

# EAS 531 / ENVIRON 411: Principles of GIS

<b>Instructors</b>	Professor: Dr. Neil Carter, School of Environment & Sustainability	Secs 003 & 004 GSI: Nathaniel Arringdale, School for Environment & Sustainability	Sec 002 & 005 GSI: Haley Mullen, School for Environment & Sustainability
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<b>Office Hours</b>	Wednesday 1-2:30pm or by appt.	Wednesday 1:30-3:30pm.	Thursday 3-5pm.
<b>Class Meets</b>	Lecture (001): Tuesdays and Thursdays 1:00 – 2:30 pm (synchronous remote lecture class) Lab: Tues. 3:00-6:00 pm (002); Tues. 6:30-9:30 pm (003); Wed. 6:00-9:00pm (004); Thurs. 6:00-9:00 pm (005) (in-person lab class)		
<b>Objectives</b>	One of the most relevant and highest growth job markets in environmental sciences is Geographic Information Systems (GIS). Graduates of this comprehensive <i>Principles of GIS</i> course are well-prepared for jobs having GIS components in a variety of professional fields. The goals of this class are therefore to provide a firm understanding of the conceptual and analytical approaches and uses (lecture), plus technical methods (lab) in GIS. The lab is mainly taught using latest versions of ArcGIS Desktop and ArcGIS Pro; we will also introduce QGIS. Labs and lecture also cover applications of GIS in the natural, social, data, and environmental sciences making this course of interest to students broadly.		
<b>Prerequisites</b>	There are no specific prerequisites other than graduate or jr/sr standing. Prior general exposure to any type of analysis and quantitative reasoning is no doubt helpful. This course can be taken as a first comprehensive GIS course or as a follow-on to GIS courses with more limited content. We introduce and teach what you need to learn. Past experience has shown that students both with and without prior exposure to GIS can succeed equally well in this course if they apply themselves and keep up with the coursework and reading.		
<b>Main Deliverables</b>	This is a high-content lecture-lab course. Deliverables are two lecture exams (midterm and final), and weekly lab assignments. Lab assignments (the homework for this course) require additional work outside of scheduled lab times.		
<b>Required Textbook</b>	<b>Required Textbook</b> – you will read much of Bolstad, P. <i>GIS Fundamentals: A First Text on Geographic Information Systems</i> , <b>Sixth Edition</b> (inexpensive and should also come with digital access).		
<b>CANVAS site</b>	An EAS531/ENVIRON411 CANVAS site will be used for class announcements, to distribute pdf copies of lecture slides, scheduling, lecture & lab recordings, materials for lab assignments, online submission of lab assignments, grading, exams, etc.		

