GIS and Forest Engineering Applications
FE 257
Lecture and laboratory, 3 credits

Instructor:
Michael Wing
Associate Professor
Forest Engineering, Resources, and Management
Oregon State University

Crop Science 347, phone: 541.737.4009
Michael.Wing@oregonstate.edu

Lecture: MW 1200-1250, Learning Innovation Center 210
Lab 9:00-10:50 (Tuesday), Rich 313
Lab 2:00-3:50 (Tuesday), Rich 313
Lab 2:00-3:50 (Wednesday), Rich 313
Lab 12:00-1:50 (Thursday), Rich 313
Lab 5:00-6:50 (Thursday), Rich 313

Syllabus
COURSE DESCRIPTION
An introduction to the appropriate use and potential applications of geographic information systems (GIS) and related technologies (GPS and remote sensing) in forest management, operations planning, and problem solving. Students are presented with lectures and exercises that cover a wide range of GIS and GIS-related topics and issues including spatial database creation, structure, analysis, and modeling.

Class meetings include a lectures and hands-on GIS exercises in a computer lab. Students are required to complete weekly lab assignments and a final project.

LEARNING OBJECTIVES
Students who successfully complete this course should have:

An understanding of GIS fundamentals and theory and an ability to apply these concepts to solve problems.

The ability to create thematic maps.

The ability to work with data of different structures and to use these data to solve problems.

The ability to import data of different cartographic projections and to use these data to solve problems.

The ability to communicate with others in writing and orally regarding GIS applications.

Familiarity with advanced GIS operations and the ability to use these techniques.

The ability to design and successfully complete a spatial analysis.

COURSE MATERIALS
1. Materials including lecture and lab notes are made available at the course WWW site:
   http://fe257.forestry.oregonstate.edu/

These materials are provided for your convenience. Please print them out prior to class and bring them with you to lecture and lab.

2. Students must purchase a copy of (available at the OSU bookstore):

Wing, M.G. and P. Bettinger. 2008. Geographic information systems: Applications in natural resource management. Oxford University Press, Oxford. 272 pp.

GRADING
Weekly exercises and labs	50%, 100 points possible
Final project	25%, 50 points possible
Exams (3)	25%, 50 points possible

Midterm (20 pts)
Final (20 pts)
Lab exam (10 pts)

Weekly exercises and labs are due at the beginning of your lab period, one week after they are assigned. All submitted assignments should include assignment number, problem number, class number (FE 257), and your name(s). *Late work will not be accepted and all work must be type written.*

Letter grades will be based on the following table.

Letter grade	% of total points
A	92.5-100
A-	90.0-92.5
B+	87.5-90.0
B	82.5-87.5
B-	80.0-82.5
C+	77.5-80.0
C	72.5-77.5
C-	70.0-72.5
D	60.0-69.9
F	< 60.0

FINAL PROJECT GUIDELINES
The project report is due by 5 PM on the Friday before finals week and is worth 50 points. I encourage you to work in teams of two but the guidelines and requirements will be identical for all projects. I would also encourage you to design your own project topic and you may use your own data. Your project should result in a spatial analysis that addresses a forestry or engineering topic. If you have trouble developing a project topic and/or finding data, I will help you. If you have questions about the suitability of a project, please check with me or with your lab TA.

REPORT GUIDELINES
Prepare a three to five page typed (double spaced) report with a cover page containing the paper title, class number (FE 257), date, and author names. Please do not put your report in a binder.

>REQUIRED PAPER SECTIONS
>Please organize your paper to include the following sections:
>INTRODUCTION (10 points)
>This explains the relevance of the topic and provides a brief background. This section should conclude with 1-3 paragraphs describing what you are intending to do and why it's important.
>METHODS (10 points)
>Describe what tools (software) you used to accomplish your project. What were the key steps in answering questions related to your project? Where did your data come from? What is the quality of your data? You should include discussion of the data scale and/or resolution.
>RESULTS (10 points)
>Describe what you discovered. This may include problems and/or successes with the methods you used. Were there any unexpected or unanticipated results?
>CONCLUSION (10 points)
>This should contain a brief summary of the importance of your results.
>MAPS (10 points)
>Include a minimum of two 8.5 * 11 inch maps with your report. One map should be show the location of your study area. The other map(s) should show your project results. Each of the maps will be graded on required map elements, and also for aesthetics.

