OrrSyllabus: GTECH 709 – Introduction to GIS
Spring 2015
Tuesdays 5:30 – 9:00 PM

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Goal/Rationale:

Since the advent of Google Maps in 2005, GIS and mapping have become omnipresent tools for visualizing data (e.g. mobile apps and data journalism). This era of the democratization of cartography has also benefitted from recent government mandates to make data open and available to the general public. In addition, with mobile devices collecting location service information, the spatial information derivatives have become synonymous with “big data”. It is an exciting time to learn GIS.

In this course, we will cover the whole GIS production process from data modeling and acquisition to editing, analysis, and yes, cartographic output. GTECH 709 addresses students from both geography and other disciplines. Lecture examples, as well as hands-on exercises cover a range of application areas. The course itself is divided into two equally important parts: lectures, which introduce the concepts underlying all GIS, and lab exercises, which help you to familiarize yourself with many aspects of several software packages. The laboratory sessions will start at a very basic level, requiring little more than elementary experience with the windows operating system. The course utilizes a variety of resources, including the energy and creativity of students in the class.

Goals: This course is an introduction to GIS in general. We will be using a variety of online and web-based GIS in your lab assignments but the lectures concentrate on general principles and will note software-specific exceptions were applicable.

Objectives: You learn to see GIS as a process from conceptualizing spatial problems to different representations of spatial data, data sources, data organization, vector and raster analysis, and map production.

Outcomes: By the end of this course, you will be able to work independently with GIS, determine what is easy to do with GIS, what will take you considerable amounts of time, and which spatial research questions do not lend themselves to a GIS solution.

Textbooks:

Required: None
Recommended:

• QGIS 2014. A Gentle Introduction to GIS. Free (like the software) and available online at http://docs.qgis.org/testing/en/docs/gentle_gis_introduction/
Pre-requisite: None (basic computer and numerical literacy expected)

Policies:

Attendance is crucial. Given that the class-learning environment is active learning, meaning that most of the student performance is practical assignments rather than tests, adherence to protocols and the course timetable is very important. Active involvement in the course is evidenced in part by undertaking the mechanics of the practical assignments systematically, and learning the tools by hours of practice. In so doing the tools soon come to be seen as a means to an end, rather than the end itself. For example, you will make many maps, and may get caught up in this creative activity, but remember that the maps are being made for particular scientific purposes. Class participation includes timely attendance at laboratory sessions, participation in organized class discussions, accomplishments of in-class tasks, and accomplishment of the preliminary assignment on time. Remember that a good part of your grade depends on class participation. Of course, you are expected to behave respectfully towards the instructor and the other students, by not imposing a dominating or threatening presence in conversations and discussions, and by allowing others to speak and be heard, especially if they are shy and their voice weaker than yours.

Electronic recording devices are allowed during class. All other personal electronics should be turned off before coming into the classroom. This includes cell and smart phones.

Web-enhancement in the context of this course means that everything pertaining to this course will be communicated through BlackBoard. You are required to check the BlackBoard course site on a daily basis. All changes to the syllabus will be announced on the course home page. All lecture and lab materials are accessible through BlackBoard, and this is also the place where you upload your assignments. Your exams and lab assignments will be graded based on what you have uploaded to BlackBoard and this is where you will find your grades and may access course statistics that help you to assess your standing at any given time.

All email messages about this course should include GTECH 709 in the subject line, and be signed with your full name.

Academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) is simply not acceptable. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures. Helping other students on use of the software is encouraged.

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

Special accommodations for persons with disabilities are provided upon request. Please see the instructor if you feel the need for them. In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical,
Physical, and/or Learning) consult the Office of AccessABILITY, located in Room E1214B, to secure necessary academic accommodations. For further information and assistance, please call: (212) 772-4857 or (212) 650-3230

Lab policies are described in detail in http://www.geo.hunter.cuny.edu/techsupport/rules.html.

Assignments are due one week after they are given in class. It is in your best interests to keep up with the work and meet deadlines for assignments. Incomplete grades and time extensions are not an option for this course. There are no "extra-credit" assignments. Unless otherwise instructed, you will submit assignments in electronic form.

Syllabus change policy: Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice. All changes will/would be announced on BlackBoard, which you are expected to check on a daily basis.

Criteria for Evaluation:

Evaluation of academic performance is based on your lab exercises, your software project, and your participation according to the following breakdown:

Weekly quizzes: 14%
Lab exercises: 40%
Midterm exam: 15%
Final exam: 15%
Project: 16%

Numeric scores will be used throughout the semester. The course letter grade will be determined only at the end of the semester, although guidance as to letter grade standing will be given along the way.

