11.205: INTRO TO SPATIAL ANALYSIS

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LAB INSTRUCTORS: ARIA FINKELESTEIN (ariaritz@mit.edu) and JUAN CAMILO OSORIO (jcosorio@mit.edu)
TEACHING ASSISTANTS: RICARDO CAMPOS (rmcampos@mit.edu) and EMILY LONG (elong@mit.edu)
LECTURE: Monday and Wednesday 2:30-4pm, Room 9-354
LABS: (All in Room W31-301) Monday, Tuesday, Wednesday, Thursday 5-7pm – To Be Assigned

Class Description:
Geographic Information Systems (GIS) are tools for managing data about where features are (geographic coordinate data) and what they are like (attribute data), and for providing the ability to query, manipulate, and analyze those data. Because GIS allows one to represent social and environmental data as a map, it has become an important analysis tool used across a variety of fields including: planning, architecture, engineering, public health, environmental science, economics, epidemiology, and business. GIS has become an important political instrument allowing communities and regions to graphically tell their story. GIS is a powerful tool, and this course is meant to introduce students to the basics. Because GIS can be applied to many research fields, this class is meant to give you an understanding of its possibilities.

Learning Through Practice:
The class will focus on teaching through practical example. All the course exercises will focus on a relationship with the Bronx River Alliance, a local advocacy group for the Bronx River. Exercises will focus on the Bronx River Alliance’s real-world needs, in order to give students a better understanding of how GIS is applied to planning situations.

11.205 and 11.520:
Introduction to Spatial Analysis (11.205) and GIS Workshop (11.520) are two modular courses which taken together make up the Introduction to GIS series. Introduction to Spatial Analysis is required by the MCP degree, students who have a previous background in GIS can test-out of this course. GIS Workshop Course (11.520) focuses on developing a research project using GIS as well as introduction to some advanced topics in data collection and web-mapping. Working on your own GIS project is the best way to learn GIS as it teaches you to apply the concepts you learn beyond the step-by-step tutorial you will learn in class. Students of all GIS backgrounds are welcome to take the GIS Workshop course. Experienced students may be interested in taking the GIS Workshop course, in order to test ideas for thesis or investigate projects that use spatial analysis. Taken together Introduction the Spatial Analysis and GIS Workshop Course give you a complete set of skills needed to start your own GIS project.
Course Objectives

11.205
● Develop an understanding of basic skills necessary to work with Geographic Information Systems (GIS), using ESRI's ArcGIS software
● Learn about GIS data types
● Learn spatial data visualization techniques and cartography
● Learn about GIS and Local Government Data
● Learn about GIS and Census Data
● Learn Geo-Processing Tools
● Learn about GIS and Decision Making

11.520
● Learn how to ask spatial research questions
● Develop skills needed to work through a project that uses GIS as a management or visualization tool
● Learn how to find publicly accessible data sets
● Learn how to create GIS files using a variety of methods including GPS units
● Learn about open source GIS
● Learn basics of visualizing data on the web

Assignments & Grading

<table>
<thead>
<tr>
<th>ASSIGNMENT</th>
<th>% of TOTAL</th>
<th>DUE</th>
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<tbody>
<tr>
<td>WEB PAGE</td>
<td>5%</td>
<td>9/15</td>
</tr>
<tr>
<td>EXERCISE #1</td>
<td>10%</td>
<td>9/22</td>
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<tr>
<td>EXERCISE #2</td>
<td>15%</td>
<td>9/29</td>
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<tr>
<td>PROBLEM SET (1)</td>
<td>20%</td>
<td>10/6</td>
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<tr>
<td>PROBLEM SET (2)</td>
<td>30%</td>
<td>10/20</td>
</tr>
<tr>
<td>EXERCISE #3</td>
<td>15%</td>
<td>10/27</td>
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<tr>
<td>CLASS PARTICIPATION</td>
<td>5%</td>
<td>NA</td>
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NO LATE ASSIGNMENTS WILL BE ACCEPTED!! I cannot accept late assignments—the class is too short. If I allow late assignments it holds up grading for all the other students.

All Assignments will be posted on the Stellar website.

Materials
**Hard Drive:** It is recommended that everyone get an external hard drive to hold data for your assignments and final project. I suggest a hard drive with a minimum of 40 GB of space, but you can find much larger drives, up to a terabyte, at very reasonable prices. The "WD My Passport 1 TB" is a great drive and costs roughly $60 on Amazon, which is an amazing amount of data. This drive will be useful for this class and beyond.

**Book:** I have scanned most of "GIS for the Urban Environment" by Julie Maantay and John Ziegler, but you might be interested in purchasing a copy as most of the readings come from that book. Amazon often has great prices.

