Syllabus: Remote Sensing of the Environment

Geography 2030 - Fond du Lac Tribal and Community College – Fall 2022

Syllabus and schedule are subject to changes at the discretion of the course instructor.

Instructor

Dr. Carl M. Lemke Oliver Sack (he/they). I prefer to be called Carl; if you feel more comfortable referring to me by my last name, just use Sack (as in Dr. Sack and Professor Sack).

Contact Information

Email: carl.sack@fdltcc.edu. I reply to all student emails within 24 hours.
Cell Phone: (608) 712-8335. Call or text at any time; you will not bother or disturb me. If you call and I don't answer, please leave a voicemail. I generally reply to voicemails and texts within a few minutes to a few hours.

Office Hours

10:45 AM-12:45 PM Mondays & Wednesdays, or by appointment, in Room W222 on campus or via Zoom at https://minnstate.zoom.us/j/91632633584.

Class Meetings

1-3:40 PM Mondays & Wednesdays, in Room 208 or by Zoom at https://minnstate.zoom.us/j/98343827617 (note this is different from the address for office hours above). Unless otherwise notified by email, you may choose to come to class in person or join by Zoom. If you come in person, you must follow any COVID protocols set by our campus administration. If I must quarantine or care for a sick family member, I will email everyone and we will hold class exclusively over Zoom as necessary.

Course Overview

If you've ever looked at the satellite imagery on a web map, you have used remotely sensed data. Hundreds of satellites circle the Earth, not just taking pictures but sensing temperature, moisture, plant life, geology, and much more. Radar, LiDAR, and other active sensing technologies have revolutionized our view of the Earth's surface and subsurface. Besides satellites, sensors are everywhere: on planes, drones, even in your pocket! In this course you will learn how to find, capture, process, and use remotely sensed geodata for a wide variety of applications. This course fulfills MnTC Goal Area 3: Natural Sciences.

Course Goals

Upon completion of this course, students will be able to:

1. Identify the major divisions of the electromagnetic spectrum and their usefulness for remote sensing
2. Collect, manipulate, and analyze reflectance data
3. Perform land cover classification
4. Distinguish between different image acquisition platforms
5. Produce meaningful image analyses
6. Identify real-world applications of remotely sensed images and analysis
7. Use remotely sensed imagery in a GIS
8. Assess the data needs for remote sensing projects in different locations
9. Apply calculations to remotely sensed imagery to derive new information about the image content (e.g., NDVI for vegetation health)
10. Perform land cover change analysis

Technology

This is a technology-heavy course. All technology for the course will be provided to you in the computer lab in Room 208 on campus during class periods, and is available in the Open Computer Lab at other times. We also have laptop PCs equipped with GIS software available for checkout. Campus laptops are to be used for school purposes only, and their replacement cost is $1,200 if they are lost or damaged. If you prefer to use your own computer, it must be a Windows PC and meet the system requirements for ArcGIS Pro.

We will use Microsoft OneDrive for file transfer and cloud backup. On the first day of class, you will be asked to pick a computer in the lab for use throughout the semester, and sync OneDrive on that machine with your Office 365 campus account. It is recommended that you sync OneDrive with this account on other devices you own or may use for the course. Other software you will use in this course includes a web browser (preferably Chrome or Firefox), the D2L Brightspace learning management system, Windows File Explorer, 7-Zip File Manager, Microsoft Excel, ArcGIS Online, and ArcGIS Pro.

For general technological assistance, contact our Instructional Technology Specialist, Robin Anderson, at robin.anderson@fdltcc.edu. For questions specific to GIS software, contact the course instructor (Carl).

Learning Resources

Readings to accompany course lectures will be from free online sources. We will be using the online text *Fundamentals of Remote Sensing* provided by the Canada Centre for Mapping and Earth Observation, a division of Natural Resources Canada. Some readings will also come from *The Geographic Information Science & Technology (GIS&T) Body of Knowledge*. Links to all assigned readings will be posted on the D2L course site.

