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600 and CSS 610 or permission of instructor. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 640: *Human and Social Evolutionary Complexity*. 3 credits. Examines long-term evolution of human and societal complexity from global and cross-cultural perspective with emphasis on computational aspects leading to today's globalization. Global history from the computational social science perspective. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600, 620, and permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 643: *Land-Use Modeling Techniques and Applications*. 3 credits. Survey of literature on spatially explicit empirical models of land-use change. Hands-on experience developing and running simple models. Techniques include statistical models, mathematical programming models, cellular automata, agent-based models, and integrated models. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600 (may be taken concurrently) or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 645: *Spatial Agent-Based Models of Human-Environment Interactions*. 3 credits.

Discusses key challenges in spatial modeling of human-environment interactions. Reviews agent-based modeling applications in urban and rural interactions, agriculture, forestry, and other areas. Hand-on development of simple ABM models. Investigates linkages between GIS and ABM. Notes: CSS 600 may be taken concurrently. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: GGS 631 or CSS 600 (may be taken concurrently) or permission of instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 650: *Physics Methods for Analyzing Social Complexity*. 3 credits. Surveys complexity theoretic tools including strange attractors, Ising models, correlation functions, ergodic theory, power spectra, meanfield theory, and renormalization group. Emphasizes application to social, economic, or political systems. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.
Recommended Prerequisite: CSS 600 and permission of instructor. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 655: *Social Systems Dynamics*. 3 credits.

Introduces systems dynamics modeling of social systems governed by levels/rates or stocks/flows processes, with applications to global modeling, terrorism, urban dynamics, organizations, and social and international conflict. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 665: *Complex Adaptive Systems in Public Policy*. 3 credits.

Students learn (i) basic concepts of complex adaptive systems (CAS) and how they can be applied to policy analysis, and (ii) how to use agent-based modeling as a tool for policy analysis. Address modeling issues on representing a system, agent decision making, validation, experiment design and analysis, as well as incorporating empirical data and methods to inform agent-based modeling. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Registration Restrictions:

Required Prerequisite: CSS 600^{B-}.

^{B-} Requires minimum grade of B-.

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 671: *Natural Language Processing for Complex Systems*. 3 credits.

This course focuses on the fundamentals of Natural Language Processing (NLP), Natural Language Understanding (NLU) and Large Language Models (LLMs), comparatively or coupled with other computational methods used in modeling communication, such as agent-based modeling, social network analysis, audio and image processing. It teaches topic modeling, topic2vec, speech recognition, clustering methods, and other relevant methods applied to social science and complex systems. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 610

Registration Restrictions:

Required Prerequisite: CSS 605^{B-}.

^{B-} Requires minimum grade of B-.

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 692: *Social Network Analysis*. 3 credits.

Methods and applications that examine complex social systems based on relations, structures, connectivity, matrix representations, location, roles, interactions, and other network properties. Applications to terrorism, cognition, organizations, and other social phenomena. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600. Concurrent enrollment is also permitted.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 695: Agent-based Computational Economics. 3 credits.

Present lectures on neoclassical economic theory as we investigate how to use agent technology to move beyond neoclassical specifications. Survey the most well-known results in agent-based economics. Read and present papers that are at the research frontier. A semester long research project 1. Will be the focal point of weekly model development (coding), data analysis, and writing. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 610. Undergraduate microeconomics.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Junior Plus, Non-Degree or Senior Plus.

Enrollment is limited to Graduate, Non-Degree or Undergraduate level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

700 Level Courses**CSS 710: Advanced Agent-based Modeling and Simulation.** 3 credits.

Cover topics related to large-scale agent models including how to 1) make use of available compute resources (CPU and memory) through threading and related code parallelization ideas and technologies; 2) sample data from large-scale models and calibrate/estimate such models, and 3) design experiments for models that are expensive to evaluate. Digress into other topics at the frontier of agent modeling. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 610.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 717: Verification and Validation of Models. 3 credits.

