CSC 105: Virtual Worlds

Instructor: Dr Philippe J. Giabbanelli

Fall 2018 Course Outline

I. Contact Information

The instructor for this course is Dr Philippe J. Giabbanelli. Office hours are in Riley 200-D on Wednesday 1:30-4:30pm and on Tuesday 1-2:15pm, or by appointment. Please see me if you have any questions during the course. Alternatively, you are welcome to email me at giabba@furman.edu. The office phone number is 864-294-3221.

II. Class Meetings

Lectures are on MWF 11:30-12:20am in Riley 106. Labs are on Tuesday, 2:30-4:30 in Riley 201.

III. Course Overview

Imagine that you want to help your community to be safer or healthier. Would you just go ahead with building a new police station or sports center? If it fails, resources were wasted. And even if it works out, there may have been a better solution. Building virtual worlds using computer programs provides a safe and thorough approach to identify possible interventions, before doing them in the real world. This multidisciplinary course will introduce techniques to capture the complexity of our real world and make accurate predictions.

IV. Learning Objectives

Upon completion of the course, you will be able to:

- Explain how virtual worlds can be used to address 'what-if' questions. Virtual worlds can be used for explanatory (e.g., "how did we get to this...") or predictive questions (e.g., "what will happen if I choose to do this..."). This course emphasizes predictive questions so we can design for the future.
- Design virtual worlds using Agent-based Modeling (ABM). We will examine how to construct computer representations of individual entities (who could be people, animals, or robots) and equip them with goals, beliefs, and behaviors that are representative of their real world counterpart.
- Critically assess the design and implementation of agent-based models. We will discuss and establish guidelines to assess models. These guidelines will be applied to previously developed models in health.
- Implement agent-based models using the `NetLogo` software. We will program our models and discuss technical choices including the representation of time, space, cognition, and interaction.
- Examine the role of data to construct models, or as an output of models. In the 'big data' era, we will emphasize good practices in using data to ensure that our virtual population is realistic and that the model as a whole is valid. Several of these practices can also be used at an analytical stage, when investigating what the output of a model is suggesting about the interventions to test in the real world.

V. GRADING

A. Reference scale

The reference scale to assign a grade is the following: $A \geq 90$, $A^- \geq 86$, $B^+ \geq 82$, $B \geq 77$, $B^- \geq 70$, $C^+ \geq 65$, $C \geq 60$, $D > 50$, $F \leq 50$. The scale may be adjusted based on class performance, but adjustments cannot be to your detriment: for instance, if you score 90 or above, you are guaranteed to get an A.

B. Graded activities

Your percentage will be determined based on the following factors:

- **Laboratory Activities**: 12%. Your work will be graded either at the end of the lab, or at the end of the second lab (when it is designed to span over two sessions).
- **Final Project**: 25% of the total grade. It will be sub-divided into smaller tasks called *milestones*.
- **Homework Assignments**: 18% of the total grade. Assignments will have a different weight, based on their length and level of difficulty.
- **Quizzes**: 20% of the total grade. All quizzes with be worth the same. We target either 4 (each worth 5%) or 5 (each worth 4%) quizzes depending on class progress.
- **Final exam**: 25% of the total grade.

Like in real-life, if you have not done well on something, it does not 'disappear'. There is no mechanism to 'drop the lowest grade' on a quiz or lab. However, there will be multiple opportunities to earn **bonus points**. That is, if you have not done well on one occasion, you'll have a chance to catch up by going beyond expectations later.

C. Submitting work for grading

Submissions of assignments and project milestones are all online. *You can submit as many times as you want, up to the deadline,* and the server will not accept submissions after the deadline. This has three consequences:

(1) We may discuss solutions in class just after the deadline is past, when you have a fresh memory of what you just completed. This makes for lively discussions!
(2) Work cannot be submitted for grading passed the deadline, but the instructor will always give you feedback when asked.
(3) You should not try to submit a few minutes before the deadline (e.g. you may lose internet connection when you need it most). You can regularly submit versions of your work, thus using our server to make backups.

D. Missing a graded activity

Missing any graded activity (e.g., quiz) **can only be excused for an unavoidable event with official documentation**. For instance, a medical emergency is beyond your control, and a note from a physician/nurse practitioner/hospital release constitutes official documentation. Conversely, stating that you felt ill or sending in unflattering pictures showing your condition does *not* constitute an official documentations of illness. Similarly, scheduling a

surgery is understood as being beyond your control, but a routine checkup is not. When you are aware of an unavoidable scheduled event conflicting with graded activities, please contact the instructor so arrangements can be made in advance. We take your well-being seriously and look at it in a comprehensive manner, thus 'emergency' or 'medical' in this context refers to physical well-being as well as mental well-being.

