INTERDISCIPLINARY 607 – CE/CRP/GEOG/GEOL/GS 607
Fundamentals of Geographic Information Systems
Autumn Quarter 2006

Course Description: Basic principles of geographic and land information systems and their use in spatial analysis and information management.

Course Coordinator: Mei-Po Kwan, Professor, Geography (Room 1154, Derby Hall, 292-9465, kwan.8@osu.edu).

Objectives of the Course: The course is designed to give students an understanding of geographic information systems, their capabilities, uses, and limitations. Relevant applications for each discipline area are demonstrated in the computer laboratory portion.

Textbook: M.N. DeMers, 2005. *Fundamentals of Geographic Information Systems*, 3rd edition, John Wiley & Sons, Inc.

Class website: http://carmen.osu.edu

Call #	*Department*	*Day*	*Time*	*Location*	*Instructor*
05047-1	Civil Engineering	Tue	9:30-11:18 A.M.	HI 322	Merry
04945-6	City & Reg Planning	Thu	5:30-8:18 P.M.	KN 430	Gordon
09952-2	Geography	Mon	10:30-12:18 P.M.	DB 140	Kwan
09953-8	Geography	Wed	10:30-12:18 P.M.	DB 140	Kwan
09958-5	Geodetic Science	Tue	9:30-11:18 A.M.	HI 322	Merry
10689-4	Geological Sciences	Tue	5:30-8:18 P.M.	ML 356	Pride
10690-1	Geological Sciences	Wed	5:30-8:18 P.M.	ML 356	Pride

Lab Instructors	*Email*	*Office*
Steve Gordon (SG)	sgordon@osc.edu	KN 290 – 275 W Woodruff Ave
Mei-Po Kwan (MK)	kwan.8@osu.edu	DB 1054 – 154 N Oval Mall
Carolyn Merry (CM)	merry.1@osu.edu	HI 470 – 2070 Neil Ave
Doug Pride (DP)	pride.1@osu.edu	ML 275 – 125 S Oval Mall

Lecture Format:
The course will be team-taught, with three lectures per week in a large auditorium from 12:30-1:18 MWF. This is a complex syllabus; there may be changes or corrections announced in class.

Date	*Lecturer*	*Topic*	*Chapter Readings*
Wed, Sept 20	Kwan	Introduction	1
Fri, Sept 22	Gordon	Introduction to spatial data	2
Mon, Sep 25	Ahlqvist	Maps and map analysis	3
Wed, Sep 27	Ahlqvist	Maps and map analysis	
Fri, Sep 29	Munroe	Vector GIS	4: 95-106; 5: 129-130
Mon, Oct 2	Munroe	Vector GIS	
Wed, Oct 4	Merry	Raster GIS	4: 85-95; 5: 130-133; 10: 246-250
Fri, Oct 6	Merry	Raster GIS	
Mon, Oct 9	Xiao	Spatial databases	4: 72-85
Wed, Oct 11	Xiao	Spatial databases	
Fri, Oct 13	Merry	Data in GIS: remote sensing	5: 133-138
Mon, Oct 16	Liu	Data in GIS: acquisition	5: 113-129, 139-143
Wed, Oct 18	Liu	Data in GIS: editing, data quality	6
Fri, Oct 20	Xiao	Data in GIS: storage	6
Mon, Oct 23	Gordon	GIS capabilities	7
Wed, Oct 25	Gordon	GIS capabilities	8
Fri, Oct 27	Ahlqvist	GIS visualization	14; 17: 422-424
Mon, Oct 30	Gordon	GIS implementation	15
Wed, Nov 1	Gordon	GIS implementation	
Fri, Nov 3	Merry	GIS applications in civil engineering	
Mon, Nov 6	Gordon	GIS applications in city and regional planning	
Wed, Nov 8	Murray	GIS applications in geography	
Fri, Nov 10		Holiday	
Mon, Nov 13	Pride	GIS applications in geology	
Wed, Nov 15	Pride	GIS applications in geology	
Fri, Nov 17	Kwan	GIS applications in geography	
Mon, Nov 20	Crecelius	GIS applications in natural resources	
Wed, Nov 22	Davis	GIS activities in Ohio	
Fri, Nov 24	-	Thanksgiving Break	
Mon, Nov 27	Elhami	GIS applications in real estate	
Wed, Nov 29	Merry	The future of GIS; Ethics in GIS	
Fri, Dec 1	Kwan	Review & wrap-up	
Tue, Dec 5		Final Exam – 11:30-1:18 P.M.	

Course Syllabus

1. Introduction (MK)
    a. Basic concepts
    b. What is a GIS?
    c. Users of GIS
    d. History of GIS
    e. Recent developments

2. Introduction to spatial data (SG)
    a. Spatial elements – points, lines, areas and surfaces
    b. Spatial measurement levels
    c. Spatial location and reference
    d. Spatial relationships
    e. GIS data models
    f. Attribute data

3. Maps and map analysis (OA)
    a. Map elements and their properties
    b. Real and virtual maps
    c. Map projections, distortions and transformations
    d. Map referencing – direct, relative
    e. Mapping principles applied to digital maps and spatial analysis
    f. Coordinate systems

4. Vector GIS (DM)
    a. Vector data and its characteristics
    b. Advantages and limitations of vector mapping systems
    c. Topology
    d. Vector GIS capabilities
    e. TIN model
    f. Network model
    g. Connectivity

