

GIS 4037C & GIS 5033C: Digital Image Analysis (3 credits)

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And by appointment

This on-line course was originally designed by Dr. Charles Roberts at FAU and improved by Dr. Caiyun Zhang and Ms. Georgia H. De Stoppelaire.

Prerequisite Courses:

Introduction to GIS Mapping (GIS 3015C)

Remote Sensing of Environment (GIS 4035C)

Course Organization:

This is the second course in a three course remote sensing sequence, based on the national model for remote sensing curriculum. It covers the basic principles of remote sensing technology applied to environmental and urban analysis, and includes a survey of remote sensing data sources. **THIS COURSE IS CONDUCTED FULLY ONLINE.**

Course Objectives:

Students will learn advanced theories and common applications for remote sensing of the earth, and they will go through a sequence of hands-on remote sensing procedures and projects with a variety of common remote sensing data sets. Preliminary exposure to digital image analysis procedures in Remote Sensing would have already prepared students for this second course, Digital Image Analysis.

Recommended Textbook:

Jensen, John, Digital Image Processing, Englewood Cliffs: Prentice-Hall, Latest edition.

Course Materials on Blackboard are located in four areas under course documents: Check each area every week:

1. **Lecture Notes**: **THESE ARE THE BASIS FOR THE QUIZZES**. Study this, use the Power Points and the streaming videos as an aid, but study the lecture notes.
2. **Lecture Videos/Voice Over Power Point**: Links to streaming media that consist of the lectures given by Dr. Roberts and corresponding voice over power points for select lectures. In some cases the voice over power point is offered because no video lecture exists but normally the voice over power point acts as a supplement to video lecture. The voice over power point can be stepped through like a normal power point when watching video lecture. In addition, if parts of the video lecture are unclear (maybe less than optimal filming), the voice over power point will clear things up.
3. **Lab Tutorials and Lab Instructions**: This is the hands-on portion of the course. Course notes on blackboard. **The lecture notes rather than the Power Points or videos are the basis for the quizzes**. 60% of the course grade comes from successfully completing these labs in a timely manner.
4. **Discussion Board**: This is the interface medium for questions, discussions, and ancillary information to complete labs, and helpful hints.

The lecture notes rather than the power points or videos are the basis for the quizzes.

FAU Geosciences Computer Resources

The Geosciences Lab is located at the FAU Boca Raton Campus in the Science and Engineering Building (SE) 483, and is available to students taking this course. Systems are available on a first come first serve basis when a scheduled class does not occupy the room. The Geoscience Lab is staffed with Graduate Teaching Assistants and instructors to assist students taking this course. Check the schedule posted outside the lab for lab hours. Each Wednesday from 6:00 PM to 7:00 PM, a GIS lab is held with GIS course instructors available to assist and meet with students.

For more information about the Geosciences Computer Lab, go to <http://www.geosciences.fau.edu/> and click on the Computer Resources link.

Working from Home or Other Computer

Thousands of students have successfully used our online system for distance learning. However, should a student experience technical difficulties if remotely accessing the course from home or other locations outside the Geosciences Lab, it is up to each student to solve their own technical issues.

If students experience technical problems, information technology support can be found at the following resources:

FAU's [Online Computing Support Center](#) allows you to search the Knowledge Base for answers to common questions. Submit your own help ticket by clicking on "Submit a ticket". If the Blackboard server is not available at night or on the weekend, please contact the FAU Help Desk at 561-297-3999.

FAU's **Geosciences Help Desk** provides support for the Geosciences remote applications as well as the department's network drives (e.g., student G: drive). Submit your own help request via e-mail to GeoHelpDesk@fau.edu.

Students should contact the course instructor for assistance with course-related software questions.

| <u>WEEK</u> | <u>UNIT</u> | <u>WEEK BEGINNING</u> | <u>TOPIC</u> |
|-------------|-------------|-----------------------|--|
| 1 | 1 | August 20 | Introduction (Chapters 2, 3) <u>Lecture Topics:</u> History of Digital Image Analysis Systems Digital Image Analysis System Considerations Unique to Remote Sensing Understanding Imagery as Digital Data |
| 2 | 2 | August 27 | Project Design and Image Preprocessing (Chapters 1, 6, and 7) <u>Lecture Topics:</u> Designing a Remote Sensing Project Advantages and Disadvantages of Digital Data Digital Image Analysis Techniques Theory and Problems of Machine Interpretation vs. Human Interpretation Image Preprocessing Radiometric Corrections Radiometric Effects of the Atmosphere |

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|---|---|--------------|--|
| | | | Geometric Corrections |
| 3 | 3 | September 3 | QUIZ 1 (Unit 1 only) and Contrast Enhancement (Chapter 8) <u>Lecture Topics:</u> Linear Contrast Stretch Histogram Equalization Percentage Stretch Standard Deviation Stretch Piecewise Stretch |
| 4 | 4 | September 10 | Spatial Filtering (Chapter 8) <u>Lecture Topics:</u> Moving Window Concept Low Frequency Filtering High Frequency Filtering Edge Detector |
| 5 | 5 | September 17 | Image Ratioing (Chapter 8) <u>Lecture Topics:</u> 2 Band Ratioing Normalized Difference Indexing Ratioing Vegetation Indices AVHRR data Tasseled Cap Transformation |
| 6 | 6 | September 24 | QUIZ 2 (Units 2, 3, and 4) and Change Detection and Time Series Analysis (Chapter 12) <u>Lecture Topics:</u> Image Differencing Image Ratioing Post classification Comparisons Comparisons of Preprocessed Imagery Change Vector Analysis Designing a Baseline study for past and future comparison |

