Modeling, Simulation, and Military Gaming

INTA 4742/ 6742, CX 4232, CSE 6742

3.0 Credits
Spring 2024
Wednesday, 6:30-9:15pm**
Cherry Emerson 320
***On Wednesday, April 17th we'll hold our "Hot Wash" final presentation at 3-5pm to accommodate external judges that will be joining us. Please let me know ASAP if you have a conflict with that time so we can try to address it.*

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Office Hours: By appointment

Course Description: Computer modeling and simulation offers a unique perspective on events because of the ability to hold some variables constant and change others, and run a scenario repeatedly searching for underlying themes. This enables an understanding of the cumulative impact of seemingly minor events on grand outcomes. Computer simulation has been used as an analytical tool in the natural sciences, business, commerce, government and politics.

This course focuses on the creation and application of computer simulations to model strategic international events concerning warfare. The course is project-based, requiring computing and international affairs students to work together in multidisciplinary teams to analyze specific questions utilizing computer-based modeling and simulation tools (largely, but not exclusively, "NetLogo"). The students will collaboratively define and evaluate specific questions, formulate hypothesis concerning the resolution of these questions, utilize modeling and simulation software to aid in an analysis, and apply the tools to test hypotheses and formulate conclusions from this investigation.

The learning objectives will be accomplished in the context of a specific wargame scenario. For example, a team interested in World War I might focus on the German Schlieffen Plan. This was Germany's plan for the invasion of France through Belguim and Luxembourg in 1914, at the beginning of the Great War, that subsequently was halted at the First Battle of the Marne, six weeks after the war began. There have been 100 years of debate over the reasons that the plan failed, and this debate continues among scholars today. Through computer simulation the group would replicate the plan (or some portion of the plan) and test a particular explanation given for the plan's failure.

Alternatively, student teams could analyze battles from antiquity, the gunpowder age, or the 20th Century. It may also include potential future scenarios, such as the use of anti-satellite weapons in future conflict. Simulations from previous classes included Gaugamela (Alexander the Great vs Darius), Zama (Scipio vs Hannibal), Cannae (Hannibal vs Roman

Legions), Bunker Hill, Gettysburg, Tarawa, and the US Marines' retreat from the Chosin Reservoir (Korean War).

***Learning Objectives**:*
The learning objectives for this course include:

- Demonstrate the ability to formulate specific study questions concerning international events, and formulate hypothesis that can be tested through experimentation with computer simulation tools.
- Develop an understanding of the capabilities and limitations of modern modeling and simulation techniques as applied to the analysis of strategic international events.
- Demonstrate an understanding of accepted methodologies and practices concerning the creation and use of computer simulations to study international events to derive reasoned and justifiable conclusions.
- Demonstrate an understanding of the underlying models, abstractions, and software realizations used in modern wargame simulations.
- Demonstrate an understanding of the basic software architecture and elements of modern wargame simulations.
- Demonstrate the ability to communicate complex concepts to multidisciplinary teams including students from computing and international affairs backgrounds.
- Demonstrate the ability to understand and incorporate concepts from a different discipline and integrate them in the development and use of wargame simulations.
- Demonstrate the ability to collect and incorporate data from historical and other records for use in wargame simulation tools.
- Students will be proficient in basic mathematical skills and be able to formulate problems in international affairs mathematically if appropriate. Use software, process and analyze information, quantitative and qualitative methods.

Course Text
The majority of the readings for this course will be journal articles, government and industry reports, and newspaper articles. These additional readings will be listed on Canvas at least one week in advance of the class for which they should be read, and can be found online through the Georgia Tech library.

You may purchase these optional texts for your own reference and background reading:

- Wilensky, U., & Rand, W. (2015). *An introduction to agent-based modeling: modeling natural, social, and engineered complex systems with NetLogo*. MIT Press.
- Tolk, Andreas. *Engineering principles of combat modeling and distributed simulation*. John Wiley & Sons, 2012.
- Sabin, P. (2012). *Simulating war: Studying conflict through simulation games*. A&C Black.
- Keegan, John. *The face of battle: A study of Agincourt, Waterloo and the Somme*. Random House, 2011.
- Biddle, Stephen D., and Stephen D. Biddle. *Military power: Explaining victory and defeat in modern battle*. Princeton University Press, 2004.

