Spring 2022
Complexity Theory in the Social Sciences
CSS 625

Mondays January 24 – May 2: 4:30–7:10pm

Research Hall 201

Syllabus
v20220130

Instructor
Prof. Dale S. Rothman
Computational Social Science Program
Department of Computational and Data Sciences
College of Science
Research Hall, Room 374

Office hours: Tuesdays 2:30-4:30 and Wednesdays 1:00-3:00PM and by appointment in office or on Zoom (see instructions below)

COURSE OVERVIEW

This course is divided into three main parts.

- Part I focuses on reviewing and deepening our theoretical understanding of the core concepts of complexity and complex adaptive systems. We will approach this from the perspective of the social sciences, albeit not exclusively. In any case, doing so will also require a review of some key general underpinnings of social science in general. The goal is to strengthen our theoretical foundations for working in the area of computational social sciences.
- Part II is devoted to the issues of identifying and measuring complexity. The goal is to enhance our empirical descriptions and analysis of complex systems.
- Part III is dedicated to reviewing how the ideas of complexity and complex adaptive systems have, or have not, played a role in a number of social science disciplines, most of which predate these ideas. The goal is to familiarize ourselves with existing work and provide a historical foundation for future work in computational social sciences.

Students who have not previously taken CSS600 (Introduction to Computational Social Science) should study the main readings from that course to familiarize themselves with background knowledge that is necessary to perform well in this course. Please ask the instructor, or your classmates who have taken CSS600, for suggestions.

COURSE MANAGEMENT

Course Website

The class website on Blackboard is the hub for this course. It contains, *inter alia*, a copy of this syllabus, Zoom links to the synchronous sessions, office hours, weekly outlines, links to readings (other than from the required text) and other preparatory material, links to the software to be used in the course, course assignments, and your grades.

Material for each week is provided in the weekly overview sections. Please note that lecture slides will be made available after classes.

Any important changes to the website during the semester will be announced.

Office Hours

Professor Rothman: My official office hours will be on Tuesdays from 2:30-4:30and Wednesdays from 1:00-3:00PM. I use the Bookings feature on Microsoft Teams to manage pre-scheduled appointments during these times. The link for pre-scheduling 15 minute blocks (you can schedule more than one) is https://outlook.office365.com/owa/calendar/GMUDale@gmuedu.onmicrosoft.com/bookings/. This will automatically set up a Zoom meeting, but we can also meet in my office if we are both on campus. The system is set up such that you need to book your appointment at least an hour in advance and no more than 30 days in advance. You should also feel free to stop by my office or check Zoom (https://gmu.zoom.us/j/4590669912?pwd=aExGMVZkRTJtZWgzTmt0KzJtbFRQdz09) during these times. If I am not assisting another student, I will be happy to meet with you until the next scheduled appointment our until the end of scheduled office hours for that day, whichever is first. For appointments outside of these hours, please contact me to schedule a time that works for both of us.

Contacting Prof. Rothman outside of Office Hours

You may send me messages using the Email feature on Blackboard or via regular email sent from your GMU email account. My ground rules for messages are as follows:

- Messages from your GMU email related to the course *must* include 'CSS625' at the start of the Subject field. Messages from non-GMU email accounts or lacking 'CSS625' at the start of the Subject field will be ignored.
- Messages received between midnight Sunday and noon Friday will be responded to within 24 hours. Emails received between noon Friday and midnight Sunday will be responded to by noon on the following Monday. If an email has not been responded to in this time period, please first confirm that it was sent via Blackboard or from your GMU email account and includes 'CSS625' at the start of the Subject field.
- If your questions are involved enough, I will ask you to schedule an appointment with me.
- Messages related to an assignment received within 24 hours of the deadline

for the assignment will likely not receive a response prior to the deadline.[1] Messages related to an assignment should also not request the instructor or TA to 'pre-grade' the assignment.

[1] Exceptions to this rule are determined on a case-by-case basis. For example, I will do my best to respond when there are unexpected technical glitches.

