GGS650 Introduction to GIS Programming

COURSE DESCRIPTION

INSTRUCTOR: CHAOWEI YANG

7:20 pm - 10:00 pm Mondays Exploratory Hall 2103 (maybe online depending on 2020 fall scheduling)

- **Fundamental Knowledge**
  How to find the centroids, 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 language, 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 native programming tool, Pycharm, or Enthought Canopy) will be introduced within 1/2 of the course.

- **Application and Integration**
  We will also examine several technical aspects of GIS related to algorithms. These include some fundamental concepts in computational geometry, computer graphics, common analytical algorithms used in GIS environment, and features represented by points, lines, polygons, and volumetric objects. Algorithms related to surface modeling will also be addressed. ArcGIS and related extensions from ESRI will be used as examples for interpreting the internal GIS functions and provide a commercial software environment for programming. The course will provide hands-on experiences by implementing some algorithms.

- **Pre-requisite**
  Any introductory GIS course, and blind typing. The class will have a lot of programming exercises, and we will not wait for slow typing.
  The students need to bring their own laptops to the class for some of the meetings starting from the second half of the semester for the easy and customized installation of third-party python libraries.
- **Project, Exam, and Homework**
  A term project, and mid-term exam, and 10 homework will help students 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 geographically related problems at the modeling and algorithm level.

University Honor Code is strictly enforced.

GRADING

- Homework: 10 times, total 50 points with 5 points each
- Mid-term exam: 25 points (given in the 7th week)
- Term project: 25 points, with project report 20 points and presentation 5 points

REQUIRED MATERIALS

- Book: Introduction to GIS Programming and Fundamentals with Python and ArcGIS, CRC Press, 1st Edition, by Chaowei Yang
- Python online tutorial, Python 2.7: https://docs.python.org/2/tutorial/ or Python 3 (any version of Python 3 is fine): https://docs.python.org/3.5/tutorial/
- ArcPy documentation: http://desktop.arcgis.com/en/arcmap/10.3/analyze/arcpy/what-is-arcpy-.htm or any higher version

LESSONS

Lesson 1: August 24, 2020

Class overview; Introduction to Python language; Revisit GIS fundamental elements: point, line, and polygon; Quiz 1; Homework 1 given

Lesson 2: August 31, 2020

Introduction to Object-Oriented Programming; Python syntax introduction: variables, data types, statements, and control structure; Quiz 2; Homework 2 Given

Lesson 3: September 7, 2020

Python syntax continued: data types continued, functions and modules. Quiz 3; Homework 3 Given.

Lesson 4: September 14, 2020

Python language control structure, file input/output, and exception handling. Quiz 4. Homework 4 Given.

Lesson 5: September 21, 2020

Programming Thinking and Vector Data Visualization. Quiz 5. Homework 5 Given.

Lesson 6: September 28, 2020

Shapefile handling. Homework 6 Given.

Lesson 7: October 5, 2020

Mid-term Exam. Project options given.

Lesson 8: October 12, 2020

Do not meet

Lesson 9: October 19, 2020

Python programming environment: Python IDLE, Pycharm installation, third-party library installations. Students need to bring their own computers to the class for exercise. Homework 7 given.

Lesson 10: October 26, 2020

Vector data algorithms. Quiz 6. Homework 8 Given.

Lesson 11: November 2, 2020

ArcPy Programming Introduction. Homework 9 Given.

Lesson 12: November 9, 2020

Raster data processing: indexing, compression, area calculation, reclassification; Surface data processing: DEM, TIN, contours, slope, aspect, flow direction, etc. Homework 10 Given.

Lesson 13: November 16, 2020

Advanced python GIS programming: 3 use cases for mastering several commonly used third-party libraries, such as numpy, matplotlib, and optionally mayavi, basemap, etc.

Lesson 14: November 23, 2020

Advanced python GIS programming continued. Quiz 7.

Lesson 15 &16: November 30 & December 7, 2020

Project Presentation