

TOWSON UNIVERSITY
Department of Geography and Environmental Planning
Geography 416/631

Course Outline

Instructor: Dr. John Morgan

I. Course Description

GEOG 416/631 Introduction to Remote Sensing and Digital Image Processing (3 credit hours). Obtaining quantitative information from remotely sensed images; visual and automated techniques in the study of spatial and environmental relationships. Students will process remotely sensed images using Windows-based image processing software. Prerequisite: 6 credit hours of geography or consent of instructor (GEOG 101, GEOG 109, and GEOG 221 are strongly recommended). A working knowledge of Windows XP is also strongly recommended.

II. Learning Outcomes

Upon completion of this course students will be able to:

- A. Identify the major features of the electromagnetic spectrum
- B. Describe various interactions of radiation with the Earth's atmosphere and surface
- C. Explain and use basic concepts related to remotely sensed observations of the earth
- D. Demonstrate awareness of a variety of remote sensing systems, sensors, and observation strategies
- E. Describe the characteristics and applications of different passive and active sensors used for image data collection
- F. Select the sensor(s) and data product(s) best suited to a specific application
- G. Perform selected digital image processing tasks (geometric and radiometric corrections, color composite creation, contrast enhancement, filtering, data transformations, unsupervised classification, supervised classification) using IDRISI Taiga (Clark University)
- H. Discuss the differences between supervised and unsupervised classification of remotely sensed data.
- I. Describe practical applications and limitations of Earth observation missions
- J. Understand the importance of the integration of remote sensing and geographic information systems

III. Course Content

- A. Overview of remote sensing and digital image processing techniques
- B. History of remote sensing
- C. The electromagnetic spectrum and image bands
- D. Remote sensing systems
- E. Introduction to digital data
- F. Image statistics
- G. Digital image processing techniques
 - 1. Preprocessing data including geometric and radiometric error correction
 - 2. Improving image contrast through band combinations and contrast stretches

3. Enhancing images through the use of filters
 4. Transforming data through band ratios, principal components analysis, and vegetation indexes
 5. Analyzing images through density slicing and unsupervised and supervised classification techniques
 6. Accuracy assessment
 7. Advanced digital image processing software and techniques
- H. Satellite remote sensing applications
- I. Remote sensing/GIS integration

IV. Course Requirements

- A. Assigned readings from textbook, class handouts, and faculty reserve materials
- B. Bibliography
A bibliography for this course is available at:
http://pages.towson.edu/morgan/pages/students_gisbooks.htm.
- C. Course project
A course project involving student use of digital image processing software (IDRISI Taiga) and Landsat and other remotely sensed data will be assigned during the semester.
- D. Tests
Two tests will be scheduled during the semester. The tests will include a combination of objective, short answer, and essay questions. Students must take both of the tests. Make-up tests will be given only in the event of an emergency. A notification from the Dean of Students may be required in order to take a make-up test.
- E. Class attendance
Class attendance is required because the textbook does not contain all of the material that is discussed in the lectures and the laboratory sessions. A "class list" will be circulated, for your signature, at each class. It is your responsibility to sign the class list, and to keep track of your absences. The maximum number of absences without penalty is 2. Any absence in excess of the 2 permitted absences will result in the student's course grade being lowered by one letter grade for each additional absence. Class absences will be excused for documented reasons. According to the University's Attendance and Absence Policy, excused absences include "illness or injury when the student is unable to attend class, religious observance where the nature of the observance prevents the student from attending class, participating in University activities at the request of University authorities, and compelling verifiable circumstances beyond the control of the student." Students who are absent from class are responsible for any missed work, assignments, and tests. Students with documented excused absences will be allowed to make up missed work, assignments, and tests.
- F. Class participation
In addition to submitting all relevant assignments (some of which require your physical presence in the classroom to present various material to the rest of the class), you are expected to attend and actively participate in every class. The instructor reserves the right to give "extra credit" to students who consistently contribute meaningful commentary and analysis to class discussion.
- G. Students with a disability
If you need accommodation due to a disability, see me during my office hours. Please bring a statement from Disability Support Services with you authorizing your accommodation.

