NUTR 231 Fundamentals of GIS

Spring 2021

This syllabus is subject to change. Check the course Canvas site for latest version.

Class Meetings: Wednesdays 4pm-7pm
Course format: Synchronous, fully remote
Course Zoom link: https://tufts.zoom.us/j/95704180267?pwd=OUhyZ2JoTjNsVUQwTFgzQUljYUJOZz09

Instructor: Alexandra Thorn, alexandra.thorn@tufts.edu
Pronouns: she, her, hers
Instructor Office Hours: TBD
Office hours link: https://tufts.zoom.us/j/813190272 1?pwd=aWEwNUZXbTc3WWROdHQ5SGFKRWhlUT09

Teaching Asst.: **Ziyu Wang ziyu.wang@tufts.edu**
Pronouns: she, her, hers
Teaching Asst. Office Hours: TBD

Semester Hour Units: 3 Semester Hour Units

There are no prerequisites. Students are expected to have competence in computer use and some familiarity with Microsoft Windows environment and file management (folders, subdirectories, copying).

NOTE: The methods of course delivery may change subject to COVID-19 status.

Course Description:
This course introduces Geographic Information Systems (GIS) and its applications. GIS is a combination of software, data, methods and hardware with capabilities for manipulating, analyzing and displaying spatially referenced information. In its simplest applications GIS links spatial location to data. It is extremely helpful in layering location data from various sources which could be at the most micro level for example: trees, people and parcels that can be aggregated to larger macro level spatial units like cities, states or countries. This layering of different kinds of data can help us ask and answer spatial questions. For example, you could use location data for crimes and

shops that sell alcohol to ask: Do crimes cluster closer to shops that sell alcohol? Similarly with the appropriate data layers you could ask: Can the spatial distribution of tweets mentioning words that mean protest be used to track mass activism? Do countries with high rates of mining activity have higher numbers of conflicts? Are there differences in access to parks within a city?

Course Objectives:
The major goals of this course are to learn:

- Spatial data structures, data formats, and geo-referencing
- Geo-processing and Spatial analysis methods

By the end of this course students will have achieved the following learning objectives:

- Recognize data formats in spatial data (raster and vector)
- Understand projections and coordinate systems, including identification of suitable coordinate systems for display and analysis
- Use spatial databases for spatial and attribute joins and queries
- Geocode spatial data
- Use appropriate spatial analysis methods to combine spatial data including spatial joins, buffer, intersect, union, dissolve, map algebra, and zonal statistics
- Design and implement an independent project that incorporates spatial methods

Text:
Campbell, J and M. Shin, 2011, Essentials of Geographic Information Systems
ISBN 13: 978-1-4533219-6-6.
Available free at: https://open.umn.edu/opentextbooks/textbooks/essentials-of-geographic-information-systems

Additional Materials

Because the course is being taught remotely, students need a reliable internet connection. Students must have access to a laptop or desktop computer **with an external mouse** for completion of assignments.

Assignments will require the use of either QGIS 3.1+ or ArcGIS Desktop 10.7+. QGIS is free and runs on Windows, Mac, and Linux. ArcGIS requires a license and runs on MS Windows version 7 or beyond. Students have the option to remotely access lab computers and can also obtain a free one-year license to ArcGIS to install on their own computers.

Students are should purchase an external mouse.

Organization of the online course:
Given the prevailing public health situation this year, the class will meet in a combination of online formats:

- Lectures will be pre-recorded for asynchronous viewing
- Whole class synchronous discussions will be recorded and posted online. These synchronous "meetings" will be dedicated to the following activities:
  - Question-and-answer sessions in which students bring any questions on the readings, homework assignments, or projects
  - Review of weekly self-assessment quizzes
  - Student presentations on final project topic ideas
  - Small-group activities: labs and/or discussions
- Each week students will be expected to complete the following asynchronous activities:
  - View recorded lectures & demonstrations
  - Complete assigned readings
  - Complete tutorials & accompanying worksheets (to be submitted over Canvas for a grade)
  - Self-assessment mini-quizzes (for participation credit)
- Students will also complete a final project applying spatial analysis tools to answer a research question
  - Smaller assignments related to the project (e.g. literature review of similar past projects, assembling

    - datasets that will be needed to answer your question) will be assigned throughout the semester
    - To increase opportunities for social learning, students are encouraged to work with a partner on the final project
  - Students should plan to meet individually with either the instructor or the TA every two weeks to check in about progress
  - Students may are encouraged to schedule additional 1:1 meetings as needed (these scheduled meetings serve as instructor and TA office hours)
  - 1:1 meetings / office hours will not be recorded.