**Readings:** Any articles and book chapters assigned are provided on the Stellar site.

**HELP!!** There are various ways to get help for this class.

**Discussion Forum on Stellar:** If you have a question, it is likely that others might have that question too, or have already found a solution to the same issue. I encourage you to post questions to the discussion forum on Stellar first. Both the TA’s and lab instructors will be answering questions that arrive at the discussion forum, before we answer questions received via our personal email. So please try to use the discussion board first.

**Teaching Assistants and Office Hours:** The Teaching Assistants will have office hours. This will be time in which you can work on assignments and ask the TA’s for help - I strongly suggest taking advantage of TA’s office hours. **All office hours are in computer lab space in Building 9, Floor 5 unless otherwise noted.** Please check Stellar for office hours.

**GIS Laboratory in the Libraries:** Located in Rotch library, this is a great resource for GIS data and technical questions. The GIS Laboratory collects GIS data and might have data you need for your final project. The GIS lab also has technical consultants available for questions regarding the acquisition of data as well as the technical questions related to performing certain GIS operations. Seek them out. They can be researched by contacting gishelp@mit.edu.

**ESRI GeoNet and User Forums:** There are two websites that are great resources for technical GIS software questions. The old ESRI user forums and the new GeoNet set are found at [https://geonet.esri.com](https://geonet.esri.com)

**General Comment about Email**

I will not always be able to respond to email right away. Therefore it is very important that you try to use the other resources you have available such as the discussion forum on Stellar, the TA’s, and our office hours. **There are a lot of ways to find help for this class, please don’t let an unanswered email hold you back.** If I have not answered and email by the next time I see you in class please be sure to remind me at class. It is likely I did not see your email yet.
ABBREVIATED WEEKLY SCHEDULE

<table>
<thead>
<tr>
<th>DATE</th>
<th>WEEK</th>
<th>Exercise Given</th>
<th>Exercise Due</th>
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<tbody>
<tr>
<td>9/5</td>
<td>Week 0 : Getting Started : Lab Set-Up : What Is GIS</td>
<td>Setup/Website</td>
<td>Always Due Midnight Thursday</td>
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<td></td>
<td>Labs only Wednesday and Thursday</td>
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<tr>
<td>9/12</td>
<td>Week 1 : Making Maps and Spatial Analysis Overview</td>
<td>Exercise 1</td>
<td>Setup/Website</td>
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<tr>
<td>9/19</td>
<td>Week 2 : Joining Data</td>
<td>Exercise 2</td>
<td>Exercise 1</td>
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<tr>
<td></td>
<td>Working with Parcel Data</td>
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<tr>
<td></td>
<td>Map Design</td>
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<tr>
<td>9/26</td>
<td>Week 3 : Census and American Community Survey</td>
<td>Problem Set 1</td>
<td>Exercise 2</td>
</tr>
<tr>
<td>10/3</td>
<td>Week 4 : Geoprocessing Analytics and GIS</td>
<td>Problem Set 2</td>
<td>Problem Set 1</td>
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<tr>
<td>10/10</td>
<td>Week 5 : Geocoding and Finding Address Locations</td>
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<td>Work on Problem Set 2</td>
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<tr>
<td></td>
<td>No Class Monday</td>
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<tr>
<td>10/17</td>
<td>Week 6: Raster Decision Making, Suitability Analysis and GIS</td>
<td>Exercise 3</td>
<td>Problem Set 2</td>
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<td>(Must add 11.520 by this Week)</td>
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<tr>
<td>10/24</td>
<td>Week 7: ONLY CLASS FOR 11:520</td>
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<td>Exercise 3</td>
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</tbody>
</table>

WEEKLY SCHEDULE

Week 0 – Getting Started and What is GIS? (9/7/2016)

- Familiarize with Lab
- Desktop Environment Setup
- Webspace and Website Setup
- What is GIS?

Readings


Case Study Readings (Optional Helpful for Homework)


Helpful Resources for Websites
• DUSPVIZ – Intro to HTML and CSS - http://duspviz.mit.edu/web-map-workshop/code-your-first-website/
• Additional website and programming resources - http://duspviz.mit.edu/tutorials/
• Connecting to your AFS locker from your Laptop with FTP - http://duspviz.mit.edu/tutorials/afs-connection.php
• Examples of previous student websites created in the course.
  ○ http://web.mit.edu/alaamuk/www/
  ○ http://web.mit.edu/casainz/www/
  ○ http://web.mit.edu/jfsun/www/
  ○ http://www.mit.edu/~jfabi/11.205page.html

Exercise 0 Assigned: Create GIS website, Add GIS project/article to newly created web site.

Week 1 – Cartography and Map Design (9/12 and 9/14)
• Case Study: Power of Maps
• Map Design and Cartographic Standards

Readings
• Juliana Maantay and John Ziegler, GIS for the Urban Environment, ESRI Press, 2006 - Chapter 4 pg. (105-115).

