GEOG 377: An Introduction to Geographic Information Systems

(Spring, 2017)

Last UpDate: January 21, 2019

Instructor:
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Course Websites:
Lecture and lab materials: canvas

Schedule and Location:

Lecture Hours:
Tues. and Thurs. 4:00 p.m. - 5:15 p.m. (Humanities 1641)

Lab Hours:

See *Lab Syllabus*

Office Hours:
Instructor:
Tues. & Thurs: 2:30 p.m. – 3:30 p.m.
Other times: by appointments
T.A.:
See *Lab Syllabus*

1. Description:

Geographic Information Systems (GIS) deals with the analysis and management of geographic information. This course offers an introduction to methods of managing and processing geographic information. Emphasis will be placed on the nature of geographic information, data models and structures for geographic information, geographic data input, data manipulation and data storage, spatial analytic and modelling techniques, and error analysis.

The course is made of two components: lectures and labs. In the lectures, the conceptual elements of the above topics are explained. The labs are designed in such a way that students will gain first-hand experience in data input, data management, data analyses, and result presentation in a geographical information system.

Students must be clear that this is not a class specifically on any particular GIS software. It is a course on the underpinng theory and concepts in GIS. The understanding of these concepts and theories will help you to perform spatial analysis in a GIS system properly and better.

2. Objectives:

In general, this is an ice-breaking course into GIS and serves as the foundation course for other advanced courses in GIS. The basic objectives of this course for students are:

1) To understand the basic structures, concepts, and theories of GIS.
2) To gain a hand-on experience with daily routines of GIS operations.

3. Prerequisites:

None

4. Computing Environment and Software:

ArcGIS (both the vector and the raster components) will be used for class assignments to illustrate the practical use of certain geographic information processing concepts and techniques.

5. Grading:

To meet the new requirements of graduate school toward graduate program, this class evaluates graduate students and undergraduate students separately. The differences are: 1) the graduate students will have an extra question in each of the two exams; 2) the graduate students will be graded on a different curve from that used for the undergraduate students. Note: students in the GIS Certificate Program do NOT count as graduate students.

5.1 Components:

Exercises	40%
Exam One	25%
Exam Two	25%
Quizzes (in class)	10%

5.2 Grading policy:

Grades of exercises are based on:

1) academic merit of your answers to the questions
2) conciseness of answers. ***NO BEATING AROUND THE BUSH***
3) organization of presentation. No one wants to flip through a messy assignment report looking for answers. Here is a general format for your presentation:

Question:

Your answer and discussion

Your support documents (images, graphs, tables, etc.)

The grade for each of the exercises and examinations is reported as ***points_scored*** / ***total_points_of_exercise***. For example, if an assignment is worth 20 points and your answers score 16 points then you should see ***16/20*** on your marked assignment.

5.3 Due date and time:

Each of the assignments will have a due day clearly written under the title of the assignment. The due time is the beginning of the lab session on the due day. Any assignment that is turned in after the due time on the due day is considered late. As you know, late assignments will receive penalty.

5.4 Penalty for late assignments:

The penalty for a late assignment is based on the number of days late (including weekends). If an assignment is late less than 24 hours, it is considered 1 day late. If an assignment is late less than 48 hours but more than 24 hours, it is considered 2 days late, and so on. Late assignments are penalized 10% per day. Here is the formula for calculating the points of a late assignment:

Points_get = Points_scored - 0.1*num_days_late*Points_scored

The minimum value of *Points_get* is 0. Assignments handed in after the TA has returned the graded assignment to class (usually a week after the due date) will receive ***no points***.

6. Other Important Issues:

Sickness often gets in the way of completing assignments, particularly after a long weekend. If sickness is used as an excuse for turning in an assignment later or missing an examination, we (the TA and the instructor) need to see a written report from a medical doctor stating your inability to attend class and/or to complete an assignment.

We will certainly give you ample time to complete each assignment. There is no reason for us to be told that the computer is down or the software is not working a day before the assignment is due. This will ***NOT*** be taken as an excuse for a late assignment!

