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FORS 350.01: Special topics - GIS Applications

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The University of Montana

FORS 350 \GPHY 491

GIS Applications

Spring 2014

GIS Apps Lecture, Rm. 304, Stone Hall
Tuesday and Thursday, 12:40-2:00 PM

GIS Apps Laboratory 1, Rm. 218, Stone Hall
Wednesday, 2:10-4:00 PM

GIS Apps Laboratory 2, Rm. 218, Stone Hall
Thursday, 2:10-4:00 PM

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COURSE DESCRIPTION:

GIS is the science of answering spatial questions with the proper use of geographic information. The main concern is the analytical application of tools for investigating the distribution of physical and cultural phenomena in space. Unfortunately, the majority of maps in the modern discourse grossly distort the data and lie to the user. This most likely stems from a lack of basic cartographic knowledge and usually happens when a graphic designer is tasked with throwing data on a map. Decades of academic study into user perceptions, proper data management, and effective techniques inform a large body of geographic science that we will use as a foundation for applied GIS analysis. You will learn to ask appropriate spatial questions, construct methods for analysis, and produce maps that truthfully represent the answers.

The course will discuss all the major concepts and theories behind several GIS applications and put those skills into practice with laboratory exercises using GIS software. We will sample the use of GIS science in multiple disciplines, highlighting the unique skills required to effectively use GIS in those fields. Also important, we will practice ways to leverage those skills for use in any GIS application. Finally, the entire course will be governed by a respect for map integrity and imbue the student with a reverence for the power of maps.

Objectives:

- To learn the tools of spatial analysis in order to properly make spatial decisions in a variety of GIS applications.
- To understand the structure and analysis of nominal, ordinal, interval, and ratio data in a spatial context.
- To become proficient in the construction of choropleth, dot density, proportional symbol, isarithmic, and cartogram maps.
- To develop software skills in programs used for GIS analysis in the modern geographic information workflow.
- To learn to overcome software limitations and produce aesthetically pleasing maps that convey design rather than automatic generation.

Learning Outcomes: *By the end of this course you will*:

1. Understand the terminology, structures, concepts, and theories of GIS project management.
2. Gain necessary skills to perform spatial analyses using various data within a GIS environment.
3. Learn common GIS applications associated with managing natural and cultural resources.
4. Be proficient in applying the scientific methods to spatial problem solving.
5. Know the proper styles and formats for documenting research in a scientific report.

Course Format:

The general program for each week will be Tuesday and Thursday lectures, followed by a lab section. However, this schedule is subject to change, and will vary with the needs of the class, workload, or in special circumstances. This is especially true towards the end of the semester.

Lecture days will start with announcements, and then move to group map critiques or class discussion of readings. This will be followed by a lecture on principles of GIS. Time permitting, there will be short on-screen demonstrations of valuable software techniques for use in the labs. These demos should be used to fulfill the Demonstration Tutorial write-up requirement.

New lab assignments will be introduced during a **Tuesday Lecture**, so that each lab section has equal time to finish projects. The majority of the labs will not be written up in a button-by-button click format. You are expected to refer back to previous skills learned in other courses, tutorials provided by the instructor, the ESRI Help directory and outside resources found on the web. Utilize your time in the labs to ask questions of your fellow students, the TA, and the instructor.

Required Text:

Maphead: Charting the Wide, Weird World of Geography Wonks, by Ken Jennings, 2011.

Recommended Text:

Cartography: Thematic Map Design, by B. Reading et al., 6th Ed. 2008 (or 5th Ed.).

Geographic Information Systems: Applications in Forestry and Natural Resource Management, by Michael G. Wing and Pete Bettinger, 2nd edition, Oxford University Press (ISBN: 019542610X)

There will be various supplemental readings supplied as pdf's throughout the semester, many from the books above. Every student should have an atlas. They are great resources for those that are interested in the world and\or will continue to make maps in their professional fields.

Required Storage: You will need a thumb-drive or external hard drive with at least 4 GB of space. Create a Word doc on the drive called "1st Owner Information." Use the number one in the title and it will always be on top in the file list. Type up all you contact information so when you lose your drive, and you will, it can be returned. A reward can be an incentive. Drives left in the lab should be turned into and collected from Nancy, the geography secretary.

