Fall 2016
Online

GEOS 5043

Geospatial Technologies Mathematical Toolkit

Instructor: Jackson Cothren
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Phone: 479-575-5421
Office: JBHT304
Office Hours: MW 8-10am

Teaching Assistant: TBD

Overview

Basic mathematical tools applied in geospatial technology, including trigonometry in mapping, linear algebra in remote sensing, optimization in spatial decision support, and graph theory in routing. Course develops the framework for spatial data analysis and decision support. Students may receive credit for the course through testing

Goals

The objective of this course is to develop a fundamental understanding of mathematical tools as specifically applied to a range of spatial methods and technology.

- Fundamental 2D computational geometry applied description of GIS entities and their interactions.
- Projection of raster and vector spatial data using affine and other transformations
- Methods for analyzing and traversing graphs, reflecting movement through a geospatial network
- Matrix operations necessary to calculate accuracy of remotely sensed data and map derivatives
- Propositional Logic in GIS and spatial reasoning
- Link geospatial mathematical tools to a graduate research application

Requirements and Evaluation

Evaluations will be based on the following:

1. Weekly graded work due Friday each week (25%)
2. Two mid-course exams (15% each)
3. Final project and research paper (25%)
4. Final exam (20%)

Datasets and digital materials used in weekly graded work and/or exams will be available through Blackboard.

Materials

- Introduction to Mathematical Techniques used in GIS, Peter Dale, 2014.
- Surveying Theory and Practice
- Various online material

Milestones

Week 4
First mid-term exam

Week 10
Final Project Proposal Due

Week 9
Second Mid-term exam

Week 15
Final Project and Research Paper Due

Week 16
Final Exam

Week	Date	Topic	Readings	Assignment
1		The Math behind GIS: Overview and Motivation		
2		Propositional Logic in Spatial Reasoning		
3		Predicate Logic in Spatial Relationships		
4		Logical Inference applied to Spatial Decision Support Systems		
5		Set Logic for Geometric Structures		
6		Relations and Functions: Coordinate Geometry		
7		Cartesian, Polar and Spherical Coordinate Systems and Transformations I		
8		Cartesian, Polar and Spherical Coordinate Systems and Transformations II		
9		Cartesian, Polar and Spherical Coordinate Systems and Transformations III		
10		Algebraic Structures for Map Overlay and Analysis		
11		Topologies of Spatial Relationships		
12		Ordered Sets in Spatial Analysis		
13		Basic Graph Theory applied to spatial networks I		

Week	Date	Topic	Readings	Assignment
14		Basic Graph Theory applied to spatial networks II		
15		Spatial Modeling I		
16		Spatial Modeling II		

EMERGENCY PROCEDURES

Many types of emergencies can occur on campus; instructions for specific emergencies such as severe weather, active shooter, or fire can be found at **emergency.uark.edu**.

Severe Weather (Tornado Warning):

- Follow the directions of the instructor or emergency personnel.
- Seek shelter in the basement or interior room or hallway on the lowest floor, putting as many walls as possible between you and the outside.
- If you are in a multi-story building, and you cannot get to the lowest floor, pick a hallway in the center of the building.
- Stay in the center of the room, away from exterior walls, windows, and doors.

Violence / Active Shooter (CADD):

- **CALL** 9-1-1
- **AVOID** If possible, self-evacuate to a safe area outside the building. Follow directions of police officers.
- **DENY** Barricade the door with desk, chairs, bookcases or any items. Move to a place inside the room where you are not visible. Turn off the lights and remain quiet. Remain there until told by police its safe.
- **DEFEND** Use chairs, desks, cell phones or whatever is immediately available to distract and/or defend yourself and others from attack.

GEOS 5073 Geospatial Technologies Computational Toolkit

Fall 2016 Syllabus

Instructor: Xuan Shi, Ph.D.

Dept. of Geosciences | Office: 424 JBHT | Email: xuanshi@uark.edu | Phone: 479-575-7906 | *Office Hours:* Wednesday 2-5pm

Time	Topic	Homework assignment
Week 01 [08/25-08/29]	Overview of class	Checking data and software requirements
Week 02 [09/01-09/05]	Getting started with Python programming environment	
Week 03 [09/08-09/12]	Variables, data types, operators, statements or expressions	
Week 04 [09/15-09/19]	Control flows and error handling	Homework 1
Week 05 [09/22-09/26]	Functions, objects and classes in OOP and OOD	Homework 2
Week 06 [09/29-10/03]	Fundamental and useful Python functions	Homework 3
Week 07 [10/06-10/10]	Geo-processing by Python for ArcGIS	Homework 4
Week 08 [10/13-10/17]	Mid-term exam	
Week 09 [10/20-10/24]	Features and attribute handling	Homework 5
Week 10 [10/27-10/31]	Geometry and spatial operations	Homework 6
Week 11 [11/03-11/07]	Raster data and spatial modeling (Quiz 1)	Homework 7
Week 12 [11/10-11/14]	Working with maps	Homework 8
Week 13 [11/17-11/21]	Advanced spatial analysis	Homework 9
Week 14 [11/24-11/28]	Thanksgiving break	
Week 15 [12/01-12/05]	Creating custom tools (Quiz 2)	Homework 10
Week 16 [12/08-12/12]	Final project development and delivery	
Week 17 [12/16-12/19]	Final research paper due	

Objectives: This course introduces fundamentals of developing geospatial computing toolkit through Python and offers hands-on tutorials on geospatial data processing and application development within ArcGIS. Topics include Python fundamentals with major useful functions, general routines and application development in ArcGIS. After completing the course, students will have the capability to develop geospatial computing modules and toolkit.

Readings and references:

1. Python Scripting for ArcGIS (**Author**: Paul A. Zandbergen | **Publisher**: ESRI Press **| ISBN**: 1589482824)
2. The Python Tutorial, available from the Python website.
3. *Think Python*, 2nd edition. Freely available online in HTML and PDF.

Class & Lab: a) The lecture in each week covers a specific topic towards building the capability of developing geospatial computing modules and toolkits. b) A total of 10 assignments (40 points each; 400 points total) should be submitted within one week. Assignments can be submitted after the deadline given, but will be marked down 20% each weekday they are late. c) Two quizzes (100 points total) will be given during the second half of the semester.

Exams: Midterm exam will be given in the week of October 13-17, 2014. The exam (300 points) focuses on both the concepts discussed in the class and the programming skills.

Final Project and Research Paper:

The final project and paper will be proposed and designed to exemplify students' capability to develop geospatial computing modules and toolkits by utilizing the technologies developed in this semester to accomplish a series of tasks identified by the students. Ideally these will link geospatial computational tools to a graduate research application of interest.

