Department of Forest Resources
University of Minnesota
FNRM 3131- GIS for Natural Resources – Fall 2023

	FNRM 3131				
In-person	Lecture: Monday, 4:05 – 6:00 p.m., 110 Green Hall, and one of the following:				
	6:00 p.m. –	8:00 p.m.	Monday	35 Skok	Section 2
	12:50 p.m. –	2:45 p.m.	Wednesday	35 Skok	Section 3
On-line Lecture	(see Class Website); (you can also come to any in-person lecture if/as needed)				Section 20
On-line Lab	(you can also come to any in-person lab session if/as needed)				Section 21

(Online students view lectures and lab materials from in-person sections asynchronously and may participate in a discussion section.)

Both In-person and Online students: An optional discussion session(s) will be added, based on student schedules, on the first day of class.

Instructors: Andrew C. Jenks (he/him), 215 Green Hall, 651-387-9600, ajenks@umn.edu; Paul Bolstad (he/him), 301H Green Hall, 612-624-9711, pbolstad@umn.edu

Office Hours: Monday, 3-4 pm in 215 Green Hall & (click for Zoom link)

Required Texts: GIS Fundamentals: A First Textbook on Geographic Information Systems, Seventh Ed., Bolstad, Paul V., Eider Press, 2022. This book is on reserve in the Magrath Library and should be at the St. Paul Campus Bookstore, and via links at website www.gisfundamentals.org/order. A digital version is available via RedShelf for $18 (half year) or $24 (lifetime), and the physical book for around $44. Readings from this book are required. There are also supplementary readings, which will be posted on the class web link, http://giscourses.cfans.umn.edu/fnrm3131.
You should do the readings before class meets; there is a quiz each week prior to start of each Monday lecture on the week's reading assignment.

Required Materials: You may download and print the exercises as PDFs from the class website, http://giscourses.cfans.umn.edu/fnrm3131. Throughout the labs sessions you will need to save/backup your work. You will be provided UMN class disk space, use it for your work.

Other Resources: The class website is http://giscourses.cfans.umn.edu/fnrm3131. This website has copies of this syllabus, and lab exercises. A related website, http://paulbolstad.net/gisbook.html has information on the textbook.

Student Responsibilities: You should attend the lectures (or access on-line lecture materials), do the readings, do assigned lab and homework problems submit them via Moodle; complete all quizzes and exams via Canvas. All material from lectures and readings may appear on the examinations.

If you need any assistive devices, services, or accommodations, or have any other special request, please contact the instructor(s).

FNRM 3131 Schedule

NOTE: Readings are from the required textbook, all lab sections meet 2nd week in-person or online

Week	Lecture Topic -- Monday	Labs & Homework	Required Readings	On-Line Exams
1	No Classes due to Monday Holiday	**No Lab due to Monday Holiday**		
2	Course Introduction: Course mechanics Introduction to GIS, data models, data structures.	**\L1:** Intro. and practice with ArcGIS	Chapters 1 & 2	
3	Geodesy, datums coordinate systems, map projections	**\L2**: Projections	Chapter 3 & ESRI PDF, Understanding Map Projections (skim)	
4	Maps, data entry & editing, metadata, map transformations	**\L3**: Digitizing	Chapter 4	Exam 1 (Chapters 1,2,3)
5	GPS, begin aerial and satellite images	**\L4**: Topology;	Chapters 5 & 6 up to pg. 273	
6	Continue aerial and satellite images, digital data, data sources,	Optional lab **\L5:** GPS (due end of 9th week) **\L6**: Digital Data and Basic Table Operations Start Homework 1 (see Week 6 on website)	Chapter 6 to end & Chapter 7,	
7	Introduction to Tables & relational databases	**\L7**: Tables Start Homework 2 (see Week 7 on website)	Chapter 8, up to pg. 357	Exam 2 (Chapters 4,5,6)
8	Spring Break Week	**Spring Break Week**		
9	Tables, normal forms	**\L8**: Table Import and Join	Chapter 8, pg. 358 to end	
10	Basic spatial analyses	**\L9**: Buffering, overlay **Homework 1 due Friday**	Chapter 9	Exam 3 (Chapters 7 & 8)
11	Raster analysis	**\L10**: Raster Analysis **Homework 2 due Friday**	Chapter 10	
12	Terrain analysis, more spatial analysis	**\L11**: Terrain and more spatial analysis	Chapter 11	
13	Interpolation, prediction, core area delineation.	**\L12**: Interpolation	Chapter 12	Exam 4 (Chapters 9, 10, & 11)
14	Cartographic modeling, flowcharts	**\L13:** Grouse Habitat Modeling	Chapter 13	
15	More cartographic modeling, dynamic spatial models, standards, data quality	**\L14:** Cartographic Modeling	Chapter 14	
16	New developments/future trends	Continue Lab 14 **Lab 14 due Fri., Friday**	Chapter 15	Exam 5 (comprehensive, but weighted, towards Chapters 12-14)
17	Finals Week			