Server Address: R:\Classes\Spring2014\FORS350_GPHY491

POLICIES AND PROCEDURES:

The following policies are the minimum standards for which all students are responsible. They set the ground rules so that class can move forward in an efficient and productive manner. Please review and put into practice:

- Please consult the Class Schedule for relevant dates.
- All assignments will require submission on the due date specified in the Class Schedule unless otherwise noted.
- Required Class Attendance: Class will include theory, discussion, map critiques, and exercises – all of which are important to the overall understanding of GIS and Cartography. Much of this information will only be available in class. If you must miss a class, **YOU** are responsible for making arrangements with another student to get the material covered.
- Participation: This class is interactive and requires student participation in hands-on exercises and group discussions. Students that do not participate will not do well in the class. It is important to work with your fellow students and share ideas. They will be your best resource for missed material, design advice, technique tips, and moral support.
- Please don't do disrupt class with personal conversations. If you are disturbing the lecture, I may ask that you exit the classroom.
- No cell phones **ON** in class! Please make sure your cell phone is off before lecture begins.
- **Be on time!** I expect everyone to be on time for class in order to not disturb the lecture. If for some reason you are late, I ask that you be extremely quiet and not disturb anyone as you enter and sit down. Do not leave the class early. If you have a special reason for leaving early please contact me before class begins and sit close to the door in order to exit quietly.
- Please do not read outside material during class, including on the internet. While I am lecturing or we are engaged in group discussion, power off the all computer screens. Please pay attention to each lecture. Those caught surfing the web during these times will be asked to leave.

- For assistance with writing, please consult the on-line resources of the UM Writing Center, Liberal Arts 144 at: www.umt.edu/writingcenter.

- Student Conduct Code – Consult the Student Affairs website at: http://life.umt.edu/vpsa/stuReading_conduct.php. Carefully review the sections on plagiarism. Cheating and plagiarism are not tolerated and will be dealt with as outlined in the Code. This includes copying text verbatim from the internet or books (Please paraphrase and cite), texting during an exam, or taking a picture of an exam, etc. Integrity matters; your academic career depends on it!

- This course is accessible to and usable by otherwise qualified students with disabilities. To request reasonable program modifications, please consult with the instructor. Disability Services for Students will assist the instructor and student in the modification process. For more information, visit the Disability Services website at http://www.umt.edu/disability.

- Syllabus is subject to change.

CLASS ASSIGNMENTS:

- *Lab Exercises*
  Labs will consist of exercises that provide a means to put theory as presented through the lectures and reading material into practice. The labs are software intensive utilizing ESRI ArcGIS and a Microsoft Excel. There will be instructions for each lab that outline the learning objectives and the steps that should be taken to complete the project. Although some steps will be written-up in detail, there will not be explicit instructions for every button-click in the software. The student is responsible for applying the on-screen demonstrations, technique videos, and outside resources that will be well introduced by the instructor. **Each lab will be documented in a report that follows the standard scientific format. This includes the following sections: Introduction, Methods, Results, Discussion, Conclusion and References.** We will cover how to write the various sections of the report and build up to a complete paper for the final projects. The maps, tables, and graphs generated in labs are to be used as figures for the reports. **Always place maps as large as possible, one to a page, rotated if nessassary**. A Scientific Report Template will be provided and must be used or points will be deducted. It follows the K. Turabian Manual for Writers of Research Papers, Theses, and Dissertations. All labs are worth 100 pts.

- *Demonstration Tutorials*
  There will be on-screen demonstrations of various cartographic techniques in the software used for class. Some of these will also be available as video tutorials on the class blog. You are **responsible for writing-up 5** of these demos in a tutorial format that will be covered in class. They are rarely more than a page of printed text, and can **only be handed in Tuesday mornings** the week after they were demonstrated. They are worth 10 points each and are graded as complete or incomplete. Additional tutorial write-ups will be considered extra credit up to 50 pts. Completed tutorials belong in your Resource Notebook.

- *Resource Notebook*
  Each student is required to put together a 3-ring notebook filled with the content featured in the class. The purpose of this notebook is to give the student a "take-away" resource of GIS techniques for future mapping projects. Do not wait until the last minute to put together the notebook. Start adding content the first week and continue to keep it organized throughout the semester. It will be your one-stop reference for the theory and techniques covered in class. **It should be organized with tabbed dividers, labeled with categories that make sense to the student, and indexed with a table of contents page at the beginning. At a minimum, it should contain the TOC, at least 5 tutorial write-ups, all of the supplemental readings, class notes, exam study guides, the lab instructions, and your completed labs.** Extra material can include tutorials from the class blog and other resources from the web. The notebook will be turned in toward the end of the semester for a grade worth 100 points.