Academic Conduct: Each student is responsible for upholding the highest standards of academic integrity, as specified in the Friedman School's Student Policies and Procedures Manual (https://nutrition.tufts.edu/sites/default/files/documents-forms/2018-2019PolProc.pdf) and Tufts University policies (http://students.tufts.edu/student-affairs/student-code-conduct/academic-integrity-resources). 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.

Student Responsibilities and Classroom Conduct:

1) ***Keep up*** with readings, tutorials, self-assessment quizzes, and other assignments. Students will be evaluated on knowledge and skills obtained from lecture, discussion, readings, and assignments.
2) Be prepared for class ***discussions and participation***. Arrive prepared to ask questions and help other students to learn.
3) ***Be helpful*** to other students, while understanding that each student (or assigned group) should be responsible for completing assignments independently. Both during and between class sessions, students are expected

to show a community spirit and readiness to help others understand the software and relevant concepts.

4) Follow the student ***honor code and ethical standards***. The academic code of conduct can be accessed over the web at: https://students.tufts.edu/student-affairs/student-life-policies/academic-integrity-policy
5) In-class and out-of-class assignment should be written in ***formal academic language*** and be free of spelling errors and poor grammar. References must be cited properly.
6) Students should make their best effort to submit all assignments on time. Late assignments will be ***penalized 1% per day*** of lateness, with a ***maximum penalty of 20%***. The final project may **not** be submitted late.
7) If you need to communicate with the instructor, you may do so via e-mail, or in scheduled appointments during Zoom office hours, or by making a personal appointment. ***Dr. Thorn checks email Monday – Friday.*** It may take at least one workday for her to return an e-mail message. Please plan accordingly. If you need more then 5-10 minutes of the instructor's time, it may be best to schedule an appointment.
8) Be prepared to ***spend many hours working with GIS software***, learning to work with the software and data.
9) You are encouraged to meet with the instructor not only when you have questions or concerns about the material in class but also when you just need someone to brainstorm or have a conversation.
10) Available Academic Supports: Tufts University has assistance available for students in need of academic help. The Academic Resource Center https://students.tufts.edu/academic-advice-and-support/academic-resource-center provides writing support and advice on avoiding plagiarism, among other supports, to ensure students' successful undergraduate careers.

Assessment and Grading:

The final course grade will be based on:

Assignments (HW & Labs)	20%
Take home final	20%

Participation (assessed weekly)			20%
Final project			40%
	Topic presentation	5%	
	Data-gathering	5%	
	Find and summarize references	5%	
	Proposal	10%	
	Final poster	15%	

The purpose of the Final Project is to provide additional experience in collecting, processing, analyzing and synthesizing spatial data. The project can be relevant to your research interests, to your thesis or for a joint project or final paper in another course. The project should use ArcGIS, QGIS, or other GIS software to examine the spatial implications of a research problem. Students must start thinking about project ideas early in the semester. They will be expected to hand in a project proposal by the start of the synchronous class session on March 31 The proposal should include your research question, background on why the question is important or interesting, what spatial and non-spatial data will be required to answer the question, and a proposed methodology. The final project will take the form of a poster, due **11:59pm on May 12**. ***Group projects are encouraged*** but the products of group work will be expected to scale-up corresponding to the number of members in the group.

Grading Range:

A passing grade in the course is B- or better. Course grades will be based on the below (subject to revision during the course):

A	≥ 94%
A-	90 - 93.95%
B+	87 - 89.95%

B	84 - 86.95%
B-	80 - 83.95%

Instructions for Submission of Assignments and Exams:
Unless specified otherwise, all assignments should be submitted via the course site on Canvas.

Accommodation of Disabilities:
Tufts University is committed to providing equal access and support to all students through the provision of reasonable accommodations so that each student may access their curricula and achieve their personal and academic potential. If you have a disability that requires reasonable accommodations please contact the Friedman School Assistant Dean of Student Affairs at 617-636-6719 to make arrangements for determination of appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

Course Topics and Assignment Schedule at a Glance:

The schedule is subject to change.