Grading
The primary output for this course is a final presentation, which includes the results of your historical research, model development, and analysis. Student grades will be largely dependent on the quality of this final product. Grades will also be affected by the quality of interim presentations and short assignments that are assigned throughout the semester, taking into account preparedness for these presentations and overall quality. Individual effort within each team will be taken into account using peer evaluations. Individual participation and contributions to the course as a whole, including preparedness for lecture, engagement in class discussions, and provision of constructive feedback to other teams, will also affect students' final grades.

Short Assignments – 20%
Interim Presentations – 20%
Contribution to Team (Peer Review) – 20%
Final Presentation/ Project – 40%

Schedule
Much of the work for this course is done within the teams, leveraging the skills and expertise of each member. While lectures will provide some initial guidance, significant effort is required to find and consult relevant sources for historical analysis and data collection as well as model-building techniques. Much of the course will be spent having teams present their progress and current issues, with classmates and professors providing constructive criticism, feedback, and guidance. The following provides a loose guide to the schedule for the semester. Note that the schedule is subject to change.

Week	**Date**	**Topic**	**Readings/ Assignments Due**
1	Jan. 10	*Introductions* *Lecture:* Introduction to Modeling and Simulation *Lecture:* Using Models for Research and Analysis *Activity:* Evaluating Models *Activity:* Heroes and Cowards	
2	Jan. 17	*Guest Lecture:* Gen. Phil Breedlove, Former NATO Supreme Allied Commander *Lecture:* Watch Agent Based Modeling and Netlogo [Video]	*Assignment:* NetLogo Tutorials [Due Jan. 17] *Assignment:* Working with NetLogo [Due Jan. 17]
3	Jan. 24	*Groups Assigned* *Activity:* Meet with groups *Activity: Simulation/ Wargame Activity*	*Lecture:* Developing a Question for Analysis [Video]

			Lecture: Watch Military History, Strategy, and Tactics [Dr. Mike Salomone, Video] *Assignment:* Interim Presentation - Battle Background and Research Question [Due Feb. 7/14]
4	Jan. 31	*Lecture:* Example Battles (Dr. McLean) *Lecture:* Sensitivity Analysis (Dr. McLean) *Lecture:* Military Battles and Policy Analysis (Dr. Thom McLean)	
5	Feb. 7	*Guest Lecture:* Adm. Sandy Winneld, Former Vice Joint Chiefs of Staff *Interim Presentations:* Battle Background and Research Question (1/2)	*Assignment:* Short response on Chapter 3: Waterloo from "Face of Battle" by John Keegan [Feb. 14]
6	Feb. 14	*Interim Presentations:* Battle Background and Research Question (2/2) *Activity:* Discuss "Face of Battle" Ch. 3	*Assignment*: Interim Presentation – Conceptual Model [Due Feb. 21/28]
7	Feb. 21	*Interim Presentations:* Conceptual Model (1/2)	*Assignment:* Short response on three readings (Gowlett, Wheeler, Millikan) [Due Feb. 28]
8	Feb. 28	*Interim Presentations:* Conceptual Model (2/2) *Activity:* Discuss Gowlett, Wheeler, Millikan	*Assignment:* Interim Presentation – NetLogo Model [Due March 6/ 13]
9	March 6	*Interim Presentations:* NetLogo Model (1/2)	
10	March 13	*Interim Presentations:* NetLogo Model (2/2)	*Assignment:* Interim Presentations: Analysis and Conclusions [Due March 27/ April 3]
11	March 20	Spring Break	
12	March 27	*Interim Presentations*: Analysis and Conclusions (1/2)	
13	April 3	*Interim Presentations*: Analysis and Conclusions (2/2)	*Assignment:* Interim Presentation – Final

			Presentation [Due April 17]
14	April 10	Dress Rehearsal	
15	April 17	Hot Wash [TIME CHANGE: 3-5pm]	