ASSIGNMENTS AND GRADING

There are a total of 100 possible points in this course. You will be graded on a series of written reflections (Part I of course), quantitative exercises (Part II of course), and session preparation and write-up (Part III of course). I have also reserved 5 points for general participation in the course discussions and unexcused absences.

For Part I of course

- Written reflections on readings (5 reflections * 7 points each = 35 points): For weeks 2-5 you will need to prepare short, written reflections on the readings. These should be approximately 500 words and submitted prior to class on Blackboard. You may also wish to bring a copy with you to the class discussion. I will provide 2-3 questions to stimulate your thinking, but you are free to write what you wish as long as it addresses the readings. Please note that these should not simply be summaries of the readings.

For Part II of course

- Exercises (1 or 2) on Identifying and Measuring Complexity (20 points): You will need to complete one or two numerical exercises applying the methods discussed in this part of the course. Details will be forthcoming.

For Part III of course

- Weekly session (20 points): Weeks 9-13 of the course will be partly student led. Students will be responsible for working with the professor to identify 2-3 key readings, distribute the readings at least a week prior to the session, and running half of the session for that week. Since we have 5 sessions and 7 students, we will need to cover two disciplines in two of the weeks. I have tentatively identified a number of social science disciplines, but students can propose alternatives. We will set the exact coverage for each week early in the semester.
- Session review and summary (20 points): After leading their session, each student will prepare a review and summary of the session. This should be approximately 2500 words and will be due on Monday, May 9.

In all cases, assignments are to be submitted on Blackboard. All assignments will be subject to late penalties of 10% if submitted after the deadline but within 24 hours, 25% if submitted between 24 and 48 hours after the deadline, and 50% if submitted between 48 and 72 hours after the deadline. No credit will be given to assignments submitted more than 72 hours after the deadline. Students may request extensions to the assignments for appropriate reasons by contacting the professor. Except for clear extenuating circumstances, these must be communicated to the professor at least 24 hours prior to the deadline for the assignment.

Based on the final total score, your final grade will be determined as follows: A+ [97-101], A [93-96.99], A- [90-92.99], B+ [87-89.99], B [83-86.99], B- [80-82.99], C+ [77-79.99], C [73-76.99], C- [70-72.99], D [65-69.99], F [<65].

If you make a good faith effort in the course, i.e., you assist with the course section in Part III and submit credible versions of all of the other assignments, with no more than 1 late assignment, you will receive a final grade no lower than a B-.

COURSE MATERIALS

Readings and other Preparatory Material

All readings and preparatory material are listed in the weekly sections on the class website. These will consist of, *inter alia*, required readings, optional readings, links to websites, and videos. The optional readings may or may not be discussed in class, depending on the time available, but is nonetheless included in the interest of depth and completeness.

We will draw heavily from the following three books.

- Byrne, David S., and Gill Callaghan. 2014. *Complexity Theory and the Social Sciences: The State of the Art*. First Edition. New York: Routledge, Taylor & Francis Group.
- Ladyman, James, and Karoline Wiesner. 2020. *What Is a Complex System?* New Haven: Yale University Press.
- Morçöl, Göktug. 2012. *A Complexity Theory for Public Policy*. Routledge Research in Public Administration and Public Policy 1. New York: Routledge.

I have placed electronic copies of the first and third of these on Blackboard – see Textbooks in the course menu. You will need to purchase a copy of the book by Ladyman and Wiesner.

Other readings will be made available on the course website.

Software

There is no specific software for this course.

