

## CSS 645

### Spatial Agent-based Models of Human-Environment Interactions

#### 1. General Information

<b>Instructor:</b>	Dr. Hamdi Kavak ( <a href="mailto:hkavak@gmu.edu">hkavak@gmu.edu</a> )
<b>Backup Instructor:</b>	Dr. William G Kennedy ( <a href="mailto:wkennedy@gmu.edu">wkennedy@gmu.edu</a> )
<b>Where:</b>	Online via Zoom (go to Blackboard for links and recordings)
<b>When:</b>	Monday from 4:30 PM - 7:10 pm
<b>Course website:</b>	The GMU Blackboard Website ( <a href="https://blackboard.gmu.edu/">https://blackboard.gmu.edu/</a> )
<b>Credits:</b>	3
<b>Prerequisites:</b>	CSS 600 or permission of instructor.
<b>Office Hours:</b>	Fridays from 1:30 PM - 5:00 PM (email the instructor at <a href="mailto:hkavak@gmu.edu">hkavak@gmu.edu</a> with your preferred meeting time).

#### 2. Course Description

This course will introduce graduate students in the spatial, environmental, and computational social sciences to the use of agent-based techniques as a means of modeling human-environment interactions. Major topics include spatial processes, the use of spatial identifiers to link socioeconomic and biophysical models, and where possible, links to geographic information and associated technologies. We will cover applications in areas such as agriculture, epidemiology, forestry, biodiversity, habitat degradation, interactions between human populations and nonhuman species and urban modeling.

The course will combine literature review with some hands-on modeling. When demo versions are available, we will compile and run models as we review articles based on those models. In addition, students will complete a class project where they develop their own models in their areas of interest. Students with no programming background can develop simple models using NetLogo or AnyLogic. Students with advanced programming abilities are encouraged to develop more sophisticated models using packages such as GAMA, Repast, MASON, Mesa, etc., or may develop their own spatial agent-based model using the programming language of their choice.

#### 3. Who Should Take This Class?

Students should have a familiarity with spatial structures and concepts, some background in a social science, and a high level of computing competence. Students should have some familiarity with agent-based modeling and complexity theory, such as would be provided by Introduction to Computational Social Science (CSS 600), Agent-Based Modeling and Simulation (CSS 610), or Land-Use Modeling Techniques and Applications (CSS 643). Knowledge of a programming language is helpful but not required. *Additional readings will be suggested for students lacking background in any of these areas.* Generally, no one student has a background in all of these areas. Students are encouraged to make stronger contributions in their areas of expertise, and to learn from the expertise of others in their weaker areas.

#### 4. Learning Outcomes

By the end of the course, students will

- have a fundamental understanding of agent-based modeling to research human-environment interactions
- gain state-of-the-art methodological knowledge to conceptually spatial design agent-based models involving human-environment interactions,

- gain hands-on experience to develop spatial agent-based computational models involving human-environment interactions and geographical information systems (GIS),
- expand their literature knowledge in the application of spatial agent-based models in various topics.

#### 5. Lecture Format and Course Recordings

The course will be taught as **synchronous online Zoom lectures** supported with additional material disseminated through the course website. All synchronous Zoom lectures are accessible using the links provided on Blackboard (see Zoom menu item) and will be recorded automatically for offline access. Recordings will also be stored on Blackboard and will only be accessible to students taking this course during this semester.

#### 6. Student Privacy

All course materials posted to Blackboard or other course sites are private; 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.

- Video recordings of class meetings that include audio or visual information from other students are private and must not be shared.
- Live Video Conference Meetings (e.g. Collaborate or Zoom) that include audio or visual information from other students must be viewed privately and not shared with others in your household.

#### 7. Textbooks and Other Instructional Material

We have no required textbooks for the class. Articles and chapters are available online or are made available on the course website.

For students with no experience with Agent-based modeling or NetLogo you might consider the following book:

- **Crooks, A.T., Malleson, N., Manley, E. and Heppenstall, A.J. (2019)**, Agent-based Modelling and Geographical Information Systems: A Practical Primer, Sage, London, UK.

#### 8. Technology Requirements

Activities and assignments in this course will regularly use the Blackboard learning system and the Zoom communication technology. Students are required to have regular, reliable access to a computer with an updated operating system (recommended: Windows 10 or Mac OSX 10.13 or higher) and a stable broadband Internet connection (cable modem, DSL, satellite broadband, etc., with a consistent high speed. You can check your speed settings using the speed test software websites. Weekly lectures are broadcasted live through Zoom.