WEEKLY SCHEDULE

Week 1
GIS fundamentals

What does a GIS do?
>GIS applications
>Brief GIS history
>GIS theme overlay
>Why GIS and natural resources?

GIS application Examples

LAB 1:   Basic GIS operations with ArcGIS
                Calculating stream lengths and watershed areas

Week 2

Data structures
        Typical database structures
                Raster v. vector structures

        Other spatial database structures
        The need for multiple structures

Map scale and resolution
A close look at a USGS Quadrangle map
Map accuracy standards

Data sources
        Free/Low Cost
                USGS- Nationwide
                OGDC- Statewide
        Commercial Venders
                EOSAT- National/International
                ESRI- National/International

Cartographic principles
        What is a map?
        Typical elements
        Communication strategies

LAB 2:   Cartographic operations with ArcMap
                Creating maps of watershed analysis results

Week 3

Inputting data into GIS databases
        Global Positioning Systems (GPS)
                Principles and practice
        Digital Total Stations
        Laser Range Finders
        Image Acquisition and Processing
        Digitizing
        Scanning

Selecting landscape features in a GIS database
Clip and erase processes

LAB 3:   Working with attribute data and clipping spatial data
               Determining land use and ownership patters associated with streams

Week 4

Examples of past final projects

Acquiring, creating, and editing GIS databases
          Examining spatial database errors

Buffering landscape features
               Various buffering techniques

LAB 4:   ArcGIS proximity operations
               Buffering streams based on land use
               Analyzing nesting locations and geology within stream buffers

Week 5

Guest speaker (Mon.): John Sharrard (ESRI)

Combining (dissolving) and splitting landscape features
Merging GIS databases

Overlay processes
          Union, intersect, identity
          Basic GIS overlay operations

LAB 5:   Overlay and proximity operations
               Using an orthophoto to update a forest inventory
               Calculating timber volumes

Week 6

Projections
          Presenting an elliptical globe on a flat plane
          Projections
          Coordinates
          Datums
          Spheroids
          Geoids

          Recognizing the need for a common projection in Oregon
          Projection Examples

LAB 6:   Using ArcGIS projection tools
               Converting data to Oregon's recommended Lambert projection
               Determining stand size, stand types, road length, and stream length

MIDTERM EXAM (during Wednesday lecture period)

Week 7

Guest Speaker: Matt Gregory (OSU)

Joining and linking spatial and non-spatial databases
Raster GIS database analysis
Types of raster databases
       Digital Elevation Models (DEMs)
       Orthophotoquads (DOQs)
       Digital Raster Graphs (DRGs)
       Satellite Imagery and digital camera applications
       What ArcGIS can accommodate and how

Integrating imagery with GIS tools
       The need for imagery in GIS applications

Interaction of raster and vector databases

LAB 7:   The geodatabase
           Database modeling with the Spatial Analyst extension
           Calculating elevation and slope values for forested roads, streams, and stands

Week 8

Guest Speaker (Wed.): Jim Strittholt (Conservation Biology Institute)

Updating GIS databases

Synthesis of techniques applied to advanced GIS topics

LAB 8:   Raster data applications
           Viewshed analysis
           Watershed delineation

Week 9

Guest Speaker (Wed.): Kevin Loso (City of Corvallis)

Contemporary Issues in GIS
       Trends in technology
       Institutional challenges and opportunities
       Certification and licensing

Concluding session
       What does the future hold for GIS tools and applications?

Preparing yourself for a career involving Geographic Information Science
Career Opportunities
Career Considerations

Lab exam (During your lab time)

Week 10

Guest Speaker (Mon.): Quantum Spatial

Alternatives to ArcGIS

Final review

Final
Noon, Wed., March 18. Learning Innovation Center 210.