Spring 2-1-2018

GPHY 488.00: Applications of GIS

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The University of Montana

FORS 350 \ GPHY 488

GIS Applications

Spring Semester 2018 Syllabus*

FORS 350\GPHY 488, Lecture Section 00, Rm SH 304
Tuesday and Thursday, 2:00-3:20 PM

FORS 350, Laboratory Section 01, Room SH 218
Wednesday, 2:00-3:50 PM
GPHY 488, Laboratory Section 01, Room SH 218
Wednesday, 2:00-3:50 PM
FORS 350, Laboratory Section 02, Rm SH 218
Thursday, 3:30-5:20 PM
GPHY 488, Laboratory Section 02, Rm SH 218
Thursday, 3:30-5:20 PM

Instructor: Dr. John DiBari
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Office Hours: Tues 12:30-1:30 or by appointment
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TA: Morgan Voss
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Email: morgan.voss@umconnect.umt.edu

COURSE DESCRIPTION:

Geographic Information Systems (GIS) have become a powerful research tool in the natural and social sciences. The main concern is the analytical application of tools for investigating the distribution of physical and cultural phenomena on the surface of Earth. Decades of academic study into user perceptions, proper data management, and effective techniques inform a large body of science that we 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 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 skills required to effectively use GIS. Also important, we will practice ways to leverage skills for use in any GIS application. Finally, the entire course will be governed by a respect for data fidelity and map integrity.

OBJECTIVES:

- Advance competency in applying GIS concepts
- Conceptualize and solve problems in a cartographic context
- Demonstrate analytical skills using multiple data models

- Conduct spatial analyses encountered in professional settings
- Effectively communicate results of analyses orally, cartographically, and in writing

APPROACH:

This course is predominantly project-based and provides the opportunity to explore GIS applications that address real-world questions.

The intent of this class is not to provide basic GIS instruction. Rather it is to provide an opportunity for students with GIS skills to apply those skills as they would in a professional setting. In this respect, all of us together will explore answers to spatial questions using a variety of methods – including some that may be new. Answers to the questions posed may not be known a priori. Additionally, there may be several ways of correctly solving the same problem; we will explore the pros and cons associated with various techniques.

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 Wednesday and Thursday lab sections. 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 be followed by a presentation on the principles of GIS and cartography. Some lectures will be supplemented by hands-on demonstrations or group exercises. Time permitting there will be short onscreen demonstrations of software techniques for use in the labs. These demos should be used as how-to tutorials. Take notes to include in your Resource Journal, as the information can be useful for labs and/or future analyses. 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. Rather, students 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. Use your time in the labs to ask questions of your fellow students, the TA, and the instructor.

Required Texts:

GIS for Environmental Management, by Robert Scally, ESRI Press. 2006. (Available on Amazon or from ESRI Press) Select essay questions on both the mid-term and final exams will come from this book.

GIS Tutorial, Spatial Analysis Workbook 2, by David W. Allen, ESRI Press. 2016. (Available on Amazon or from ESRI Press)

Texts of Interest:

Companion texts to GIS Tutorial, Spatial Analysis Workbook 2: ***The ESRI Guide to GIS Analysis Volumes 1 & 2.***

Cartography: Thematic Map Design, by Borden Dent, McGraw Hill. 6th Ed. 2009 (or 5th Ed.).

Geographic Information Systems: Applications in Forestry and Natural Resource Management, by Michael G. Wing and Pete Bettinger, Oxford University Press (ISBN: 019542610X). 2nd Ed. 2008.

There may be various supplemental readings supplied as pdf's throughout the semester.

Required Storage: 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 your contact information so when you lose your drive, and you will, it can be returned. Drives left in the lab should be turned into and collected from Karin, the geography administrative associate.

Server Address: R:\Classes\Spring2018\GIS_Applications

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.
- 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 the material covered. Ask another student for their notes, as I don't take any while lecturing. There maybe be in-class assignments that reward students with credit for attendance. If you are not in class, you **CANNOT** receive credit.
- Participation: This class is interactive and requires student participation in hands-on exercises and group discussions. You will also partner-up for some labs. 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 disrupt class with personal conversations.
- **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.
- No **CELL PHONES ON** in class! Please make sure your cell phone is off before lecture begins.
- **LAPTOPS ARE NOT NECESSARY** in class! Please pay attention to each lecture. Numerous studies suggest that digital note taking is ineffective as multi-tasking with other computer distractions impairs cognitive work retention (See this article). Take written notes, and if you must transpose them to a computer, it will be a valuable second exposure to the material.
- 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 Students Affairs website at: http://www.umt.edu/vpesa/Dean%20of%20Students/default.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.

Please note, this course is time consuming. Be prepared to synthesize information and apply what you learn to things not covered in class. Be prepared to spend several hours per week outside of class in the computer lab working on assignments. Be prepared to study course material frequently.

