INTERDISCIPLINARY 607 – CE/CRP/GEOG/GS 607
Fundamentals of Geographic Information Systems
Autumn Quarter 2008

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 1054, 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: P.A. Longley, M.F. Goodchild, D.J. Maguire, and D.W. Rhind (editors), 2005. *Geographic Information Systems and Science.* 2nd edition, John Wiley & Sons, Inc.

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

Call #	*Department*	*Day*	*Time*	*Location*	*Instructor*
05436-1	Civil Engineering	Tue	9:30-11:18 A.M.	BO 416	Merry
05332-1	City & Reg Planning	Tue	5:30-8:18 P.M.	KN 430	Gordon
10615-8	Geography	Tue	10:30-12:18 P.M.	DB 140	Kwan
10616-3	Geography	Thu	10:30-12:18 P.M.	DB 140	Kwan
10516-5	Geodetic Science	Tue	9:30-11:18 A.M.	BO 416	Merry

Instructors	*Email*	*Office*	*Office Hours*
Ola Ahlqvist (OA)	ahlqvist.1@osu.edu	DB 1049B	M: 1-3pm
Steve Gordon (SG)	sgordon@osc.edu	KN 290	T: 10am-12noon
Mei-Po Kwan (MK)	kwan.8@osu.edu	DB 1054	By Appointment
Desheng Liu (DL)	liu.738@osu.edu	DB 1189	M W: 4-5pm
Carolyn Merry (CM)	merry.1@osu.edu	HI 470	M W: 10.30-11.30am
Darla Munroe (DM)	munroe.9@osu.edu	DB 1123	T R: 1-3pm
Doug Pride (DP)	pride.1@osu.edu	ML 317	By Appointment
Ningchuan Xiao (NX)	xiao.37@osu.edu	DB 1132	M W: 3-4pm

Building Directory:

DB is	Derby Hall:	154 N Oval Mall
HI is	Hitchcock Hall:	2070 Neil Avenue
KN is	Knowlton Hall:	275 W Woodruff Ave
ML is	Mendenhall Laboratory:	125 S Oval Mall

Lecture Format:
The course will be team-taught, with three lectures per week in a large auditorium (Dreese Lab 113) 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 24	Kwan	Introduction	Ch 1
Fri, Sept 26	Gordon	Introduction to spatial data	Ch 3, 63-74; 85-90
Mon, Sep 29	Ahlqvist	Maps and map analysis	Ch 3: 76-81, Ch5
Wed, Oct 1	Ahlqvist	Maps and map analysis	Ch 12
Fri, Oct 3	Merry	Raster GIS	Ch 3: 63-83; Ch 6: 136-137
Mon, Oct 6	Merry	Raster GIS	Ch 3: 63-83; Ch 6: 136-137
Wed, Oct 8	Munroe	Vector GIS	Ch 3 64-72; 75-82
Fri, Oct 10	Munroe	Vector GIS	Ch 9
Mon, Oct 13	Merry	Data in GIS: remote sensing	Ch 9: 199-216; Ch 20: 459-464
Wed, Oct 15	Xiao	Spatial databases	Ch 10: 218-228
Fri, Oct 17	Xiao	Spatial databases	Ch 10: 218-228
Mon, Oct 20	Liu	Data in GIS: acquisition	Ch 9
Wed, Oct 22	Liu	Data in GIS: editing, data quality	Ch 6: 136-149
Fri, Oct 24	Gordon	GIS capabilities	Ch 14, 15
Mon, Oct 27	Gordon	GIS capabilities	Ch 14, 15
Wed, Oct 29	Ahlqvist	GIS visualization	Ch 13, Ch 11
Fri, Oct 31	Xiao	Data in GIS: storage	Ch 10: 229-234
Mon, Nov 3	Gordon	GIS implementation	Ch 17
Wed, Nov 5	Gordon	GIS implementation	Ch 17
Fri, Nov 7	Gordon	GIS applications in city and regional planning	42-46; 55-60; 350-358
Mon, Nov 10	Kwan	GIS applications in geography	
Wed, Nov 12	Merry	GIS applications in civil engineering	
Fri, Nov 14	Crecelius	GIS applications in natural resources	
Mon, Nov 17		Holiday	
Wed, Nov 19	Pride	GIS applications in geology	Ch 2: 35 – 60
Fri, Nov 21	Pride	GIS applications in geology	Ch 2: 35 – 60
Mon, Nov 24	Elhami	GIS applications in real estate	
Wed, Nov 26	Davis	GIS activities in Ohio	
Fri, Nov 28	-	Thanksgiving Break	
Mon, Dec 1	Merry	Ethics in GIS	Ch 21: 471-486
Wed, Dec 3	Merry	The future of GIS	Ch 21: 471-486
Fri, Dec 5	Kwan	Review & wrap-up	
Mon, Dec 8		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 & Online Quiz Schedule:

Week of:	*Labs and Quizzes*	*Due dates:*
September 29	Pass out & work on Lab 1	Lab 1 due: October 14, 16
October 6	Continue work on Lab 1 – Quiz 1	
October 13	Pass out Lab 2	Lab 2 due: October 28, 30
October 20	Continue work on Lab 2 – Quiz 2	
October 27	Pass out Lab 3	Lab 3 due: November 4, 6
November 3	Continue work on Lab 3 – Quiz 3	
November 10	Pass out Lab 4, 5	Lab 4 due: November 25, 27
November 17	Continue work on Lab 4, 5– Quiz 4	Lab 5 due: December 5
December 1	Continue work on Lab 5 – Quiz 5	

Grading will be based on five lab exercises, five online quizzes, in-class pop-up quizzes, and a final exam. The exercises will count for 60% of the grade, the online quizzes 10%, in-class pop-up quizzes 5%, 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)