We offer a complimentary time for each exam, in case of conflicting schedule. If you cannot take either exam in the regular time, please directly notify me via email in ***one week*** advance. We are not able to accommodate if you give me a short notice. All regrading issues should be resolved in the week after handing the exams back to you.

The in-class quizzes will be held at unannounced time point starting from the second week. Each quiz will be three to five questions only, either in true/false format or multiple choices. By the end of the semester, we will count the highest five scores toward your final grade. However, if you miss any quiz without a good excuse and did not notify us in advance (i.e., four hours before the lecture starts), we will directly deduct 2% from your final grade until all 10% for quizzes have been deducted, regardless how well you do on the other quiz. If you miss any quiz with acceptable reasons and notified us beforehand, you have an opportunity to take *ONE* make-up quiz at the end of semester (does not matter how many you actually miss with good reasons).

It is very easy to shoot an email to me when you are reading and run into a problem or have a question. I strongly suggest that you hold back you urge to send an email to me whenever you run into a problem or have a question. The simple reason is that this form of contacting me deprives yourself of the chance to learn or to explore with this question or problem. Learning is about solving problems/answering questions and about resolving conflicts in your understanding. The most efficient way to learn is to resolve these conflicts and solve the problems on your own as much as possible. If you send me an email for solution or explanation whenever you run into a question or problem, you won't get the opportunity to do these on your own. There will be times that you cannot figure the problems out after you try very hard. In this case, you are certainly welcome to contact me for help. The trick in contacting me for help but still giving yourself the opportunity to learn is to phrase your questions in the form of seeking a "yes" or "no" from me. I bet that many of the problems or questions will be answered by yourself in the process of formulating the questions in this format. The reason is that this way of formulating the question is how humans are advancing knowledge. If you do that, ***you are learning how to learn***.

I have discovered from previous experiences that some topics are better presented through an online module. Some of these topics will be presented in online modules. Therefore, I will mix in-person lectures with online modules for this class.

7. Course Materials:

7.1 Recommended Text:

Chang, K.T., 2016. *Introduction to Geographic Information Systems* (Seventh Edition). McGraw Hill, New York, 425 p.

7.2 Other key texts (for lineage):

Aronoff, Stan, 1993. *Geographic Information Systems: A Management Perspective*, Ottawa: WDL Publications, 294 p.

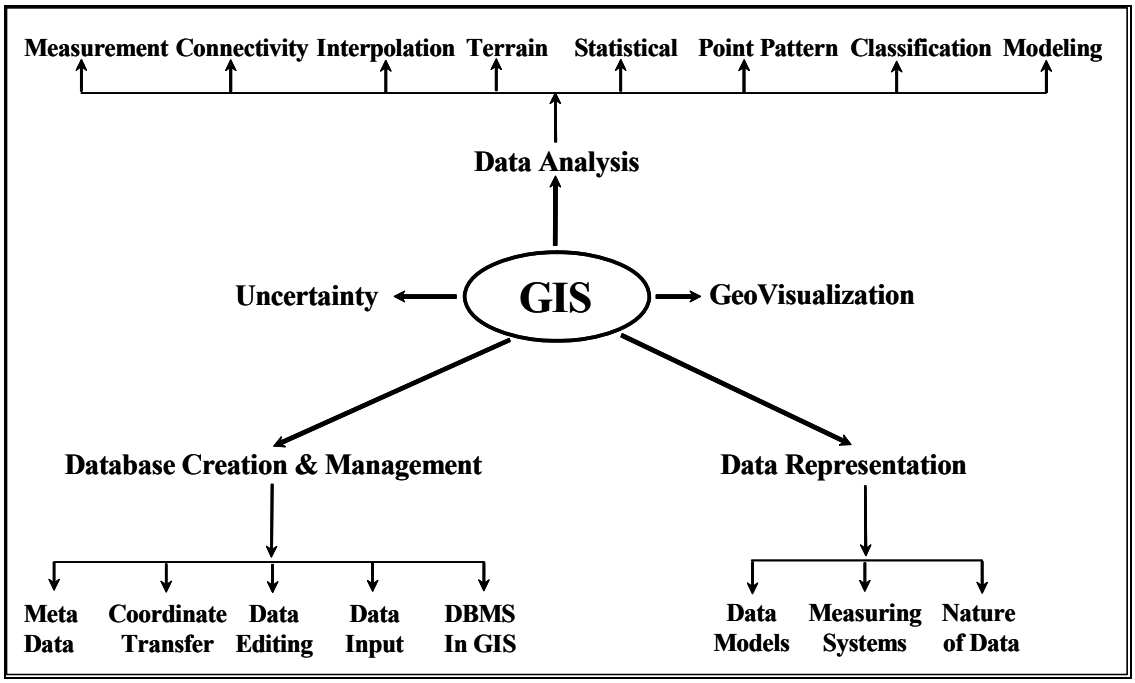
Bonham-Carter, Graeme F., 1994. *Geographic Information Systems for Geoscientists*, New York, Pergamon, 398 p.

