11:216:474 Undergraduate Advanced Remote Sensing Spring 2016
16:450:615/16:215:604 Graduate Seminar in Remote Sensing

Class Meeting: T 3:55-5:15 PM ENR 123 Th 3:55-5:15 5PM ENR 247 (CRSSA Teaching Lab)
Instructor: Rick Lathrop e-mail: lathrop@crssa.rutgers.edu
http://rutgersonline.net/ Phone: 848 932-1580

Course Objectives: Students should learn the fundamentals of digital analysis, interpretation and application of satellite remotely sensed imagery. Students should develop an understanding of digital image processing techniques (including the basic data structures and algorithms involved) and become proficient in the hands-on application of these techniques using the ERDAS image processing workstations. Students should learn not just how but also why and when to apply digital image processing techniques in the analysis of remotely sensed imagery.
Textbooks: J. Jensen, Introductory Digital Image Processing, 3rd ed, Prentice-Hall, 2005;
ERDAS IMAGINE Field Guide (7th edition)
Graduate students: additional journal articles on Sakai

Learning Goals:

1: Develop a comprehensive understanding of software, hardware, field and laboratory techniques commonly used in the study of ecology, evolution, and natural resources management.

2: Demonstrate the ability to design experiments and interpret numeric and graphical data.

3: Think critically and solve problems using evidence-based reasoning.

4: Communicate effectively orally and through written text and graphics.

5: Evaluate ecology, evolution, and natural resource management concepts in a global context.

Lecture Schedule:

Week 1 Lecture: INTRODUCTION TO SATELLITE IMAGE ANALYSIS
Jan 18-22 Web Lecture 1 & Supplemental: Image Data Acquisition
Homework 1: Ordering LANDSAT Images
Lab INTRO: Introduction to ERDAS IMAGINE and Graphical Modeler
Reading: Ch 1, 2, 3; ERDAS CH. 1, 3
Remote Sensing Applications article review handed out

Week 2 Lecture: IMAGE DISPLAY AND ENHANCEMENT
Jan 25-29 Web Lecture 2 & Supplemental: Image Statistics
Lab 1: Image Segmentation
Graduate Student Reading Discussion after Tuesday lecture
Homework 2: Image Statistics
Reading: CH 4, 5:151-164, 8:255-272; ERDAS Ch. 4, 6:141-157, ERDAS App A Math Topics

Week 3 Lecture: IMAGE RESTORATION & ATMOSPHERIC CORRECTION
Feb 1-5 Web Lecture 3
Lab 2: Image Normalization
Homework 3: Landsat TM Thermal IR Calibration
Reading: CH 6; ERDAS Ch. 5:132-135;

Week 4 Lecture: IMAGE RECTIFICATION
Feb8-12 Web Lecture 4 & Supplemental: Cartography and Map Projections

Graduate Student Reading Discussion after Tuesday lecture
Lab 3: Geometric Correction
Homework 4: Geometric Correction
Reading: CH 7; ERDAS CH 10, 13, App. B

Week 5 Lecture: SPATIAL ENHANCEMENT/FILTERING
Feb 15-19 Web Lecture 5
Lab 4: Spatial Enhancement
Homework 5: Spatial Filtering
Reading: CH 8:276-329; ERDAS Ch. 6:157-160, 189-201
Feb 19 Remote Sensing Applications article review due

Week 6 Lecture: MULTI-IMAGE MANIPULATION
Feb 22-26 Web Lecture 6
Graduate Student Reading Discussion after Tuesday lecture
Lab5: Principal Components Analysis
Homework 6: Principal Components Analysis
Reading: CH 5:164-169, 8:274-276, 296-301; CH 11:443-445; Field Guide CH 6:162-183
Take-home Exam Distributed. Due Monday Mar 12 in class.

Week 7 Lecture: IMAGE CLASSIFICATION: UNSUPERVISED CLASSIFICATION
Feb 29-Mar 4 Web Lecture 7
Lab 6: Unsupervised Classification
Homework 7: Spectral Clustering
Reading: CH 9:379-389; Field Guide CH 7:221-225, 231-235

Week 8 10 Lecture: SUPERVISED CLASSIFICATION
Mar 7-11 Web Lecture 8
Graduate Student Reading Discussion after Tuesday lecture
Lab 7: Supervised Classification
Homework 8: Supervised Classification Algorithms
Reading: CH 9:337-389; Field Guide CH 7:257-231, 235-253
Grad students: Research paper/proposal due March 28
Week 9 Spring Break
Mar 14-18

Week 11 Lecture: CLASSIFICATION REDUX: ADVANCED METHODS
Mar 21-25 Web Lecture 9
Lab 8: Knowledge-based Classification
Reading: CH 9:389-401, CH 10, CH 11:445-457
Return/Review take-home exam
Grad Students Reading Evaluation: write a two-three page paper critiquing and summarizing your 3 favorite papers and your 3 least favorite papers from the course. Due: Week 15.