Grades:		**Scale:**	
Assignments	400	A	90-100%
Midterm exam	300	B	80-89%
Final project and research paper	200	C	70-79%
Quizzes	100	D	60-69%
	1,000 points	F	0-59%

Notes: *1) During normal class week,* if the student uses the lab in JBHT, please take good care of the rooms and equipment and follow the lab policies;
2) Changes to the syllabus may occur during the semester, in case students have any specific requirement.

Integrity: "As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail."

"Each University of Arkansas student is required to be familiar with and abide by the University's 'Academic Integrity Policy' which may be found at http://provost.uark.edu/. Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor."

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EMERGENCY PROCEDURES

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- Stay in the center of the room, away from exterior walls, windows, and doors

Violence / Active Shooter (CADD):

- **C**ALL- 9-1-1
- **A**VOID- If possible, self-evacuate to a safe area outside the building. Follow directions of police officers.
- **D**ENY- Barricade the door with desk, chairs, bookcases or any items. Move to a place inside the room where you are not visible. Turn off the lights and remain quiet. Remain there until told by police it's safe.
- **D**EFEND- Use chairs, desks, cell phones or whatever is immediately available to distract and/or defend yourself and others from attack.

GEOS 5083

Geospatial Technologies Statistical Toolkit

Fall 2016
Tuesday/Thursday 3:30 – 4:50pm. JBHT 231

Instructor: Jackson Cothren
E-Mail: jcothren@cast.uark.edu
Phone: 479-575-5421
Office: JBHT304
Office Hours: MW 8-10am

Teaching Assistant: TBD
Email:
Office: JBHT 304 Hours: MW 12.30 – 2.30pm

Overview

Basic statistical tools for geospatial technologies. Exploratory data and spatial data analysis, probability distributions and application, single and multivariate analysis and hypothesis testing, and spatial smoothing and interpolation. Emphasis will be on problem solving in geospatial settings using the R statistical language. Students may receive credit for the course through testing.

Objectives

The objective of this course is to develop a fundamental understanding of statistical tools as specifically applied to a range of spatial methods and technology. Detailed objectives for each week are listed in the course schedule. Students will learn how to use the open-source R statistical computing language to graphically explore a dataset, compute summary statistics, explore the nature of discrete and continuous distributions, and create a model to perform analysis of variance and regression with one or more dependent continuous or categorical variables. As a graduate class, a final objective is to link geospatial statistical tools to a graduate student research application of interest.

Requirements and Evaluation

Evaluations will be based on the following:

1. Weekly graded work due Friday each week (25%)
2. Two mid-course exams (15% each)
3. Final project and research paper (25%)
4. Final exam (20%)

Datasets and digital materials used in weekly graded work and/or exams will be available through Blackboard.

Materials

- Rogerson's Statistical Methods for Geography 3rd Edition (2010)
- Various online material
- R on-line documentation including http://www.r-tutor.com/r-introduction and http://www.statmethods.net/

Milestones

Week 4
First mid-term exam

Week 10
Final Project Proposal Due

Week 10
Second Mid-term exam

Week 15
Final Project and Research Paper Due

Week 16
Final Exam

Week	Topic and Objectives	Readings
1	**Statistics and Geospatial Data** By the end of this week students will… • be able to articulate what kind of problems geospatial technologists' encounter that require and understanding of statistics • know what software is available for statistical computations • be familiar with R as a statistical or data mining "calculator" in the geospatial context • understand different types of data and how to simply describe them	Rogerson, Chapter 1 Quick-R: • http://www.statmethods.net/index.html • http://www.statmethods.net/interface/index.html • http://www.statmethods.net/interface/help.html • http://www.statmethods.net/interface/workspace.html • http://www.statmethods.net/interface/io.htm
2	**Descriptive Statistics I** At the end of this module week, students will… • be able to explain how and why data are categorized as nominal, ordinal, interval and ratio • be able to explain a variety of techniques to visualize and describe data including several forms on central tendency, spread, and distribution • know how to import a variety of data types into R and organize them in to useful data objects	Rogerson, Chapter 2
3	**Descriptive Statistics II** At the end of this module week, students will… • know how to use R visualize numerical and categorical data • use R to compute descriptive statistics for spatial data • use R to compute descriptive statistics for angular data	Rogerson, Chapter 2
4	**Discrete Probability Distributions I** By the end of this module students should be able to… • explain what a discrete probability distribution is and how it is related to a histogram • describe the characteristics of a discrete probability distribution name and describe 4 discrete probability distributions (binomial, Poisson, geometric, hypergeometric)	Rogerson, Chapter 3
5	**Discrete Probability Distributions II** By the end of this module (week 4) students should be able to… • read model a problem using one of the four discrete probability distributions • calculate probabilities of events using each of four models using a calculator (for small problems) and using R (for larger, and most, problems)	Rogerson, Chapter 3
6	**Continuous Probability Distributions I** By the end of this module students should be able to… • explain what a continuous probability distribution is and how it is related to a histogram • describe the characteristics of a continuous probability distribution • name and describe 3 continuous probability distributions (normal, exponential, Poisson)	Rogerson, Chapter 4

Week	Topic and Objectives	Readings
7	**Continuous Probability Distributions II** By the end of this module students should be able to… • read model a problem using one of the three continuous probability distributions • calculate probabilities of events using each of the three models using a calculator (for small problems) and using R (for larger, and most, problems)	Rogerson, Chapter 4
8	**Inferential Statistics: Confidence Intervals, Hypothesis Testing, and Sampling I** By the end of this module students should be able to… • explain the reasoning behind and the limitations of, inferential statistics • use R to construct confidence intervals around means and proportions • use R to test hypotheses about means and proportions	Rogerson, Chapter 5
9	**Inferential Statistics: Confidence Intervals, Hypothesis Testing, and Sampling II** By the end of this module students should be able to… • understand and explain the effects of spatial dependence on statistical tests • test hypotheses about spatial centrality and spatial variability	Rogerson, Chapter 5
10	**Second Mid-term and Review of Weeks 1-9**	
11	**Analysis of Variance** By the end of this module students should be able to… • explain how to compare means of three or more samples and determine the likelihood of them being drawn from the same population By the end of this module students should be able to… • use R to compare three or more sample means from a variety of datasets	Rogerson, Chapter 6
13	**Correlation** By the end of this module students should be able to… • explain the nature of the relationship between two variables • explain the effects of sample size on tests of significance • use R to analyze the relationship between two variables and test for significance • apply tests of correlation when assumptions are not reasonable	Rogerson, Chapter 7
14	**Introduction to Regression I** By the end of this module students should be able to… • model one variable as a function of another • fit a straight line through a set of points plotted in two dimensions • explain the relationship of regression to analysis of variance •	Rogerson, Chapter 8
14	**Introduction to Regression II** By the end of this module students should be able to…	Rogerson, Chapter 8

