Syllabus for GIS 420: Remote Sensing & Image Analysis, Fall 2020
Instructor: Dr. Tora Johnson, GIS Director, Office: Science 107A

NOTE: Due to the pandemic, I will rarely be in my office and will never be in the lab. The best way to reach me is email, cell call or text, or chat via Google or Facebook.

Phone: (207) 255-1214 (office) / (207) 266-2268 (cell) ~ Email: tjohnson@maine.edu
Office Hours (SUBJECT TO CHANGE): Tuesdays & Fridays 12 - 2pm & Wednesdays 3:30 - 5pm or by appointment

YOU MAY RESERVE TIMES TO MEET WITH TORA DURING OFFICE HOURS BY PHONE OR ZOOM AT http://bit.ly/toraofficehours. If you are meeting via Zoom, check your email at your meeting time or simply log onto https://maine.zoom.us/j/2072551214. You may use audio via your computer microphone and speakers or via telephone: US: +1 646 876 9923 or +1 669 900 6833 or +1 408 638 0968 (in Canada: +1 647 558 0588). Meeting ID: 207 255 1214

1. Class Meetings:

Lectures: Thursdays from 6:30 to 8:20pm. Tora will lecture via Zoom. On campus section students may be in the GIS lab for lecture if they choose.
Labs: Complete exercises on your own.

IMPORTANT: All students are required to use the course website on Brightspace for assignments, quizzes, discussion forums, grades and streaming lectures. No work will be accepted via email.

2. Prerequisites: Students must either do course work in the UMM GIS laboratory or own or have access to a computer that meets the minimum system requirements for the following software:

Students in the on-campus section will have access to the UMM GIS laboratory in Torrey 223 until Thanksgiving Break. After break, students may only access the lab computers remotely or by special permission. **YOU WILL NEED A PAIR OF HEADPHONES OR EARBUDS FOR EACH CLASS,** AS OUR LECTURES WILL BE VIA ZOOM, AND WE ARE NO LONGER PROVIDING LOANERS HEADSETS.

Students in the online sections and students in the blended section after break must either…

- Have a computer (Windows only) that meets the minimum system requirements for ArcGIS Pro and Global Mapper. We will provide software for free.

OR

- Have a computer (Windows or Mac--no tablets or Chromebooks) and broadband internet access to remotely access a computer in the UMM GIS lab or Nutting 254 on the Orono campus. We will provide information about how to access the computers remotely in class.

Students must have or have access to a broadband internet connection for watching lectures and downloading and uploading data for assignments. A webcam and microphone is recommended but not required.

3. Course Description: This course introduces remote sensing technologies used in mapping, with an emphasis on satellite imagery. Using industry standard software and imagery, students learn basic image analysis for oceanographic modeling, land cover change detection, climate analysis and similar applications. The course combines lecture, discussion and mapping exercises which cover the remote sensing technologies and image formats, the physics of light and optics, potential sources of error, analytical methods and applications of remote sensing in a variety of fields. The semester culminates in a final project. Prerequisites: GIS 300 and GIS 400, or permission of instructor. 4 credits.

4. Learning Outcomes

A. Ability to describe at least five different remote imaging technologies and their respective data formats
B. Ability to describe the physical and optical processes relevant to remote sensing, including absorption, reflectance and spectral signatures
C. Ability to describe sources of distortion and error in remotely sensed data and ways to avoid or mitigate distortion and error
D. Ability to locate and download image data of at least three passive satellite arrays for use in image analysis software
E. Ability to describe the basic principles of image processing, visualization and analysis
F. Intermediate ability to use at least one industry-standard image analysis software application
G. Ability to describe and apply at least five standard indices for spectral analysis to detect surface phenomena
H. Introductory ability to conduct supervised and unsupervised classification of satellite multi-spectral imagery
I. Intermediate ability to ground truth spectral analyses, including the use of Global Positioning System receivers and field spectrometers
J. Introductory ability to perform a change detection analysis using multi-spectral imagery
K. Ability to assess, troubleshoot and solve unique technical problems arising as part of an image analysis project

4. Methodology: This course relies heavily upon learning advanced image analysis software and applying it to geographic problems. To this end, the course includes lab assignments, lectures, activities, assignments, and discussions intended to provide students with the knowledge, skills, and perspectives they need to understand and use remotely sensed GIS data.

5. Activities and Assignments: Late assignments, without PRIOR arrangement with the instructor, will receive a reduced grade.