Burrough, P.A., 1986. *Principles of Geographic Information Systems for Land Resources Assessment*. Walton Street, Oxford: Oxford University Press, 194 p.

Longley P.A., M.F. Goodchild, D.J. Maguire, D.W. Rhind, 2015. *Geographic Information Systems and Science*. John Wiley and Sons, New Jersey, 477 p.

8. Intended Topics:

8.1. An Overview:



8.2 Intended Lectures:

Lecture 1: Jan. 22

Course Overview

GIS: System v.s. Background

Introduction to Geog. 377

Lecture 2: Jan. 24

Introduction

The nature of geographical information

What is GIS

Lecture 3: Jan. 29

Data Representation (I)

Measuring Systems

Location: Coordinate systems

Lecture 4: Jan. 31

Data Representation (II)

Measuring Systems (continued…)

Location: Coordinate transformation

Lecture 5: Feb. 5

Data Representation (III)

Measuring Systems (continued…)
Topology: Basic geometric elements
Attributes: data types
Data in Computers

Lecture 6: Feb. 7
Data Representation (IV)
Spatial Data Models:
Introduction
Raster Data Models

Lecture 7: Feb. 12
Data Representation (V)
Spatial Data Models:
Relational Data Models (basic model for data representation)
Vector Data Models I

Lecture 8: Feb. 14
Data Representation (VI)
Spatial Data Models:
Vector Data Models II

Lecture 9: Feb. 19
Data Representation (VII)
Spatial Data Models:
TIN:
Comparison of Raster, Vector and TIN

Lecture 10: Feb. 21
Data Representation (VIII)
Spatial Data Models: Summary
Linking attribute data with spatial data
Recent Development of Data Models

Lecture 11: Feb. 26
GIS Database Creation and Maintenance (I)
Data Input (spatial and thematic)
Data Editing (spatial and thematic)

Lecture 12: Feb. 28
GIS Database Creation and Maintenance (II)
DBMS and its use in GIS

Lecture 13: Mar. 5
GIS Database Creation and Maintenance (III)
Metadata
Database creation Guidelines
NSDI

Review for Exam One: Mar. 7

Lecture 14: Mar. 12
Data Analysis (I)
Measurement operations
Connectivity operations

Exam One (75 minutes) Mar. 14

Spring break (Mar. 16 – Mar. 24)

Lecture 15: Mar. 26
Data Analysis (II)
Interpolation operations

Lecture 16: Mar. 28
Data Analysis (III)
Digital terrain analysis

Lecture 17: Apr. 2
Data Analysis (IV)
Statistical operations
Point Pattern Analysis

Lecture 18: Apr. 4
Data Analysis (V)
Classification (Online module)

Lecture 19: Apr. 9
Data Analysis (VI) (Online module**)**
Spatial Overlay
Data Analysis Summary - Spatial Queries

Lecture 20: Apr. 11
Uncertainty

Lecture 21: Apr. 16
Geovisualization
Geo-representation and Geo-presentation
New ways of visualizing geographic information

Lecture 22: Apr. 18
GIS-based Modeling (I)
Concepts and Processes (Online module)

Lecture 23: Apr. 23
GIS-based Modeling (II)
Application in Physical Geography
Application in Human Geography

Review for Exam Two: Apr. 25

Lecture 24: Apr. 30
New Developments in GIS
Session for making up quizzes

Exam Two: (75 minutes) May 2