7:20 pm - 10:00 pm Tuesday Exploratory Hall 2310

- **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 8th 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

LESSONS

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

August 28, 2018

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

September 4, 2018

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

September 11, 2018
Lesson 4
Python language control structure, file input/output, and exception handling. Quiz 4. Homework 4 Given.

September 18, 2018
Lesson 5
Programming Thinking and Vector Data Visualization. Quiz 5. Homework 5 Given.

September 25, 2018
Lesson 6
Shapefile handling. Homework 6 Given.

October 2, 2018
Lesson 7
Do not meet

October 9, 2018
Lesson 8
Mid-term Exam. Project options given.

October 16, 2018
Lesson 9
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.

October 23, 2018
Lesson 10
Vector data algorithms. Quiz 6. Homework 8 Given.

October 30, 2018
Lesson 11
ArcPy Programming Introduction. Homework 9 Given.

November 6, 2018
Lesson 12
Raster data processing: indexing, compression, area calculation, reclassification; Surface data processing: DEM, TIN, contours, slope, aspect, flow direction, etc. Homework 10 Given.

November 13, 2018
Lesson 13
Advanced python GIS programming: 3 use cases for mastering several commonly used third-party libraries, such as numpy, matplotlib, and optionally mayavi, basemap, etc.

November 20, 2018
Lesson 14
Advanced python GIS programming continued. Quiz 7.

November 27, 2018
Lesson 15
Project Presentation

December 4, 2018