Tufts University | Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

NUTR 231: Fundamentals of GIS

Fall 2022

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

Class Meetings: MedEd 514
(except September 16, October 28, and December 9; see class schedule below)
Friday 9am-12pm

Instructor: Alexandra Thorn, alexandra.thorn@tufts.edu
Pronouns: she, her, hers

Instructor Office Hours: TBD

Teaching Asst.: Monica Mutinda, monica.mutinda@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 and Materials:

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 of the uncertainties around the ongoing pandemic, it is highly recommended that students plan for the possibility of lockdowns or isolation. *In the event of a quarantine,* students will need a reliable internet access and a laptop or desktop computer **with an external mouse** for completion of assignments.

Assignments will require the use of ArcGIS Pro and/or QGIS 3.16+. ArcGIS Pro system requirements are listed here: https://pro.arcgis.com/en/pro-app/latest/get-started/arcgis-pro-system-requirements.htm. ArcGIS Pro site licenses can be accessed using your Tufts UTLN, and can be used either for installing the software on your personal computer or for accessing the software on the remote Data Lab. QGIS is free and runs on Windows, Mac, and Linux.

Organization of the course:

The course utilizes a number of formats for content delivery.

- Most lectures will be pre-recorded, and should be viewed before attending class
- Each in-person class meetings will be dedicated to some combination of the following activities:
    - Question-and-answer sessions in which students bring any questions on the readings, homework assignments, or projects
    - Short lectures or demonstrations
    - Labs and/or discussion activities
    - Small group breakout discussions
    - Peer review activities
    - Dedicated work time for working on projects or beginning weekly tutorials

- Each week students will be expected to complete the following activities before class:
  - 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 meet with the instructor a minimum of **three times** over outside of class over Zoom to check in about progress on the course
- 1:1 meetings and 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***. The Take-home Midterm and the Final Project may **not** be submitted late.
7) If you need to communicate with the instructor, you may do so via e-mail, during class/lab, during 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 in the computer labs*** 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, Graded peer reviews)	25%
Take-home Midterm	20%
Participation (assessed weekly)	10%
Final project assignments	45%

Project assignments include:

Identify current events article	1%
Topic presentation	4%
Find and summarize references	5%
Data-gathering	10%
Project 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 Pro, 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 beginning of class **Nov 8th**. 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 **Dec 16th**. 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. Sessions not in MedEd 514 highlighted in yellow. Make sure to bring a laptop on those dates.

Week & Location	Topic	Tutorial(s) and assignments due	Readings due
Week 1 (Sept 9: **MedEd 514**)	Course overview Introduction to GIS		
Week 2 (Sept 16: **Jaharis 156**)	GIS Basics & Spatial Questions	**Project: Identify Current Events Article**	Campbell & Shin, Ch 1, 3, 4
Week 3 (Sept 23: **MedEd 514**)	Spatial data models	ArcGIS Basics – Somerville Tutorial **Project: Topic Ideas Presentations**	Campbell & Shin, Ch 2 & http://giscommons.org/earth-and-map-preprocessing/
Week 4 (Sept 30: **MedEd 514**)	Coordinate Systems and Projections	Troubleshooting Coordinate Systems	Campbell and Shin, Ch. 6.3, Ch. 9 & https://web.archive.org/web/20190220192538/http://giscommons.org/output
Week 5 (Oct 7: **MedEd 514**)	Symbology, Classification, & Cartography	Using Census Data to Calculate Social Inequality in Colombia	Review Campbell & Shin, Ch. 5.2; https://www.census.gov/programs-surveys/geography/guidance/geo-identifiers.html; https://desktop.arcgis.com/en/arcmap/latest/manage-data/tables/about-joining-and-relating-tables.htm
Week 6 (Oct 14: **MedEd 514**)	Joins, Relates, and Geodatabases	Census Data and Joins Tutorial **Project: Summarize References**	Campbell and Shin, Ch. 6.1 & 6.2
Week 7 (Oct 21: **MedEd 514**)	Queries	Using the Selection Tools for Querying (Haiti)	Campbell and Shin, Ch 7

Week & Location	Topic	Tutorial(s) and assignments due	Readings due
Week 8 (Oct 28: **Jaharis 133, Conference Room**)	Vector Analysis	Proximity Analysis: Nuclear Power Plant Risk Assessment **Project: Gather Data**	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 9 (Nov 4: **MedEd 514**)	Raster Analysis	Malaria Risk Tutorial	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 10 (Nov 8*: **MedEd 514**) **Class meets on Tuesday*	Principles of Design	***Project: Proposals Due***	
Week 11 (Nov 18: **MedEd 514**)	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
Thanksgiving Break	*****	*****	*****
Week 12 (Dec 2: **MedEd 514**)	Projects	***Project: Draft Posters Due*** *Short presentations on project progress*	

Week & Location	Topic	Tutorial(s) and assignments due	Readings due
Week 13 (Dec 9: **Jaharis 133, Conference Room**)	Projects	*Short presentations on project progress*	
FINALS WEEK (Dec 16: ***no class***)		***Final Posters Due*** **(11:59pm Dec 16)**	

Course Topics, Assignment Schedule, and Learning Objectives:

Week 1: Course overview and Introduction to GIS

Learning Objectives:

- Understand what GIS is and how it is used
- 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

Week 2: GIS Basics and Spatial Questions

Learning Objectives:

- Read and interpret descriptions of GIS analysis
- Develop ideas on possible topics for spatial analysis

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

Self-assessment Quizzes: Quiz 1

Assignments Due: Current Events Article

Week 3: Data Models

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 2; http://giscommons.org/earth-and-map-preprocessing/; View Lecture 3

Self-assessment Quizzes: Quiz 2

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

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 and Shin, Ch. 6.3, Ch. 9; http://giscommons.org/output/; View Lecture 4

Self-assessment Quizzes: Quiz 3

Assignments Due: HW 2: Trouble-shooting Coordinate Systems

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

Self-assessment Quizzes: Quiz 4

Assignments Due: HW 4: Using Census Data to Calculate Social Inequality in Colombia;

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 and Shin, Ch. 6.1 & 6.2; View Lecture 6

Self-assessment Quizzes: Quiz 5

Assignments Due: Summarize References for Projects; HW 5: Census Data and Joins Tutorial

Week 7: 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 7; View Lecture 7

Self-assessment Quizzes: Quiz 6

Assignments Due: HW 3: Using Query Tools – Haiti

Week 8: Vector Analysis

Learning Objectives:

- Using Geoprocessing tools to answer questions
- Introduction ArcGIS ModelBuilder

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

Self-assessment Quizzes: Quiz 7

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

Week 9: Raster Analysis

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: Microsoft Publisher Tutorial: https://sites.tufts.edu/gis/files/2014/02/Designing-and-Creating-your-Poster-Publisher-setup-and-PDF-directions_2018.pdf**;** View Lecture 9

Assignments Due: HW 7: Malaria Risk Tutorial

Week 10: Principles of Design

Learning Objectives:

- Organize information graphically using layouts, fonts, and colors
- Critique design of past GIS Expo 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: *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: N/A

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: *Draft Posters 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: *Project Progress report Presentations*

Week 13: Work on Posters

Learning Objectives:

- Refine analysis, models and design for final posters

Readings Due: N/A

Assignments Due: *Project Progress report Presentations*

FINALS WEEK: *Final Posters Due*

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

Assignments Due: *Final Projects*: Due 11:59pm Dec 16 2022