	Topic	Assignments due	Readings due
Week 1 (Jan 20)	Introductions, course overview, norms		
Week 2 (Jan 27)	Introduction to GIS	• Lab: MassGIS Data • Connect to the Tufts Remote Data Lab • VoiceThread - Introductions • Install ArcGIS and/or QGIS on your personal computer	
Week 3 (Feb 3)	Spatial data models	• Lab: Topic Brainstorming • HW 1: ArcGIS/QGIS Basics – Somerville Tutorial	Campbell & Shin, Ch 1, 3, 4
Week 4 (Feb 10)	Coordinate Systems and Projections	• Lab: Map Document Telephone • HW 2: Troubleshooting Coordinate Systems	Campbell & Shin, Ch 2 & http://giscommons.org/earth-and-map-preprocessing/
Week 5 (Feb 17)	Queries	• Lab: Making Sense of Projections • HW 3: Using the Selection Tools for Querying (Haiti) • *Topic Ideas Presentations* • **Summarize References for Projects**	Campbell and Shin, Ch. 6.1 & 6.2

	Topic	Assignments due	Readings due
Week 6 (Feb 24)	Joins, Relates, and Data Creation	• HW 4: Census Data Tutorial (adapted from ScholarsLab) • Lab: Queries • *Topic Ideas Presentations*	Campbell and Shin, Ch. 5; www.ncjrs.gov/html/nij/mapping/ch4_3.html & http://giscommons.org/data-tables-and-data-preprocessing/
Week 7 (Mar 3)	Symbology, Classification, & Cartography	• HW 5: Using Census Data to Calculate Social Inequality in Colombia • Lab: TBD • *Topic Ideas Presentations* • **Gather Data for Projects**	Campbell and Shin, Ch. 6.3, Ch. 9 & https://web.archive.org/web/20190220192538/http://giscommons.org/output
Week 8 (Mar 10)	Vector Analysis	• HW 6: Proximity Analysis: Nuclear Power Plant Risk Assessment • Lab: Maps for Peer-Review • *Topic Ideas Presentations*	Campbell and Shin, Ch 7

	Topic	Assignments due	Readings due
Week 9 (Mar 17)	Raster Analysis	• HW 7: Malaria Risk Tutorial • Peer-review maps • *Topic Ideas Presentations*	Campbell and Shin, Ch 8; Berry, 6.1, https://web.archive.org/web/20190826154928/ & http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry6_1_Suitability_Modeling
Week 10 (Mar 31)	Principles of Design	• ***Project Proposals Due***	Microsoft Publisher Tutorial: https://sites.tufts.edu/gis/files/2014/02/Designing-and-Creating-your-Poster-Publisher-setup-and-PDF-directions_2018.pdf Design presentation: https://youtu.be/I7jqBy1lMfk
Week 11 (Apr 7)	Understanding Autocorrelation and Interpolation	• Peer-review Project Proposals • ***Take-home Midterm Due***	Berry, 4.1, https://web.archive.org/web/20190826154928/ & http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry4_1_Surface_Modeling
Week 12 (Apr 14)	Projects	• *Short presentations on project progress*	
Week 13 (Apr 21)	Projects	• ***Draft Posters Due*** • *Short presentations on project progress*	

	Topic	Assignments due	Readings due
Week 14 (Apr 28)	Projects & Course Wrap-up	• *Short presentations on project progress*	
FINALS WEEK (Dec 18)		***Final Posters Due*** (11:59pm May 12)	

Course Topics, Assignment Schedule, and Learning Objectives:

Week 1: Introduction: Course overview and Introduction to GIS

Learning Objectives:

- Introduce ourselves
- Overview of course
- Software orientation
- Become familiar with the MassGIS website
- Learn to formally describe research questions that can be answered with data
- Use metadata to assess usefulness of data for answering questions

Readings Due: N/A

Assignments Due: N/A

Quizzes: N/A

Week 2: Introduction to GIS

Learning Objectives:

- Understand what GIS is and how it is used
- Think in more detail about research questions

Readings Due: Syllabus and Data Lab Orientation Materials; View Lecture 1

Assignments Due: Install Software

Week 3: Working with data

Learning Objectives:

- Create an ArcMap document
- Use relative paths to ensure portability of data between systems
- Identifying whether or not research questions are spatial
- Practice backing up data

Readings Due: Campbell & Shin, Ch 1, 3, 4; View Lecture 2

Assignments Due: Topic Ideas Presentation; HW 1: ArcGIS Basics

Week 4: Coordinate Systems and Projections

Learning Objectives:

- Learning to recognize different types of projections
- Choosing an appropriate projection for display of data
- Using Tissot's Indicatrix and knowledge of standard lines to communicate about the distortions associated with different projections

