NUTR 231: Fundamentals of GIS  
Spring 2021

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

Class Meetings: MedEd Room 514
Friday 9am-12pm

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

Instructor Office Hours: MedEd Computer Lab: Wed 9:30-11:30am

Teaching Asst.: Xu Jaing, xu.jiang@tufts.edu
Pronouns: she, her, hers

Teaching Asst. Office Hours: Thursday 3-4pm

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:**
Available free at: [https://open.umn.edu/opentextbooks/textbooks/essentials-of-geographic-information-systems](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 quarantines. *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
  - Student presentations on final project topic ideas
  - 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** outside of class (either in person or over Zoom) to check in about progress on the course
  - 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](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](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](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, 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 than 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](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) 25%
- Take home final 20%
- Participation (assessed weekly) 10%
- Final project 45%
  - Topic presentation 5%
  - 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 5th. 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 17th. 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):

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>≥ 94%</td>
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<tr>
<td>A-</td>
<td>90 - 93.95%</td>
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<td>B+</td>
<td>87 - 89.95%</td>
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<tr>
<td>B</td>
<td>84 - 86.95%</td>
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<tr>
<td>B-</td>
<td>80 - 83.95%</td>
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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.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Tutorial(s) and assignments due</th>
<th>Readings due</th>
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</thead>
<tbody>
<tr>
<td>1(Sep 10)</td>
<td>Course overview Introduction to GIS</td>
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<tr>
<td>2(Sep 17)</td>
<td>Spatial data models</td>
<td>ArcGIS Basics – Somerville Tutorial</td>
<td>Campbell &amp; Shin, Ch 1, 3, 4</td>
</tr>
<tr>
<td>4(Oct 1)</td>
<td>Queries</td>
<td>Using the Selection Tools for Querying (Haiti)</td>
<td>Campbell and Shin, Ch. 6.1 &amp; 6.2</td>
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<tr>
<td>5(Oct 8)</td>
<td>Symbology, Classification, &amp; Cartography</td>
<td>Using Census Data to Calculate Social Inequality in Colombia</td>
<td>Campbell and Shin, Ch. 6.3, Ch. 9 &amp; <a href="https://web.archive.org/web/20190220192538/http://giscommons.org/output">https://web.archive.org/web/20190220192538/http://giscommons.org/output</a></td>
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<tr>
<td>Week 7  (Oct 22)</td>
<td>Topic</td>
<td>Tutorial(s) and assignments due</td>
<td>Readings due</td>
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<td></td>
<td>Vector Analysis</td>
<td>Proximity Analysis: Nuclear Power Plant Risk Assessment</td>
<td>Campbell and Shin, Ch 7</td>
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<tr>
<td></td>
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<td><strong>Gather Data for Projects</strong></td>
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<td><strong>Topic Ideas Presentations</strong></td>
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<tr>
<td>Week 8  (Oct 29)</td>
<td>Raster Analysis</td>
<td>Malaria Risk Tutorial</td>
<td>Campbell and Shin, Ch 8; <a href="https://web.archive.org/web/20190826154928/">https://web.archive.org/web/20190826154928/</a>; &amp; <a href="http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry6_1_Suitability_Modeling">http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry6_1_Suitability_Modeling</a></td>
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<td><strong>Topic Ideas Presentations</strong></td>
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<td><strong>Take-home Midterm Due</strong></td>
<td>Berry, 4.1, <a href="https://web.archive.org/web/20190826154928/">https://web.archive.org/web/20190826154928/</a> &amp; <a href="http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry4_1_Surface_Modeling">http://www.innovativegis.com/basis/papers/other/asprschapter/#Berry4_1_Surface_Modeling</a></td>
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<tr>
<td>Week 10 (Nov 12)</td>
<td>Understanding</td>
<td>Peer-review Project Proposals</td>
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<td></td>
<td>Autocorrelation and</td>
<td><strong>Take-home Midterm Due</strong></td>
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<td></td>
<td>Interpolation</td>
<td><strong>Project Proposals Due</strong></td>
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<tr>
<td>Week 11 (Nov 19)</td>
<td>Projects</td>
<td><strong>Short presentations on project progress</strong></td>
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<tr>
<td>Topic</td>
<td>Tutorial(s) and assignments due</td>
<td>Readings due</td>
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<tr>
<td>Thanksgiving Break</td>
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| Week 12 (Dec 3)        | Projects                                                              | *Draft Posters Due  
*Short presentations on project progress* |
| Week 13 (Dec 10)       | Projects                                                              | *Short presentations on project progress* |
| FINALS WEEK (Dec 17)   | *Final Posters Due*                                                  |              |

*Final Posters Due*  
(11:59pm Dec 17)
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: 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
Self-assessment Quizzes: Quiz 1
Assignments Due: HW 1: ArcGIS Basics

Week 3: 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
Self-assessment Quizzes: Quiz 2
Assignments Due: HW 2: Trouble-shooting Coordinate Systems
**Week 4: 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

**Self-assessment Quizzes:** Quiz 3

**Assignments Due:** Sign up for Topic Ideas Presentations; HW 3: Using Query Tools – Haiti

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**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 and Shin, Ch. 6.3, Ch. 9; [http://giscommons.org/output/](http://giscommons.org/output/); View Lecture 5

**Self-assessment Quizzes:** Quiz 4

**Assignments Due:** Summarize References for Projects; HW 4: Using Census Data to Calculate Social Inequality in Colombia; *Topic Ideas Presentations*

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**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
Self-assessment Quizzes: Quiz 5
Assignments Due: HW 5: Census Data and Joins Tutorial; Topic Ideas Presentations

Week 7: Vector Analysis
Learning Objectives:
• Using Geoprocessing tools to answer questions
• Introduction ArcGIS ModelBuilder
Readings Due: Campbell and Shin, Ch 7; View Lecture 7
Self-assessment Quizzes: Quiz 6
Assignments Due: Gather Data for Projects; HW 6: Proximity Analysis: Nuclear Power Plant Risk Assessment; Topic Ideas Presentations

Week 8: 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: 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: HW 7: Malaria Risk Tutorial; Topic Ideas Presentations

Week 9: 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; View Lecture 9
Assignments Due: *Project Proposals Due*
Week 10: 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 11: Work on Posters
Learning Objectives:
- Refine analysis, models and design for final posters

Readings Due: N/A

Assignments Due: Project Progress report Presentations

Weeks 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

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 17 2021