Introduction to Raster GIS  
Fall Semester 2017

Zan Dodson, Carnegie Mellon University, Fall 2017, 94-838 (6 units)  
Office Hours by appointment <zdodson@andrew.cmu.edu>

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Office hours: Tue. 4:30-5:20 p.m. & Fri. 9-10:30 a.m in HBH 2009

Course Description:

Raster GIS leverages environmental data collected in the form of satellite imagery, digital aerial photographs, climate data such as precipitation and temperature, as well as 3D imagery to better understand the impact of land cover and land use change on our environment. Emphasis is placed on the collection and processing of digital raster data which can be integrated with traditional GIS data to better understand the coupled human-environment relationship. Application-driven, this course will demonstrate how these data can be used to address problems ranging from environmental determinants of health to more traditional land use planning. ArcGIS will be used for image processing and analysis.

The course includes lectures, computer labs, and a project using the leading desktop GIS software, ArcGIS Desktop, from Esri, Inc. Subject areas include:

- **Fundamentals of raster analysis** (remote sensing, raster GIS, remote sensing instruments)
- **Raster data** (sources of raster data, description of raster properties, EM radiation and interaction with environment, resolution)
- **Manipulating raster data for analysis** (ordering and retrieving raster data, layer stacking, image mosaicking)
- **Raster data analysis** (visual image interpretation, digital image processing, geometric registration, calculation of vegetation indices)
- **Image classification and change detection** (supervised and unsupervised classification, change detection methods, introduction to LiDAR)

_This course is not a substitute for Intro to GIS (94802)!!_

Course Objectives:

1. Develop a strong foundation in using GIS for both vector and raster data analysis; this will provide a significant advantage in the information technology field.
2. Identify real-world problems that can be answered using spatial data through hands-on, application-focused labs.

Objectives are met and assessed through weekly homework assignments and a final project.
Course Materials:

- Note, this is only offered as Kindle book, please download an app that allows you to read Kindle materials (either on your Kindle, phone or desktop)

Power Point Slides: used in lectures for note taking (available from Blackboard)

ArcGIS Desktop 10.5 software: available from Heinz Computing Services (downloaded at: https://download2.heinz.cmu.edu/secure/sdl/) or via Heinz VMWare

GIS data copied from Blackboard or Heinz server

Readings provided on Blackboard

Grades:

Homework assignments (5 @ 15% each) 75%
Final project 25%

Grade interpretation points credit toward graduation
A+ 97% to 100%
A 93% to 97%
A- 90% to 93%
B+ 87% to 90%
B 83% to 87%
B- 80% to 83%
C+ 77% to 80%
C 73% to 77%
C- 70% to 73%
R less than 70%
Communication

Clarification and discussion of Raster GIS concepts and procedural knowledge are not limited just to lectures and lab sessions. Also provided are the instructor’s office and lab meetings, TA office hours, and a Canvas Discussion Board. Neither instructor nor the TA will answer questions through email that would have benefit for the class, but instead will monitor the Canvas Discussion Board daily and respond to questions. Canvas Discussion Board questions are answered 9am-5pm Monday-Friday.

Late Homework Policy:

Homework assignments build upon each other, so it is important to be up to date on your assignments. **No assignment will be accepted after the due date** unless previously arranged with me due to extraordinary circumstances (e.g. illness, out of town).

Re-grading Homework Assignments and Quizzes:

If you believe that there was an error in grading an assignment, please contact the TA to resolve the issue. If you cannot resolve the issue to your satisfaction with the TA, then please send an email message to me with the issue.

Please ask for any re-grading of an assignment within one week after it has been returned, otherwise, we will not re-grade the assignment.

Policy on Collaboration and Cheating:

I will follow Heinz College policies on ethics and discipline as stated in student handbooks. A specific policy of this course is as follows:

*Homework*—Do not copy or modify homework solutions for your homework solutions. Homework must be individual work unless otherwise stated. You may consult each other on clarification, technical and conceptual issues, but you must do individual problem solving and derive your own solutions, including your own computer work.

You are not permitted to be in possession of any assignments from another student or other source either from the current semester or from past semesters whether they are electronic or paper. Possession of or sharing such files constitutes an infraction of the academic integrity policies of this course.
Class Schedule
*tentative*

**Week 1, Fundamentals of Raster GIS**
8/28 and 8/30

*Wiki Assignment due 12 p.m. (noon) 9/03/2017*

*Note: all assignments are posted on Canvas*

- Introductions
- Course overview and policies
- Introduction to remote sensing and raster GIS
- Remote sensing instruments
- Raster GIS applications and examples

Chapters 1-4

**Week 2, Raster data.**
9/06

*Assignment #1 due 12 p.m. (noon) 9/14/2017*

- Sources of raster data
- Description of raster data properties
- EM radiation and interaction with environment
- Spatial, spectral, and radiometric resolution

Chapters 7-8

**Week 3, Manipulating raster data for analysis** 9/11 and 9/13

*Assignment #2 due 12 p.m. (noon) 9/21/2017*

- Visual image interpretation
- Digital image processing
- Image mosaicking

Chapters 9-10

**Week 4, Raster data analysis**
9/18 and 9/20

*Assignment #3 due 12 p.m. (noon) 9/28/2017*

- Geometric registration
- Vegetation indices
- Unsupervised classification methods

Chapters 11-12, 14
Week 5, Image classification and change detection 9/25 and 9/27

- Project proposal due 5 p.m. 9/25/2017
- Assignment #4 due 12 p.m. (noon) 10/05/2017
  Supervised classification methods
  Change detection methods and applications
  Introduction to LiDAR data

Chapters 17-19

Week 6, Accuracy assessment, Final project work 10/02 and 10/04

- Assignment #5 due 12 p.m. (noon) 10/12/2017
  Confusion matrices
  Error and accuracy assessment

Chapters 17-19

Week 7, Advanced applications, Final project work 10/09 and 10/11

Examples of advanced raster applications
Free time to work on final project

Week 8, Advanced applications, Final project work 10/16

- Final presentations—in class
- No more than 10 minutes per group