GEOG3130– Advanced GIS
Winter Quarter, 2017

Class Time: Tuesday and Thursday 2:00 PM -3:50 PM
Class Date: Jan 3, 2017 - Mar 17, 2017
Classroom: Boettcher Center West 125

Instructor: Jing Li
Office: Boettcher Center West 106
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Email: Jing.Li145@du.edu
Office hours: Tuesday 4:00 PM –5:30 PM, Wednesday 1:30PM - 3:00PM or by appointments

Teaching Assistant: Laura Atkinson
Email: laura.atkinson@du.edu
Office hours: Wednesday and Friday 10:30 AM –12:00 PM

1. Course Description:
This is an upper-level undergraduate, to graduate-level course in Geographic Information Science (GIS) that explores the more technical aspects of GIS functions and data structures. It will provide students with the most up-to-date tools and information for developing customized GIS tools using object-oriented languages. Python, which is an open source programming language used for developing ArcGIS functions, will be introduced in this course. Students will develop programming skills to explore, manipulate and analyze spatial data using basic geoprocessing functions.

Concepts and techniques to be covered in this course include:
- Programming using Python: variables, data structures, functions, modules and flow controls;
- ArcGIS programming framework and interfaces: geoprocessing, attribute manipulation, raster and vector data analysis;
- Customized GIS application development: plan, integrate, customize, automate and extend GIS functionalities for specific spatial problems;
- Selected advanced GIS concepts: data quality evaluation, SQL in attribute tables, advanced vector and raster analysis;

2. Course Objectives:
Upon the completion of the course, students are able to:
- Understand general software engineering concepts and programming methods;
- Become familiar with the basic usages of Python and perform object-oriented programming tasks using Python;
- Develop GIS tools to automate the process of manipulating, managing and producing geospatial data;
- Conceptualize, plan and implement a customized GIS tool with functions provided by ArcGIS programming framework;
3. Prerequisite:
It is expected that students have taken at least one introductory GIS course (e.g. Introduction to GIS) and comprehended the basic usages of GIS software (e.g. ArcGIS).

4. Textbooks, Readings and Online Resources
Required:
  ISBN: 9781589482821

Additional reading materials will be distributed through Canvas
Most lectures include assigned readings should be completed before the lecture.

Python Tutorial: http://docs.python.org/2/tutorial/

5. Course Assessment:

<table>
<thead>
<tr>
<th></th>
<th>Undergraduate</th>
<th>Graduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly exercises</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Take-home tests</td>
<td>30% (3*10%)</td>
<td>30% (3*10%)</td>
</tr>
<tr>
<td>Assignments</td>
<td>40% (8*5%)</td>
<td>40% (8*5%)</td>
</tr>
<tr>
<td>Software review</td>
<td>NA</td>
<td>5%</td>
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<tr>
<td>Final project</td>
<td>20%</td>
<td>15%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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Grading criteria:
- 93-100% A
- 90-92.99% A-
- 87-89.99% B+
- 83-86.99% B
- 80-82.99% B-
- 77-79.99% C+
- 73-76.99% C
- 70-72.99% C-
- 67-69.99% D+
- 63-66.99% D
- 60-62.99% D-
- < 60% F

**Weekly exercises**: You will acquire hands-on experience through a series of exercises. A portion of the class time will be dedicated to the exercises.

**Assignments**: Take home assignments will be given to reinforce the technical skills learnt in the class. **Graduate students** are expected to complete additional questions as specified in the assignment instructions.

**Software review**: **Graduate students** are expected to identify an open source GIS software package and review the functions of the package. A summary report is expected to submitted.
Take-home tests: Students are expected to complete take-home tests. Each test consists of multiple programming tasks.

Term project: You are expected to demonstrate your knowledge and skills learnt in the course through the term project. In this project, you are expected to create a new GIS tool that can be integrated into the ArcToolBox and write a report on the tool. To discuss the project topic with the instructor, you are expected to submit a project proposal by Week 7.

Project presentation: To present the tools in the class, students are expected to deliver professional presentations in class.

6. Course Policies:

Late submission policy: Students are expected to turn in assignments and project report before 2:00PM on the due day. 5% of the maximum grades will be deducted per day.

Academic integrity: Students are expected to follow the DU Honor Code. For further information, please visit the Office of Student Conduct’s website at www.du.edu/honorcode

Accommodations: All academic accommodations regarding disabilities must be arranged through the Disability Services Program (DSP) (http://www.du.edu/disability/dsp or 303.871.2455 / 2278 / 7432). Information is also available on line at http://www.du.edu/disability/dsp; see the Handbook for Students with Disabilities.
7. **Class Schedule (subject to change):**

You are responsible for keeping up with the readings, exam dates, and lectures. Any changes to this schedule will be announced in class and posted to the course page.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Reading</th>
<th>Assignment</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Programming basis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Course introduction; Geoprocessing and ModelBuilder</td>
<td>Chapter 1; Chapter 2</td>
<td>A: Create a model using ModelBuilder</td>
</tr>
<tr>
<td>2</td>
<td>Introduction to Python: data types, variables and functions; Error handling, work with message;</td>
<td>Chapter 3; Chapter 4; Other</td>
<td>A: Python fundamentals: design functions</td>
</tr>
<tr>
<td>3</td>
<td>More on Python functions; Error handling, work with message;</td>
<td></td>
<td>A: Troubleshooting in Python</td>
</tr>
<tr>
<td>4</td>
<td>GIS data quality evaluation and file operations in Python</td>
<td>Chapter 12; Chapter 11;</td>
<td>T: Test 1 A: Use Python modules and file operations</td>
</tr>
</tbody>
</table>

**Writing scripts using ArcPy**

| 5    | Geoprocessing using Python; Introduction to ArcPy; | Chapter 5; Chapter 6 | A: Manage spatial data |
| 6    | Work with attribute data; More on SQL in ArcGIS; Python in Field Calculator | Chapter 7; | T: Test 2 A: Work with attribute data |
| 7    | Work with vector data and vector analysis | Chapter 8 | A: Vector analysis |
| 8    | Work with raster data and raster analysis | Chapter 9 | A: Raster analysis |
| 9    | Packaging; integration with ArcGIS; Project discussion; | Chapter13; Chapter 14 | T: Test 3 |
| 10   | Project discussion; presentation; Teaching evaluation; | | |
| 11   | Final | | P: Project report due |