EXPECTED TECHNICAL SKILLS:

Everyone should be able to manage files, make use of operating system utilities, map network drives, and have experience using other software including word processing, spreadsheet, and perhaps statistical software. Additionally, everyone should be comfortable accessing course information and assignments on the network. Assignments, reading materials, and various items may be posted online. Some of these documents will be in Adobe Acrobat (.PDF) format. Additionally, I may ask you to access information posted to other websites.

MOODLE:

Class materials will be available on **Moodle** the week they are covered in class. This syllabus will be posted in the header for the entire semester. Refer to it often for due dates and reading assignments. Each lab will be submitted to its own digital drop box on **Moodle.** That drop-box closes at **2:00 pm** on the **Wednesday** that the lab is due. This is so you come to labs prepared to work on the new material. **All** labs should be submitted as **Microsoft Word documents**. File naming convention is: **Lastname_LabX.doc(x).** They will be graded with comments and returned digitally within the Moodle grade book.

LAB SERVER:

The address for the class server is - R:\Classes\Spring2018\GIS_Applications. Data needed for the labs will be stored in the MASTER_LABS parent folder that can only be accessed in the labs on campus. Under the STUDENTS parent folder, each student will find their private folder where all materials for the class should be stored. To start a new lab, navigate to the MASTER_LABS folder, copy the newest lab folder, then navigate to your student workspace and paste it into your student Labs folder. Work on your labs from this folder. All data will be backed-up; however, you will want to copy your student folder to an external memory device if you work at home and as a course back-up at the end of the semester.

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. Students are responsible for applying information from their own knowledge and experience, through investigation, or from the instructor. Each lab will be documented in one of two ways depending on whether they are book or instructor exercises. We will cover how to write sections of a scientific report and build up to a complete paper for the final project paper that includes the following sections: Introduction, Literature Review, Methods, Results,

Discussion, Conclusion and Literature Cited. 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 necessary. Book and instructor lab templates will be provided and must be used or points will be deducted. Towards the end of the semester we may work on shorter lab exercises to round out your GIS skillset.

All labs will be submitted into separate Moodle drop-boxes in MS Word format only. The drop-boxes for labs will have a due by-time of 2:00 PM on the Wednesday that the lab is due. However, the drop-box remains open until the final cut-off exactly one week later (2:00 PM, the next Wednesday). Moodle timestamps submissions automatically, so we are alerted to all late labs. There will be a 10% deduction for labs submitted in the grace period. NO LABS WILL BE ACCEPTED AFTER THE FINAL DROP-BOX CUT OFF! All labs are worth 100 pts.

- ***Paper Reviews***
  Each student will select an article from the current scientific literature that uses GIS in some way, prepare a 2-page summary of the article in MS Word format, and make an electronic copy (if possible) and/or supply a link to the paper. The summary should key on the GIS part of the paper and address things like the spatial nature of the problem being solved, source and character of the data, analytical methods and application of GIS tools, and how results were conveyed. Be prepared to talk about your paper in class. Graduate students will be asked, from time to time, to present a short review of their articles. Students will do a number of these reviews over the course of the semester. The intention is that by the end of the semester every student will be asked to discuss or make a presentation at least once. We may also read and discuss technical reports on GIS software, data models, and research.

- ***Demonstration Tutorials:*** There will occasionally be on-screen demonstrations of various techniques in the software used in class. You are responsible for writing-up these demos and including them in your Resource Journal. Write-ups are rarely more than a page of text.

- ***Resource Journal***
  Each student needs to create a digital journal filled with content featured in the class. The purpose of this journal is to give students a "take-away" resource of GIS techniques for future mapping projects. On the class server, under your personal student folder, create subfolders named Readings, Lectures, Resource Journal, and Labs. In the labs folder, you will create a separate folder for each lab assignment. Keep a detailed journal for each lab and your final project – e.g., what data you used, where you got it, question you are trying to answer, analysis methods. Journal entries for each lab, demonstrations and your final project will "scale up" to be your completed Resource Journal. Append your initial journal file with entries from each lab and demo. Do not wait until the last minute to put together the journal. 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. Extra material can include exam study guides and other resources from the web. The journal will be checked toward the end of the semester for a grade worth 100 points.

- ***Quizzes, Midterm and Final Exams***
  You are responsible for knowing everything read or said in this class. Occasionally there will be quizzes, administered in class, on the material presented in class and associated with labs. There are no make-ups for quizzes – you have to be present to get credit. 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 may 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 students to identify a resource management question 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 report sections. 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 GIS 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.

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

GRADING:
This three unit class will be graded in the 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 GIS and 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

* Since there are no "A+" marks, an "A" grade requires 95% or higher.