Readings Due: Campbell & Shin, Ch 2; http://giscommons.org/earth-and-map-preprocessing/; View Lecture 3

Assignments Due: HW 2: Trouble-shooting Coordinate Systems

Week 5: Queries

Learning Objectives:

- Using queries and selections to create new (smaller) layers and tables
- Learning what kinds of questions can be answered with spatial and attribute (SQL) queries
- Planning the order of sequences of queries used to answer a question
- Use SQL to control labels

Readings Due: Campbell and Shin, Ch. 6.1 & 6.2; View Lecture 4

Assignments Due: Summarize References for Projects; HW 3: Using Query Tools – Haiti; *Topic Ideas Presentations*

Week 6: U.S. Census Data, Joins & Relates, Creating Spatial Data

Learning Objectives:

- Understanding U.S. Census FIPS classification
- Downloading Census data from American Fact-Finder
- Downloading Census boundaries from TIGER/LINE
- Formatting spreadsheets for joining to spatial data
- Use ArcCatalog to organize your data into a File geodatabase
- Joining data by FIPS ID
- Understanding fundamental data formats
- Working with non-standard data sources: addresses, text files, GPS data
- Formatting Excel files for import to ArcGIS

Readings Due: Campbell & Shin, Ch. 5; www.ncjrs.gov/html/nij/mapping/ch4_3.html; & http://giscommons.org/data-tables-and-data-preprocessing/; View Lecture 5

Assignments Due: HW 4: Joins, Relates & Creating a File Geodatabase; *Topic Ideas Presentations*

Week 7: Symbology and Classification

Learning Objectives:

- Explore the different classification systems used for symbology in GIS software
- Consider colors and symbols that meaningfully convey a message
- Create three-layer graphical cartographic hierarchies
- Critiquing maps for design and clarity

Readings Due: Campbell and Shin, Ch. 6.3, Ch. 9; http://giscommons.org/output/; View Lecture 6

Assignments Due: Gather Data for Projects; HW 5: Using Census Data to Calculate Social Inequality in Colombia; *Topic Ideas Presentations*

Week 8: Vector Analysis

Learning Objectives:

- Using Geoprocessing tools to answer questions
- Introduction ArcGIS ModelBuilder

Readings Due: Campbell and Shin, Ch 7; View Lecture 7

Assignments Due: Gather Data for Projects; HW 6: Proximity Analysis: Nuclear Power Plant Risk Assessment; *Topic Ideas Presentations*

Week 9: Raster Analysis and Interpolation

Learning Objectives:

- File system idiosyncrasies for using Spatial Analyst
- Working with land cover data (e.g. Cropscape / Cropland Data Layer)
- Brief discussion of Digital Elevation Models

Readings Due: Campbell and Shin, Ch 8; Berry, 6.1, https://web.archive.org/web/20190826154928/;

http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry6_1_Suitability_Modeling; View Lecture 8

Assignments Due: HW 7: Malaria Risk Tutorial; *Topic Ideas Presentations*

Week 10: Principles of Design

Learning Objectives:

- Organize information graphically using layouts, fonts, and colors
- Critique design of past GIS Expo posters

Readings Due: Microsoft Publisher Tutorial: https://sites.tufts.edu/gis/files/2014/02/Designing-and-Creating-your-Poster-Publisher-setup-and-PDF-directions_2018.pdf

Readings Due: View Lecture 9

Assignments Due: *Project Proposals Due*

Week 11: Density and Interpolation

Learning Objectives:

- Know when to use point density, kernel density, or interpolation
- Understand what spatial autocorrelation is and some of the ways it affects spatial analysis
- Work on projects and posters

Readings Due:

Berry, 4.1, https://web.archive.org/web/20190826154928/http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry4_1_Surface_Modeling; View Lecture 10

Assignments Due: *Take Home Midterm Due*, Peer-review Project Proposals

Week 12: Work on Posters

Learning Objectives:

- Refine analysis, models and design for final posters

Readings Due: N/A

Assignments Due: *Project Progress report Presentations*

Weeks 13: Work on Posters

Learning Objectives:

- Refine analysis, models and design for final posters

Readings Due: N/A

Assignments Due: *Draft Posters Due*; *Project Progress report Presentations*

FINALS WEEK: *Final Posters Due*

****NO CLASS!!****

Assignments Due: *Final Projects*: Due 11:59pm May 12, 2020