Geology 3403/5403 Advanced GIS

Spring, 2019; Dr. Urbanczyk

OFFICE (10-11 M-W; 8:10 – 11 TR)

This class is intended to teach a variety of modern geospatial techniques and to prepare the student to apply these skills in both an academic and a professional environment. It is an **applied** class whereby we will complete a series of projects designed to mimic the types of real world problems that a GIS specialist might encounter in a professional environment. The course meets MWF from 11 - 11:50; lab is Monday 2 - 4:50.

The content to be covered will include:

Field data collection techniques:

- Global Positioning Satellite System (GPS) techniques using Trimble hardware/software – Trimble provides a professional grade combination of both GPS hardware and software. We will explore the advanced functionality of the Trimble Pathfinder and Terrasync software.
- Real Time Kinematic (RTK) gps techniques
- Surveying with laser Total Station – We will use a laser Total Station survey instrument to create a detailed map of a local hydrologic feature. In addition to mapping relevant point features, we will create a 3-dimensional model of the area and assess geomorphic change.
- Cross section and basic surveys using a level instrument
- UAV (drone) data collection for elevation model and aerial photographs
- Survey with LiDAR for elevation models

Lab GIS techniques:

- Basic Desktop software review: Excel
- A detailed summary of Spatial Analyst, which also is an extension to our ArcGIS software that creates, manipulates, and analyzes raster data. This portion of the class will include the incorporation of the total station field data to create an elevation model
- A review of ESRI's Model Builder and Python scripting
- A review of QGIS (open source GIS)
- A review of modern Geomorphic Change Detection techniques
- A review of ArcHydro: ArcHydro is a geographic database containing a GIS representation of a Hydrological Information System; and ArcHydro Groundwater (subsurface) analyst.
- A review of Remote Sensing techniques with a focus on recognizing the spectral signatures of regional land cover types (various rock, soil and vegetation types), and attempts to remotely discriminate between them. For this part of the class, we will use Multispec and Trimble's eCognition Object Oriented Image Analysis software to interpret datasets generated with the UAV and multispectral camera and data from USDA.

Course Summary:

- The course is designed to be a hands-on experience. Content will be discussed during lecture, and the projects will be assigned for lab work. Students will be expected to work in teams of 2 or 3 in order to facilitate communication and learning. The teams will be given problems to solve using the skills and techniques discussed in the lectures and the reading assignments.

- **Specific Learning Objectives:** Upon completion of this class, students will be expected to have an understanding of the technical aspects of field and laboratory GIS applications, and to be able independently solve real world problems such as would occur in a modern professional work environment. Successful students will have the following skills:
    - Field survey techniques:
        - Level survey instrument
        - Total Station
        - GPS and RTK GPS
        - UAV drone data collection
        - LiDAR data collection
    - Lab Techniques
        - Construct 3D model using TIN and GRID formats
        - Construct cross sections from field data and from elevation data
        - Apply Manning equation to calculate discharge at different stages
        - Assess geomorphic change using elevation data
        - Use Archydro to delineate drainage basins and more
        - Use Multispec, eCognition and Arcmap to process remotely sensed data
- **Textbooks:** None. Optional books include (all are on reserve in the GIS lab):
    - Nathanson and others, 2011, Surveying Fundamentals and Practices
    - Lillesand, Kiefer, and Chipman, Remote Sensing and Image Interpretation, Wiley and Sons, ISBN 0-471-15227-7, any edition will be OK
    - Ogaja, Applied GPS for Engineers and Project Managers, ASCE press
    - Topographic Surveying, ASCE press
    - Jensen, Introductory Digital Image Processing, Prentice Hall
    - Campbell, Introduction to Remote Sensing, Guilford press
    - Sabins, Remote Sensing, Principles and Interpretation, Freeman and Company

The course evaluation will consist of:

- Exams: 30%
- Lab midterm/final: 20%
- Lab Projects: 30% (this grade will include project reports and project assessments; the assessments will consist of completed worksheets pertaining to the project, and will be issued upon completion of the project)
- Term Project: 20%
- Students taking the class for graduate credit will be expected to answer extended questions on the exams, to provide more extensive homework, and to complete projects with a higher level of technical detail.

Item	Percentage
Exam 1	10
Exam 2	10
Final Exam	10
Lab midterm	10
Lab final	10
Lab Projects	30
Term Project	20
	100

Conduct: Students are expected to observe the University's Code of Student Conduct (see Student Handbook, http://www.sulross.edu/sites/default/files//sites/default/files/users/docs/student_svc/handbook.pdf - page 38).

Please turn OFF all cellular phones, IPODs, MP3s, etc.

Sul Ross State University is committed to equal access in compliance with the Americans With Disabilities Act of 1973. It is the student's responsibility to initiate a request for accessibility services. Students seeking accessibility services must contact Mary Schwartze, M. Ed., L.P.C., in Counseling and Accessibility Services, Ferguson Hall, Room 112. The mailing address is P.O. Box C-122, Sul Ross State University, Alpine, Texas 79832. Telephone: 432-837-8203. E-mail: mschwartze@sulross.edu .

week	date	Topic	Lab #	Lab
1	1/11	Fundamental concepts		
	1/13	Software review - Excel, csv		
	1/15			
2	1/18	Spatial analyst review	1	Review of basic arcmap tasks, spatial analyst, QGIS
	1/20	QGIS		
	1/22	QGIS		
3	1/25	QGIS	2	Go outside - use an RTK and total station to collect field data
	1/27	Survey and trig review, RST		
	1/29	intro to python		
4	2/1	local to projected	3	Obtain OPUS solution, process field data, RST on paper, in excel and in python
	2/3	UTM and grid to ground		
	2/5	**Exam 1**		
5	2/8	Intro to UAV data collection	4	UAV data collection
	2/10	SFM		
	2/12	SFM		
6	2/15	SFM	5	UAV data processing - SFM
	2/17	SFM		
	2/19	multispectral imagery		
7	2/22	multispectral imagery	6	Multispec and eCognition image analsysis
	2/24	eCognition		
	2/26	eCognition		
8	3/1	eCognition		Lab Midterm
	3/3	eCognition		
	3/5	eCognition		
	3/8	Spring Break		
	3/10	Spring Break		
	3/12	Spring Break		
9	3/15	eCognition	7	Multispec and eCognition image analysis
	3/17	eCognition		
	3/19	**Exam 2**		
10	3/22	LiDAR	8	Multispec and eCognition image analysis / LiDAR
	3/24	LiDAR		
	3/26	LiDAR		
11	3/29	LiDAR	9	Outside - LiDAR data collection
	3/31	LiDAR		
	4/2	LiDAR		
12	4/5	LiDAR	10	LiDAR data processing
	4/7	LiDAR		
	4/9	LiDAR		
13	4/12	Archydro	11	Archydro
	4/14	Archydro		
	4/16	Archydro		
14	4/19	Change detection	12	Geomorphic Change Detection
	4/21	Change detection		
	4/23	Change detection		
15	4/26	other		Lab final
	4/28	Last Class		
	4-May	Final Exam Tuesday 10:15 to 12:15		