Overview

FNRM 3131 is an introduction to geographical information systems, focusing on spatial data development and analysis in the science and management of natural resources. Many of our most pressing environmental problems involve "what" and "where," for example, which coastal communities are in danger of sea-level rise, what intersections are most dangerous for traffic, where might an oil spill cause the most damage, or which power plants are causing the most acid rain? We have developed tools, called GIS, which help us address many of these problems, but there are dangers as well as opportunities here, as our conceptions and values as much determine our recommendations as do our technical capabilities. This course seeks to impart both a technical expertise to perform spatial analysis and the basis to evaluate how our conceptual framework affects our conclusions. The course provides a technical understanding of the tools needed to solve these environmental problems, and how we may select the best conceptual models for any given problem. Topics covered in this course include basic data models, structures, data sources, data collection, data quality, geodesy and map projections, spatial and tabular data analyses, digital elevation data and terrain analyses, cartographic modeling, cartographic layout, metadata, and accuracy assessment. Laboratory exercises provide practical experiences that complement the theory covered in lecture.

This course introduces the methods and models that have been developed to solve spatial problems. Computers have enabled sophisticated, affordable, and easy spatial analysis. For example, spatial technologies allow us to identify the specific communities and households downwind of any given coal-fired power plant, and estimate the specific levels of particulates, sulfates, mercury, and other noxious pollutants we expect to fall on each household. This allows a fuller, fairer measure of the costs in siting, expanding, or upgrading such plants. Water pollution, the distribution of resources, risk to natural disasters, crime analysis, and endangered species recovery are examples of other problems that have been addressed with spatial analyses.

This course is time intensive, as it is a four-credit lab course covering theory and practice. For in-person or online students should expect to spend four hours a week completing and digesting the required readings, two hours on the lectures and material provided therein, two hours a week in lab and an additional two hours outside of lab time each week, approximately an hour each week on quizzes, discussions, and homework, and an average three to four hours every three weeks in a repeat-access exam. Our exams typically cover two to three chapters and are a combination computer and person-scored instruments. The computer scored sections are assessed immediately, and students provided feedback on the missed answers. You may then study themes where you performed poorly and retake the exam, for a total of three times. Questions are a random draw from a large pool, and hence will not be exactly the same between exams but will test the same thematic area. In this way exams are both an assessment and instructional tool.

Liberal Education – Technology and Society Theme

This course satisfies the liberal education Technology and Society theme. We seek to develop broad knowledge and transferable skills, with a strong understanding of how to rationally solve challenging problems for important issues without resorting to dogma, and being conscious of the difference between fact, opinion, and values in judgement. The lecture, quizzes, and homework's are software-agnostic, and help develop ways of thinking that should transcend technical developments or new methods. The labs teach how to apply concepts using the currently most common software tools.

The course examines technologies that have had and continue to have immense, measurable impact on contemporary society. Geographic Information Systems (GIS) are transformational technologies that have been deployed deeply and broadly across government, business, community, and volunteer organizations. Nearly everyone in the developed world has been affected by GIS, as it is key to Google Maps, GPS, FedEx or UPS deliveries, commercial airline navigation, and most transportation, energy, and water networks. GIS is used by political parties to plan campaigns, schools to redistrict, in most E911

emergency services, in environmental monitoring and compliance, and in infrastructure planning and management by public and private organizations (please see attached Chapter 1, from textbook used in the course).

