Florida International University, Department of Earth and Environment

GIS and Spatial Analysis for Earth Scientists (3)
GLY 5758, Fall Term 2015
Tu/Th 5:00 – 6:15 GISRSAL Lab, GL 274

Course Syllabus

Instructor
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Office Hours: Tuesday 11-12, Thurday 11-12 and 2-4, or by appointment

Course Description:
Spatial analysis is a set of techniques for analyzing patterns of and interrelationships between map data. The field of spatial analysis has seen much growth in recent years with the introduction of inexpensive and easy to use Geographic Information Systems (GIS). While many users employ GIS only for building spatial databases and displaying maps, GIS are powerful tools for performing spatial analysis. This course will introduce advanced undergraduates and graduate students to techniques for using GIS technology to solve problems in the earth and environmental sciences. Emphasis in this course will be on applying raster analysis techniques.

The course will be comprised of lectures and computer exercises. Computer instruction will utilize the GIS laboratory in the FIU Library. Course will be composed of 1) Review of GIS concepts and data models; 2) concepts of spatial statistics; 3) methods of spatial analysis including density mapping, buffer zone analysis, surface estimation, geostatistics, map algebra, and suitability modeling.

Course Objectives/Learning Outcomes:
Students completing this course will have a strong understanding of the theory of and the basic functions used in GIS raster analysis and modeling. Students will have a functional understanding of the Spatial Analyst and Geostatistical Analyst extensions for ArcGIS 10.

Prerequisites and Recommended Background:
An introductory GIS course (*GIS 3043*, *GIS 3048, GIS 5050 or equivalent*) or previous experience with ArcGIS is strongly recommended. It is **required** that students without previous experience with ArcGIS to on their own time complete the following free on-line short course from ESRI during the first 2 weeks of the course: *Getting Started with GIS*

- Available at: http://training.esri.com
    - Search for course **Getting Started with GIS** in the Find Training box. The course is free, but you will be required to register.

Basic analytic geometry, trigonometry, and statistics is recommended. Competence with personal computers and application software is essential.

Required Reading:

1. M. J. de Smith, M.F. Goodchild, and P. A. Longley, *Geospatial Analysis, A Comprehensive Guide to Principles, Techniques and Software Tools, 5th Ed.,* Matador (an imprint of Troubador Publishing Ltd), 2015.
   - Available free online at www.spatialanalysisonline.com. Pdf, Kindle, and hardcopy versions may also be purchased from the publisher (students can receive a discount)
2. ArcGIS manuals:
   ESRI provides an excellent set of documentation. It can be accessed via the following:
   - From the Help menu in ArcGIS (select ArcGIS Desktop Help)
   - From the Windows All Programs Menu (ArcGIS → ArcGIS for Desktop Help)
   - Online at http://desktop.arcgis.com/en/documentation/

Recommended Reading:

3. A. Mitchell, *The ESRI Guide to GIS Analysis, Volume 2: Spatial Measurements & Statistics*, ESRI Press, 2005, ISBN: 9781589481169
   - available from ESRI Press ($35), http://esripress.esri.com/display/index.cfm
4. P. A. Zanderbergen, *Python Scripting for Arc GIS*, ESRI Press, 2013, ISBN: 9781589482821
   - available from ESRI Press ($79), http://esripress.esri.com/display/index.cfm

Software:

Most examples and exercises will utilize ESRI's ArcGIS V.10.3 with the Spatial Analyst, Geostatistical Analyst and 3-D Analyst extensions. ArcGIS must have these extensions installed in order f*or you to do the exercises in this course.*

- GIS Lab Accounts (GL 274 and GL 273-MUIS Lab)
  - ***Username***--the FIU e-mail address without the "@fiu.edu"
  - ***Password***--the universal "My Accounts" password
  - Domain: Diamond
- At Home Student Copy
  - Students may obtain 1-year ArcGIS licenses free of charge.
    Go to http://maps.fiu.edu/gis/services/software-licenses/software-licenses-students and follow the instructions.

Additional numerical analysis will use Microsoft Excel.

Internet Resources

This is a web assisted course. A course webpage will be maintained with **Blackboard Learn**. This page will contain this syllabus, lectures notes, reading materials, exercises, data sets and links.

To access this resource, go to https://ecampus.fiu.edu/ and click on **Blackboard** under the **Login** menu. In the Blackboard Login window enter your FIU MyAccounts User Name and Password. Select *1158 - GLY5758 - GIS and Spatial Analysis for Earth Scientists - Section U01 - Fall 2015*.

For help with Blackboard, click the *Student* menu on the ecampus website or call the UTS Help Center at (305) 348-2284.