Week	Topic and Objectives	Readings
	• state the assumptions on which linear regression depends • test the significance of the regression slope • use R to compute and analyze the first five objectives	
15	**More on Regression III** By the end of this module students should be able to… • model one variable as a function two or more other variables • interpret multiple regression coefficients • choose explanatory variables from a set of observations • regress with categorical dependent variables • explain the consequences of poor satisfied assumptions	Rogerson, Chapter 9
16	**Review of Weeks 11-15 and Final Exam**	

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Unit	Wk	Date Week of..	Topic	Readings and Videos	Deliverables
1	1	Aug 24	How to use the lab, personal accounts, and computer drives. An intro to geospatial technology, geospatial data, geospatial jobs, and Google Earth	Chapter 1: It's a Geospatial World Out There Lecture Videos	• Ch 1 Quiz • Conceptual Exercises (CEs) • Ch 1 Lab • Esri Learning ArcGIS Desktop (LAD) 1
	2	Aug 31	Locations in a digital world, position measurements, datums, coordinate systems, GCS, map projections, UTM, and SPCS **LABOR DAY – Sept 7**	Chapter 2: Where in the Geospatial World are You? Lecture Videos	• Ch 2 Quiz • Ch 2 CEs • Ch 2 Lab • Esri LAD 2 • Esri LAD 3
	3	Sep 7	Reprojecting, georeferencing, control points, and transformations	Chapter 3: Getting Your Data to Match the Map Lecture Videos	• Ch 3 Quiz • Ch 3 CEs • Esri LAD 4 • Esri LAD 5
2	4	Sep 14	Geographic Information Systems, modeling the real world, vector data and raster data, attribute data, joining tables, metadata, Esri, and ArcGIS	Chapter 5: Working with Digital Spatial Data and GIS Lecture Videos	• Ch 5 Quiz • Ch 5 CEs • Groundwater Lab • Esri LAD 6
	5	Sep 21	Database query and selection, buffers, overlay operations, geoprocessing concepts, and modeling with GIS	Chapter 6: Using GIS for Spatial Analysis Lecture Videos	• Ch 6 Quiz • Ch 6 CEs • Ch 6 Lab • Esri LAD 7 • Esri LAD 8
Exam 1		Sep 27 – Oct 4	**Exam 1 Covers Units 1-2**		Oct 4 - Last Chance to Turn-in Late Work from Units 1-2

3	**6**	Sep 28	Where aerial photography came from, color infrared photos, orthophotos, oblique photos, visual image interpretation, and photogrammetric measurements	Chapter 9: Remotely Sensed Images from Above Lecture Videos	• Ch 9 Quiz • Ch 9 CEs • Ch 9 Lab
	7	Oct 5	Electromagnetic energy, the remote sensing process, spectral reflectance, NDVI, digital imagery, and color composites	Chapter 10: How Remote Sensing Works Lecture Videos	• Ch 10 Quiz • Ch 10 CEs • Ch 10 Lab
	8	Oct 12	Satellite remote sensing, satellite orbits, sensor resolutions, the Landsat program, and high-resolution satellite sensors	Chapter 11: Images from Space Lecture Videos	• Ch 11 Quiz • Ch 11 CEs • Ch 11 Lab
4	**9**	Oct 19	Scale, map elements, map layouts, type, thematic maps, data classification methods, color choices, and digital map distribution formats **Fall Break Oct 19-20**	Chapter 7: Using GIS to Make a Map Lecture Videos	• Ch 7 Qui • Ch 7 CEs • Ch 7 Lab
	10	Oct 26	Vehicle navigation systems, road maps in a digital world, creating a street network, geocoding, shortest paths, and street networks online	Chapter 8: Getting there Quicker with Geospatial Technology Lecture Videos	• Ch 8 Quiz • Ch 8 CEs • Esri Geocoding Module • TLC Modules
	11	Nov 2	GPS origins, position measurement, errors, accuracy, GNSS around the world, applications, and geocaching	Chapter 4: Finding Your Location with the Global Positioning System Lecture Videos	• Ch 4 Quiz • Ch 4 CEs • GNSS Exercise • GPS Lab
Exam 2		Nov 8 - 15	**EXAM WEEK** **Exam 2 Covers Units 3-4**		Nov 15 - Last Chance to Turn-in Late Work from Units 3-4

5	**12**	Nov 9	Digital topographic maps, contours, digital terrain modeling, digital elevation models, NED, SRTM, LiDAR, and 3D views of landscapes and terrain	Chapter 13: Digital Landscaping Lecture Videos	• Ch 13 Quiz • Ch 13 CEs
	13	Nov 16	3D Geovisualization, 3D modeling and design, prism maps, Google SketchUp, Google Earth in 3D	Chapter 14: See the World in 3D Lecture Videos	• Ch 14 Quiz • Ch 14 CEs • Ch 14 Lab
6	**14**	Nov 23	Land information and parcels **THANKSGIVING BREAK – Nov 26-27**	Readings (TBD) Lecture Videos	• Chapters 4, 5 and 6 of MPLS handbook • Quiz • Parcel Lab
	15	Nov 30	New frontiers in Geospatial technology, geospatial tech in K-12, college and university programs, how to easily get data, a geospatial world online, and other developments	Chapter 15: What's Next for Geospatial Technology? Lecture Videos	• Ch 15 Quiz • Ch 15 CEs
	16	Dec 7	What they know about you: Census data, demographic data and related spatial datasets **DEAD DAY – Dec 11**	Other Readings (TBD) Lecture Videos	• Esri Business and Community Analyst Lab • GeoTech Exercise
Exam 3		*Dec 4 – 10*	**Exam 3 Covers Units 5-6** **(note change in exam schedule due to partial week and Dead Day)**		Dec 10 - Last Chance to Turn-in Late Work or Extra Credit
Final Exam			**Final Exam Date/Time TBD During Exam Period**		

GEOS 5553: Introduction to Geospatial Analysis using ArcGIS
Fall 2015

General Information

Instructor

Fred Limp
JBHT 425
(479) 575-7909
fred@cast.uark.edu

Teaching Assistant
TBD

Classroom

Class is completely "online" but, if they choose to do so, students may utilize the computer lab in JBHT231 (access to building and room via UA Student ID)

Textbooks

Gorr, Wilpen L. and Kristen S. Kurland 2013 *GIS Tutorial 1 for ArcGIS 10.1: Basic workbook.* ESRI Press. Redlands CA. ISBN-13: 978-1589483354 (Gorr in syllabus)

Allen, David 2013 *GIS Tutorial 2 for ArcGIS 10.1 spatial analysis workbook.* ESRI Press. Redlands CA. ISBN 978-1589483375

Readings

ArcGIS Online materials and help files
ESRI online training modules (access codes will be provided)

Schedule

Lab Support Hours (JBHT 231)	*TBD*	
Office Hours (Instructor)	*TBDs*	*TBD*
Important Dates	*Unit 1 Exam*	*End of Week 3 – Due Sept 13 at midnight*
	Unit 2 Exam	*End of Week 5 - Due Oct 4 at midnight*
	First Paper	*Sept 20 at midnight*
	Unit 3 Exam	*End of Week 8 - Due Oct 25 at midnight*