COURSE SCHEDULE

Overview of Schedule[2]

I. INTRODUCTION
Week 1 (January 24)

II. PRINCPLES of COMPLEXITY
Week 2 (January 31): Hierarchy, Feedback, Non-Linearity, and Adaptability
Week 3 (February 7): Emergence and Self-Organization
Week 4 (February 14): Path Dependence, Self-Organized Criticality, Coevolution, Tipping Points, and Discontinuities
Week 5 (February 21): Agents and Agency
Week 6 (February 28): Link to the Social Sciences

III. IDENTIFYING AND MEASURING COMPLEXITY
Weeks 7 and 8 (March 7 and 21): Identifying and Measuring Complexity

(Note that the week of March 14-18 is Spring Recess)

IV. COMPLEXITY in SELECTED SOCIAL SCIENCE DISCIPLINES
Week 9 (March 28): Political Science
Week 10 (April 4): Sociology
Week 11 (April 11): Human Geography
Week 12 (April 18): Economics
Week 13 (April 25): Anthropology/Archaeology

V. COURSE CONCLUSIONS and REFLECTIONS
Week 14 (May 2)

[2] Subject to change due to unforeseen circumstances.

Detailed Schedule[3]

I. INTRODUCTION

Week 1 (January 24)

- Byrne and Callaghan Ch. 1 (Understanding the Complex), Ch. 2 (Restricted Complexity and General Complexity)
- Ladyman and Wiesner Ch. 1 (Introduction), Ch. 2 (Examples of Complex Systems)

II. PRINCPLES of COMPLEXITY

Week 2 (January 31): Hierarchy, Feedback, Non-Linearity, and Adaptability

- Ladyman and Wiesner Ch. 3 (Features of Complex Systems - sections 3.1, 3.2, 3.3, 3.9, 3.10, 3.11)
- Holland, John H. 1996. *Hidden Order: How Adaptation Builds Complexity*. Illustrated edition. Cambridge, Mass.: Basic Books. Ch. 1 (Basic Elements)

Week 3 (February 7): Emergence and Self-Organization

- Ladyman and Wiesner Ch. 3 (Features of Complex Systems - sections 3.4, 3.5, 3.6, 3.7, 3.8)
- Morçöl Ch. 3 (Emergence) and Ch. 4 (Self-Organization)

Week 4 (February 14): Path Dependence, Self-Organized Criticality, Coevolution, Tipping Points, and Discontinuities

- Morçöl Ch. 5 (System Dynamics)
- Bak, Per, and Kan Chen. 1991. "Self-Organized Criticality." Scientific American 264 (1): 46–53.
- David, Paul A. 2007. "Path Dependence: A Foundational Concept for Historical Social Science." Cliometrica 1 (2): 91–114.
- Page, Scott E. 2006. "Path Dependence." Quarterly Journal of Political Science 1 (1): 87–115.

Week 5 (February 21): Agents and Agency

- Byrne and Callaghan Ch. 5 (Structure and Agency), Ch 6 (Time and Place)
- Axtell, Robert L. 2000. "Why Agents? On the Varied Motivations for Agent Computing in the Social Sciences."
- Epstein, Joshua M. 2014. Agent_Zero: Toward Neurocognitive Foundations for Generative Social Science. Princeton, NJ: Princeton University Press. Preface and Introduction

Week 6 (February 28): Link to the Social Sciences

- Byrne and Callaghan Ch. 3 (Complexity Theory and the Philosophy of Social Science), Ch. 7 (Complexity and Methodology), Ch. 8 (Hunting Causes in a Complex World), and Ch. 9 (Researching the Complex Social)

III. IDENTIFYING AND MEASURING COMPLEXITY

[3] Further details on weekly readings and class activities are provided on class website. These are subject to change as the semester progresses.

Weeks 7 and 8 (March 7 and 21): Identifying and Measuring Complexity

- Ladyman and Wiesner Ch. 4 (Measuring Features of Complex Systems) and Appendix (Some Mathematical Background)

IV. COMPLEXITY in SELECTED SOCIAL SCIENCE DISCIPLINES

Week 9 (March 28): Political Science

- Readings TBA

Week 10 (April 4): Sociology

- Readings TBA

Week 11 (April 11): Human Geography

- Readings TBA

Week 12 (April 18): Economics

- Readings TBA

Week 13 (April 25): Anthropology/Archaeology

- Readings TBA

V. COURSE CONCLUSIONS and REFLECTIONS

Week 14 (May 2)

- Byrne and Callaghan Ch. 11 (Opening the Social Sciences) and Conclusion
- Ladyman and Wiesner Ch. 5 (What is a Complex System?)