When you have an excused absence from a graded activity, we will support you by offering an alternative date to complete the activity, increasing the weight of another activity, or waiving it. This decision will be made by the instructor based on the importance of the graded activity for your learning journey in this course.

VI. Academic Honesty

Academic honesty plays a key role in our efforts to maintain a high standard of academic excellence and integrity. Students are advised that all acts of intellectual dishonesty are subject to disciplinary action. Intellectual dishonesty includes, but is not limited to, copying work (from other students/textbooks/the Internet), helping others to copy, or working on assignments/projects with people external to your team. Computer science being a team-centric discipline, you will have many opportunities for productive collaborations with each other throughout the term, but your collaborations must remain within the framework of the pair or team that you are a part of.

A first act of intellectual dishonesty results in getting 0 on an activity and/or failing the course. Repeated acts of intellectual dishonesty may result in your expulsion from the university. All acts of intellectual dishonesty are documented, and future employers have the right to ask the university about your record. We will use all available means to ensure a high standard of academic excellence and integrity.

VII. Books

We will use a hands-on book, with several step-by-step examples to use the `NetLogo` software:

- "An introduction to agent-based modeling" by Uri Wilensky & William Rand, MIT Press, 2015.

There is only one edition. You can get this book in any format that suits your learning style and budget. If you like to annotate and search, you may consider a digital copy (e.g., Kindle ebook).

VIII. Attendance Policy

Research has shown that students who attend class regularly do better regardless of other behaviors. This is not an online class, so we do expect you to come to all classes. Announcements will be made in class, and it is expected that you will be aware of all such announcements. If you miss a class, it is your responsibility to catch up.

Class participation is strongly encouraged, and that is why you are actually taking a physical class instead of watching one on youtube. There is an etiquette for class participation. It is expected that you will be punctual, and will substantively and respectfully engage in discussion. Sleeping, doing other work, leaving the class during lecture, or texting/playing with your phone are examples of rude behavior that are strongly discouraged. Engaging in such rude behavior will damage your reputation as seen both from the instructor and your peers, and is likely to decrease your performance in the class as well. We allow laptops to be used for taking notes and programming, and you can also use your phone to take pictures of key slides if necessary.

IX. Accessibility

If you need an accommodation for this class, please contact Dr. Judy Bagley, Director of Accessibility Resources (2322) on the first level of the Earle Infirmary. After meeting with her, contact me so we can start putting your accommodation in place. Please note that accommodations can only work *going forward*: we apply them once they have been agreed, but we cannot retroactively look at your grades *before* an accommodation was set-up. The sooner you let us know your needs, the sooner we can assist you in achieving your learning goals in this course.

X. Course organization

The main themes are listed in the table below. A numbered module (i.e. one row) corresponds to a slide-deck: some modules may be covered within a single lecture, and others may span multiple lectures. The extent to which the theme of "Experimentation" will be addressed will depend on when the previous themes are completed.

TABLE I
Course Organization

	Theme	**Content**	**Resources**
1	Introduction	How does this course work?	N/A
2		Why should we build virtual worlds?	Readings
3		Approaches to building virtual worlds	Chap. 0-1
4	Simple agents	Introduction to NetLogo	Doc.
5		States, Conditionals, and Iterations	Chap. 2
6		Sample models	Chap. 3
7		It's about time	N/A
8	Intelligent agents	Sensing and adapting	Chap. 4-5 Readings
9		Interacting with the environment	
10		Interacting with other agents	
11		Describing intelligent agents	
12	The role of data	Initializing heterogeneous agents	
13		Calibration of parameter values	Readings
14		Validation and verification	Chap 7
15	Experimentation	Repeatedly running a model	Chap 6
16		Experimental design	Readings

XI. Beyond the course

Modeling and simulating complex systems remains an important tool to support decision-making activities. The themes introduced in this course will be revisited and deepened in CSC 343 "Artificial Intelligence". They are also applied extensively in other fields, as detailed in these books:

- Generative Social Science: Studies in Agent-Based Computational Modeling, by Joshua M. Epstein
- Agent-Based Models (Quantitative Applications in the Social Sciences), by Nigel Gilbert
- Multiagent Systems (Intelligent Robotics and Autonomous Agents series), by Gerhard Weiss