The course builds student understanding of the science and engineering behind the technology addressed. It teaches both the theory and application of GIS through combined lectures and laboratory exercises. In person offerings meet twice a week for fifty-minute lectures and once a week for a two-hour lab. Online offerings view recorded lectures covering the same material, and are required to do the same lab work. There is an average of approximately 60 pages of reading required each week, with reading quiz at the start of each week to gauge completion. There is a weekly discussion during the first half-hour of the required lab period, addressing impact, motivation, ambiguity, alternative evaluation, and outcomes. Conceptual models, algorithmic foundations, data collection, processing, quality, and control, database organization, transparency, and access, and major classes of analyses are covered. Impacts and evaluation of the strengths, biases, and weaknesses of alternative data processing and analytical approaches within the major classes of analysis are taught. A set of 12 exercises complements theory with practical application of the most used commercial software (attached exercise).

Students are exposed to concepts of the ethical and unethical use of technology, for example, in learning modified area unit theory, the concept underlying biased districting, and analyzing observed racial or income gerrymanders in recent elections. We teach the methods can be applied to design equitable or unrepresentative groupings, and how to document biased groupings.

Students consider the impacts of technology from multiple perspectives that include developers, users/consumers, and those indirectly affected. Diverse perspectives are examined at several points in the course, key to some sections. In several modules we stress how question framing may directly constraint the possible range of answers in spatial analysis. Through readings, lectures, and single and group exercises we underscore the importance of an adopted world view on the types of data collected and how these data are structured, and how choices on structure and type guide subsequent analysis. Students are challenged to develop data models and analytical frameworks from different perspectives within class and in homework and laboratory exercises. Various perspectives in synthesis and analysis are engaged, for example, a developer vs. a conservationist in land use planning, or both producer?s and user?s concepts on accuracy (please see attached Chapter 1, from the textbook).

Students engage in a process of critical evaluation that provides a framework with which to evaluate new technology in the future. An evaluation of the accuracy, utility, and appropriateness of GIS technology is a thread woven throughout the course. This is particularly stressed in our treatment of the differences inherent in algorithmic selection and analytical methods, the stress on the conceptual foundation that remains constant while hardware and software evolve, and the emphasis on logical and empirical evaluations of results. We seek to provide a foundation that will remain salient as technologies evolve.

The process of evaluation is dyads, paired or small group exercises, typically introduced in lecture or lab to engage active thinking. Given the large or online class size, this group formation can be self-assigned, but will be automatically assigned during synchronous meetings. These are typically short questions to be answered, for example, contrast how a logger or a wildlife biologist might structure a forest vegetation spatial database (variables, categories, linkages), justify these choices, and highlight the major similarities and differences between them. These activities typically take 10-15 minutes, including a problem or discussion topic, a goal, and a written and/or oral resolution. Students typically confer to resolve the problem, based on recent readings, lectures, and lab exercises, and typically finish with a volunteer, student-led discussion of a particular group?s reasoning and conclusions.

Mechanics

You should read the required book materials each week, typically a chapter or two comprised of 40 to 70

pages, before the start of the week. You will take a short quiz on the reading before the first lecture of the week. You should come to lecture either in-person or online and/or view the class videos each week. You should check for and complete any additional homework's required for the week and prepare for and take exams as appropriate (5 exams over the semester). You should participate in the lab in person, or through one of the online sessions, engaging in the discussion section at the start of each lab. You should then complete the weekly lab exercise. You may complete the exercises at a campus computer lab or at home. You should read the lab in advance, and review/note new procedures or activities. Labs usually require more than the two-hour period to complete, with an average of approximately two extra hours each week. This class is generally a greater time investment than most other classes, as it is a 4-credit, lab class. The Skok 35 and Green 210A labs (as well as other UMN Computer Labs) are open additional hours.

Several options exist for access to the required ArcGIS Pro software and data *(you choose the approach; you can use either of the options or switch between as needed throughout the class).*

1. Attend class lab session and use the provided computers, software and data.

2. Install the UMN provided Citrix receiver software and then access the CFANS virtual desktop via a web browser. This will allow direct network computer access to ArcGIS without installing ArcGIS on your computer. *(this approach can be used with Windows or MacOS computers).*

All Labs assignment will to be submitted via Canvas, https://canvas.umn.edu.