- Lab Assignments: There will be weekly lab exercises

- Quizzes: There will be periodic quizzes on the course website

- Problem Sets: In addition, there will be two or three assignments that allow students to practice and apply the concepts and skills presented in class. The problem sets will commonly include both map-making exercises and written responses. Assignments must be submitted via the course website to receive full credit.

- Final Project: Each student will be responsible for completing a final project applying the course concepts and skills to a problem of interest. In addition to maps, the project will include thorough documentation of the process, relevant background, and theoretical frameworks.

- Final Project Presentation: Each student will give a 10 to 15 minute presentation of their final project at the end of the semester. If the class does one or more group service projects for clients, the presentations will likely be given to the clients as well as classmates.

6. Attendance and Class Participation Policy:

Attendance in the weekly synchronous sessions is required and necessary for success in the class. A link to live lectures is on the homepage of the course website. Attendance will be taken at each session, and a code will be provided on the video for students who are absent. Recorded lectures will be available on the course website on the content page for that week, so if you miss a class you can make up the missed material and gain partial credit for attendance.

You should plan to log into the course website at least three to four times per week.

Participation: In addition to participation in the lectures, students are expected to contribute to class discussions on Brightspace for some problem sets over the course of the semester.

7. Evaluation: Grades will be calculated as follows:

A. Attendance & Participation (10%)

B. Problem Sets (25%): Students will earn full credit for assignments that include required written, electronic and printed components in which the assigned questions and activities are addressed completely and directly.

C. Lab Assignments (25%): There will be a short quiz or something to hand in for each lab with unlimited attempts allowed (note that you may--and are encouraged to--have lab tutorials and the lab quiz open at the same time). To regard each lab completed, you must have a grade of 80% or higher on the module quiz.

D. Quizzes (10%): Periodic 10 question quizzes on the course website will cover lecture and reading materials.

E. Final Project (25%): This is a major part of the course and must receive a significant amount of each student's attention. Final project topics must be approved in advance by the instructor. Most classes take on one or more group projects for clients, in which case students will be required to contribute to a larger effort. Projects on unapproved topics will not be accepted. The grade for this project will be assessed based on data modeling and management, cartographic and graphic quality of maps or digital map products, thoroughness of documentation, effort and conscientiousness, and applicability to the problem being addressed.

F. Final Project Presentation (5%): Each student must create a presentation that effectively presents the results of their GIS final project. Presentations awarded full points will be professional (well-rehearsed, high-quality products) and will clearly demonstrate the student's seriousness and perseverance.

8. Grading System

	-		+
A	90-92	93-97	98-100
B	80-82	83-87	88-89
C	70-72	73-77	78-79

D	60-62	63-67	68-69
F		<60	

9. Required Materials

IT IS IMPOSSIBLE TO PASS THIS COURSE WITHOUT THE REQUIRED TEXTBOOK:

An Introduction to Contemporary Remote Sensing by Weng, Qihao (2012). McGraw Hill Pub
ISBN: 9780071740111

The book is available (new and used; print and ebook) from the following websites:

- Half.com
- Barnes and Noble
- Amazon.com
- UMM Bookstore

You will need to use the text beginning on September 10th.

We will also be using other free and open-source materials, as assigned.

10. Accommodations and Special Circumstances: The University of Maine at Machias is committed to providing reasonable accommodations for people with disabilities. If you have a disability and need accommodations please contact the appropriate person at your campus for assistance:

UMM: Jo-Ellen Scribner, Manager for Student Accessibility Services at ummdisability@maine.edu or 207-255-1228. The office is located on the second floor, room 202 of Powers Hall.

UM: Student Accessibility Services, 121 East Annex, 581.2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with Tora Johnson, your instructor, privately as soon as possible.

If you have ANY other circumstance that makes it difficult for you to feel comfortable in class, complete your coursework, or access education, please feel free to let me know. Even if you are taking the class from a distance, there is a lot I can do to help.

11. Academic dishonesty policies will be strictly enforced. Academic dishonesty is bad for everybody—it's disrespectful to the cheater's fellow students and instructor, and most important, it does a disservice to the cheater. You are expected to abide by the expectations and responsibilities of academic trust as outlined in the University of Maine System's Academic Integrity Policy found at the following address: https://www.maine.edu/board-of-trustees/policy-manual/section-314/.

Assignments that are flawed by academic dishonesty will receive a zero. Two incidences of academic dishonesty will result in a failing grade for the course. **All instances of academic dishonesty will be reported to the Vice President for Academic Affairs and the Student Conduct Office.** A special consideration when using GIS data: Students must cite the source of all spatial and attribute data provided by or derived from outside sources and must abide by data usage guidelines of the data product provider.