Special Note: Visual impairments

Because of the subject matter of this course, there is no reasonable substitute for good vision. If you are vision impaired, you will need to wear appropriately corrective glasses or contact lenses while doing course activities. If you are legally blind, notify me right away and I will do what I can to reasonably accommodate.

What you can expect from me

I intend to lay out course expectations in a clear and concise manner, and to be open to constructive feedback. I will be hands-on in providing assistance, assessing your work regularly, and helping you to improve your skills. I will be as responsive as possible to e-mails from students in the class; typically, this means that you will get a response within 24 hours (please allow for a little longer on the weekends). If you need special accommodation, please follow the procedure in the Disabilities Notice below and then let me know as soon as possible so I can work with your plan accordingly.

What I expect from you

This is a 4-credit (2 lecture, 2 lab) sophomore-level college course. I expect you to put in *11-12 hours per week total* on average for the course, including class meetings and homework. I expect you to keep up with the course reading and lectures, take notes, attend *every* course meeting or let me know *in advance* if you can't make it, participate fully in class discussions, and turn in assignments on time or communicate *in advance* if you need an extension. *You MUST check your campus email DAILY* for communications regarding the course. I strongly encourage you to be curious about the material we are learning, ask lots of questions, and consider yourself part of an engaged community of learners.

Course Feedback

Your direct and timely feedback will help improve the class. I am open to any suggestions you have both during class meetings and via private communication. If you are experiencing a problem, the sooner you let me know, the sooner I will be able to address it and the easier it will be to solve.

Course Structure and Activities

The topic and activity sequence is given in the schedule at the end of the syllabus. Course activities will include:

Readings

You will be assigned reading homework to complete for each topic. Readings will support and extend the lecture material. I recommend taking cursory notes on the reading, but will not require you to turn in these notes.

Video Lectures and Notes

Lecture material will be delivered in class. You are expected to **take notes on the lectures**. Each lecture includes prompts for discussion that you will answer in writing as well. You will submit photos of your hand-written notes and responses to prompts OR a document with typed notes and responses for a grade one week after the corresponding lecture.

Quizzes

For each topic, you will take an open-note quiz covering the lecture and associated reading a week after the lecture is given. You will be able to retake the quiz on your own as many times as you like, but only the first attempt will be graded. You can earn missed points back by emailing me the *correct answer* and *an explanation of why it is correct* for each answer you got wrong on the first try. Notes and quizzes will be worth equal grade points each week.

Lab Activities

Each topic will include at least one hands-on lab assignment corresponding to the reading and lecture material for that module. Lab assignments will increase in complexity and length as the semester progresses and you gain remote sensing skills.

Class Participation

We will use our class meetings for lecture, topical discussion, demonstrations, and work on lab activities so you can receive assistance as you are completing them. **Whether you join class in person or via Zoom, you are expected to remain in the lab or on the meeting for the entire class period**. You will receive a participation grade for each class period: 4 points for arriving on time and staying until dismissed, 2 or 3 points for coming late and/or leaving early, 1 point if you need to miss class and inform me in advance, and 0 points for no show/no call.

Exams

There will be a Midterm Exam and a Final Exam. Both will be open-book/open-note and based on the concepts covered by prior quiz and lab questions, with the addition of some short answer analysis questions. The Final Exam will be open during our finals period (Friday, December 16, 1-2:50 PM).

Grading

Percentages of your final grade:

- Attendance and Participation: 10%
- Notes and Quizzes: 20%
- Lab Assignments: 50%

- Exams: 20%

Final grade breakdown:

A. 90-100%
B. 80-89%
C. 70-79%
D. 60-69%

I reserve the right to curve grades upward based on the class distribution of final grades. You will never get a lower grade based on your score than what is indicated above.

Late Work

All work is due by the start of class (1 PM) on the due date unless you have been granted an extension in advance. Work submitted up to 1 week late without an extension will be docked 15% of available points; work submitted more than 1 week late but before the Final Exam period will have 50% subtracted. I will not accept late work after 11:59 PM on December 17.