	Unit 4 Exam	*End of Week 12 - Due Nov 15 at midnight*
	Unit 5 Exam	*End of Week 15 - Due Dec 10 at midnight*
	Final Paper	*Dec 10 at midnight*
	FINAL EXAM	*Proctored On Campus during Finals Week (Date/Time TBA)*

Course Summary and Objectives

This is the graduate version of GEOS 3553 and in addition to all the requirements of 3553 it includes the requirements of two specialized graduate papers. The objective of GEOS 5553 "Introduction to geospatial analysis using ArcGIS" is to develop spatial analytical skills through use of the widely available ArcGIS software. As part of this larger objective we will also cover ESRI "Best Practices" at a level that is preparatory for the ESRI Technical Certification of ArcGIS Desktop Associate 10.3. In accordance with this goal, key metrics of these objectives are the qualifications for the ArcGIS Desktop Associate Certification as outlined by ESRI on the official ArcGIS Technical Certification webpage and summarized below.

According to ESRI - a qualified candidate (for the ArcGIS Desktop Associate Certification) should:

1. demonstrate basic ArcGIS Awareness.
2. demonstrate Coordinate System (Spatial Reference) Awareness.
3. be able to manage data in ArcGIS for Desktop.
4. be able to analyze data in ArcGIS Desktop.
5. be able to edit data in ArcGIS Desktop.
6. be able to visualize data in ArcGIS Desktop.
7. understand and be able to accomplish geoprocessing in ArcGIS Desktop.
8. be able to share content from ArcGIS Desktop.

This course has as a requirement GEOS 3543 *Introduction to geographic information science*. Completion of that course or equivalent experience is an essential background to this class. The content of GEOS 3543 and GEOS 3553 alone is likely not adequate to fully prepare the student for the ESRI certification exam, but additional online training materials will be discussed in the class which, in conjunction with this class, should prepare the student. These additional materials are ESRI web-based classes that can be accessed by enrolled UA students. Access codes can be obtained from the class instructor during or after the class.

ESRI has published a new text "*ESRI ArcGIS Desktop Associate Certification Study Guide*." You would be well advised to study the book before the exam.

The course is designed to be part of a comprehensive curriculum that prepares the student for the **ASPRS Certified Mapping Scientist (GIS/LIS) Provisional Certification** exam. Details are on this page. Basically ASPRS allows an active student to complete the qualification exam and then begin professional practice. The course is

also designed to prepare students for meeting the requirements for the **Geographic Information Systems Professional (GISP) certification**. Details are here.

Students planning to pursue careers in the field are strongly urged to acquire both certifications. This course is also a key class in the UA's **Specialization in cartography/GIS/remote sensing.** In this program a student must complete three required courses – which includes this class as well as GEOS 3023 (Introduction to Cartography) and GEOS4413 (Principles of Remote Sensing) as well as an additional nine hours chosen from a range of 3000 and 4000 level classes. Details are here.

The class is also a required element in the University's new **Certificate in Geospatial Technologies.** This is a program recognized by the Arkansas Department of Higher Education and details can be found here. Courses for the Certificate and the Specialization closely overlap and a student can easily acquire both.

Students planning a career in the geospatial arena are STRONLY encouraged to acquire the ASPRS, GISP, UA Certifications and toe Geosciences Specialization.

A new approach

This class approaches education in a new way and is based on much new research in education strategies. Content that was previously delivered in a traditional lecture will be available in a series of (short) online videos. There will also be a wide range of other online content. As students develop questions they can be e-mailed (or tweeted) to the instructors. Students may complete the course work on their own computers, see below for specifications, or if they prefer, they may utilize the Geomatics training facilities in JB Hunt (Room 231). Attendance is not a requirement, but we will be available during designated lab support hours and by appointment. We presume that lab support time will be largely used by students to ask questions on any topic and to work on their lab exercises. The instructor and/or TA will be available to assist students and you are encouraged to work together. The quizzes and exams will also be online. Their details are below – you are not required to take these in the lab.

Inclement Weather, Religious Holiday and Emergency Policies

Since you are not required to attend class or exams, there is no need for any approved absences or any inclement weather questions. If your religious beliefs prevent you from performing any of the class activities you should inform the instructor within the first week of class as to the specifics and an alternative option will be developed. If you are using the labs many types of emergencies can potentially occur on campus; instructions for specific emergencies such as severe weather, active shooter, or fire can be found at **emergency.uark.edu**.

For **severe weather**

- Follow the directions of the instructor or emergency personnel
- Seek shelter in the basement or interior room or hallway on the lowest floor, putting as many walls as possible between you and the outside
- If you are in a multi-story building, and you cannot get to the lowest floor, pick a hallway in the center of the building
- Stay in the center of the room, away from exterior walls, windows, and doors

If you encounter **violence** or an **active shooter**

- **CALL-** 9-1-1
- **AVOID-** If possible, self-evacuate to a safe area outside the building. Follow directions of police officers.

- **DENY-** Barricade the door with desk, chairs, bookcases or any items. Move to a place inside the room where you are not visible. Turn off the lights and remain quiet. Remain there until told by police it's safe.
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Details

Class components

There are a number of class components: text readings (Gorr and Kurland, and Allen), online videos and lectures, exercises, lab assignments, ESRI modules, online quizzes, and online exams.

Each week you will be given selected readings, online videos and online lectures to watch. You are expected to read and view the videos and lectures. You may email any questions you might have as you do these. In the same week you will have quizzes, labs and exercises that utilize the readings and lecture content.

The quizzes and especially the exams are structured in a format similar to the ESRI certification exam. Each exam will focus on the specific unit but will also be comprehensive to provide additional reinforcements to the topics. The final exam is comprehensive and also structured similarly to the ESRI exam. A solid score on the final should be a good indication that you have mastered the concepts covered in the course and the corresponding ArcGIS and spatial analysis skills. Remember, however, that you should also take additional ESRI online classes to more fully prepare for the certification exam. Details on these will be provided on BlackBoard.

We anticipate that you will be using ArcGIS in your graduate work or research. To assist you in going forward we have structured a **two-part project** that provide the additional responsibilities of graduate students beyond the normal responsibilities of undergraduates. Note also that there are additional exercises for graduate students as well. The first paper is expected to be in the range of 5-7 pages. It should be a preliminary statement describing of the type of spatial analyses you are considering using ArcGIS (or other software?) for in your upcoming MA/MS/PhD/professional work. This is not a scholarly paper but a working description to allow us to provide you with some feedback early-on. You should start with a brief statement of the ways in which you anticipate you may use GIS in your work. This would be followed by about the first two thirds of the paper that would provide a brief literature review of the specific types of GIS applications that you believe may be of value in your research. This review should be based on the scholarly literature in your field and examples of applications of the type you anticipate conducting. In so far as possible restrict your review to those areas where ArcGIS is used or can be used. The (approximately) last one third of the paper should identify at least four (4) different data sets that already exist in digital form that you anticipate would be (or are similar to) the types of data that you'll be using in your own research. Provide us with information on where the data is available its resolution and any particular problems you think you might encounter in acquiring. While you will not obviously have completed the course provide us with some insights on the type of GIS analysis operations you think will be involved in your work. With this information we can provide you with some advice early on. You should discuss some of the anticipated data that you may need and in general what type of analytical directions you anticipate taking.