- *Midterm and Final Exams*
  You are responsible for knowing everything read or said in this class. Exams will have several sections starting with multiple choice and true or false questions. Then there will be a definition matching section based on the glossary terms in the readings. Finally, essay questions will require you to evaluate a map, outline the theory behind a GIS analysis technique, or discuss chapters from the narrative book. A review document will be handed out a week before the exam that contains all possible questions for the test. Only questions from the review sheet will be used on the exam, but you need to study by answering all of them. We will spend approximately half a lecture period to clarify any points of confusion in the review document. The final exam **IS Comprehensive**, with questions not used on the midterm review sheet being "fair-game." However, the final will mostly consist of material covered in the second half of the semester. The Final Exam is longer and will be worth more than the Midterm. See the Points Table below for details.

- **Final Group Projects:**
  A semester-long assignment, the group GIS project requires the students to identify a unique resource management problem that can be answered with GIS analysis. Each group must submit a project proposal following a format that will be discussed in class. As a group, develop a research question, review the literature for what techniques have been applied previously, decide what data is required, and design the methods for your analysis. Document your analysis in a formal research paper that follows the scientific format used in the lab reports with the addition of a small literature review. Include maps, graphs, tables, and figures that support your research and its results. The project design, workflow and conclusions will be presented to the class at the end of the semester. The 400 point project is worth close to one third of your total grade and is divided as follows:

Project Proposal	50 pts.
Final Group Paper	300 pts.
Presentation	50 pts.

The assignments and exams administered throughout the semester cover the topics that we discuss in class and are related your readings. The purpose of these assignments is to ensure that each student understands the concepts being discussed, practices and improves their thematic cartography skills, completes the required readings, and attends each lecture. These assignments will be all that determines your final grade. Make sure to turn them in complete and on time.

There are no late assignments accepted after the due date,

PERIOD!

If you are having trouble with a project, come and see me well before it is due. If you have an emergency, illness, or crisis; send an email, call, or dispatch a carrier pigeon to me before the assignment is due. Once the due date and time have passed, no excuses will be entertained.

GRADING:

This is a three unit class where the labs cannot be separated from the lectures. There will only be one grade given for all work submitted in traditional letter grade (T) format. The tables below break down the point values for all assignments. Grades are evaluated on the completeness and organization of the project, as well as the use of the theory and techniques taught in class. Maps will not be graded purely on a subjective assessment of aesthetic appeal; however, a poorly executed map is certainly worth less than a professional one. Not everyone is an artist, but the student should demonstrate progress toward cartographic competency. All assignments, as well as the final grade, are evaluated on the following grading scale:

A ..... 95 – 100%
A- ..... 90 – 94.99%
B+ ..... 87 – 89.99%
B ..... 83 – 86.99%
B- ..... 80 – 82.99%
C+ ..... 77 – 79.99%
C ..... 73 – 76.99%
C- ..... 70 – 72.99%
D ..... 60 – 69.99%
F ..... 59.99% and below

*Please note that in order to be fair to all students, grades will not be rounded up. For example, if you earn 79.99%, you will receive a 'C +' in the course. Since there are no "A+" grades, an "A" grade requires 95% or higher and is reserved for students with the highest work ethic.

Points Table:

Assignments	**Points**
Lab 1	100 pts.
Lab 2	100 pts.
Lab 3	100 pts.
Lab 4	100 pts.
Lab 5	100 pts.
Lab 6	100 pts.
Resource Notebook	100 pts.
Tutorials 5 x10 pts.	50 pts.
Midterm Exam	200 pts.
Final Exam	250 pts.
Final Projects	400 pts.
Total	**1600 pts.**