Great Visual Guides to Symbols and Classification: Great Reference for Homework: Optional but Recommended

Case Study Readings: Power of Visualization
• Laura Kurgan, Close-Up at a Distance, Mapping Technology and Politics, (Chapter 9 Million Dollar Blocks), 187-204.

Optional Reading (Great for designers!)

Exercise 0 Due: 11:59 PM September 15 to Stellar
Exercise 1 Assigned: The Basics: Creating Maps and Working with Data

Week 2 – Spatial Data - Types, Structures, and Representation (9/19 and 9/21)
Relational Databases
• Querying and Working with Tables
• Vector vs. Raster
• Nominal and Ordinal Data
• Geodatabases, Shapefiles, and formats
• Topology

Readings
Case Study Readings: Zoning and GIS

Web Sites to Explore (MUST DO BY MONDAY)
- “What is PLUTO Data Exactly?” http://andrewxhill.com/cartodb-examples/scroll-story/pluto/#0
- OASIS MAP: http://www.oasisny.net/map.aspx

Optional Reading (Quick Summary - Helpful for Quick Understanding)

Exercise 1 Due: 11:59PM September 22
Exercise 2 Assigned: Working with Spatial Data

Week 3 – Quantitative Mapping: Census Data and the ACS (9/26 and 9/28)
- History of Census/American Community Survey
- Census Geometry
- Calculating New Variables and Making New Table Fields
- Census Variables
- Estimation Methods

Readings
- Juliana Maantay and John Ziegler, GIS for the Urban Environment, ESRI Press, 2006 - Chapter 6
- Alan Peters and Heather MacDonald, Urban Policy and the Census, ESRI Press 2011 - Chapters 1 and 2, Chapter 3 Optional

Case Study: Segregation, Funding and Schools
- Turner, Corey “The 50 Most Segregating School Borders In America” NPR, 2016

Web Sites to Explore
● Census Data Visualization Site: [https://www.census.gov/dataviz/](https://www.census.gov/dataviz/)
● Community Data Portal, Pratt Center for Community Development: [http://prattcenter.net/neighborhood-data-portal-0](http://prattcenter.net/neighborhood-data-portal-0)

Optional Reading


Guest Lecture

● Jeremy White, New York Times

Exercise 2 Due: 11:59PM September 29

Problem Set 1 Assigned: Bronx River Alliance - Bi-Lingual Signage

**Week 4 – Spatial Data Formats and Geoprocessing (10/3 and 10/5)**

● Data Formats
● Concepts of Spatial Analysis
● Geoprocessing Tools (Buffer, Clip, Dissolve, Update, Union, etc)

Readings


Case Study: Transportation Catchment Areas and GIS

● Anderson, Jonas and Alex Landex, “GIS-based Approaches to Catchment Area Analysis of Mass Transit” ESRI User Conference.
● Cox, Wendell, “Region’s Transportation and land-use policies have little effect on traffic congestion.” The Seattle Times, May 1, 2012

Optional Reading


Guest Lecture

● Tim Reardon, MAPC

Problem Set 1 Due: 11:59PM October 6
Problem Set 2 Assigned: Bronx River Alliance - Transportation/Bi-Lingual Signage

Week 5 - **Geocoding and Address Finding (10/10 and 10/12)**

- What is Geocoding?
- Geocoding Process
- Terminology
- Geocoding Datasets
- Common Errors and Problems

Readings


Case Study: Geo-coding (Pick one to read)

- **For Those Interested in US Based Economic Development and Arts and Culture**: Currid, Elizabeth and Sarah Williams, “The Geography of Buzz: art, culture and the social milieu in Los Angeles and New York”, *Journal of Economic Geography*, (July, 2009) pg 1-29

Case Study: Addressing the Favelas *(Everyone look at this)*

- What3words: [https://what3words.com/2016/08/what3words-partners-riogo-olympics-planning-app/](https://what3words.com/2016/08/what3words-partners-riogo-olympics-planning-app/) *(Watch the video! There are many other project examples on the what3words site, too. Explore the site if you are interested.)*

Reference Reading To Understand Geocoding Errors and Issues :


No new assignments: Work on Problem Set 2

Week 6 – **Raster Decision Making and Suitability (10/17 -10/19)**

- Raster Data Format
- Map Algebra
- Overlay
- Suitability Analysis
- Decision Making and GIS

Readings
• Juliana Maantay and John Ziegler, *GIS for the Urban Environment*, ESRI Press, 2006 - Chapter 9, pg 219-239, Chapter 12, pg 300-305

Case Study

Optional Reading

Weekly Current Event: To Be Discussed in Class

**Problem Set 2 Due: 11:59pm October 20**
**Exercise 3 Assigned: Raster Data and Decision Making - Due: 11:59 October 27**

GIS WORKSHOP (11.520) STARTS October 24, 2016