## Course Policies

<b>Attendance</b>	The course will be taught synchronously this Winter 2022. The lecture will be remote via Zoom and the labs will be in person. Because the lectures will be recorded, it will be possible to view them asynchronously as well but please attend them synchronously if possible.
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	<p>The best predictors of performance in 531/411 are 1) thorough familiarity with lecture material 2) reading the textbook, and 3) completion of labs. Be on time for lecture and lab sessions.</p> <p>We encourage you not to be absent during the academic semester. However, if you have any unavoidable formal absences (i.e. a required conference presentation etc.) that might interact with lab or other graded deadlines you must: a) let us know about this at the <b>beginning of the semester</b> and b) provide a formal note from your academic advisor. If absences conflict significantly with this course and its graded material, they may not be approved. See also Exams and Grading below. Do <b>not</b> plan to miss exams.</p>
<p><b>Labs &amp; Assignments</b></p>	<p>Labs will be held in 3325 Dana and start promptly on the hour or half hour.</p> <p>Attendance in lab is expected as it is the most efficient time to interact with your GSI regarding questions about the technical aspects of lab. Doing so will be considerate of your GSI's time. The GSI also gives a short presentation at the beginning of each lab. If you will have to miss lab, notify your GSI as soon as possible beforehand.</p> <p>Although you may talk to each other about lab assignments, <b>each student is expected to do every part of each lab themselves and to turn in your own unique write-ups and maps. Written answers must be <u>in your own words</u>.</b></p> <p>You will have one week to complete a lab assignment. Completed labs must be submitted before or by the official start of your next lab period to be on time. Labs must be submitted via the assignment tool on CANVAS as a single PDF file. (To do this it will be necessary to convert Word documents and map files to PDFs and merge them so contact your GSI if you're unsure how to do this). Maps must always be on a <u>separate page</u> and in the best format for the shape of the particular map (landscape or portrait). <b>Always name your file as follows:</b></p> <p>Uniqname_LabAssignment### example: ncarter_Lab01</p> <p>There are multiple places/ways to access GIS software outside of lab to complete your assignment. We have the software installed for you in both the Dana Bldg. computer classroom (3325), the 2<sup>nd</sup> floor computer lab (2315), and most other Windows-based computer labs on campus. It is also possible to install a student copy of ArcGIS on your personal computer (Windows OS only) by following the instructions at <a href="http://www.itcs.umich.edu/sw-info/gis/arcgis.php">http://www.itcs.umich.edu/sw-info/gis/arcgis.php</a> Finally, you can access ArcGIS by logging into <a href="http://virtuallsites.umich.edu">virtuallsites.umich.edu</a> or using <b>Apps Anywhere</b> (link at <a href="http://virtuallsites.umich.edu">virtuallsites.umich.edu</a>). If you use your own computer, you yourself are responsible for its systems administration and installing the software.</p> <p>For this course you will use the University of Michigan's AFS space to save lab instruction documents, GIS data, your work and write-ups. It is important for you to <b>REQUEST YOUR AFS SPACE PRIOR TO LAB 1</b> using the AFS Self-Provisioning Tool found at <a href="http://mfile.umich.edu/">http://mfile.umich.edu/</a> For an AFS overview see: <a href="http://documentation.its.umich.edu/node/234/">http://documentation.its.umich.edu/node/234/</a> We recommend that you keep your AFS space and course materials well-organized as later 531 labs and lab exams rely on performing tasks that are described in detail in earlier labs materials.</p>

<b>Grading and Exams</b>	Your semester grade will be based on one lecture midterm exam, one lecture final exam (both also remote, through Canvas), and 12 lab assignments. Lecture exams are cumulative and focus on thorough understanding of the concepts presented in both lecture and textbook. Should serious circumstances beyond your control result in missing an examination, documented verifiable evidence must be presented. Otherwise missed examinations will not qualify for make-up procedures. Your lab grade will be based on 12 (weekly) lab assignments. Your lab instructor (GSI) will grade your lab assignments. Unexcused late lab assignments will lose 2 points per day late, up to a maximum of 50% lost (in addition to points lost due to answer quality) if turned in.
<b>Disabilities or Religious holidays</b>	We will make every effort to accommodate the needs of students with hearing, visual, or other disabilities in coordination with Rackham policy: <a href="https://rackham.umich.edu/rackham-life/students-with-disabilities/accommodations-for-graduate-students-with-disabilities">https://rackham.umich.edu/rackham-life/students-with-disabilities/accommodations-for-graduate-students-with-disabilities</a> . Likewise, we will try to accommodate for major religious holidays. If you are an SEAS international student located in a significantly different time zone let us know at beginning of the course and also contact SEAS OAP staff so that they have a record of this situation. <i>Be sure to let us know your needs <b>well in advance</b>.</i>
<b>Participation</b>	Your instructors are committed to the principle of universal learning. This means that our classroom, our virtual spaces, our practices, and our interactions be as inclusive as possible. Mutual respect, civility, and the ability to listen and observe others carefully are crucial to universal learning.
<b>Covid-19</b>	Elements of the syllabus, assignments, and course structure may change based on potential public health developments. SEAS students should contact the SEAS Office of Academic Programs if your health is impacted by Covid-19 and of course let your course staff know as well.
<b>For All Classes</b>	For the safety of all students, faculty, and staff on campus, it is important for each of us to be mindful of safety measures that have been required for our protection. By returning to campus, you have acknowledged your responsibility for protecting the collective health of our community. Your participation in any course on an in-person basis is conditional upon your adherence to all safety measures mandated by the State of Michigan and the University, including maintaining physical distancing of six feet from others, and properly wearing a face covering in class. Other applicable safety measures may be described in the Wolverine Culture of Care, the University’s Face Covering Policy for COVID-19 and SEAS Questions & Concerns document. Your ability to participate in any course in-person as well as your grade may be impacted by failure to comply with campus safety measures. Individuals seeking to request an accommodation related to the face covering requirement under the Americans with Disabilities Act should contact the Office for Institutional Equity. If you are unable or unwilling to adhere to these safety measures while in any face-to-face class setting, you will be required to participate on a remote basis (if available) or to disenroll from the class. You are also encouraged to review the Statement of Students Rights and Responsibilities and check-in with the Office of Academic Affairs Director to navigate support and resources for you.

