94-838: Introduction to Raster GIS  
Spring Semester 2016

Instructor: Darryl Bishop  
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Office hours: by appointment.

Class Time/Location: Mondays 6pm – 8:50pm  
239 Hamburg Hall

Course Description:

Raster GIS has emerged as a very effective tool for planners and policy makers in the modern world of data and information. Raster data in the form of digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps helps a policy maker to understand issues and challenges in diverse fields such as ecology, forestry, geology, urban and regional planning, water resource management, food security, public health, disaster management, climate change, energy use etc. Raster GIS can be used to analyze and study short term changes like Forest fires, volcanic eruptions, weather, mining, crops growing & harvesting, leaves falling off trees etc. as well as long term changes like urban area expansion, river changing course, deforestation, lakes drying up, melting glaciers etc. The objective of the course is to familiarize the students with the basic concepts of Raster GIS and how various analysis tools and methodologies can be used to analyze and study Raster data for several policy and planning applications. ERDAS, a widely used geospatial image processing and analysis package would be used for the course.

Course Schedule:

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<th>Date</th>
<th>Topic</th>
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<tr>
<td>Jan 11</td>
<td>Lecture/Exercise 1</td>
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<td>Jan 18</td>
<td>MLK Holiday (no class)</td>
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<td>Jan 25</td>
<td>Lecture 2, Exercise 2</td>
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<td>Feb 1</td>
<td>Lectures/Exercises 3 &amp; 4</td>
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<td>Feb 8</td>
<td>Lecture/Exercise 5 &amp; 6</td>
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<td>Feb 15</td>
<td>Lecture/Exercise 7 &amp; 8</td>
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<td>Feb 22</td>
<td>Lecture/Exercise 9 &amp; 10</td>
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<td>Feb 29</td>
<td>Final presentations</td>
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Grade allocation:

Exercises: 5% each (x 10 = 50%)
Final Presentation: 50%

Exercise screenshots are due by 11:59pm on Feb 29th. Ideally screenshots should be turned in within one week of their assignment.

Exercises not turned in by 11:59pm on Feb 29th will be given a 0.

The mean grade in the course will be 3.5. This standard grade guideline endorsed by the Heinz College faculty and is resulted from a substantial variation that emerged in grading practices across the courses and a slow but steady grade inflation that set in over the past several years.

Academic Integrity:

“Academic credit awarded to an individual should represent the work of that individual. Therefore, students at Carnegie Mellon are expected to produce their own original academic work. Collaboration or assistance on academic work to be graded is not permitted unless explicitly authorized by the course instructor(s). The citation of all sources is required. When collaboration or assistance is permitted by the course instructor(s), the acknowledgement of any collaboration or source of assistance is likewise required. Failure to do so is dishonest and is the basis for a charge of cheating, plagiarism, or unauthorized assistance. Such charges are subject to disciplinary action.”

http://www.cmu.edu/policies/documents/Academic%20Integrity.htm

Students should submit exercise assignments individually. Duplicate files will not be accepted for students working together to complete homework assignments and will be given a grade of 0.

Attendance policy:

Attendance will not be recorded, but is strongly recommended for each class. The computer lab will be available for students to use outside of class to complete tutorials and homework assignments, but questions regarding ERDAS and the tutorials are best answered during class time.

Classroom etiquette:

Students are encouraged to collaborate to complete tutorials, as I believe the best way to learn a program is to teach it to someone else. Off-topic conversation is permitted during tutorial sessions so long as it is not disruptive to other students. Talking will not be tolerated during lecture and presentations by classmates.
**Lecture 1: Introduction**
- Course overview and policies
- Brief history of Remote Sensing/Raster GIS
- Raster GIS applications: policy analysis/planning and management
- Current state of the art
- Introduction and overview of ERDAS

**Lecture 2: Raster Data**
- Fundamentals of Raster GIS/Data
- Bands
- Importance of different bands
- Sensors/Satellites
- Spatial resolution
- Radiometric resolution
- Band combinations - True and False color
- Different image types - Panchromatic, Multispectral, Hyperspectral
- Using ERDAS to understand basic raster image characteristics

**Lecture 3: Raster Data Sources**
- Creating AOIs and subset images
- Layer stacking
- Image mosaicking - basic concepts

**Lecture 4: 3D Modeling**
- VirtualGIS module in ERDAS
- Displaying DEM and raster layers in Virtual GIS
- Creating flight paths for terrain visualization
- Creating Cloud, Water and Mist layers
- Importing and positioning new 3D models

**Lecture 5: 3D Modeling**
- 3D data source(s) - http://ned.usgs.gov/
- 3D data storage
- 3D data analysis - Slope, Aspect, Shaded Relief and Painted Relief features

**Lecture 6: Spectral Data Analysis with ERDAS**
- Spectral profile analysis (Points, Lines, Surfaces)
- Understanding spectral data
- Saving/Export/Import File/Data formats
- GeoTiff & GRD files
- Pixels
- The meaning of pixel values
- Pixel values and its relevance to policy analysis/planning
- Georeferencing data files
Lecture 7: Raster Index Calculation
- Calculating raster indices from spectral data: UI - Urban Index, EBBI - Enhanced Built-Up and Bareness Index, NDVI - Normalized Difference Vegetation Index
- Using One and Two Image Functions in ERDAS for index calculation
- Meaning of indices
- Rescaling indices
- Using and understanding the Model Maker tool in ERDAS
- Calculating surface temperatures from spectral data using a model - application in areas of Global Warming, Climate Change, Solar Energy and Energy Use
- Standard raster indices in ERDAS
- Changing spatial resolution - based on file size restrictions/requirements

Lecture 8: Raster Models
- Reprojection (from one geographic co-ordinate system to other)
- Convert vector shapefiles to AOIs
- Compute raster statistics in AOIs
- Making models - correlation of raster statistics and ground data
- Using the model and Model Maker tool to generate ground data from raster statistics
- Calculating Population Density/Population for any AOI in a raster data file

Lecture 9: Analyzing and Quantifying Change
- Using the DeltaCue module in ERDAS
- Standard change detection algorithms
- Difference formulas
- Brightness, Greenness, Blueness, Tasseled-Cap Transformations (Green Difference & Soil Difference)
- Displaying change
- Setting contour levels in change display
- Saving the change display file

Lecture 10: Image Classification
- Image classification concepts - USGS classification guidelines
- Supervised and Unsupervised classification
- Unsupervised classification in ERDAS - advantages and disadvantages
- Supervised classification in ERDAS - advantages and disadvantages