For the second paper you should acquire the (minimum of) four (4) different digital data sets and load them into ArcGIS, dealing with any questions of projections, coordinate systems and the like. You should provide 8 1/2 by 11

cartographic products showing the nature of these data sets. Be SURE to have all the proper cartographic elements, (legend, scale, sources, north arrow etc.) In the paper you should describe at least three different classes/types of GIS analytical operations that you have performed on the data and why you have performed these. Your discussions should provide us adequate information so that a capable our GIS user could, if necessary, reproduce your work. Provide cartographic products showing the outcomes of these various steps. The paper should close with a discussion of any lessons learned and any insights provided into your future GIS research.

Class weekly schedule

This course is organized into Units, usually 3 weeks each. In general, each unit's materials will become available the last Friday of the previous unit. All readings and assignments for a given unit are due at any time up to the END date of the unit, but for your planning, the materials have been further divided into conceptual weeks. Some weeks will have more work than others, so we recommend you try to get ahead when you can to give yourself some breathing room in case you run into difficulties. As soon as the exam is completed the next unit's materials are available. The exam for each unit will be typically accessible for one week.

ESRI training: Selected parts of the course will utilize the online courses provided through the ESRI Training (training.esri.com). Each of these have and ESRI"price" but, through the campus site license, you will be given a unique keycode to allow you to access the various courses and detailed instructions will be provided on Blackboard.

A Note About Software

ArcGIS 10.3 works on the Windows 7 and 8 operating system. ArcGIS has not yet been certified on Windows 10 but will likely run. You can also run ArcGIS on Mac computers via Bootcamp or virtualization software (e.g. Parallels, VMWare, etc.). We will only be able to provide **FULL** support for systems running Windows 7 but have a fair amount of experience in VMWare and BootCamp and will do want we can if you have technical issues. Note that there are very specific hardware requirements for ArcGIS – which can be found here. For those using mac a minimum of 8GB is strongly recommended – especially if you run virtualizations.

It is expected that the student will have access to Microsoft Office. While OpenOffice, LibreOffice, iWork or other alternatives may be sufficient for most or all of the work, it is the student's responsibility to troubleshoot any challenges that may occur from using software other than MS Office. Since the MS Office suite is available across campus for student use, the Instructor and TA will **expect all submissions of documents, spreadsheets, or presentation files to be in MS Office formats** (i.e. .doc, .xls, .ppt, or .docx, .xlsx, pptx). If you have a fairly new version of Office, you may need to install drivers to support older office file types for use within ArcGIS. If you get a database error when trying to access xlsx documents in ArcGIS, see our Troubleshooting page for help.

Class points

Deliverable	Points and Quantity	Total Points
Quizzes	30	360

Exercises (including ESRI modules)	54	540
ESRI Modules	4	40
Unit exams	5	500
Final Exam	1	200
First Graduate Paper		25
Final graduate paper		200
Total		***1,865***
Final exam extra credit		***28***
Unit survey extra credit		***50***
Maximum possible		***1,943***

Grand total is 1,865 points. Grades are based on 90 (A), 80 (B), 70 (C), 60 (D) and below percent of total. Since grading is not curved students are strongly encouraged to form study groups and work together on the laboratory assignments and in preparing for the exams. With the exception of the final, the quizzes and exams are OPEN BOOK, OPEN LECTURE; you are welcome to utilize texts and sources given in the course materials as long as such use is properly cited. You will note that there are more than 61 graded exercises and the total possible is 500. That is the maximum possible. You may complete all and miss various points but still get a total of 500 points. The quizzes similarly offer more the maximum number of points.

In addition for each unit there will be a "Satisfaction Survey" – if you complete all of these (5) you will receive 50 Extra Credit points. The survey consists of a few easily answered questions and will take only a minute or two to complete but it provides us with essential feedback on the course.

Practice, practice, practice

Why so MANY EXERCISES? There is an old joke that goes something like this… "A traveler walking down 5th Avenue in Manhattan asks a passerby "Say, how do you get to Carnagie Hall?" The reply – "practice, practice, practice." So too for GIS applications -- and especially for ArcGIS competency. The ONLY way to become proficient in using ArcGIS is to "practice, practice, practice." Each of the class exercises is designed to expose you to a particular tool or operation and to revisit earlier ones so that using them becomes second nature. You may have an urge to rush through an exercise simply following the instructions – which are usually very precise. DON'T! Instead, think about what you are doing; consider the tools and the various options. Consider how changing the operation's parameters changes the outcomes. If you go down a blind alley, backtrack and consider where you got lost. Remember you may e-mail, chat or tweet Limp or XXXX at any time. We will try to get back to you as soon as we can. If we are online (and we usually are) we may be able to reply right away.

Exams

Course exams 1, 2, 4 and 5 can be considered "take-home" exams, in that they are not timed or proctored. They are BlackBoard multiple choice online. Exam 3 is a timed exam must be completed within the allotted time frame – this is to provide you with experience in the ESRI test format. The final is BOTH timed and proctored. You MUST plan to attend during the designated final exam time. Except for the final, the exams are OPEN BOOK, OPEN NOTE, and OPEN LECTURE. You are also welcome to use online and external materials provided in the course, as long as such use is properly cited. **For the final exam you may bring ONE (1) 8.5 x 11 sheet of paper (both sides are OK) that has any notes, formula etc**. Late exams are not accepted.

Late Work Policy

Quizzes, labs and other assignments may be turned in at any point **until the exam is due covering the section of the class in which the material was assigned**. Late exams will not be accepted without prior arrangement. After the exam late work for that unit will not be accepted. This does not apply to extra credit assignments, for which there is no due date or late penalty until the date of the final exam. All extra credit work must be submitted before the final exam.

Collaboration

Professional involvement in GIScience almost always means that you will be part of a team focusing on solutions to problems. As a result you need to develop team participation skills. You are encouraged to collaborate on the lab problem sets and exercises.

Academic Integrity

As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail. Each University of Arkansas student is required to be familiar with and abide by the University's 'Academic Integrity Policy' which may be found at http://provost.uark.edu/245.php. Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor.

