GTECH 73300 – GIS Modeling and Problem Solving
Tuesday 5:35 – 8:15 pm
Room 1001D-Hunter North

Instructor

Gordon M. Green, PhD

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Prerequisites: GTECH 73100 and GTECH 73200

Required textbook:

There is no required textbook, but the texts listed in the references section below are representative of the resources we will use, and short excerpts will be distributed within fair use guidelines. Students are also expected to access recommended journal articles using the Hunter College or other CUNY library systems.

Course Description

This project-based course will introduce you to geographic modeling concepts and methods from a programming perspective. We will first review commonly-used models of spatiotemporal phenomena at geographic scales, and the concepts and methods they have in common. We will then look at specific approaches and applications including static relational vector and raster data models; mapping with layer-based cartographic models and with various methods of classification and regression; predicting the future state of a landscape with spatial Markov chains; describing emergent behaviors of autonomous agents in a landscape; modeling network-based spatiotemporal phenomena; and spatiotemporal process models. Throughout the class we will primarily be using the Python and JavaScript languages for the modeling and visualization aspects respectively.

Students will be expected to summarize several journal articles from the relevant literature over the course of the semester. There will be three projects, the specific subjects of which are up to each student: an implementation of one of the covered algorithms; a web-based visualization of a geospatial model; and a main course project, including a preliminary proof-of-concept implementation and a completed modeling project described in a short research paper and an in-class presentation.

Course Objective

The goal of the course is to expand students' technical toolset with a flexible set of geographic modeling and problem-solving methodologies, and also to improve their ability to select the right approach for a given problem, and to explain and analyze methods and results.

Expected Learning Outcomes

You should come away from this course with an understanding of how to select appropriate conceptual models for a variety of geographic problems, and with an improved comfort level using Python and JavaScript programming tools to address a range of geographic problems.

Preliminary List of Software Tools

Python 2.7; Postgres 9.3 / PostGIS 2.1 spatial database; Numpy, SciPy, Orange, and CherryPy Python libraries; jQuery, Leaflet, HighCharts and D3 JavaScript libraries.

Course Calendar and Content

Week	Lecture and Lab Topic
2/2	Introduction – model taxonomies – software infrastructure
2/16	The modeling process – model selection – implementation – verification – calibration – validation – evaluation – visualization – web basics
2/23	Spatial data models – spatial database – raster and vector data representation – Python data retrieval – web service implementation – *article summary 1 due*
3/1	Cartographic models and feature engineering - working with layer data – web map layer visualization – *first project due*
3/8	Mapping with classification and regression models – model evaluation and selection – visualizing web service output
3/15	Simulation and probabilistic models – *article summary 2 due*
3/22	Spatiotemporal models of landscape change – cellular automata – spatial Markov models – displaying dynamic data – *second project due*
3/29	Agent-based models
4/5	Spatiotemporal process and network models
4/12	Guest lecture TBD – *article summary 3 due*
4/19	*Main project proof-of-concept due – project review*
5/3	Additional topics in JavaScript and web-based visualization
5/10	Project workshop
5/17	Project workshop
5/24	*Main project presentations*

Please refer to the Hunter College registrar's site for important dates and deadlines.

Grading

Grading will be based on the three projects (20%, 20%, and 50% respectively), and the article reviews (10%).

Essential Policy Information:

- There is absolutely no eating or drinking in the computer laboratory, either during class or when working independently. You run the risk of having your departmental computer account suspended if you are caught eating or drinking in HN 1090B.
- Attendance/lateness policy – students are expected to arrive on time and to email me when classes will be missed.
- Late work– in-class programming challenges and assignments will be due either in class or the following week. Late assignments will be marked down a letter grade. All assignments and the final project must be completed by the last class session to receive credit. Incompletes will not be granted
- Policy for extra credit – There is no extra credit.
- Policy on the use of instructional technologies – I will post class materials on Blackboard, and will make class announcements through the Blackboard announcement system.

Hunter College Policy on Academic Integrity

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

ADA Policy

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical, and/or Learning) consult the Office of Accessibility, located in Room E1214B, to secure necessary academic accommodations. For further information and assistance, please call: (212) 772- 4857 or (212) 650-3230.

Syllabus Change Policy

This syllabus is a guide for the course and is subject to change with advance notice by email and/or class announcement.

Preliminary Bibliography

Bolstad, P. *GIS Fundamentals: A First Text on Geographic Information Systems.* XanEdu, 2012. ISBN: 9780971764736.

Burt, J. et al. *Elementary Statistics for Geographers, Third Edition.* Guilford Press, 2009. ISBN: 9781572304840

Congalton, Russell G, and Kass Green. *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices.* Boca Raton: CRC Press/Taylor & Francis, 2009. ISBN: 9781420055122.

Fath and Jorgenson, *Fundamentals of Ecological Modeling.* Elsevier 2011. ISBN: 9780444535672.

Ford, A. *Modeling the Environment, Second Edition.* Island Press, 2009 ISBN: 9781597264730.

Franklin, J. *Mapping Species Distributions, Spatial Inference and Prediction.* Cambridge University Press, 2009. ISBN: 9780521700023.

Gaylord and Nishidate, *Modeling Nature Cellular Automata Simulations with Mathematica.* Springer, 1996. ISBN: 9780387946207.

Harrington, P. *Machine Learning in Action*, Manning Press, 2012, ISBN 9781617290183.

Longly et al. *Advanced Spatial Analysis: The CASA Book of GIS.* Paperback, ESRI Press, 2003. ISBN: 9781589480735.

Murray, S. *Interactive Data Visualization for the Web.* O'Reilly, 2013. ISBN: 978-1449339739

Marsland, S. *Machine Learning, an Algorithmic Perspective.* Boca Raton, CRC Press, 2009. ISBN: 9781420067187.

Railsback, S. and Grimm, V. *Agent-Based and Individual-Based Modeling: A Practical Introduction.* Princeton University Press, 2011. ISBN: 9780691136745.

Rigaux et al. *Spatial Databases: With Application to GIS,* Morgan Kauffman, 2002. ISBN: 9781558605886.

Sheldon M. Ross, *Simulation.* Academic Press, 2009. ISBN: 9780124158252.

Turner, M. et al. *Landscape Ecology in Theory and Practice: Pattern and Process.* Springer, 2003, ISBN: 9780387951232.

Westra, E. *Python Geospatial Development.* Pakt Publishing 2010. ISBN: 9781849511544.