## Computing

<b>Remote Instruction</b>	Remote instruction for lecture is expected to take place using Zoom. All students should have both Zoom software/app loaded on their personal computers before the first day of class (first synchronous lecture session) and know how to connect. You will receive a meeting invite prior to your first class period – check your UMICH email.
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<b>Software</b>	Zoom: <a href="https://its.umich.edu/communication/videoconferencing/zoom/getting-started">https://its.umich.edu/communication/videoconferencing/zoom/getting-started</a>
<b>Recordings &amp; Course Materials</b>	<p>Course lectures may be audio/video recorded and posted on canvas for all students in this course. As part of your participation in this course, you may be recorded. If you do not wish to be recorded, please contact your instructor just prior to the first class meeting (or as soon as you enroll in the course, whichever is latest) to discuss alternative arrangements or technology use.</p> <p>Students are prohibited from recording/distributing course lectures or labs, except as necessary as part of approved accommodations for students with disabilities. Any approved recordings may only be used for the student's own private use.</p> <p>Students are also prohibited from posting or sharing any curricular materials made available through this UM course to persons or locations outside of this course and canvas site.</p> <p><a href="https://safecomputing.umich.edu/be-aware/privacy/privacy-u-m/videoconferencing/recording-privacy-concerns">https://safecomputing.umich.edu/be-aware/privacy/privacy-u-m/videoconferencing/recording-privacy-concerns</a></p>

### Grade Calculation

Assignment(s)	Dates	% of Final Grade	Overall %	Letter Grade
Lab Write-ups	Weekly	60	97.0 or above	A+
Lec Midterm	February 17	20	91.0 to 96.9	A
Lec Final	Apr 26	20	89.5 to 90.9	A-
			85.5 to 89.4	B+
			81.0 to 85.4	B
			79.5 to 80.9	B-
			75.5 to 79.4	C+
			71.0 to 75.4	C
			69.5 to 70.9	C-
			65.5 to 69.5	D+
			61.0 to 65.4	D
			59.5 to 60.9	D-

Covid-19 semester updates to grading: All university graduate courses will use a modified grading system that awards letter grades of A to B- and a notation of "NRC" (No Record COVID) for grades of C+ to E. Students who receive an NRC for grades of C-, C, or C+ may choose to earn course credit by converting to a letter grade. Letter grades of D+ or lower do not receive Rackham credit. Students will be able to view their letter grade through Wolverine Access Student Business before deciding whether to convert a notation of NRC. Converted letter grades will appear on the transcript and will be used to recalculate the GPA. Deadlines for converting NRC notations to letter grades will be posted in the updated Rackham Academic Policies as soon as they are available.