Computer Access

Students may utilize their personal computers or the computing facilities in JB Hunt. Each enrolled student will be provided an access code to download a full version of ArcGIS 10.3 with extensions from the ESRI web site and copies of the required exercise data are provided on DVDs that come with the text books. Instructions on the installation of the software are provided on the Blackboard site. The ESRI software requires substantial computer resources – described in detail at https://desktop.arcgis.com/en/desktop/latest/get-started/system-requirements/arcgis-desktop-system-requirements.htm#ESRI_SECTION1_4D839759F08146819E273A6DDD01DCBB. A MINIMUM of 2.2 GHz CPU, 4 GB RAM and substantial disk space is recommended. Note that students with a Macintosh can use the ESRI software if they utilize BootCamp, VMWare, Parallels or other Windows emulators. Details on these are also provided on the class BlackBoard site. Students may also choose to use the geomatics instructional labs in JB Hunt (JBHT 228 and 231 - see http://cast.uark.edu/home/ about/facilities/teaching-labs.html). Detailed information about working with the computers in JBHT can be found on the Blackboard site. All students and faculty using any UA computer

facilities are required to agree to and follow the University of Arkansas Code of Computing Practice. A copy of the code can be found here. Note that there is very specific guidance as to approved and not approved use. Violations of these rules will be cause for disciplinary and, potentially, legal action. In particular, no system is to be used for any activities that violate any law including loading of unauthorized or pirated software and/or distribution of illegal materials.

The JBHT labs will be open to students at all times except when they are in use for other classes and for special periods to be announced. Note that the J.B. Hunt Center is locked each evening and is locked on weekends. However, students enrolled in the class will be able to use their UA student ID cards to access the building and computer lab 24/7 – unless there is an already scheduled class or activity using it.

ESRI Virtual Campus

ESRI has created an extensive suite of online courses at their web site training.esri.com. You will be REQUIRED to complete selected ones of these as part of the class. You will be given a **unique keycode** to allow you to access the course, and further instructions are provided on Blackboard. There are many additional modules in the ESRI Virtual Campus. If you would like to work on any of these please let the instructor or TA know and we can generate an access key for you.

Course Calendar

Unit	Wk	Date	Topic	Readings and Videos	Deliverables
1	1	*Aug 24*	How to use the lab, personal accounts, and computer drives. Intro to basic navigation in ArcGIS	• GIST 1 Chapter 1 • ESRI geodatabase training (module 1) • Lecture Videos	• GIST 1 Assignments ○ 1-1 • ESRI Module 1 Certificate • GIST 1 Quiz 1

	2	*Aug 31*	Map design and GIS Outputs	• *ESRI geodatabase training* (module 2)
				• GIST 1 Chapter 2
				• GIST 1 Chapter 3
				• Lecture Videos
					• GIST 1 Assignments
					  ○ 2-1
					  ○ 2-3
					  ○ 3-1
					  ○ 3-3
					• ESRI Module 2 Certificate
					• GIST 1 Quizzes 2 & 3

	3	*Sept 7*	Esr geodatabase principles 1	• *ESRI geodatabase training* (modules 3-4) • GIST 1 Chapter 4 • Lecture Videos	• GIST 1 Assignments ○ 4-1 • ESRI Module 3-4 Certificates • GIST 1 Quiz 4
Exam 1		*Exam due midnight Sept 13th*	EXAM Available During WEEK 3 Exam 1 Covers Weeks 1-3		

First Paper		*Due Sept 20*			
2	**4**	*Sept 14*	ESRI geodatabase principles 2 and metadata	• GIST 1 Chapter 5 • GIST 1 Chapter 6 • Lecture Videos	• GIST 1 Assignments ○ 5-1 ○ 6-1 ○ 6-3 • GIST 1 Quizzes 5 & 6
	5	*Sept 21*	Geocoding	• GIST 1 Chapter 7 • Optional - *Geocoding with ArcGIS Desktop* (ESRI online module – strongly recommended if you did NOT complete it in the IGIS class) • Lecture Videos	• GIST 1 Assignments ○ 7-2 • GIST 1 Quiz 7
	6	Sept 28	Geoprocessing	• GIST 1 Chapter 8 • Lecture Videos	• GIST 1 Assignments ○ 8-1 ○ 8-2 ○ 8-3 • GIST 1 Quiz 8
Exam 2		*Exam 2 due midnight Oct 4th*	EXAM Available During WEEK 6 Exam 2 Covers Weeks 1 - 6		
3	**7**	*Oct 5*	Digitizing and spatial analysis	• GIST 1 Chapter 9 • Lecture Videos	• GIST 1 Assignments ○ 9-1 ○ 9-3 • GIST 1 Quiz 9
	8	*Oct 12*	3D Analyst	• GIST 1 Chapter 10 • Lecture Videos	• GIST 1 Assignments ○ 10-1 ○ 10-3 • GIST 1 Quiz 10
	9	*Oct 19*	ArcGIS Spatial Analyst	• GIST 1 Chapter 11 • Lecture Videos	• GIST 1 Assignments ○ 11-1 ○ 11-2 • GIST 1 Quiz 11
Exam 3		*Exam 3 due midnight Oct 25th*	EXAM 3 is a MIDTERM and is a timed exam but is online Exam 3 Covers Weeks 1-9		

4	**10**	*Oct 26*	"Mapping where things are" and "Mapping the most and the least"	• GIST 2 Chapter 1 • Mitchell pages 1-36 • GIST 2 Chapter 2 • Mitchell pages 37-62 • Lecture Videos	• GIST 2 Exercises ○ 1-1 ○ 1-2 ○ 1-3 ○ 2-1 ○ 2-2 ○ 2-3 ○ 2-4 • GIST 2 Quizzes 1 & 2
	11	*Nov 2*	"Mapping Density" and "Finding what's inside"	• GIST 2 Chapter 3 • Mitchell pages 60-85 • GIST 2 Chapter 4 • Mitchell pages 87-104 • Lecture Videos	• GIST 2 Exercises ○ 3-1 ○ 3-2 ○ 3-3 ○ 4-1 ○ 4-2 • GIST 2 Quizzes 3 & 4
	12	Nov 9	"Finding what's nearby"	• GIST 2 Chapter 5 • Mitchell 115-147 • *Distance analysis using ArcGIS* • *Network Analysis using ArcGIS* (ESRI online modules) • Lecture Videos	• GIST 2 Exercises ○ 5-1 ○ 5-2 ○ 5-3 ○ 5-4 ○ 5-5 ○ 5-6 ○ 5-7 ○ 5-8 ○ 5-9 • Module Certificates • GIST 2 Quiz 5
Exam 4		Exam 4 due midnight Nov 15th	EXAM 4 Available During WEEK 12 Exam 4 Covers Weeks 1-12		
5	**13**	Nov 16	"Analyzing patterns" and "mapping change"	• GIST 2 Chapter 6 • Lecture Videos	• GIST 2 Exercises ○ 6-1 ○ 6-2 ○ 6-3 • GIST 2 Quiz 6
		Nov 23	Thanksgiving break		
	14	Nov 30	Measuring geographic distributions	• GIST 2 Chapter 7 • GIST 2 Chapter 8 • *Exploring spatial patterns in your data using ArcGIS* (ESRI online module) • Lecture Videos	• GIST 2 Exercises ○ 7-1 ○ 7-2 ○ 7-3 ○ 7-4 ○ 7-5 ○ 8-1 ○ 8-2