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| 7 | 7 | October 1 | Spatial Resolution Tools and <u>Lecture Topics:</u> Image Display Image Subsetting Image Resampling |
| 8 | 8 | October 8 | Unsupervised Classification (Chapter 9) <u>Lecture Topics:</u> Unsupervised Classification Cluster Analysis Histogram Peak Technique Isodata Clustering |
| 9 | 9 | October 15 | Supervised Classification 1: Parallel Piped Classification <u>Lecture Topics:</u> Supervised Classification Training Field Selection Parallel Piped Classification |
| 10 | 10 | October 22 | Supervised Classification 2 <u>Lecture Topics:</u> Minimum Distance Classification Textural Classification |
| 11 | 11 | October 29 | QUIZ 3 (Units 5, 6, 7, 8, 9, and 10) and Supervised Classification 3 <u>Lecture Topics:</u> Maximum Likelihood Classifier Fuzzy Classification |
| 12 | 12 | November 5 | Principal Components Analysis |
| 13 | 13 | November 12 | Image Retrieval: Feature Extraction using spatial frequency and image texture |
| 14 | 14 | November 19 | Ground Truthing and Accuracy Assessment |
| 15 | | November 26 | QUIZ 4 (Units 11, 12, 13, and 14) |

Labs and Due Dates

The objective of the lab assignments is to expose students to wide-ranging, advanced concepts of digital image analysis of remotely sensed data. Students are expected to complete tutorial image processes and experiment with tools to learn techniques, procedures and data organization skills to manage and manipulate imagery and geospatial data as well as to discern patterns and spatial relationships through image enhancement, image classification and time series analysis. The importance of data standards, following complex instructions and independent trouble-shooting are reinforced and emphasized more greatly in the grading than the actual lab results. For more information, see section on Lab Grading.

Most labs will become available Mondays at 5 PM and will be closed on Mondays at 11:59 PM. Be sure to check the syllabus each week as some labs dates are scheduled to accommodate for larger assignments. Please make all efforts to complete and submit labs assignments via Blackboard Assignments by 11:59 PM on the due date. If this time is passed, Blackboard (Bb) will accept your assignment; however, it will be considered late and a late penalty will apply of a 10% reduction in grade per day.

| <u>Labs</u> | <u>Date Available</u> | <u>Due date</u> |
|--------------------|------------------------------|------------------------|
| Lab 1 | August 20 | August 27 |
| Lab 2 | August 27 | September 3 |
| Lab 3 | September 3 | September 10 |
| Lab 4 | September 10 | September 17 |
| Lab 5 | September 17 | October 1 |
| Lab 6 | October 1 | October 8 |
| Lab 7 | October 8 | October 15 |
| Lab 8 | October 15 | October 22 |
| Lab 9 | October 22 | October 29 |
| Lab 10 | November 19 | November 26 |

Lab Grading

| Grading Criteria | Penalty for Noncompliance |
|--|---|
| Lab submitted on time via Blackboard Assignments. Labs are only accepted via Blackboard Assignments. | 10% deduction of points for each day late. After ten days, the lab is worth zero points. |
| Location of original work files on G:drive. (G:\SemesterTempDrive). | "F" Grade if original work files are not saved to folder to support lab. |
| File path to original work files is listed in "Comments" field of Blackboard Lab Assignments submission of completed lab document. | 10% deduction of points for omission or wrong path location. |
| Correct File Format. | 10% deduction of points for wrong format. |
| Completion of actual digital analysis work as assigned in lab. | Varies with each lab assignment. |
| Individual work only. | All work must be your original work, not a copy of group or team project you did with someone else. |

Grading:

Course grading is worth 100 points.

Late Projects: -10% off per day late, including weekends, rigidly enforced.

*** Students enrolled in the graduate version GIS 5033C should follow the undergraduate syllabus, and do an additional research project to be assigned by the instructor.**

Lab Participation and Projects: 60 points
QUIZ 1: 10 points
QUIZ 2: 10 points
QUIZ 3: 10 points
QUIZ 4: 10 points

Quizzes are based on labs and lecture notes associated with units.

Grading Scale:

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|---------------------|-----------|
| 93-100 | A |
| 90-92 | A- |
| 87-89 | B+ |
| 83-86 | B |
| 80-82 | B- |
| 77-79 | C+ |
| 73-76 | C |
| 70-72 | C- |
| 67-69 | D+ |
| 63-66 | D |
| 60-62 | D- |
| less than 60 | F |

***GIS 5033C: Graduate Project**

Pass/Fail

Incomplete Grades are awarded only under extreme circumstances at the discretion of the instructor. The University policy is that candidates for an Incomplete Grade must have extreme circumstances that hinder the completion of the course AND must be passing the course at the time of the occurrence of the extreme circumstance.

Students with Disabilities

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca Raton, -SU133(561-297-3880), in Davie-MOD 1 (954-236-1222), in Jupiter SR117 (561-799-8585) or at the Treasure Coast- CO 128 (772-873-3305), and follow all OSD procedures.

Honor Code

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty, including cheating and plagiarism, is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the University community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see http://www.fau.edu/regulations/chapter4/4.001_Honor_Code.pdf