All labs exercises are designed for a 3-hour period, that is beyond the introduction that you will get in each weekly session. You are free to work with them at your own leisure either in the cartographic studio or at your private home. You can use our computer labs at any time outside of the posted instruction times for other courses. It is your responsibility to manage your time to conduct both the labs as well as project work during the hours that the cartographic studio is accessible. Of course, you are free to work at home as much you want – if you can arrange for access to the software that you need.

Each week, as we cover a new topic, students will apply lessons learned to an individual semester-long software project that involves the GIS analysis of a substantial geographical problem. At the beginning of each class we will hold a “round table” and discuss discoveries and challenges we encounter along the way.

There are no requirements with respect to what software the student uses. In a similar vein, the application area (field) is to be chosen by the student, who is also responsible for gathering the necessary data. Basically, you can choose whatever topic you want, provided it has to do with geographical analysis; the stress is on both words! It is your responsibility to find a suitable project, which will have to be accepted by the instructor. A few ready-made projects are available but experience shows that motivation increases when students take pride in their own project.
Course Calendar:
This class typically meets on Tuesdays (except when it is a CUNY holiday). Special dates are:
- 02/17, last date to drop without a W
- 03/31, midterm exam
- 03/31, project proposal due
- 05/12, project presentation
- 05/19, final exam

Week-by-Week Breakdown of GTECH 709:

Week 01 (Feb 3): In our first session, we will review the syllabus, what we will cover this semester, and introduce to you some of the many uses of GIS. We will also begin to discuss ideas for your individual project.

Week 02 (Feb 10): In week 2, we will cover some principles underlying GIS. You will learn what it means to think like a geographer, what we mean by spatial relationships, scale, the role of time in GIS, and finally, the importance of spatial references, that is, references to locations on the surface of this planet. We will then dissect the acronym G.I.S, talk a little about the disciplines that underlie GIS. This course has an unofficial sub-title: “Geography, the relationship game”. There are relationships everywhere. Relationships between layers of information, relationships between the features as we conceptualize them in the real world, their representation in the computer, and, finally, their presentation in form of maps. We will talk about the geo-relational principle and talk about GIS as a process.

Week 03 (Feb 17): During week 3, we will dive into conceptual and implementation models. You will learn about the differences between vector data, raster data, object, and field representations. We will also scratch the surface of a branch of mathematics called topology. This will be accompanied by a first introduction to either ArcGIS Online or a third party tool that builds on ArcGIS Online, called GeoCommons. Here you will create your first map using both raster and vector data and by doing so, you will apply some of the relationships covered in the lecture components of week 2.

Finally, we will explore a few other tools that have recently made geospatial data visualization more accessible (e.g. Google Fusion Tables, OpenStreetMap, D3.js, and Github).

Week 04 (Feb 24): This applied component will get a bit more interesting in week 4, when you will use your first desktop GIS. You will be introduced to the two most widely used software packages: ESRI's ArcGIS, a proprietary product, and Quantum GIS (QGIS), an open source platform. You will learn about how to create and edit GIS data and we will revisit the notion of locational references. Rather than creating data from scratch, we are usually much better served by using data that others have created.

A good part of this week’s material therefore covers secondary data sources. They can be searched by topic, sector, or location. Suitable data can be in the form of traditional GIS files or increasingly in the form of web services. Both governments and data vendors provide Geodata portals. We will also cover metadata, data about data, and the importance of its role in finding trusted data.

Week 05 (March 3): One of the most important sources of geodata is the US Census Bureau. This is true even for those among you who are primarily dealing with physical or environmental phenomena. There is nothing on this planet these days that is not influenced by or influences the anthroposphere. And Census data is extremely valuable because it is both very comprehensive and comes in comparatively high resolution or detail. The theoretical components of this week will therefore deal with census geographies, tabulations, estimates, and projections. You will learn about different Census programs
such as the American Community Survey and Longterm Economic and Household Data. On the practical side, you will learn to navigate the Bureau’s FactFinder website, to download and massage Census data, and, finally, to join attribute data to geometries. You will use QGIS in this lesson.