This course covers verification and validation (V&V) practices across different modeling techniques. Topics include V&V terminology, data visualization for V&V, runtime verification, validation of machine learning, agent-based, cognitive, statistical, and network models as well as ethics of model development and use. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May not be repeated for credit.

Recommended Prerequisite: CSS 600, CSS 605, CSS 610, or CSS 692; or the permission of the instructor.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy, Graduate or Non-Degree.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 739: Topics in Computational Social Science. 3 credits.

Selected topics in computational social science not covered in fixed-content computational social science courses. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 9 credits.

Specialized Designation: Topic Varies

Recommended Prerequisite: Permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Lecture

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 796: Directed Reading and Research. 3 credits.

Reading and research on specific topic in computational social science under direction of a faculty member. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: Permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Research

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 798: Research Project. 3 credits.

Project chosen and completed under guidance of graduate faculty member, resulting in acceptable technical report. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 6 credits.

Recommended Prerequisite: 12 graduate core requirement credits and permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate or Non-Degree level students.

Students in a Non-Degree Undergraduate degree may **not** enroll.

Schedule Type: Thesis

Grading:

This course is graded on the Graduate Special scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

800 Level Courses

CSS 898: Research Colloquium in Computational Social Science. 1 credit. Presentations in specific research areas in computational social science by Center for Social Complexity-associated faculty and professional visitors. Notes: Maximum 3 credits of CSS 898 and 899 may be applied toward PhD. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 3 credits.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Seminar

Grading:

This course is graded on the Satisfactory/No Credit scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 899: Colloquium in Computational Social Science. 1 credit. Presentations in variety of areas of computational social science by Center for Social Complexity-associated faculty and professional visitors. Notes: Maximum 3 credits of CSS 898 and 899 may be applied toward PhD. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 2 credits.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

900 Level Courses

CSS 909: Advanced Topics in Computational Social Science. 3 credits. Covers selected topics in computational social science and socioinformatics not covered in fixed-content courses. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 9 credits.

Specialized Designation: Topic Varies

Recommended Prerequisite: Permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Seminar

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 996: Doctoral Reading and Research. 1-12 credits. Reading and research on specific topic in computational social science under direction of faculty member. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree for a maximum 12 credits.

Recommended Prerequisite: Admission to the doctoral program and permission of instructor.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Research

Grading:

This course is graded on the Graduate Regular scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 998: Doctoral Dissertation Proposal. 1-12 credits.

Covers development of research proposal, which forms basis for doctoral dissertation, under guidance of dissertation director and doctoral committee. Notes: Candidates must complete a combined minimum of 12 credits of doctoral proposal (CSS 998) and doctoral dissertation research (CSS 999), of which at least three credits must be of CSS 999. A combined maximum of 24 credits of CSS 998 and CSS 999 may be applied to the degree. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree.

Recommended Prerequisite: Permission of advisor.

Registration Restrictions:

Enrollment is limited to Graduate level students.

Schedule Type: Dissertation

Grading:

This course is graded on the Satisfactory/No Credit scale. (<https://catalog.gmu.edu/policies/academic/grading/>)

CSS 999: Doctoral Dissertation. 1-12 credits.

Doctoral dissertation research under direction of dissertation director. Notes: Candidates must complete a combined minimum of 12 credits of doctoral proposal (CSS 998) and doctoral dissertation research (CSS 999), of which at least three credits must be of CSS 999. A combined maximum of 24 credits of CSS 998 and CSS 999 may be applied to the degree. Offered by Computational & Data Sciences (<https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/>). May be repeated within the degree.

Recommended Prerequisite: Approval of dissertation proposal.

Registration Restrictions:

Enrollment limited to students with a class of Advanced to Candidacy.

Enrollment is limited to Graduate level students.

Schedule Type: Dissertation

Grading:

This course is graded on the Satisfactory/No Credit scale. (<https://catalog.gmu.edu/policies/academic/grading/>)