Class Schedule		
***Week*/Day**	**Topic**	**Assigned Reading**
***Week 1**: Introduction to GIS Applications*		
Tuesday, 1/28	Welcome, Syllabus, Moodle, Lab, Resources How is GIS applied to the scientific method?	*Reading 1
Thursday, 1/30	Projection, Scale, and Geodatabase Review	
Lab Orientation: Start Pre-Lab: GDBs and Projections Review		
***Week 2**: Measuring and Reporting on Spatial Phenomenon*		
Tuesday, 2/4	***Scientific Writing – Introduction Sections***	*Reading 2 *Jennings Ch. 1
Thursday, 2/6	Scales of Measurement	
Start Lab 1: Mapping Forest Region 1		
***Week 3**: Quantitative Maps - Choropleth Mapping*		
Tuesday, 2/11	Choropleth Maps	*Reading 3 *Jennings Ch. 2
Thursday, 2/13	Data Classification	
Start Lab 2: Demographic Analysis, **Lab 1: Due by Weds. at 2:00 PM**		
***Week 4:** Map Design in GIS*		
Tuesday, 2/18	Type & Color, ***Writing Methods Sections***	*Reading 4 *Jennings Ch. 3
Thursday, 2/20	Map Design: Getting the Most Out of ArcMap	
Work on Lab 2		
***Week 5:** Proportional Symbol and Dot Density Mapping*		
Tuesday, 2/25	Proportional & Graduated Symbols	*Reading 5 *Jennings Ch. 4
Thursday, 2/27	Dot Density & Enumeration	
Start Lab 3: Volume vs. Density**, Lab 2: Due by Weds. at 2:00 PM**		
***Week 6:** Cognitive Reckoning – Human Spatial Awareness*		
Tuesday, 3/4	***Writing Results & Discussion Sections***	*Reading 6 *Jennings Ch. 5
Thursday, 3/6	Defining Space & Place	
Work on Lab 3		

Class Schedule		
***Week*/Day**	**Topic**	**Assigned Reading**
***Week 7:** Isarithmic Mapping*		
Tuesday, 3/11	Isarithmic Maps	*Reading 7 *Jennings Ch. 6
Thursday, 3/13	Data Interpolation	
Start Lab 4: Surfaces from Points**, Lab 3: Due by Weds. at 2:00 PM**		
***Week 8:** Maps as Communication*		
Tuesday, 3/18	Effective Storytelling, ***Writing Conclusions***	*Exam Review
Thursday, 3/20	**Midterm Exam 12:40 – 2:00**	
Work on Lab 4		
***Week 9:** Raster Operations*		
Tuesday, 3/25	Slope, Grade, & Raster Calculations	*Reading 8 *Jennings Ch. 7
Thursday, 3/27	***Proposals for the Final Project***	
Start Lab 5: Spread Analysis, **Lab 4: Due by Weds. at 2:00 PM**		
***Week 10:** SPRING BREAK*		
Tuesday, 4/1	***NO CLASS***	*Jennings Ch. 8
Thursday, 4/3	***NO CLASS***	
No Lab		
***Week 11:** Non-spatial Components in Maps*		
Tuesday, 4/8	Flow & Temporal Maps	*Reading 9 *Jennings Ch. 9
Thursday, 4/10	Viewshed and Watershed Analysis	
Work on Lab 5, **Project Proposals Due by Fri. at 5:00 PM**		
***Week 12:** Vector Operations*		
Tuesday, 4/15	Unions and Intersects	*Reading 10 *Jennings Ch. 9
Thursday, 4/17	Merge, Erase and Join Functions	
Start Lab 6: Overlay Analysis, **Lab 5: Due by Weds. at 2:00 PM**		

Class Schedule		
***Week*/Day**	**Topic**	**Assigned Reading**
***Week 13:** Problem Solving*		
Tuesday, 4/22	Wildlife Habitat Modeling	*Jennings Ch. 11
Thursday, 4/24	Noxious Weed Treatment	
Work on Final Projects, **Lab 6: Due by Weds. at 2:00 PM**		
***Week 14:** Real-world Project Management*		
Tuesday, 4/29	Workflow for Successful GIS Analysis	*Jennings Ch. 12
Thursday, 5/1	Special Lecture	
Work on Final Projects		
***Week 15:** Final Projects*		
Tuesday, 5/6	**Resource Notebook: Due In Class** Project Presentations	*Exam Review
Thursday, 5/8	Project Presentations	
Work on Final Projects		
***Week 16:** Final Exam*		*Whatever You Like!
Monday, 5/12	**Final Exam 1:10 – 3:10**	
Final Projects: Due by Thurs. 5/15 at 5:00 PM		