**9. Course Outline (tentative)**

In this course, we will cover the following topics, which are subject to change at the discretion of the instructor, and changes will be announced during our lectures or via announcement emails.

Week (Date)	Topic	Short writing assignment	Paper presentation	Term project
Week 1 (Jan 25)	<ul style="list-style-type: none"> <li>Course Introduction</li> <li>Agent-based Modeling</li> </ul>			
Week 2 (Feb 1)	<ul style="list-style-type: none"> <li>Complexity in Human Environment Systems, Pattern Oriented Validation</li> </ul>			
Week 3 (Feb 8)	<ul style="list-style-type: none"> <li>ABM/GIS Integration. Model Communication / Ontologies</li> </ul>			
Week 4 (Feb 15)	<ul style="list-style-type: none"> <li>ABM/GIS Integration</li> </ul>			
Week 5 (Feb 22)	<ul style="list-style-type: none"> <li>Applications: Agrarian societies</li> </ul>	●	●	<b>Abstract due at midnight.</b>
Week 6 (Mar 1)	<ul style="list-style-type: none"> <li>Applications: Slums and Urban Poverty</li> </ul>	●	●	
Week 7 (Mar 8)	<ul style="list-style-type: none"> <li>Guest Lecture: Dr. Taylor Anderson</li> </ul>	●		
Week 8 (Mar 15)	<ul style="list-style-type: none"> <li>Applications: Overview of Urban Models, Gentrification</li> </ul>	●	●	
Week 9 (Mar 22)	<ul style="list-style-type: none"> <li>Applications: Residential Land Markets</li> </ul>	●	●	
Week 10 (Mar 29)	<ul style="list-style-type: none"> <li>Applications: Individual-based Models</li> </ul>	●	●	
Week 11 (Apr 5)	<ul style="list-style-type: none"> <li>Guest Lecture: Na Jiang (Richard)</li> </ul>	●		
Week 12 (Apr 12)	<ul style="list-style-type: none"> <li>Applications: Human/non-Human Interactions</li> </ul>	●		
Week 13 (Apr 19)	<ul style="list-style-type: none"> <li>Applications: Mobile Agent Models</li> </ul>	●		
Week 14 (Apr 26)	<ul style="list-style-type: none"> <li>Applications: Disasters and Disease Models</li> </ul>	●		
Week 15 (May 3)	<ul style="list-style-type: none"> <li>Term Project Presentations (Group 1)</li> </ul>			<b>Group 1 slides due at noon.</b>

Week 16 (May 10)	<ul style="list-style-type: none"> <li>Term Project Presentations (Group 2)</li> </ul>			<p><b>Group 2 slides due at noon.</b></p> <p><b>Paper, code, data due at midnight.</b></p>
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**10. Grades**

Weekly, you will complete 10 short writing assignments from week 5 to week 14.

You will present two papers selected from weeks 5, 6, 8, 9, and 10 topics.

Finally, you will develop a spatial agent-based model as your final project involving an initial abstract/proposal, up to 12-page paper, and live presentation.

Short writing assignment	<b>30%</b>
Presentations	<b>30%</b>
Final project	<b>40%</b> (10% abstract, 20% presentation, 70% paper)

Final grades at the end of the course will be assigned based on the following table, independent of the relative standing in the class.

Final Mark	Corresponding Grade
97.0 or more	A+
94.0 – 96.99..	A
90.0 – 93.99..	A-
87.0 – 89.99..	B+
84.0 – 86.99..	B
80.0 – 83.99..	B-
77.0 – 79.99..	C+
74.0 – 76.99..	C
70.0 – 73.99..	C-
60.0 – 69.99..	D
less than 60.0	F

**11. Exams**

There are no exams in this class.

**12. General guidelines for assignment/presentation/term project preparation and submission**

• **Weekly Show Writing Assignments (SWAs) (30%)**

- From week 5 to week 14, there will be at least one short writing assignment. Topics will be posted on the class website for that week. Starting the 24th of February, each student

will be required to complete a brief written review of one of the weekly readings, based on the SWA questions posted on Blackboard. Check the Assignments menu for guidance.

- Submissions are uploaded to Blackboard under the Assignments menu.

