Introduction to Programming for GIS and Spatial Data Analysis

Course Number: GEO4938, Sec. 1469 (Undergraduate)  
GEO6938, Sec. 147A

Term: Fall 2013

Location: TUR3018 (Tuesday and Thursday, Lecture and Lab)

Meeting Days:  
Tuesday, 9:35 am – 11:30 am (Per. 3-4)  
Thursday, 10:40 am – 11:30 am (Per. 4)

Instructor: Forrest R. Stevens  
forrest@ufl.edu  
352.219.4040 (mobile)  
http://www.clas.ufl.edu/users/forrest/

Office Hours:  
Tuesday, 1:00 pm – 3:00 pm, TUR3142  
(and by appointment)

Course Description and Objectives:
There are two primary goals for this course. First, students will learn introductory computer programming concepts and features. Students will deconstruct examples from a variety of programming and scripting languages (primarily Python, R, VBA, and IDL), learning how to identify common logic, flow control and syntactic features. Students will learn the purpose of these structures and how to start using the programming and scripting environments of common statistics, geographic information systems (GIS) and remote sensing (RS) platforms.

Second, students will learn how to use a high-level programming language, Python, for scripting and geoprocessing applications. With Python, students will learn algorithmic operations, implement basic programmatic concepts, load and manipulate data of different types, generate graphical output and create productive workflows using Python alone. Students will then integrate these methods with GIS and advanced geoprocessing workflows via ArcGIS 10.1 and the statistical processing environment, R.

The primary outcome will be to facilitate students’ use of Python and advanced geoprocessing via ArcGIS to analyze data of their own choosing on a final project. Students will present these methods to the class for others to critique, analyze and learn from. Code sharing and re-use is highly emphasized, as is in- and out-of-class collaboration.
Prerequisites:
There are no formal prerequisites for this course, however, a basic statistical methods course (e.g. GEO3162C/GEO6160) and familiarity with ArcGIS (e.g. GEO3043/GEO5107C), either taken previously or concurrently will be greatly beneficial.

Course Resources:
There is no required text for this course. However, *Applied Spatial Data Analysis with R* is a good reference for basic R usage and advanced spatial statistics. You may find it useful to purchase, though it can also be found in electronic and print form in the UF libraries:


Furthermore, throughout the semester readings will be distributed and discussed on an as-needed basis. Most if not all of these readings will be free, online books or articles and will be posted on the class website.

E-Learning will be used as a place for distributing and submitting weekly assignments, required discussion, and class announcements:

[http://lss.at.ufl.edu](http://lss.at.ufl.edu)

Many resources may be linked to from the instructor's course website:

[http://www.clas.ufl.edu/users/forrest/teaching.html](http://www.clas.ufl.edu/users/forrest/teaching.html)

Class Meetings
In general, programming concepts and theory will be presented in a one hour lecture. During the remaining two hours per week in-lab time, practical examples will be discussed and lab exercises will be conducted. Attendance in lecture is not required except when student presentations are scheduled. **Unexcused absences during student presentations will result in 100 points per day's absence deducted from your final presentation score.**

The schedule given below is subject to change depending on the interest of students and adaptation to needs for members of the class.