Week 12 Lecture: ACCURACY ASSESSMENT
Mar 28-Apr 1 Web Lecture 10
Graduate Student Reading Discussion after Tuesday lecture
Lab 9: Accuracy Assessment
Homework 9: Accuracy Assessment
Reading: CH 13, Field Guide CH 6

Week 13 Lecture: Lecture: VEGETATION INDICES
Apr 4-8 Web Lecture 11
Lab 10: Vegetation Indices
Homework 10
Reading: CH 8:301-322, CH 11:431-443, 457-462

Week 14 Lecture: HYPERSPECTRAL REMOTE SENSING

Apr 11-15 Web Lecture 12
Graduate Student Reading Discussion after Tuesday lecture
Lab 11: Hyperspectral Remote Sensing
Reading: Field Guide CH 10-11

Week 14 Lecture: CHANGE DETECTION
Apr 18-22 Web Lecture 13
Lab 12: NJ Change Detection
Reading: CH 12

Week 15 Lecture: FUTURE DIRECTIONS
Apr 25-29 Web Lecture 14
Lab 13: Classification Project Due. Project Synthesis.
Graduate Student Reading Discussion after Tuesday class
Take-home final exam distributed April 30

Week 17 May 11 Final Take Home Exam Due 8am

COURSEWORK EXPECTATIONS:

Reading assignments are expected to be read prior to the class date that is listed in the syllabus above. Students are expected and encouraged to ask questions concerning the reading assignments and lecture material. **If you don't ask, I won't know you don't understand.** Graduate students will meet every other week after Wednesday lab to discuss the readings.

Homework assignments have been designed to supplement the lecture material and give the student added preparation in some of the details. Homework will be distributed on Mondays and will be returned (completed) to Professor Lathrop the following Monday. Each homework assignment is generally worth 3 points: 0 - not completed; 1 - unsatisfactory; 2 - satisfactory; 3 - excellent. Late homework will be downgraded by 1 point.

Lab assignments are hands-on exercises using the ERDAS image processing work stations. During lab periods, students will work in groups (of 2) to complete the exercises. Interaction between students and the professor is expected and encouraged. Students are encouraged to work in the CRSSA teaching lab, alone or with other class members, outside of normal class periods. Don't let your lab partner do everything - students are expected to develop the proficiency to work unassisted on the ERDAS systems. There will be six lab assignments (5 pts each) during the first half of the semester. Graduate students will have a major cumulative lab assignment during the second half (worth 50 points).

There will be a take-home exam and a final exam. These exams will be on the material covered in lecture, lab and the reading. There will be a literature research paper due during the first half of the semester focussing on RS applications. There are a series of extra readings for graduate students; we will meet biweekly to discuss. Grad Students Reading Evaluation: write a two-three page paper critiquing and summarizing your 3 favorite papers and your 3 least favorite papers from the course.

There will be a final project incorporating hands-on image classification and/or change detection and/or RS/GIS integration, etc. The work to complete the project will be done outside of normal class meeting times. Each student is expected to work independently. You can confer with other students on different approaches, techniques used, etc., but the final results and project write-up should be your own. A

separate handout concerning the project will be distributed later in the semester.

The CRSSA teaching lab is open 5 days a week (Monday to Friday) from 8:30AM to 6PM. Additional weeknight and weekend hours will be posted. You will only be able to work on the ERDAS Image Processing systems during CRSSA's normal posted hours (check www.crssa.rutgers.edu/help/lab_sched_html). No eating or drinking. is allowed in the lab.

GRADING:

Midterm Take-home Exam	100 points
Homework	30 points
Labs	30 points
Article Review/critique	30 points
Final Exam	100 points
Participation	10 points
Final Project (ugrad)	100 points
Graduate students only:	
Classification lab	50 points
Independent project	100 points
Reading Evaluation	50 points
Total	400 points (ugrad) 500 points (grad)

Grading Scale is quite standard; though there may be some scaling, use the following as a guide.

A	90-100
B	80-89
C	70-79
D	60-69
F	Below 60