PERSONAL POLICIES

Class Attendance and Behavior in Class

Class attendance is expected, but, unless noted, not mandatory. This includes students registered for synchronous online sections. However, not attending a class session is not considered a valid excuse for missing information about class content or assignments. I do not plan on recording the sessions on Zoom. However, if you know you will not be able to attend in person, please let me know ahead of time and I will record the session and send you a link to the recording.

While in class, I expect a certain pattern of behavior. I plan to start class sessions on time; if you arrive late, please enter in a way that does not disturb others.

Assignments in General

I try to be as clear as possible in the guidance I provide for the assignments, either in the assignment itself or a separate guidance document. I do expect you to read these carefully and to contact me, before you submit the assignment if anything is not clear. Sometimes this includes specifications on how I want you to prepare your submission, e.g., what software to use (e.g., Microsoft Word), formatting, and filenames. Please do not forget to include your name (or those of your group members) on your assignments and, unless otherwise noted, include page numbers. I do reserve the right to deduct points, or send back submissions for re-submission, for not following these guidelines. These may seem unnecessarily prescriptive, but they are intended to: 1) instill good practices in your work and 2) make the grading process, including providing feedback, smoother and faster. Please be aware that I tend to be somewhat forgiving early in the semester, but get increasingly strict as the semester proceeds. I appreciate your cooperation with this.

Writing in Assignments

While this is not a class on writing, and I recognize that English is not everybody's first language, I do expect your assignments to be well written. Excellent analysis cannot make up for poor communication. This includes, but is not limited to: extensive grammatical errors and/or misspellings; inadequate citation and/or missing/incomplete references; and confusing, illegible, or inadequately described figures and tables. Furthermore, I look for clarity and proper explanation in your writing. When I grade, I will not "read between the lines." By this, I mean that I will not spend a lot of time trying to figure out what you mean or connecting the dots, so it is best to err on the side of more explanation than less.

I do have a couple of pet grammatical peeves. If you have questions about any of these, please let me know:

- make sure you know the difference between effect and affect
- make sure you know the difference between its and it's
- the word data is plural, so you should say, e.g., the data are, not the data is; the singular of data is datum

All this is to say, when doing an assignment, please leave yourself enough time to review and, if necessary, edit what you have written. I try to do the same in the materials I prepare for you, and you should feel free to let me know when I fall short of these standards.

Finally, if you feel you need further assistance with writing, please make use of the GMU Writing Center - https://writingcenter.gmu.edu/.

GENERAL CAMPUS POLICIES

Academic Honesty and Collaboration

The integrity of the University community is affected by the individual choices made by each of us. GMU has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are: (1) all work submitted should be your own or that of your assigned group; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct.

Plagiarism means using the exact words, opinions, or factual information from another person without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using MLA or APA format. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

As in many classes, a number of projects in this class are designed to be completed in groups. With collaborative work, names of all the participants should appear on the work. Collaborative projects may be divided up so that individual group members complete portions of the whole, provided that group members take sufficient steps to ensure that the pieces conceptually fit together in the end product.

Other projects are designed to be undertaken independently. In the latter case, you may discuss your ideas with others and conference with peers on drafts of the work; however, it is not appropriate to give your paper to someone else to revise. You are responsible for making certain that there is no question that the work you hand in is your own. If only your name appears on an assignment, your professor has the right to expect that you have done the work yourself, fully and independently. Furthermore, it is unacceptable to use a model or a paper developed for another class in this class.

The re-use of computer models is also not acceptable. If one does use code from another model, please ensure the code that is used is accredited to the original model (just as you would do to a reference in a paper).