Plagiarism

You may not copy others' work without attribution/citation or have others complete your work for you. If you copy text, it must be in double-quotes ("") with credit given to the original author, and should account for a small minority of your submission. Unless otherwise noted in assignment directions, there are no team-based assignments in this course; you must submit your own unique product for each assignment. Plagiarism, or presenting the work of another as your own (a.k.a. "copying"), results in an automatic 0 on the assignment. Multiple instances of plagiarism may result in a F in the course and be subject to any other disciplinary actions mandated by this institution and the Minnstate system.

Disabilities Notice

Fond du Lac Tribal & Community College is committed to providing equitable access to learning opportunities for all students. Under the Americans with Disabilities Act and Section 504 of the Rehab Act, Fond du Lac Tribal & Community College provides students with disabilities (e.g., mental health, attentional, learning, chronic health, sensory or physical) reasonable accommodation to participate in educational programs, activities or services. Students with disabilities requiring accommodation to participate in class activities or meet course requirements should first complete an intake form and necessary requirements with Nancy Olsen, Disability Services coordinator, to establish an accommodation plan. She can be reached at nancy.olsen@fdltcc.edu or 218-879-0819.

Sexual Violence

Fond du Lac Tribal & Community College is committed to providing an environment free of all forms of discrimination and sexual harassment, including sexual assault, domestic and dating violence, gender or sex-based bullying and stalking. If you or someone you know has experienced gender or sex-based violence (intimate partner violence, attempted or completed sexual assault, harassment, coercion, stalking, etc.), know that you are not alone. Fond du Lac Tribal & Community College has staff members trained to support survivors in navigating campus life, accessing resources, providing accommodations, assistance completing with protective orders and advocacy. For more information regarding the Campus Security Report, the following link will give you a report on the Clery Compliance and Security Report at FDLTCC: http://fdltcc.edu/about-us/policies-reports/campus-security-policies-reports/

Please be aware that all Fond du Lac Tribal & Community College employees are required to report any incidents of sexual violence and, therefore it cannot guarantee the confidentiality of a report, but it will consider a request for confidentiality and respect it to the fullest extent possible. If you wish to report sexual misconduct or have questions about school policies and procedures regarding sexual misconduct, please contact Anita Hanson, Dean of Student Services, at 218-879-0805 or anita.hanson@fdltcc.edu.

Course Schedule

Subject to change by the instructor

Class Date	Work due and class meeting agenda
M 8/22	**Agenda:** • Overview syllabus • Lecture 1: Remote Sensing Key Concepts & History • Overview Lab 1: NASA Earth Images **Reading:** *GIS&T Body of Knowledge* "Remote Sensing Platforms" Sections 1-3
W 8/24	**Agenda:** Work on Lab 1

Class Date	Work due and class meeting agenda
M 8/29	**Due:** • Lecture 1 notes • Lab 1 **Agenda:** • Review Lecture 1 • Quiz 1 • Present images from Lab 1 • Lecture 2: Electromagnetic Radiation • Overview Lab 2: Measuring Radiation **Reading:** *Fundamentals* Sections 1.1-1.5 (PDF 1.2-1.6)
W 8/30	**Agenda:** Work on Lab 2
M 9/5	NO CLASS (Labor Day)
W 9/7	**Due:** • Lecture 2 notes • Lab 2 **Agenda:** • Review Lecture 2 • Quiz 2 • Lecture 3: Aerial Photography • Conduct drone survey (weather and time permitting) • Overview Lab 3: Aerial Survey Photogrammetry **Reading:** • *Fundamentals* Sections 1.6 & 2.6 (PDF 1.7 & 2.7) • *GIS&T Body of Knowledge* "Aerial Photography: History and Georeferencing"
M 9/12	**Due:** Lecture 3 notes **Agenda:** • Review Lecture 3 • Quiz 3 • Lecture 4: Image Interpretation • Overview Lab 4: Image Interpretation • Begin work on Labs 3 and 4 **Reading:** *Fundamentals* Section 4.1 (PDF 4.2)