All Labs are due the Friday (11.55 p.m.) of the week **after** your scheduled Lab session. Late labs are docked by 1/3, and labs won't be accepted if they are more than 1 week late. Makeup labs are possible if the instructor has advance notice, so please anticipate conflicts, and contact the instructor. Labs are only accepted through the Canvas Course Site. **Labs are submitted as .pdf files**; please do not send .aprx, MSWord, or shapefiles. The final lab will have special requirements for submitting your work; this will be explained before the assignment.

Grading, Integrity, Ethics

Please note you may work together on labs, but you each must do every part of each lab and turn in entirely your own work. That means each of you should perform every step indicated in the lab manual. Your grade is for individual effort; copied files/maps from other students will be construed as cheating, at a minimum you'll get zero for the lab, and you may automatically fail the course.

We will try to grade labs in a one-week period, for quick turnaround. However, this won't happen in all cases. The four on-line exams will each be worth 8.20% points; the FINAL will be worth 16.39%. Each lab and homework will be worth 2.73%, except the final lab, which is worth 5.46%. **Grading will be on a straight scale, not on a curve**. If you all do well, you will all get an A. The scale is:

A	90 – 100				
B+	88 – 89.99	B	82 - 87.99	B-	80 – 81.99
C+	78 – 79.99	C	67 - 77.99	C-	65 – 66.99
D+	63 – 64.99	D	50 - 62.9		

Class assignments are weighted as follows:

13 required labs = 38.26%, 2 required homework = 5.46%, 13 on-line quizzes = 7.1%, 4 on-line exams = 32.79%, Final Exam = 16.39%); in addition, there are several opportunities to obtain extra credit (up to an additional 7.29% of the total course).

Note: during the class, when checking your grades on Canvas, please note the checkbox at the bottom of the "Assignments are weighted by group:" section; the check box "Calculate based only on the graded assignments" should be UNCHECKED to project your estimated FINAL Grade.

How EXTRA CREDIT is handled in the Canvas Grade Book

There are 4 Extra Credit opportunities: A 15-point Extra Credit Homework Quiz, a 15-point Extra Credit Lab, a 5-point Extra Credit GPS Lab and 5 possible points for "finding" Geocaches. These points COULD total up to 40 Extra Credit points. These 40 points amount to an extra 7.29% of the graded class assignments.

How this Works
Extra Credit (optional, extra credit opportunities): If all extra credit is completed, you would receive and EXTRA 7.29% of the regular class. Extra Credit is Awarded IN ADDITION to the regular class work.

Extra Credit will appear in the Student Grade Book throughout the class as 0% UNTIL the final grade calculation at the end of the class. (See the Grade Book Section "Assignments are weighted by group".) When the final grades are calculated we will enter "0" in all unsubmitted Extra Credit Assignments and change the Extra Credit Group percent (%) to 7.29%; So, at the very end of the class the TOTAL possible percent will display as 107.29%.

*If you do complete one or more Extra Credit Assignments during the class, your points will be recorded, as they are submitted & graded, and WILL SHOW up in the Grade Book but **WILL NOT be included in your Total % column** until the final grade calculation at the end of the class. If you wish to CALCULATE BY HAND the value of your Extra Credit work prior to the end of the class, do the following: take your graded Extra Credit Points and divide them by 40 and then multiply the result by 7.29. This calculation will allow you to predict the extra % that will be added to your total percent (as displayed in the Grade Book during the class). At the end of the class, we will do this same calculation in the grade book and improve your total percent position by whatever percent of Extra Credit you achieved*
.
*For example, say you did 20 of the possible 40 extra credit points. (20/40) * 7.29 = 3.645*
3.645% would then be ADDED to your regular class work percentage at the final grade calculation.

Student Conduct Code
The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected to adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see:
https://regents.umn.edu/sites/regents.umn.edu/files/2022-07/policy_student_conduct_code.pdf

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach and/or a student's ability to learn." The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities.

Use of Personal Electronic Devices in the Classroom
Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each instructor to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference:
https://policy.umn.edu/education/studentresp.

