GGS 650 Introduction to GIS Programming and

Algorithms 2017 Fall Syllabus

Tuesdays: 7:20 – 10:00 PM, Exploratory Hall 2310

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Office Hours: T: 3:00-6:00 PM

Course Description

How to find the centroid, perimeter, or area of a polygon? How can the system tell that the two lines cross each other? How can the system determine if the two polygons overlap and by how much? How are geographical surfaces represented? How to derive their properties (inter-visibility, aspect, etc.)? This course addresses these fundamental GIS questions.

In this course, we learn to program using object-oriented languages, such as Python (an integrated programming language for ArcGIS). A comprehensive programming training process including computer programming, programming syntax, data types, data structure, control structures, and an integrated programming environment (such as Python & JBuilder) will be introduced within 1/2 of the whole course.

We will also examine several technical aspects of GIS related to algorithms. They include some fundamental concepts in computational geometry, computer graphics, common analytical algorithms using in GIS environment, and features represented by points, lines, polygons, and volumetric objects. Algorithms related to surface modeling will also be addressed. ArcMap and related extensions from ESRI will be used as examples for interpreting the internal GIS functions, and provide commercial software environment for programming. The course will provide hands-on experience by implementing some algorithms. Instructors support the programming languages of Python, but students can select any programming language of their choice.

A term project and some short homework will help student develop the skill and capability to understand spatial data structure and implement spatial algorithms. Students will also develop a solid and in-depth understanding of the geographic system internal organization and operations in related to spatial data handling and analysis. Potentially students will develop the ability to solve geographic related problems at the modeling & algorithm level.

Class will be given PowerPoint slides before a class meeting. Relevant hand-on exercises in class will be scheduled as necessary.

University Honor Code is strictly enforced.

Prerequisite

Any introductory GIS course, and blind typing (we will do a lot of programming class exercises so we can not wait for typing).

References

The following books and materials will serve as references:

1. Chaowei Yang et al., 2017. Intro to GIS Programming and Fundamentals with Python and ArcGIS, CRC Press, 302pp.
2. Python: the python tutorial from the help doc of Python GUI
3. ArcGIS: Geoprocessor document
    a. Geoprocessor
    b. Geoprocessor Reference Model
4. ArcToolBox

Grading

- All homeworks should be submitted before class on the due date.
- 10 Homework (60%) (Confirmation & Structural & Guided inquires coined here)
- Term Project (25%) and Presentation (5%) (Open Inquires coined here)
  e.g., Design and develop a program to support at least two basic GIS algorithms on geospatial data.
- Class Activity and Participation (10%)

Course Schedule

Date	Topic	Assignments
Aug 29, 2017 Homework 1 given	Lecture 1: Class overview and Introduction to computer programming, review of basic data models: point, line, polygon.	Install ArcGIS; Read book chapter 1; Work on Homework 1
Sep 5, 2017 Homework 1 due Homework 2 given	Lecture 2: Introduction to Object-Oriented Programming using Python	Read book chapter 2; Work on Homework 2
Sep 12, 2017 Homework 2 due Homework 3 given	Lecture 3: Introduction to language syntax, data types, and operations	Read book chapter 3; Work on Homework 3
Sep 19, 2017 Homework 3 due Homework 4 & 5 given	Lecture 4: Introduction to language control structure	Read book chapter 4; Work on Homework 4
Sep 26, 2017 Homework 4 due	Lecture 5: Programming Thinking and Vector Data Visualization	Read book chapter 5; Work on Homework 5
Oct 3, 2017 Homework 5 due	Lecture 6: Shape File Handling	Read book chapter 6; Work on Homework 6

Homework 6 given		
Oct 10, 2017	Do not meet	
Oct 17, 2017 Homework 6 due Homework 7 given	Lecture 7: Python Programming Environment	Read book chapter 7; Work on Homework 7
Oct 24, 2017 Homework 7 due Homework 8 given	Lecture 8: Vector Data Algorithm	Read book chapter 8; Work on Homework 8
Oct 31, 2017 Homework 8 due Homework 9, 10 given	Lecture 9: ArcGIS programming	Read book chapter 9; Work on Homework 9
Nov 7, 2017 Homework 9 due Project given	Lecture 10: Raster Data: run length encode, quadtree, area calculation, classification	Read book chapter 10; Work on Homework 10
Nov 14, 2017 Homework 10 due	Lecture 11: Network Data: Network data maintenance, Shortest path	Read book chapter 11
Nov 21, 2017	Lecture 12: Surface Data: DEM, TIN, Contours, Slope, Aspect, Flowing direction	Read book chapter 12
Nov 28, 2017	Lecture 13: Advanced topics Project presentation	Read book chapter 13 & 14
Dec 5, 2017 Project report due	Project presentation	