Class Date	Work due and class meeting agenda
W 9/14	**Agenda:** Work on Labs 3 and 4
M 9/19	**Due:** Lecture 4 notes **Agenda:** • Review Lecture 4 • Quiz 4 • Work on Labs 3 and 4
W 9/21	**Due:** • Lab 3 • Lab 4 **Agenda:** • Discuss lab findings • Lecture 5: Satellites • Overview Lab 5: NASA Worldview **Reading:** • *Fundamentals* Sections 2.1-2.5 & 2.7 (PDF 2.2-2.6 & 2.8) • *GIS&T Body of Knowledge* "Remote Sensing Platforms" Sections 4-6
M 9/26	**Agenda:** Work on Lab 5
W 9/28	**Due:** • Lecture 5 notes • Lab 5 **Agenda:** • Review Lecture 5 • Quiz 5 • Lecture 6: Active Microwave • Overview Lab 6: Radar Images **Reading** • *Fundamentals* Sections 3.0-3.9 (PDF 3.1-3.10)
M 10/3	**Agenda:** Work on Lab 6

Class Date	Work due and class meeting agenda
W 10/5	**Due:** • Lecture 6 notes • Lab 6 **Agenda:** • Review Lecture 6 • Quiz 6 • Lecture 7: Lidar • Overview Lab 7: Lidar **Reading:** *GIS&T Body of Knowledge* "Light Detection and Ranging (LiDAR)"
M 10/10	**Agenda:** Work on Lab 7
W 10/12	**Due:** • Lecture 7 notes • Lab 7 **Agenda:** • Review Lecture 7 • Quiz 7 • Midterm Exam review
M 10/17	MIDTERM EXAM
W 10/19	NO CLASS (Carl at NACIS conference)
M 10/24	**Agenda:** • Review exam answers • Lecture 8: Digital Imagery • Overview Lab 8: Digital Image Enhancement **Reading:** • *Fundamentals* Sections 4.2-4.4 (PDF 4.3-4.5) • *GIS&T Body of Knowledge* "Nature of Multispectral Image Data"
W 10/26	**Agenda:** Work on Lab 8

Class Date	Work due and class meeting agenda
M 10/31	**Due:** • Lecture 8 notes • Lab 8 **Agenda:** • Review Lecture 8 • Quiz 8 • Lecture 9: Image Transformations and Indices • Overview Lab 9: Vegetation Analysis **Reading:** *Fundamentals* Sections 4.5, 5.1.0-5.1.2, and 5.2.0-5.2.2 (PDF 4.6, 5.2.0-5.2.2, 5.3.0-5.3.3)
W 11/2	**Agenda:** Work on Lab 9
M 11/7	**Due:** • Lecture 9 notes • Lab 9 **Agenda:** • Review Lecture 9 • Quiz 9 • Lecture 10: Image Classification • Overview Lab 10: Unsupervised Classification **Reading** • *Introduction to Remote Sensing* Sections 12.1-12.6
W 11/9	**Agenda:** Work on Lab 10
M 11/14	**Due:** • Lecture 10 notes • Lab 10 Part 1: Spectrally classified image **Agenda:** • Review Lecture 10 • Quiz 10 • Work on Lab 10 Part 2: Post-processing
W 11/16	**Agenda:** Work on Lab 10 post-processing

Class Date	Work due and class meeting agenda
M 11/21	**Due:** Lab 10 final classified image **Agenda:** • Overview Lab 11: Supervised Classification • Work on Lab 11
W 11/23	NO CLASS—Thanksgiving
M 11/28	**Agenda:** Work on Lab 11
W 11/30	**Agenda:** Work on Lab 11
M 12/5	**Due:** Lab 11 **Agenda:** • Discuss classification labs results • Lecture 11: Accuracy Assessment • Overview Lab 12: Accuracy Assessment **Reading:** • *GIS&T Body of Knowledge* "Ground Verification and Accuracy Assessment"
W 12/7	**Agenda:** Work on Lab 12
M 12/12	**Due:** • Lecture 11 notes • Lab 12 **Agenda:** • Review Lecture 11 • Quiz 11 • Discuss accuracy assessment results • Final Exam review
F 12/16	FINAL EXAM