Scholastic Dishonesty

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy_student_conduct_code.pdf) If it is determined that a student has cheated, the student may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: https://policy.umn.edu/education/instructorresp.

The Office for Community Standards has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: https://communitystandards.umn.edu/avoid-violations/avoiding-scholastic-dishonesty. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class, e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

Makeup Work for Legitimate Absences

Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, please see: https://policy.umn.edu/education/makeupwork.

Appropriate Student Use of Class Notes and Course Materials

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: https://policy.umn.edu/education/studentresp.

University Grading Scales

The University has two distinct grading scales: A-F and S-N.

A-F grading scale. The A-F grading scale allows the following grades and corresponding GPA points:

Grade	GPA Points	Definitions for undergraduate credit
A	4.000	Represents achievement that significantly exceeds expectations in the course.
A-	3.667	
B+	3.333	
B	3.000	Represents achievement that is above the minimum expectations in the course.
B-	2.667	
C+	2.333	
C	2.000	Represents achievement that meets the minimum expectations in the course.

8
C- 1.667
D+ 1.333
D 1.000 - Represents achievement that partially meets the minimum expectations in the course. Credit is earned but it may not fulfill major or program requirements.
F 0.000 Represents failure in the course and no credit is earned.
S-N grading scale. The S-N grading scale allows for the following grades and corresponding GPA points:

Grade	GPA Points	Definitions for undergraduate credit
S	0.00	Satisfactory (equivalent to a C- or better)
N	0.00	Not Satisfactory

For additional information, please refer to: https://policy.umn.edu/education/gradingtranscripts.

Sexual harassment, sexual assault, stalking and relationship violence
The University prohibits sexual misconduct, and encourages anyone experiencing sexual misconduct to access resources for personal support and reporting. If you want to speak confidentially with someone about an experience of sexual misconduct, please contact your campus resources including the Aurora Center, Boynton Mental Health or Student Counseling Services (https://eoaa.umn.edu/report-misconduct). If you want to report sexual misconduct, or have questions about the University's policies and procedures related to sexual misconduct, please contact your campus Title IX office or relevant policy contacts.

Instructors are required to share information they learn about possible sexual misconduct with the campus Title IX office that addresses these concerns. This allows a Title IX staff member to reach out to those who have experienced sexual misconduct to provide information about personal support resources and options for investigation. You may talk to instructors about concerns related to sexual misconduct, and they will provide support and keep the information you share private to the extent possible given their University role.

https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy_sexual_harassment_sexual_assault_stalking_and_relationship_violence.pdf

Equity, Diversity, Equal Opportunity, and Affirmative Action
The University provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, membership or activity in a local commission created for the purpose of dealing with discrimination, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy_equity_diversity_equal_opportunity_and_affirmative_action.pdf.

Disability Accommodations
The University views disability as an important aspect of diversity, and is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (DRC) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

- If you have, or think you have, a disability in any area such as, mental health, attention, learning, chronic health, sensory, or physical, please contact the DRC office on your campus (UM Twin Cities - 626.1333) to arrange a confidential discussion regarding equitable access and

reasonable accommodations.

- Students with short-term disabilities, such as a broken arm, can often work with instructors to minimize classroom barriers. In situations where additional assistance is needed, students should contact the DRC as noted above.
- If you are registered with the DRC and have a disability accommodation letter dated for this semester or this year, please contact your instructor early in the semester to review how the accommodations will be applied in the course.
- If you are registered with the DRC and have questions or concerns about your accommodations please contact your (access consultant/disability specialist).

Additional information:

- Crookston - https://www.crk.umn.edu/units/disability-resource-center, myers062@crk.umn.edu
- Duluth - http://www.d.umn.edu/disability-resources, access@d.umn.edu
- Morris - http://www.morris.umn.edu/academicsuccess/disability/, hoekstra@morris.umn.edu
- Rochester - http://r.umn.edu/student-life/student-services/disability-resources, sdzavada@r.umn.edu
- Twin Cities - https://diversity.umn.edu/disability/, drc@umn.edu)

Mental Health and Stress Management

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu.

Academic Freedom and Responsibility: for courses that do not involve students in research

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost. [Customize with names and contact information as appropriate for the course/college/campus.]

* Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".