12. A Safe and Respectful Space to Learn: NO DIScounts! In this class, you must treat your classmates, your teacher, lab staff, and yourself with respect. Let's work together to make the lab and our online space a safe, pleasant, and functional place to work and learn for everyone. Be considerate, quiet, neat, helpful, and supportive. If someone is doing something inappropriate in class, please tell me immediately.

IN CLASS, DO NOT text, peruse or post on social media, play video games, surf the web for things unrelated to class, etc.

DO NOT post or say hostile, derisive or otherwise inappropriate comments.

If I catch you doing these rude things, I will call you out immediately, and you will feel very bad. Persistent disruptive behavior in class or online will be grounds for removal from the class, which will make you feel even worse. You will get an F in the class and will not receive a refund on your tuition.

13. Policies related to Discrimination, Violence and Sexual Harassment: Statement: The University of Maine at Machias is committed to making our campus a safe place for students. Because of this commitment, and our federal obligations, faculty and other employees are considered mandated reporters when it comes to experiences of interpersonal violence (sexual assault, sexual harassment, dating or domestic violence, and stalking) and discrimination based on gender, parental status, and pregnancy. Disclosures of interpersonal violence and gender discrimination must be passed along to Marnie Kaler, the University's Deputy Title IX Coordinator who can help provide support and academic remedies for students who have been impacted. More information can be found online at https://machias.edu/compliance/title-ix-information/ or by contacting Marnie Kaler at marnie.kaler@maine.edu or 207- 255-1245. You may also contact Dori Pratt, Title IX Coordinator at dorianna@maine.edu .

If you want to speak to someone confidentially, these resources are available on and off campus:

- Stacey Cherry, LCPC, with University Counseling Services, 207.255.1343
- Maine Warmline- 1-866-771-9276 for 24/7 toll-free non-crisis mental health related situations.
- Atlantic Mental Health Center (AMHC)-1-888-568-1112 for 24/7 toll-free crisis mental health related situations.
- National Suicide Prevention Lifeline- 1-800-273-8255 or text START to 741-741
- 24 Hour Sexual Assault Hotline – 1-800-871-7741
- 24 Hour Domestic Violence Hotline – 1-800-315-5579
- Passamaquoddy Peaceful Relations – 1-877-853-2613

14. COVID-19 is an infectious disease caused by the coronavirus SARS-CoV-2. The virus is transmitted person-to-person through respiratory droplets that are expelled when breathing, talking, eating, coughing or sneezing. Additionally, the virus is stable on surfaces and can be transmitted when someone touches a contaminated surface and transfers the virus to their nose or mouth. When someone becomes infected with COVID-19 they may either have no symptoms or symptoms that range from mild to severe and can even be fatal. During this global pandemic, it is imperative that all students, faculty, and staff abide by the safety protocols and guidelines set forth by the university to ensure the safety of our campus. All students are encouraged to make the Clippers Care Pact/ Black Bear Care Pact to protect the health of themselves, the health of others, and the college of our hearts always.

For the health and safety of our community, only students in the blended section will have access to the GIS lab in Torrey 223 to do their GIS classwork. Please see the lab guidelines below. Students

will not be allowed to physically enter the lab in Nutting 254. Instead, online students will be able to access lab computers in Torrey at UMM or Nutting at UM to do their classwork remotely.

15. Tech Support is available at Support Home » Support

- Phone support: Monday - Friday, 8 AM - 4:30 PM 1-800-696-4357 or Email: help@maine.edu
- Live Chat Support is available Monday-Friday, 8 AM - 8 PM and Saturdays & Sundays, 10 AM - 6 PM
- Brightspace Navigation and Tutorial Links for Students:
    - **Brightspace Student Video Tutorials**

16. Library Information: Merrill Library is here to serve you! Come in to study, read, and research. You can reach us via Chat, Zoom, Email, and phone (255-1234). Take a look at our Library Orientation page and our FAQs for a quick start. For more "How To" take a look at our Research Guides.

17. GIS Lab Guidelines:

- For UMM students in the on-campus section: There is a GIS lab at UMM in Torrey Hall room 223 available for you to use, if you don't have your own computer for GIS work. You may visit the lab for classes and whenever it is not being used for another class (a schedule will be posted on the the course website). If you need to access the GIS lab when it is closed, you may use your Clipper Card.

- ONLY 8 PEOPLE MAY OCCUPY THE LAB AT ONE TIME, including the instructor. If the lab is at capacity, please wait until someone vacates the lab before entering.