- **Paper Presentations (30%)**

- Students will be required to give an in-depth review of 2 articles over the course of the semester, starting Week 5.
- The requirements for this assignment are provided under the Assignments menu on Blackboard.
- Submission links will be provided under the Assignments menu.

- **Final Term Project (40%)**

- Each student will complete a term modeling project in their area of interest and will present the results to the class.
- An initial abstract/proposal will be submitted by week 5 while project presentation and paper are due in the last two weeks of the course. Check the Assignments menu on Blackboard for more details.
- All assignments should be submitted **through the Blackboard course website**. Every assignment should allow you to submit the work multiple times up until the deadline. The last version of the assignment will be graded.

**Please note:** Assignments should be submitted only through the Assignment submission section of the Blackboard system - DO NOT email assignments directly to the instructor.

### 13. Late submission

**Weekly Show Writing Assignments (SWAs):** The weekly short writing assignments are meant to give you some insights regarding the coming lecture. In that respect the noon deadline (of the class day) will be crucial and late papers will not be accepted. You can make up two SWAs by submitting extra papers in the following weeks. Exceptions to this policy may be made given under serious circumstances at the discretion of the Instructor. Please contact the instructor as soon as possible in such cases.

**Please note:** Deferral of a work is a privilege and not a right; there is no guarantee that a deferral will be granted. Please make sure you notify the instructor as soon as you know a deferral is required.

### 14. Attendance

Attendance is not part of the overall grade but highly recommended.

### 15. Snow-day policy

Since this course will be taught completely online, we will continue the instruction regardless of the weather conditions. Even if the university is closed, we will have our classes as scheduled. Students can resume snowball fun after class.

### 16. Military activation policy

If you are a military personnel and called on duty during the semester, check GMU's military activation policy at <https://military.gmu.edu/military-mason/military-activation-policy>.

### 17. Blackboard and Course website

The course has a Blackboard website. The Blackboard website will provide you with a portal through which you may obtain lecture notes, retrieve assignment data, review links to additional materials, and receive special announcements. You are required to visit the course website regularly and follow all announcements. Please notify ITS (and, if necessary, the instructor) if you encounter any problems accessing the Blackboard website.

#### 18. Electronic communication, office hours and support

All course-related submission of assignments should be made through the course Blackboard website. Please **DO NOT** email your assignment submissions to the instructor unless the Blackboard website is down for an extended period.

Students are encouraged to contact the instructor for questions regarding the course content. The ideal time to contact the instructor for such inquiries is the office hours which is provided under General Information in the first page. The instructor will notify the students via GMU email if there are any temporary or permanent changes in office hours. Students should contact the instructor via their @gmu.edu email to make an appointment because of the new virtual office hours mandated by the university. Ideally, the instructor will respond to course-related student emails within 2 business days.

#### 19. Students with disabilities

Disability Services at George Mason University is committed to providing equitable access to learning opportunities for all students by upholding the laws that ensure equal treatment of people with disabilities. If you are seeking accommodations for this class, please first visit <http://ds.gmu.edu/> for detailed information about the Disability Services registration process. Then please discuss your approved accommodations with me. Disability Services is located in the Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu | Phone: (703) 993-2474

#### 20. Expectations from students

- *Academic Integrity*: Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture. [See <http://academicintegrity.gmu.edu/>].
- *Honor code*: Students must adhere to the guidelines of the George Mason University Honor Code. [See <https://oai.gmu.edu/mason-honor-code/>].
- *MasonLive/Email (GMU Email)*: Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and the program will be sent to students solely through their Mason email account.
- *University Policies*: Students must follow the university policies (See <http://universitypolicy.gmu.edu>) including the Responsible Use of Computing [See <https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>].

#### 21. Frequently asked questions

- *Have another question?*

Ask the instructor via email. If your question applies to all students, it will be shared here as well.

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**Disclaimer:** Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported by the instructor.



## Department of Computational and Data Sciences

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**Notes:** (1) Recording is permitted only with the prior written consent of the professor or if recording is part of an approved accommodation plan. (2) The format and template of this syllabus is prepared based on the syllabus of Dr. Andreas Zufle's GGS 787 - Scientific Data Mining for Geo-informatics 2018 course. (3) A significant portion of the content of this syllabus is adopted from the syllabus of Dr. Andrew Crook's CSS 645 Spring 2021 course.