## EAS 531: Schedule of Topics

Date	Topic(s)	Lab	Readings 6 <sup>th</sup> ed
Thurs Jan 6	Lec 1: What is 'GIS'?; Course Goals and Logistics; Maps as models	NA	Ch 1 p 1-17, 22; Ch 2 p 39-40; Ch 4 p 150-156
Tues Jan 11	Lec 2: Geographical and Attribute Measurement	Lab 1: Intro to ArcGIS (Desktop)	Ch 2 p 27-38, p 66-67
Thurs Jan 13	Lec 3: Map Design		Ch 4 p 181-188; Ch 9 p 384-393; ESRI: Intro Map Design p 1-5, 7-14, 16-19
Tues Jan 18	Lec 4: Vector Data Structures	Lab 2: Creating Map Layouts (Desktop)	Ch 2 p 40-50, p 67-70
Thurs Jan 20	Lec 5: Raster Data Structures		Ch 2 p 51-59; p 69-72
Tues Jan 25	Lec 6: Datums, Projections & Coordinate Systems	Lab 3: Spatial Data Structures (Desktop)	Ch 3 p 87-89, 90-107, 108-113, 116-136
Thurs Jan 27	Lec 7: Attributes & Databases		Ch 8 p 331-344, p 350-365
Tues Feb 1	Lec 8: Data Creation & Georeferencing	Lab 4: Projections & Coordinate Systems (Desktop)	Ch 4 p 156-180
Thurs Feb 3	Lec 9: Data – GPS		Ch 5 p 201-217
Tues Feb 8	Lec 10: Data – Remote Sensing	Lab 5: Intro to ArcGIS <b>Pro</b> (Pro)	Ch 6 p 245-259, 270-292
Thurs Feb 10	Lec 11: Data – Existing GIS Data Case Study: GIS creation - Livelihoods in Kamchatka, Russia		Ch 7 – all pages
Tues Feb 15	Lec 12: Data Query & SQL		Ch 9 p 373-384, 394-395
Thurs Feb 17	<b>LECTURE MIDTERM</b>		
Tues Feb 22	Lec 13: Distance, Vector Buffer, Join & Overlay	Lab 6: Data Creation & Attributing (Pro) – DUE WEEK AFTER BREAK.	Ch 9 p 398-419
Thurs Feb 24	Lec 14: Metadata and Accuracy		Ch 4 p 187-191; Ch 14 p 620-634

Tues Mar 1	<b>NO CLASS (Break)</b>		
Thurs Mar 3	<b>NO CLASS (Break)</b>		
Tues Mar 8	Lec 15: Raster Analysis Basics		Ch 10 445-461
Thurs Mar 10	Lec 16: Neighborhood Operations Case Study: GIS inputs for Modeling Bird Habitat in Northern Michigan	Lab 7: GIS Query & Analysis (Pro)	Ch 10 p 462-471
Tues Mar 15	Lec 17: Cartographic Modeling Case Study: Kit Fox Habitat GIS Model		Ch 13 p 573-593
Thurs Mar 17	Lec 18: Terrain Analysis I – DEMs, DSM, TINs, Slope & Aspect	Lab 8: Application – Land- Use Change (Pro)	Ch 2 p 60; Ch 11 p 485- 493, 503-509
Tues Mar 22	Lec 19: Terrain Analysis II – Watershed & Hydrology		Ch 12 p 494-503
Thurs Mar 24	Lec 20: Distance & Cost Distance	Lab 9: Application – Raster Suitability Mapping (Pro)	Ch 10 p 471-475
Tues Mar 29	Lec 21: Network Analysis / QGIS Open Source Software		Ch 9 p 420-425
Thurs Mar 31	Lec 22: Spatial Interpolation	Lab 10: Application – Terrain / Viewshed Analysis (Pro)	Ch 12 p 521-534, 541-544
Tues Apr 5	Lec 23: Street Geocoding Case Study: Assessing Environmental Justice using GIS		Ch 9 p 426-428
Thurs Apr 7	Lec 24: Cost Distance & Model Builder Case Study: Glacier National Park Trail Planning	Lab 11: Intro to <b>QGIS</b> (QGIS)	Ch 12 p 593
Tues Apr 12	Lec 25: GIS & Society	Lab 12: Application – Developing a Least-Cost Path Model (Pro) <b>OR</b> Geocoding & Pollution Health Disparities (Pro)	Ch 14 p 619
Thurs Apr 14			
Tues Apr 19	<b>NO CLASS (study break)</b>		
Thurs	<b>NO CLASS (study break)</b>	NO LAB	

Apr 21			
Tues Apr 26	<b>LECTURE FINAL EXAM</b>		