Grading:
Course grade will be based on attendance and class participation (10%), exercises (55%), a Midterm Exam (15%), and a Final Exam (20%).

- Homework will be assigned approximately every two weeks. Assignments will be distributed through Blackboard with associated data. Normally you will have 1-2 weeks to complete the assignment. Late assignments by be downgraded. All assignments must be typed and **submitted through Blackboard**, as a Microsoft Word document unless otherwise indicated.

  I will be grading the assignments through Blackboard so your submissions should be properly formatted. Submitted assignments should have the appearance of a professional technical report containing text, tables and maps. Text should contain a brief abstract of the assignment, answers to questions and discussions where indicated in the assignment. Do not include superfluous text from the assignment. Tables should include a caption (above the table) with numbers displayed to an appropriate number of significant digits. Maps should be Jpeg files produced with the *Export Map* command (no screen dumps please!) imbedded into the Word document. Maps should contain graticules, scales, legends and titles where appropriate. All maps should contain descriptive captions, numbered as Figure 1, Figure 2, etc.
- Exams will be closed book and will test your understanding of concepts covered in class. The Final Exam may include a Computer component where you demonstrate basic skills in applying the functions explored in the exercises.

University Policy on Academic Dishonesty and Misconduct

- All students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of Florida International University. Any act that violates the student/instructor trust will not be tolerated. Acts of cheating, plagiarism, or lying will result in an "F" grade for the class and the possibility of expulsion from FIU.
- All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the *Student Handbook.*

Course Outline and Reading Assignments (*Tentative*)**:**

Week 1:	Organization. GIS Lab orientation. Maps as models. GIS data types, and structures. Vector and raster data models
Reading:	**de Smith et.al:** Ch 1-2; **Michell::** Ch 1
Week 2	What is spatial analysis? Modeling of spatial data. Review of raster analysis functions. Working with Raster Data Models; The ESRI Grid model
Reading:	**de Smith et.al:** Ch 3; **ArcGIS Help:** Modeling and Solving Spatial Problems
Exercise 1:	Getting Started with ArcGIS Spatial Analyst
Week 3	Resampling, transforming, and registering Grids Geometric Transformations of Grids
Reading :	**ArcGIS Help**: Performing analysis in Spatial Analyst
Exercise 2:	Grid Import, Resampling, and Registration, Using the Raster Calculator
Week 4:	Vector to raster; point and lines to areas.
Reading:	**ArcGIS Help**: Fundamentals of raster data; To Raster toolset concepts
Exercise 3:	Vector to raster transformations. Fractal dimension of a coastline.
Week 5 & 6:	Point and line distributions. Measurements of spatial form. Randomness, clustering, regularity and anisotropy.
Reading:	**de Smith et.al:** Chs 4.34, 5.1-5.4; **Mitchell**, Ch 3 and 4
Exercise 4:	Measuring Geographic Point Distributions
Week 7:	Geoprocessing and Python Scripting Midterm Quiz
Reading:	**Zanderbergen (TBA)**
Week 8:	Estimating surfaces; the art of computer interpolation gridding, and interpolation. TIN, IDW, trend surfaces, kriging.
Reading:	**de Smith et.al:** Ch 6.6;. **ArcGIS Help**: Geostatistical Analyst
Exercise 5:	Modeling of Surfaces I: Deterministic Methods-IDW, Splines, TIN
Week 9 & 10:	Optimal estimation of surfaces, geostatistics, kriging.
Reading:	**de Smith et.al:** Ch 6.7; **ArcGIS Help**: Creating surfaces with geostatistical techniques
Exercise 6:	Modeling of Surfaces II: Variograms, Geostatistics and Kriging
Week 11:	Univariate analysis of surfaces and raster maps. Reclassification, filtering and image processing. Local, zonal, and focal functions.
Reading:	**de Smith et.al:** Ch 4.6;

	ArcGIS help: Performing analysis in Spatial Analyst
Week 12:	Analysis of map pairs. Spatial association analysis. Cross area tabulation.
Reading:	**Michell:** Ch 5
Exercise 7:	Two map association with cross tabulation
Week 13:	Analysis of two or more coincident maps. Map algebra. Cluster analysis. Regression Modeling; Inter-map relationships.
Reading:	**de Smith et. al:** Ch 5.6; **Michell:** Ch 5;
Exercise/Demo:	Spatial regression models
Week 14 & 15	Suitability modeling.
Reading:	**ArcGIS Help:** Modeling and Solving Spatial Problems; Overlay toolset concepts
Exercise 8:	Suitability and Hazard Modeling
Finals Week:	Final Exam, Dec 8, 5-7 PM