NUTR 231   FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEMS

Syllabus for Spring 2016
Issued November 2, 2015. This syllabus is subject to change. Check the course web site for latest version.

Graduate course: 1 credit
Class Time: Wednesdays, 9:00–12:00 pm
Location: S514   Sackler Hall, Big Lab: Hirsh Library 5th floor except for the following days:
                February 24 – Sackler 507
                March 23 – Sackler 507

Enrollment Limit: 20

Instructor: Paul Cote   CV
Email: paulbcote@gmail.com
Office Hours: By Appointment

Assistant Instructor: David Grist
Email: David.Grist@tufts.edu
O**ffice Hours:** TBD in the Jaharis lounge. Check Trunk announcements for updates.

Tufts Credit: 1 credit (3 classroom hours per week over 15 weeks)
Prerequisites: Graduate standing, or permission of the instructor.

Course Description:

Many problems in agriculture, food, and nutrition are inherently geographic in nature. For example, livestock production is increasingly concentrated in large feeding operations, leading to new spatial patterns of water and air pollution or foodborne illness. Spatial clustering is equally important for food consumption, nutrition, and public health, as in hunger hotspots, food deserts, and disease corridors. This course will equip students with the skills needed to capture, analyze, and communicate spatial data in Geographic Information Systems (GIS), using a variety of examples from agriculture, food, and nutrition.

Course Objectives:

This course will provide opportunities for students to acquire the following capabilities:

1. Design and evaluate research projects involving geospatial processes and data.
2. Organize and manage data and research products for collaborative research.
3. Create and evaluate maps involving categorical, quantitative and topographic data.
4. Develop credible arguments using Vector and Raster data models.

Background and Context:

Improvements in quality and accessibility of geographically referenced data present new opportunities and expectations for management and communication concerning landscapes and their influence on food systems. Students in NUTR 231 will learn to create, organize and evaluate geographic data; to develop credible arguments using maps and analytical models; and to think strategically about how organizations manage and share information.

NUTR 231 provides students with a conceptual framework and technical skills for using geographic data, maps and geographical models in a research and decision making context.   Each week we will meet for three hours for a presentation / demonstrations that weave together several threads:

The historical context of GIS and information infrastructure provides an understanding of the problems that geographic information systems have evolved to address, and the direction that these technologies are headed; particularly in terms of research, planning and administration. At a more technical level, the historic viewpoint on GIS reveals how the two primary toolits for spatial analysis: Vector/Relational; and Raster/Map Algebra have evolved to simulate particular sorts of spatial processes and relationships.

The second thread of each weekly meeting considers the ways that problems and questions may be boiled down to conceptual models that may in turn be represented with data and procedures. How does data represent entities that may or may not exist? How are data transformed into maps that change the way that people understand the world? How can we simulate and explore real-world relationships and future scenarios by transforming data with GIS? This viewpoint on GIS reminds us that the inescapable necessity of representing requires choosing one type of error over others within a purpose-specific assessment of accuracy and confidence. This frame of mind provides the analyst with an operational sense of the utility of a dataset or analysis and a feel for how models and simulations may most effectively be improved.

Weekly meetings will feature technical demonstrations that begin with a specific question and intention, develop a conceptual model, consider some data, and apply procedures to create a map or analytic model. This aspect of the course will provide students with a "How to do it" capability which will be practiced each week as each student investigates a question of their own choosing.

A third component of each lecture, workshop and exercise of considers the problem of geographical modeling from the perspective of information management and exchange. The technical aspects of encoding and exchange of information have been the backbone of geography from its inception in 500 BCE and into the age of the World Wide Web. Students will develop and demonstrate their capacity to participate in the culture of geography as each exercise extends their well-documented, re-usable and transferrable collection of data and models.

Text: Lectures, workshops and exercises will be taken from the instructor's website: www.gismanual.com . These pages are continually updated.

Prerequisite: Students must be familiar learning and using software applications with on-line documentation and with the basics of file management using the Microsoft Windows operating system. Students will need to be able to create multiple page documents in Adobe Acrobat format.

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Assignments and Submission Instructions:

In keeping with the Tufts standard for quantity of time spent each week per credit, students should plan on spending six hours each week working on their projects for this course. Expecting problems, you should plan to get started early so that you have time to ask questions and overcome obstacles.