Disability Statement

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Disability Services (SUB I, Rm. 4205; 993-2474; http://ds.gmu.edu) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Sexual Harassment, Sexual Misconduct, and Interpersonal Violence

As a faculty member and designated "Responsible Employee," I am required to report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per university policy 1412. If you wish to speak with someone confidentially, please contact the Student Support and Advocacy Center (703-380-1434), Counseling and Psychological Services (703-993-2380), Student Health Services, or Mason's Title IX Coordinator (703-993-8730; cde@gmu.edu).

Course Material and Privacy

All course materials posted to Blackboard or other course site are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.

Videorecordings -- whether made by instructors or students -- of class meetings that include audio, visual, or textual information from other students are private and must not be shared outside the class.

Live video conference meetings (e.g., office hour meetings) that include audio, textual, or visual information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class.

All of our synchronous meetings in this class will be recorded to provide necessary information for students in this class. Recordings will be stored on Blackboard and will only be accessible to instructors and students taking this course during this semester.

Students must use their Mason email account to receive important University information, including communications related to this class.

Student Support Resources

George Mason University has a number of academic support and other resources to facilitate student success (e.g., Counseling and Psychological Services, Learning Services, University Career Services, the Writing Center, etc.). See http://www.gmu.edu for more details.

Military activation

In accordance with the "Virginia Tuition Relief, Refund, and Reinstatement Guidelines," Mason students in the uniformed services under call or order to active duty, after the beginning of a semester or summer session have two options they may consider with the dean's office of their school of enrollment and Office of the University Registrar in determining their enrollment status with the University: 1. Students may withdraw from courses in which they are enrolled as of the effective date of the call or order to report to active duty and 2. Students may take a grade of incomplete in all courses. For more details see https://catalog.gmu.edu/student-services/military-services/.

Safe Return to Campus (as of 24 January 2022)

All students taking courses with a face-to-face component are required to follow the

university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/safe-return-campus). Some key points:

- If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. I will work with you to ensure that you are able to continue with the course as best as possible.
- *COVID Health Check*: All students in face-to-face and hybrid courses must complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and you will receive either a Green, Yellow, or Red email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. *Faculty are allowed to ask to see this notification.*
- *Vaccination*: Faculty cannot require students to provide proof of vaccination, or ask other health questions.
- *Face Coverings (i.e., masks)*: University Policy 1415 COVID Public Health and Safety Precautions – Face Coverings establishes Mason requirements for wearing face coverings.
    - Everyone, even if you're vaccinated, must wear a mask when you are inside a Mason building.
    - Mason will offer a free N-95 mask to any student, faculty, or staff at Mason's COVID test sites and information kiosks on the Fairfax, Arlington, and SciTech Campuses. Students can go to the Student Involvement Office in the HUB, Suite 2300, or to the Information Desk in SUB 1 to get a mask. Masks are also available for purchase in Mason Bookstores and in vending machines on our campuses.
    - Students who have a disability that may prohibit the use of face coverings should contact the Office of Disability Services (ods@gmu.edu or (703) 993-2474) ; this will be treated just like other special accommodations coming through ODS. *You will need to present a form from ODS for this accommodation to the instructor; i.e., I can ask for this form.*
- *Physical Distancing*: If you wish to request special accommodations because of the virus, e.g., wish to sit 6 feet away from everyone, please contact the Office of Disability Services (ods@gmu.edu or (703) 993-2474); this will be treated just like other special accommodations coming through ODS. *You will need to present a form from ODS for this accommodation to the instructor; i.e., I can ask for this form.*

If you do not comply with these policies, you may be asked to leave the classroom. Repeated refusal will be treated as unruly behavior, which can lead to additional action.

Campus Closure or Emergency Class Cancellation/Adjustment Policy

If the campus closes, or if a class meeting needs to be canceled or adjusted due to weather or other concern, students should check Blackboard for updates on how to

continue learning and for information about any changes to events or assignments.