**Week 06 (March 10):** Up to this stage in the semester, you have worked only with pre-digested, that is ready-made GIS data. Lots of data out there, however, although it has a locational reference, is not in GIS format. During this 6th week, you will learn to transform tabular data from text files, web pages, or pdf files. You will use a new program called CartoDB to geocode data, that is, to create spatial references. CartoDB is a great tool because it has a deceivingly simple user interface but at the same time allows you to look under the hood and see how data is stored in geo-enabled databases.

**Week 07 (March 17):** Now that we have spent a few weeks on data gathering, it is time to organize the data. Again, you will find your instructor harping on the importance of having a good conceptual model of what it is that you are actually trying to do with GIS. To some degree, we will revisit concepts introduced in weeks 2 and 3 but now you will learn in detail about how different programs help you to organize your geospatial data.

We will cover tables, file databases, relational databases, database management systems, and classification scales. We then introduce you to ESRI’s geodatabase format. Using ArcCatalog, you will learn about relationship classes, attribute domains, and subtypes. All of which can be combined to then introduce a new spatial data structure called geometric networks. Together with topological rules, they form the most sophisticated way of spatial data handling that you will encounter in this course.

**Week 08 (March 24):** We end the first half of the semester by going back to our locational references. Up to now, we have not dealt with the fact that our planet is a round object. Both traditional paper maps as well as GIS, however, store coordinates as if we were living on a plain. The translation from one to the other requires what is known as map projections and geographic coordinate systems. It starts with different definitions of the shape and size of the Earth; we then cover a range of different ways to systematize coordinate systems that allow us to understand and work with projections libraries.

This topic is potentially a “dangerous” one, that is, it typically deals with equations and somewhat complicated math. We will bypass the math and strive for practical examples using both ArcMap and QGIS to illustrate by example the effect of wrong or missing assignments of projection information and learn how to rectify the problem. Together with the joining of attribute to geometry data, this is one of the two main issues that trip up beginning GIS students.

**Week 09 (March 31):** Week 9 starts with the midterm exam. It covers all the material of weeks 1-8. The quizzes throughout the first half of the semester should prepare you well for the midterm itself.

By now, we are at the end of March and you should have started to collect data and investigate ways to apply GIS to your individual project. This week is the deadline for declaring your project topic. The rest of week 9 is therefore devoted to GIS project management. We will revisit the material of the first eight weeks and see that they follow the steps of a typical GIS project, starting with developing the research question, searching for data, massaging the data and assembling it in a database.

**Week 10 (April 7): NO CLASS – SPRING BREAK**

**Week 11 (April 14):** In April, we are finally getting to the ‘I’ in GIS. Up till now, we have just dealt with data. Analytical GIS operations help us to transform data into information. We start easy with simple selection queries and recoding operations. Building on these, we will revisit topological relationships and then get to the core of GIS analysis: applying spatial Boolean logic to conduct so-called buffer and
overlay operations. The lab exercises will be using ArcGIS but there will be pointers to doing the same in QGIS.

**Week 12 (April 21):** Building on these elementary GIS operations, we then combine these into more sophisticated workflows. Adapting the terminology of one of the vendors, we call these geoprocessing models. You will use the model builder within ESRI’s ArcToolbox module to learn to assemble such workflows in what could be construed as a form of visual programming. This is a great way to automate repetitive workflows and you will appreciate how much faster or how much more you can get done compared to what you have been doing during the first eleven weeks of the semester.

**Week 13 (April 28):** Week 13 is devoted to working with raster data. Although we briefly introduced it in week 3, we have otherwise neglected this very useful way of organizing geospatial data. Useful because the data structure itself is very simple – which lends itself to be employed in far more powerful analysis operations than the mere buffer and overlay operations we have dealt with so far. You will learn about Map Algebra and will then have a choice of either the Spatial Analyst extension to ArcMap or a completely new GIS, SAGA GIS, to apply Map Algebra in potentially sophisticated processing models.

All of this will provide with just a glimpse of what is possible and we will go into much more depth on this topic in our Advanced GIS course GTECH 732.

**Week 14 (May 5):** Now we turn our attention towards the presentation of our results. The best way to present GIS data is obviously in the form of a map and week 13 is devoted to the art and science of map design. The emphasis is on optimizing the communication with the map reader. Ideally, this is done these days be in form of an interactive web map; but, we will certainly also cover issues of print maps.

The second half of the class will be devoted to our individual projects.

**Weeks 15 (May 12 – Last day of class):** The first half of Week 15 is reserved for your project presentations. The second half of the class will be a review to prepare for the final exam.

**Weeks 16 (May 19):** FINAL EXAM