Assignments will require the use of ArcGIS desktop version 10.3.1. This software runs on MS Windows version 7 or beyond. Students may use lab computers and may obtain a free one year license to ArcGIS.

Students are responsible for keeping their work backed up on two different pieces of media that they control. Students must be capable of restoring and revising any project document at any time before final grades have been distributed.

Writing is an essential requirement for each exercise in this course. Students with difficulty in writing in English will be responsible for getting the necessary help with editing their work.

Help Outside of Class: A weekly help session will be scheduled at a time that suits the schedules of as many students as possible.   Please use help sessions as a means of getting clarification on assignments and specific tasks. Students are encouraged to visit the Tufts GIS Center for help finding data. The purpose of the assignments in this course is to assess your ability to solve problems independently. Therefore, the teaching assistant and the data center personnel should not be relied on to design or perform extended analyses.   Office meetings with the instructor may be arranged when necessary.

Assessment and Grading:

All assignments will be assessed according to guidelines that are posted for each exercise. Weekly exercises are due the night before the next class date.

- Ten weekly exercises   100 points
- Term project in 3 installments   60 points

Accommodation of Disabilities: Students with documented disabilities are entitled to academic accommodation appropriate to their needs within the limits of the contractual requirements for course instructors. If you require accommodations, please contact me confidentially prior to the end of the second week of classes.

Academic Conduct: Each student is responsible for upholding the highest standards of academic integrity, as specified in the Friedman School's Policies and Procedures manual (http://nutrition.tufts.edu/student/documents) and Tufts University policies (http://uss.tufts.edu/studentAffairs/documents/HandbookAcademicIntegrity.pdf). It is the responsibility of each student to understand and comply with these standards, as violations will be sanctioned by penalties ranging from failure on an assignment and the course to dismissal from the school.

There are no group projects in this class. Each exercise and project should be the student's own work. Proper attribution is required for all data and ideas used in each project and exercise.

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Classroom Conduct: Success in this course requires that students attend each course meeting and hand in each exercise.   Making up for missed lectures is the responsibility of the student.

Course Schedule

All class sessions will be taught by Paul Cote. Note room changes.

Week:	Date:	Room	Topic
1.	January 27:	**S514**	Geography in the 21st Century: Infrastructure for Data and Metadata
2.	February 3:	S514	Organize geographic data for collaborative research.
3.	February 10:	S514	Geographic Referencing and Nuts and Bolts of Cartography
4.	February 17:	S514	Data Formats, Relational Databases and Creating GIS Data
5.	February 24:	**S507**	Relational Databases and Mapping Categorical Data
6.	March 2:	S514	Demographic Surveys & Mapping Quantitative Data
7.	March 9:	S514	Topographic Surveys and Mapping
8.	March 16:		Spring Break
9.	March 23:	**S507**	Vector-Relational Fundamentals: Table Queries, Views and Summaries
10.	March 30:	S514	Vector-Relational Modeling: Spatial Join and Overlay
11.	April 6:	S514	Raster Data Models: Map Algebra and Weighted Overlay
12.	April 13:	S514	Raster Interpolation and Zonal Summaries
13.	April 20:	S514	Project Proposal Presentations
14.	April 27:	S514	Poster Design and Course Conclusion
15.	May 12:		Term Project Due.

Course Topics, Learning Objectives and Assignments

1. **Geography in the 21st Century: Infrastructure for Spatial Data and Metadata**
   - Describe a question in terms of concepts and relationships that can be instantiated with data.
   - Use metadata to evaluate available datasets in terms of utility for specific purposes.
   - Cite originating and issuing sources appropriately.

   Exercise: Introduce yourself. Include a photo. Describe a research question.   Describe a dataset that may be of interest with regard to your question.   Identify a two square kilometer place in Massachusetts in which the issue you are describing makes a difference. Upload a single, multi-page PDF document to the course web site on Trunk

   Readings:
   - Spatial Models for Research and Decision Support
   - Sources of Geographic Data
   - Understanding Geographic Data
   - MassGIS Web Site

2. **Begin a Data Collection for On-Going Geographic Research**
   - Plan a File System for Ongoing Research and Archiving.
   - Obtain base map data.
   - Create an ArcMap document.
   - Back-up and restore a research archive collection of data.