V. Course Evaluation

A. Test #1 (25% of course grade)

B. IDRISI exercises and course project (50% of course grade)

The IDRISI exercises and course project will represent 50% of your course grade (10% of course grade for the IDRISI exercises and 40% of course grade for your course project). The IDRISI exercises and course project will be assigned letter grades. The equivalent numerical grades for the IDRISI exercises and course project letter grades are as follows: A+ = 100; A = 95; A-/B+ = 90; B = 85; B-/C+ = 80; C = 75; D+ = 70; D = 65; F = 55. Points (10) will be deducted for each day a laboratory project is submitted for grading after the due date. Although students are encouraged to help each other with laboratory project questions or problems, it is expected that each student will submit his/her own work. Submittal of "group work" by two or more students is not acceptable, and will be handled as described in the "grading procedure" section.

C. Test #2 (25% of course grade)

D. Course evaluation for graduate students

Students taking the course for graduate credit will be evaluated as follows: Test #1 (20% of course grade), IDRISI exercises and course project (50% of course grade), Test #2 (20% of course grade), and Applications Project (10% of course grade).

E. Grading procedure

Your grade for the course will be determined from your performance on the two tests and the laboratory project. Anyone found to be submitting "group work" for the course project, plagiarizing on a written assignment, or cheating on a test will be given a grade of 0 for the course project or test; and the incident will be reported to the Chair of the Department of Geography and Environmental Planning and the Office of Judicial Affairs as per the University's "Student Academic Integrity Policy." Letter grades for undergraduate students will be determined according to the following schedule: A = 93.0 - 100%; A- = 90.0 – 92.9%; B+ = 87.0 – 89.9%; B = 83.0 – 86.9%; B- = 80.0 – 82.9%; C+ = 77.0 – 79.9%; C = 70.0 – 76.9%; D+ = 67.0 – 69.9%; D = 60.0 – 66.9%; and F = 0 – 59.9%. Letter grades for graduate students will be determined according to the following schedule: A = 90.0 – 100.0%, B = 80.0 – 89.9%, C = 70.0 – 79.9%, and F = 0 – 69.9%. The instructor will take class participation into consideration when assigning letter grades to those students who have "borderline" course grades.

F. Classroom policies

The following are several classroom policies for this course: 1) arrive on-time for class; 2) no food or beverages may be consumed in the Computer Laboratory (LI001); 3) if you need to talk with a classmate do so before or after class, or during the break; 4) put your cell phone on vibrate mode and turn off your pager, iPod, or other electronic device before class starts; and 5) do not engage in text messaging, Twittering, or similar activities during class.

G. Graduate student applications project

Students taking the course for graduate credit will be required to complete an applications project in lieu of a research paper. Information regarding the applications project will be distributed in class.

VI. Office Hours

M, 1:00 – 4:00 pm; TR, 10:00 am – 12:00 pm. Other times by appointment. My office is

Linthicum Hall Room 030. My office telephone number is 410-704-2964, the office fax is 410-704-4702, my email address is jmorgan@towson.edu, and the URL of my personal Web page is <http://pages.towson.edu/morgan>. Students who have any questions regarding the lectures, reading assignments, laboratory projects, and applications project, or who have any other questions or problems related to the course, are encouraged to see me during my office hours, or to call or email me for an appointment.

VII. Textbook and Supplies

A. Textbooks (required)

Campbell, James B. 2006. *Introduction to Remote Sensing*. 4th ed. New York: The Guilford Press.

B. Supplies

Binder for IDRISI Taiga manuals.

USB flash drive (2GB or larger preferred).

Note: The developer of IDRISI Taiga, Clark University, makes a copy of the software available to students at a discounted price. A one-year "Student Starter" license is available for \$95.00. For information, visit <http://www.clarklabs.org/buy/upload/Clark-Labs-Order-Form.pdf>.

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