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.
Lab 7	100 pts. (TBA)
Lab 8	100 pts. (TBA)
Quizzes	10 – 20 points each
Paper Reviews (4)	100 pts. (25 pts ea.)
Resource Journal	100 pts.
Midterm Exam	200 pts.
Final Exam	250 pts.
Final Project	400
Total	**1850 points of so**

Week/Day	**Topic**	**Assigned Reading**
Week 1*: Introduction to GIS Applications*		
Tuesday, 1/23	Welcome & Intro; Scientific method, GIS using scientific method, Real application, What is GIS?	
Thursday, 1/25	Scale, Survey Systems, Projections	
Lab Orientation: Geodatabase and Arc Interface Review; Pre-Lab, Mapping Where Things Are and Most/Least Chs. 1-2 SAW2 (Review)		
Week 2*: Measuring and Acquiring Data*		
Tuesday, 1/30	Scientific Writing – Outline; Map Abstraction, Scales of Measurement	*Scally Ch. 1
Thursday, 2/1	Data Acquisition	
Start Lab 1: Lab 1 – Forest Service		
Week 3*: Data structure and Analyzing Data*		
Tuesday, 2/6	Scientific Writing – Abstract & Introduction Sections;	*Scally Ch. 2
Thursday, 2/8	Data Analysis, Data Structure; *Create Project Groups;* **Paper Review 1 due**	
Start Lab 2 - Finding What's Inside Ch. 4 SAW2, **Lab 1: Due by Friday. at 12:00 PM**		
Week 4: *Displaying Data & Project Development*		
Tuesday, 2/13	Writing Methods Section; Data Display	*Scally Ch. 3
Thursday, 2/15	GIS Project Development	
Start Lab 3: Finding What's Nearby Ch. 5 SAW2, **Lab 2: Due by Weds. at 2:00 PM**		
Week 5: *Database Specification*		
Tuesday, 2/20	Writing Results Section; Database Specification & Worked Example, Flow Chart of Analysis	*Scally Ch. 4
Thursday, 2/22	*OPEN;* **Paper Review 2 due**	
Work on Lab 3;		
Week 6: *Quantitative Maps, Proportional Symbol and Dot Density Mapping*		
Tuesday, 2/27	Writing Discussion Section & Literature Cited; Choropleth Maps, Proportional & Grad. Symbols	*Scally Ch. 5
Thursday, 3/1	Dot Density & Enumeration; Overview for Midterm	
Start Lab 4: Mapping Density Ch. 3 SAW2, **Lab 3: Due by Weds. at 2:00 PM**		
Week 7: Review and Midterm Exam		
Tuesday, 3/6	Review	*Scally Ch. 6
Thursday, 3/8	**Midterm Exam 2:00 – 3:20**	
Start Lab 5: IL – Climate Lab, **Lab 4: Due by Weds. at 2:00 PM**		

Week 8: *Isarithmic Mapping*		
Tuesday, 3/13	Isarithmic Maps	*Exam Review
Thursday, 3/15	Data Interpolation; **Final Project Proposals Due**	
No Lab attendance required, Work on Lab 5		
Week 9: *Alternate Modes of Mapping*		
Tuesday, 3/20	Cartograms	*Scally Ch. 7
Thursday, 3/22	Flow & Temporal Maps; *Proposal Review*	
Start Lab 6: Analyzing Patterns Ch. 8 SAW2, IL – International Students (extra credit), **Lab 5: Due by Weds. at 2:00 PM**		
Week 10: *SPRING BREAK*		
Tuesday, 3/27	***No Class***	
Thursday, 3/29	***No Class***	
No Lab		
Week 11: *Raster Operations*		
Tuesday, 4/3	Slope, Grade, & Raster Calculations	*Scally Ch. 8 - 9
Thursday, 4/5	Viewshed and Watershed Analysis; **Paper Review 3 due**	
Work on Lab 6, **Lab 5: Due by Weds. at 2:00 PM**		
Week 12: *Vector Operations*		
Tuesday, 4/10	Unions and Intersects	*Scally Ch. 10
Thursday, 4/12	Merge, Erase and Join Functions	
Start Lab 7: Identifying Clusters Ch. 9 SAW2, Work on Final Projects, **Lab 6: Due by Weds. at 2:00 PM**		
Week 13: *Problem Solving*		
Tuesday, 4/17	TBD – (Wildlife Habitat Modeling)	*Scally Ch. 11
Thursday, 4/19	TBD – (Noxious Weed Treatment), **Paper Review 4 due**	
Start Lab 8: Caribou data (TBD), Work on Final Projects, **Lab 7: Due by Weds. at 2:00 PM**		
Week 14: *Real-world Project Management*		
Tuesday, 4/24	TBD – (Workflow for Successful GIS Analysis)	*Scally Ch. 12
Thursday, 4/26	TBD – (Special Lecture)	
Work on Final Projects, **Lab 8: Due by Weds. at 2:00 PM**		
Week 15: *Final Projects*		
Tuesday, 5/1	Project Presentations	*Exam Review
Thursday, 5/3	Project Presentations	
Work on Final Projects, **Resource Journal: Checked in Lab**		
Week 16: *Final Exam*	*Whatever You Like!	
Monday 5/7, 1:10 – 3:10	*Final Exam*	
Final Projects: Due by Wednesday 5/9 at 3:00 PM		

**Syllabus is subject to change.*