   Exercise: Begin your Data Collection; Create a Map; Back & Restore Up Your Collection. Turn in a zip file.
   Readings:
   - Organizing Data for Re-Use

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- ArcMap 101: Collecting GIS Data and Metadata

3. **Geographic Referencing Systems**
   - Choose an appropriate map projection for a map.
   - Create a 3-layer graphical cartographic hierarchy.
   - Create a map that frames a purposeful discussion of a place.

   Exercise: Create a reference map portraying the immediate context of your study area.

   Readings:
   - Fundamentals of Geographic Referencing
   - Elements of Cartographic Style
   - Nuts and Bolts of Mapping with ArcMap

4. **Encoding observations and ideas: Georeferenced Data and Metadata**
   - Understand fundamental data formats.
   - Create new geographic datasets
   - Beware the absence of evidence is not evidence of absence fallacy.

   Exercise: Explore and explain critical aspects of the history of a place with georeferenced historical maps.

   Readings:
   - Data Formats for Geography
   - Relational Databases, Queries and Views

5. **Transforming and Mapping Categorical Data**
   - Use relational table joins to expose patterns in disaggregate data
   - Create a thematic map with categorical polygon data
   - Use conventional symbols for land use shading
   - Interpret data with appropriate deference to its categorical and spatial precision.

   Exercise: Recategorize land use data for a purpose-specific map and discussion.

   Readings:
   - Mapping with Categorical Data 2
   - About Categorical Data
   - MassGIS Land Use Data: 1955-1999, 2005

6. **Demographic Surveys and Mapping with Quantitative Data**
   - Obtain census data for your study area
   - Properly represent intensive and raw count statistics
   - Develop credible discussions in light of the modifiable aerial unit problem

   Exercise: Create demographic maps with choropleth and proportional symbol maps.

   Readings:
   - About Census Data
   - Mapping with Quantitative Data
   - Mapping Census Data Tutorial

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7. Topographic Surveys & Mapping Terrain, Introduction to Rasters

- Obtain elevation models for an area of interest.
- Properly transform elevation data for graphical display
- Create maps with synthetic hill shading.

Exercise: Add contours, hillshade, and slope or aspect to your area of interest map. Discuss.

Readings:
- [Obtaining and Transforming Elevation Data](#)

8. Vector-Relational Database Fundamentals and Procedures for Cartography

- Create layers and table views based on definition queries
- Create layers from spatial selections and buffers
- Use iconic point symbols

Exercise: Make a map exploring the relationship of populations with resources.

Readings:
- [Evolution of Vector-Relational Database Management Systems and SQL](#).
- [Vector-Relational Procedures in ArcMap](#)

9. Vector-Relational Modeling: Buffering and Overlay Techniques

- Develop a conceptual model involving spatial association (e.g. food deserts)
- Instantiate your model using point data and demographic data.
- Use geoprocessing tools to create a reusable model to experiment with policy alternatives
- Assess the degree of confidence in your model as a decision support tool.

Exercise: Create a vector data model of a study area of your choice.

Readings:
- [Vector-Relational Procedures in ArcMap](#)

10. Map Algebra & Weighted Overlay

- Develop spatial McHargian spatial filters using the logic of map algebra.
- Appropriately apply weighted overlay techniques for site selection.
- Evaluate error propagation in spatial models

Readings:
- [Raster GIS Tutorial](#)

Exercise: Prepare a locational analysis with weighted overlay.

11. Raster Fundamentals: Focal, Zonal, and Interpolation Techniques
- Create Heat maps with interpolation and focal functions.
- Use zonal functions to model accessibility and exposure
- Apply best-practices for checking plausibility of models

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Readings:
- [Raster GIS Tutorial](#) (continued)

Exercise 1. Raster interpolation and summary.
Exercise 2. Propose a GIS Analysis using a study area and data of your choice.

12. Student Project Pitches
- Define a problem that can be explored with GIS models.
- Describe datasets that represent the physical terms of your conceptual; model.
- Describe GIS procedures that represent the relationships in your model.
- Describe a research frame that includes the evaluation of planning alternatives.
- Evaluate the utility of your model for the purpose at hand.

Assignment: Develop your model.

13. Poster Design and Course conclusion

- Organize ideas graphically using layout, fonts and color.
- Discuss the future of GIS in research and decisionmaking

Exercise: Create poster for final project and the Tufts GIS Poster Show.

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