5. Raster GIS (CM)
    a. Raster data and its characteristics
    b. Advantages and disadvantages of raster mapping systems
    c. Raster functions – raster data overlay, buffers
    d. Grid model; DTM
    e. Accuracy
    f. Quadtree model

6. Spatial databases (NX)
    a. Basic file structures
    b. Data structures – relational, hierarchical, network
    c. Integration of spatial, attribute and topological data
    d. Object-oriented databases

7. Data in a GIS – acquisition (DL)
    a. Digitizing
    b. Scanning
    c. Surveying
    d. GPS data
    e. Photogrammetry
    f. Metadata

8. Data in a GIS – editing, data quality (DL)
    a. Accuracy vs. precision
    b. Measurement of logical consistency
    c. Completeness; lineage; timeliness; attribute data accuracy
    d. Accessibility needs
    e. Available tools
    f. Sources of error

9. Data in a GIS – storage (NX)
    a. Geometry
    b. Attributes
    c. Distributed
    d. SQL
    e. Database design
    f. User interfaces

10. Data in a GIS – remote sensing (CM)
    a. Electromagnetic spectrum
    b. Images – aircraft and satellite
    c. Radiometric and geometric correction
    d. Supervised vs. unsupervised classification

11. GIS capabilities (SG)
    a. Spatial objects, measurements and models
    b. Application of measures
    c. Proximity and contiguity analysis
    d. Map data retrieval and search; map overlay; classification and reclassification
    e. Neighborhood functions
    f. Cartographic algebra
    g. Logic & geometric operations
    h. Network representation
    i. Hydrologic modeling

12. GIS implementation (SG)
    a. Requirement analysis and system design
    b. Time and cost analysis for data, hardware and software
    c. Cost/benefit analysis of GIS
    d. Organization issues
    e. Choosing hardware and software

f. Operation and maintenance

13. GIS visualization (OA)
    a. Data to display
    b. Cartographic considerations
    c. Map symbols
    d. Potentials and limitations

14. GIS applications (CM, SG, DP, MK, AM)
    a. Geography/human resources
    b. Geology
    c. Transportation/engineering
    d. Environment/natural resources

15. Ethics in GIS (CM)

16. The future of GIS (CM)
    a. Technological developments
    b. New applications
    c. Data access
    d. Research and development

Weekly Lab & Quiz Schedule:

Week of:	*Lab*	*Lab Due:*
September 25	Pass out & work on Lab 1	Lab 1 due: 9, 10, 11, 12 October
October 4	Continue work on Lab 1 – Quiz 1	
October 11	Pass out Lab 2	Lab 2 due: 23, 24, 25, 26 October
October 18	Continue work on Lab 2 – Quiz 2	
October 25	Pass out Lab 3	Lab 3 due: 6, 7, 8, 9 November
November 1	Continue work on Lab 3 – Quiz 3	
November 8	Pass out Lab 4	Lab 4 due: 20, 21, 22, 23 November
November 15	Continue work on Lab 4 – Quiz 4	
November 22	Pass out Lab 5	Lab 5 due: 4, 5, 6, 7 December
November 29	Continue work on Lab 5 – Quiz 5	

Grading will be based on five lab exercises, five quizzes, and a final exam. The exercises will count for 60% of the grade, the quizzes 15%, and the final exam is 25% of the grade.

Computer laboratories:

Each department that sponsors the interdisciplinary course is responsible for developing, delivering, monitoring and grading an appropriate set of laboratory exercises. All participating departments will include an agreed upon common minimum set of exercises for each lab. Each department may also assign its own weight to the lab assignments. Lab assignments will include the following:

Lab 1. *Introduction to ArcGIS, Geodata, and Map Projections.* Using ArcGIS, students will become familiar with the ESRI ArcGIS software, explore different types of geodata available, learn basic database operations, and learn about the different types of map projections. Specific objectives include learning how to use ArcGIS; the types of geodata in a GIS environment – vector, raster and images; how to display data in ArcGIS; types of map projections; and how to generate a meaningful map. (2 weeks)

Lab 2. *Vector Data Operations.* Using ArcGIS, students will become familiar with vector data operations. Specific objectives are to perform visual interpretations of vector data, learn vector buffer operations, and learn basic vector operations using the ArcGIS GeoProcessing wizard. (2 weeks)

Lab 3. *Raster Data Operations.* Using ArcGIS, students will become familiar with raster data and learn simple data manipulations in a raster system. Specific objectives are to understand and learn general aspects and display of raster data (grid dataset), map algebra/data reclassification, and raster buffer operations. (2 weeks)

Lab 4. *Data Relations.* The purpose of this lab is to become familiar with data relationships in a GIS. Specific objectives are to understand the relationships in datasets and attribute/spatial relations, and to learn the difference between a join and relate operation. (2 weeks)

Lab 5. *Applications of GIS – Final Project.* Students will perform a spatial analysis exercise, given only the criteria to use for reaching a conclusion. Objectives are to explore a data set and the geographic distribution of the variables and to arrive at several conclusions. Other objectives include learning to design and perform the necessary data analysis in a vector-based or raster-based GIS. Data export utilities to other applications, such as Microsoft Access or Excel, will be learned for developing a more complete statistical analysis of spatial data. (2 weeks)