Labs
Learning to program is often difficult and weekly labs are reserved for in-class work and one-on-one instruction. For this reason attendance in weekly labs is required. **Labs missed without permission from the instructor will result in a zero for that week's lab assignment.** Late labs are penalized by 10 points per 24 hours after being due on E-Learning.
## Course Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Lecture Topic</th>
<th>Lecture/Lab Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Aug 22</td>
<td>Class introduction</td>
<td>Introduction to Python, software environment (ArcGIS, R)</td>
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<tr>
<td>2</td>
<td>Aug 27, 29</td>
<td>Intro. to programming and history of computing</td>
<td>Lab 1: Intro. continuation, resources for learning, deconstructing a script</td>
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<tr>
<td>3</td>
<td>Sep 3, 5</td>
<td>Analyzing the problem, using the language as a metaphor</td>
<td>Lab 2: Modeling the problem and pseudo-code</td>
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<td>4</td>
<td>Sep 10, 12</td>
<td>Data and variables, objects and data-structures</td>
<td>Lab 3: Statements and variable experimentation</td>
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<td>5</td>
<td>Sep 17, 19</td>
<td>Control statements</td>
<td>Lab 4: Controlling program flow, looping, iteration, recursion</td>
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<td>6</td>
<td>Sep 24, 26</td>
<td>Procedures and functions</td>
<td>Lab 5: Code encapsulation, re-use</td>
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<td>7</td>
<td>Oct 1, 3</td>
<td>Object orientation</td>
<td>Lab 6: Introduction to objects, classes and methods</td>
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<td>8</td>
<td>Oct 8, 10</td>
<td><strong>Mid-term evaluation</strong>, Input and output</td>
<td>Lab 7: Getting files in and out of our GIS and RS platforms programmatically, raster and vector processing</td>
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<tr>
<td>9</td>
<td>Oct 15, 17</td>
<td>ArcGIS and Python</td>
<td>Lab 8: Basic Python use in ArcGIS</td>
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<tr>
<td>10</td>
<td>Oct 22, 24</td>
<td>Automation and batch processing</td>
<td>Proposal: Find your problem, data acquisition, proposal writing</td>
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<tr>
<td>11</td>
<td>Oct 29, 31</td>
<td>Geoprocessing using Python and R</td>
<td>Lab 9: Data, objects and packages for spatial data</td>
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<td>12</td>
<td>Nov 5, 7</td>
<td>Basic spatial data analysis in R</td>
<td>Lab 10: Modeling exercise</td>
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<tr>
<td>13</td>
<td>Nov 12, 14</td>
<td>Spatial databases and Python</td>
<td>Lab 11: Using model maker and GME in ArcGIS</td>
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<tr>
<td>14</td>
<td>Nov 19, 21</td>
<td>Automation and batch processing</td>
<td>Individual project work</td>
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<tr>
<td>15</td>
<td>Nov 26</td>
<td>Taking it further, Python, R and User Interfaces</td>
<td>Individual project work, Thanksgiving</td>
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Last Update: 2013-08-16
Grading:
Students taking this course are graded based on their lab assignments (100 points per lab), their presented project work (proposal (2 pg.), final write-up (5 pg.) and in-class presentation (10 min. plus discussion). Explicit guidelines will be set for proposal and final project by mid-term. There will be no exams. However, during student presentations your attendance is required in order to facilitate critique and discussion. **Failure to attend during presentations will result in 100 points per day’s absence deducted from your final presentation score.**

Point Breakdown:
- Labs (100 per lab): 1100
- Project Proposal: 100
- Project Presentation: 500
- Project Write-up: 300

The total amount of points to be achieved is 2000. Assignments must be submitted via E-Learning, due the date and time given online. **Late assignments will have 10 points deducted from the final score for each day they are late.** However, any lab may be redone and resubmitted with permission of the instructor, as long as the assignment was originally submitted **on-time and complete.**

Grading Scale:
- A: 91.0-100%, A−: 90.0-90.9%, B+: 87.0-89.9%, B: 80.0-86.9%, B−: 78.0-79.9%, C+: 75.0-77.9%, C: 65.0-74.9%, C−: 60.0-64.9%, D+: 57.0-59.9%, D: 50.0% - 56.9%, D−: 45.0-49.9%, E: 00.0-44.9%

Academic Honesty:
You are all bound by the student academic honor code:

"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity." "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

Despite the course emphasis on code-reuse and collaboration, the final work you hand in for labs and for exams MUST be your own work or **clearly cited** as not your own. Do not plagiarize...
code or material. The first time a student is caught cheating they will get a zero on the lab/test. On the second offense the student will be reported to the appropriate student body.

**UF Counseling Services**
Resources are available on campus for students having personal problems or lacking clear career and academic goals that interfere with their academic performance. These resources include:

University Counseling Center, 301 Peabody Hall, 392-1575 (personal and career counseling); Student Mental Health, Student Health Care Center, 392-1171 (personal counseling); Center for Sexual Assault /Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161 ext. 4231 (counseling related to sexual assault and abuse); Career Resource Center, Reitz Union, 392-1601 (career development assistance and counseling).

**Software Use**
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

**Americans With Disabilities Act:**
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Student Services before bringing your request to the instructor.
Questionnaire

Name:__________________________________________  Grad/Undergrad Year:_____

Department:_____________________________________

What other coursework or experience do you have related to programming, GIS, remote sensing and statistics (please list languages/software)?
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________________________________________________________________________

What do you expect to learn by taking this course?
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What concerns do you have about taking this course?
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