					○ 8-3 ○ 8-4 • Module Certificate • GIST 2 Quizzes 7 & 8
	15	*Dec 7-10*	Identifying clusters	• GIST 2 Chapter 9 • Lecture Videos	• GIST 2 Exercises ○ 9-1 ○ 9-2 • GIST 2 Quiz 9
Exam 5		*Exam 5 due midnight Dec 10th*	*Exam 5 available during week 15* *Exam 5 Covers Weeks 1-15*		
Final Paper		*Dec 10*			
Final Exam		*Final Exam is proctored and will be offered as required by Provost's schedule in JB Hunt 231. Specific date/time will be made available as soon as it is known.* *Exam covers entire course and structured identically to the ESRI Certification Exam* *For students on campus the exam will be in JBHT 231. The Global Campus provides remote proctoring. Off campus students MUST initiate arrangements for remote proctoring by contacting the instructor at least* ***one month*** *before the exam*			

GEOS 5593 Introduction to Geodatabases

Fall 2015

Instructor

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TA: Panagiotis Giannakis
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Classroom Class is completely "online" but for those in the NW area, if they choose to do so, students may utilize the computer lab in JBHT231 (access to building and room via UA Student ID)

Textbooks ***Required:***

- ***PostGIS in Action*** (2nd edition) by Regina O. Obe and Leo S. Hsu (ISBN: 9781617291395) "Obe" in readings. Available at www.manning.com/obe2
- On-line workshop materials from Boundless Geo. "Boundless" in readings/exercises. To insure consistency we have downloaded the Boundless material and replicated it (under the CC license) at http://bluegill.cast.uark.edu/boundlessgeo/postgis-workshop/workshop/index.html
- PostGIS on-line documentation (as specified in syllabus)

Overview

Access to spatial data is an essential element in many scientific research efforts, businesses, government and other purposes. These data are usually stored and maintained in a SPATIAL database. This course is intended for students who want to learn how to create, maintain, and retrieve data from a spatially enabled (geo)database. The class will also cover the basic principles of database administration at the enterprise level and prepare students to interact effectively with an enterprise DBA, however, the class is NOT designed to train the student as an enterprise DBA.

The course begins by reviewing relational and object-oriented database topics that are of relevance in both geographic and non-geographic contexts (e.g., Structured Query Language and database design). It then focuses on the special considerations involved in the management of a spatial database. The class utilizes open-source technologies

(specifically, the Postgres database management system and its spatial extension PostGIS). In previous classes we also had a section that covers the ESRI enterprise geodatabase software. The principles are the same but each software has it's own characteristics. We have determined that this is too much content for a single semester class. At the end of this class, if you would like to become knowledgeable about the ESRI geodatabase environment, we will provide you a detailed roadmap.

For this graduate version of the class students are also required to define and complete a geodatabase project. This project will simulate a real application of geodatabases and require you to define a problem, create a PostGIS database, access and load digital data, perform an analysis and prepare a report.

The project has two components.

(1) The first is a brief paper (5-7 pages) that will

a) Define the project. What are its goals and anticipated outcomes
b) What data sets do you anticipate using and where will you acquire them?
    a. Be specific, what scale/resolution, what specific sources are you planning on using, what person/organization developed the data
c) What analytical operations do you anticipate performing
d) You should propose to use at least four (4) different datasets one (1) of which MUST be a multi-band image that can serve as a backdrop/base image.
e) The paper is due NTL midnight Sept 20.

We will review this paper and make suggestions of other possible data sets or approaches.

(2) The project itself. The final project deliverable will be a paper written in a professional/academic style that might be (if more completed work were involved) suitable to be part of a MA/MS/PhD thesis or similar investigation. You should

a) describe the project, the motivation and similar projects.
b) Describe each original data layer, its metadata. In an appendix include well developed (eg all proper cartographic elements and display) maps showing the data. Each should include a locator map as part of the representation.
c) Describe the steps needed to acquire and load the data into the PostGIS data base at a level that another experienced PostGIS user could reproduce. Discuss any specific problems encountered
d) Discuss the issues/steps to insure that all data were properly co-geo-registered.
e) Discuss the analytical operations performed in PostGIS. Provide PostGIS code and any information needed that would allow an experienced PostGIS user to duplicate your analysis.
f) Discuss the results using, where appropriate, good quality cartographic products.

g) The final project is due NLT midnight Dec 10 but I will accept papers with no penalty up to midnight Dec 13.

Prerequisites: Students taking this class should have completed GEOS 3543 *Introduction to geospatial applications* or have equivalent experience.

Hardware/software

For the first section of the course each student will download and install the open-source PostGIS database, OpenJump and QGIS on their own computers – or for those students taking the class who have access to the JB Hunt labs – on a lab computer. Detailed specifications for the hardware to run the applications on a student machine are found at http://postgis.net/install for PostGIS. Note that PostGIS, OpenJump and QGIS can run under Windows, Mac OS and Lunix but class lecture notes are specifically for Windows installations.

Course Objectives

GEOS 5953 will teach students how to (a) create a spatial database and (b) access it to address a range of spatial questions. Students will learn using both open-source database technologies.

At the successful completion of this course, students should be able to:

- retrieve data from an existing database using SQL Select and spatial extensions to SQL queries
- design a database schema from a set of requirements
- implement that design through the creation of related tables
- insert and update rows in a table
- create spatially enabled tables in Postgres/PostGIS
- answer questions using PostGIS spatial functions
- interact with a PostGIS database with OpenJump and QGIS
- model real-world entities through subtypes, domains, topology rules and relationship classes
- access and load varieties of spatial data
- manage vector and raster data in an enterprise geodatabase
- understand desktop and mobile enterprise geodatabase editing workflows
- discuss the suitability of an open-source or proprietary approach to various project scenarios

Grading

Grades will be based on points assigned to each of several components of the course as follows:

- **29 Weekly exercises** – 410 points
  Each week will typically have hands-on project to be completed individually by the student.
- **21 Lesson Quizzes** – 270 points
  Quiz will be used to test the student's comprehension of class materials and other reading as required.
- **3 Exams – 450** (Exam 1 = 100, Exam 2 = 150 and Exam 3 = 200)
- **First Paper 20**
- **Final project 250 points**
- **Total possible points 1,500**

  Letter grades are based on 100-90%, 89-80%, 79-70%, 69-60% and below 60% of the total.

- **Extra Credit**

  There is a **Weekly Satisfaction Survey**. This is an opportunity for you to provide input into the class anonymously. We do know who has and has not completed the survey but do not know who provided the answers or comments. You will receive 50 points BUT only if you complete ALL the surveys.

Unit	Week	Date	Readings	Lectures	Deliverables

Unit 1	1	Aug 24	Database design for mere mortals
			
			An incredibly brief introduction to relational databases
				Lectures
				• Introduction to Course
				• What is a geo-databases
				• Standford lectures
				  ○ Relational Model
				  ○ Querying Relational databases
				  ○ Introduction to SQL
					• Stanford quizzes
					  ○ Relational Model
					  ○ Querying Relational databases
					  ○ Introduction to SQL
					• Basic SELECT Statements quiz

	2	Aug 31	Microsoft's introduction to database concepts A quick overview on key relational database concepts and terms	• Code School TRY SQL course	Exercises • TRY SQL module • SQLZoo Select Quiz • SQLZoo Select world quiz • SQLZoo Nested Select Quiz • SQLZoo Sum and Count Quiz
	3	Sep 7	No readings!	Stanford video lectures • Table variables and set operators • Sub-queries in the WHERE clause • The JOIN family of operators • Null Values	Exercises • TRY SQL Level 2 screen cap • SQL Exercises • SQLZoo Join Quiz

	All Unit 1 Materials due by midnight Sept 13th				
	Exam 1 due NLT midnight Sept 13th				
Unit 2	4	Sep 14	Boundless • Section 3/4 through Section 5/6 • (note that the BB/CAST Boundless sections numbers are one-less than the on-line section numbers QGIS Materials • QGIS Introduction • QGIS basics	Lectures • Paul Ramsey's overview of PostGIS • Installing OpenJUMP • Creating a PostGIS-enabled databse • Installing QGIS	Boundless Quiz sec 3-5 Exercises • Install PostGIS and OpenJUMP • Create Boundless database • Using attribute queries • Install QGIS
	5	Sep 21	Obe • Chapters 1-2 Infiniti.com • Lesson 5 Geometry construction BoundlesGeo • Simple SQL	• Introduction to geometries • Basic Geometries in PostGIS o simple features points/lines o simple features polys o role of M and o Collection o MultiPMultiLineString • Complex geometries	Quiz – Obe Ch2 and Boundless Exercises • Obe "hello" real world • Query/display in OpenJUMP • Create Fayetteville database • Simple SQL queries on Fayetteville
	First Paper Due NTL Sept midnight 20				
	6	Sep 28	Boundless • Geometries; • Spatial Relationships; • Equality Obe • Chapter 9: Relating two or more spatial objects	Lecture • Introduction to Working with Spatial Queries • Geometry comparisons o ST_Equal o ST_Intersects and ST_Disjoint o ST_Crosses o ST_Overlaps o ST_Touch o ST_Within and ST_Contains o ST_Distance o ST_DWithin o Spatial equalities	Quiz – Obe Ch 9 and Boundless Exercises • Geometry Exercises; • Spatial Relationship Exercises • My Simple town - Fayetteville spatial exercises
	7	Oct 5	Boundless • Spatial Joins; • Geometry Constructing	Lecture • Spatial join • Join types o Inner	Quiz – Obe and Boundless readings Exercises

			Functions; • More Spatial Joins • Nearest-neighbor searching Obe • Chapter 10: Proximity analysis	○ Outer ○ Right/left ○ Full ○ Cross • Constructing geometries ○ ST_Centroid ○ ST_PointOnSurface ○ ST_Buffer ○ ST_Intersection ○ ST_Union • Nearest neighbor queries Common table expression	• Spatial Join Exercises • "Fayetteville" spatial join and geometry construction exercise • Proximity Exercise
All Unit 2 materials due midnight Oct 11					
8		**Exam 2** Exam available between 8 AM Oct 12 and midnight Oct 18th			
Unit 3	9	Oct 19	Boundless • Projecting Data; • Geography Obe • Chapter 3: Spatial reference system considerations • Chapter 6: Geometry and geography considerations QGIS documentation • Module 18: Using Spatial Databases in QGIS	Lecture • Spatial projections and transformations • Spatial data formats ○ Well-known text ○ Well-known binary ○ Geographic Mark-up Language ○ Keyhole Mark-up Language ○ GeoJason ○ SVG ○ Shapefiles • Geometry versus geography ○ ST_GeometryFromText ○ ST_GeographyFromText ○ Creating geography ○ Casting to geography • Using QGIS with PostGIS	Quiz – Boundless and Obe Exercises • Projection exercise • "Fayetteville" projection and geography exercise • QGIS exercise
	10	Oct 26	Obe • Chapter 4: Working with real data (up to section 4.5)	Lectures • PostgreSQL built-in tools • PostGIS packaged tools ○ GDAL/OGR ○ Osm2PgSQL • Getting and extracting data	Quiz – Working with data Exercises • "Obe" working with GE • "Fayetteville" chickens and GE

	11	**Nov 2**	Boundless
			• Section 15: Spatial Indexing
			• Section 20: Validity
			Obe
			Chapter: 15: Performance tuning
				Lecture
				• Indexing
				  ○ R-trees
				  ○ Other trees
					Quiz - Tuning
					Exercise
					• "Fayetteville "spatial indexing exercise
					• "Fayetteville validity exercise

Weeks 9, 10 and 11 deliverables due by Nov 8th at midnight					
Unit 3 (cont)	**12**	**Nov 9**	Obe • Chapter 13: Building and using topologies	Lectures • Why topologies • Creating a topology • Adding elements to a topology • Creating topogeometries • Using topogeometries	Quiz - topologies Exercises • Preparing data for topo exercises • Topology exercise
	13	**Nov 16**	Obe • Chapter (section) 4.5 • Importing and exporting rasters • Chapter 7: Raster Functions • Chapter 12: Raster Processing	Lectures • Raster data structures in PostGIS • Raster to vector and vice-versa • Band data in PostGIS • Raster analysis • PostGIS and GRASS	Quiz – Raster processing Exercises • Importing raster data from Geostor • Conversion of Fayetteville vector data to raster • "Fayetteville" raster analysis
	14	**Nov 24**	Thanksgiving week		
	15	**Nov 30**	Obe Chapter 11 • Geometry and geography processing	Lectures • Geometry and Geography processing • PostGIS and beyond • Comparing ESRI geodatabase concepts • More training on ESRI geodatabses	Quiz – Geometry and geography Exercises • Creating a linear path from points • Aggregating Fayetteville data • Tessellating and sharding • Transformations
All deliverables for Unit 3 due NLT midnight Dec 10					
Final Project Due NLT Dec 10 but will be accepted with no penalty until midnight Dec 13					
Exam 3 Exam available between 8 AM December 7 and midnight December 13					