- FACE COVERINGS/ MASKS MUST BE WORN IN THE LAB AT ALL TIMES!

- The lab is set up for social distancing. DO NOT move chairs or computers. DO NOT use computers marked for remote access only. Please maintain a 6 foot distance from others in the lab, and keep the door propped open while you are in the room to maximize ventilation..

- When you are finished using a computer, use the wipes provided to disinfect your computer, and RESTART it… never shut down!

- All of the guidelines for the campus computer labs apply to the GIS labs. In addition, the GIS labs are for GIS work only. High bandwidth uses of the labs can bog down the network, cost the school a fortune to remedy, and endanger all your hard work. Emails could introduce viruses. Using lab printers for non-GIS uses will consume ink and paper needed for your projects. Using computers and equipment for non-GIS tasks will be grounds for removal from the class.

- Food and drinks are NOT permitted in the labs, with the sole exception of water in sealable containers. Such containers must be kept sealed and off computer tables when not in use.

- DO NOT give out your passwords or software licenses to your friends, family, Uncle Jimmy, etc., even if they're really nice. Don't allow non-GIS folks to have access to the building when it is closed.

- You may only open emails on lab systems for GIS-related reasons WITH APPROVAL from the instructor or staff. Viruses can destroy files and render the systems unusable. Please let us know if you see anyone using the lab for these kinds of things.

Some Advice:

- You should plan on spending at least 5 to 10 hours per week doing GIS work. So please inspect your personal weekly schedule to be sure that you budget sufficient time. You will have several problem sets due in quick succession over the course of the semester. Be careful of falling behind in the class. Late assignments will get low grades, and you can leave yourself in a real jam with your project if you fall behind. If you start slipping behind, talk to your instructor as soon as you can so we can work on getting you caught up.

- We will be using software that is the industry standard for GIS. Though it is very powerful and versatile (that's why so many people use it), it is notoriously temperamental. Save often and don't get too attached to doing things in one particular way—often you will need to work around difficult problems. Breathe, be patient, and ask for help. Don't try to memorize all the buttons and steps; it's impossible. Instead use a heuristic, "trial and error" approach to solving problems.

- Communicate with your instructor, TAs, and classmates about problems you encounter or questions you have. You will save yourself lots of time and frustration if you draw on as many resources as you can to solve GIS problems (that's how we do it in the "real world"). It's not cheating as long as all your assignments are written in your own words and reflect your own work.

- Feel free to call me on my cell (voice or text) or send a message on Facebook or Google Chat. However, please don't call or text before 8am or after 9pm unless it's an actual emergency. I actually WANT you to call with problems, rather than spending hours in frustration. Ultimately, it will save us all time and help you learn and progress.

- Plan to spend several hours per week outside of class time to complete your assignments. It's a good idea to block out time in your schedule to spend in the lab or at your computer. That way you will be sure to devote the time and won't schedule over it. Also, expect to spend more time toward the end of the semester.

- "But I only need to make one map for my project," you say. "I can probably pull a couple of all-nighters during finals week to get it done." Don't count on it. Your project will involve generating new map layers, and the technology is not always cooperative—especially during finals week.

- DO make yourself comfortable in the lab whenever you are there. Feel free to adjust the positions of chairs, monitors, mice, and keyboards.

- DO NOT plagiarize in your written assignments. Answers for all assignments should represent your original work and your own words. That means you should NEVER, EVER copy material in print or online or from any other source without setting it apart in quotes or by indentation and using proper and complete attribution. A quote will NEVER, EVER constitute a complete answer to an assigned question and may only be used as supporting information to your original answers.

- DO NOT plagiarize maps or GIS data. Assigned maps should be designed by you and must not be made from existing templates or symbologies, except where the assignment calls for a template (group projects will often involve templates, for example). Maps made from unassigned templates will not be accepted. Typically, yellow "layer" files with the .lyr extension and map template files with the .mxt extension are not to be used to make a new map, unless your assignment specifically calls for them.

GIS 420 Geographic Information Systems (GIS) Applications 1 Fall 2020						
Dates are subject to change. Visit the course website for current info.						
Wk	**Date**	**Topic**	**Readings/ Media**	**Assigned**	**Due**	**Weekly Lab Readings & Exercises**
1	**Aug 31**	Intro to GIS 420 & RS is Awesome ! Defining Remote Sensing	Read & Explore: ArcGIS Imagery Foreward, Explore **Unlocking Information from Imagery in ArcGIS** http://arcg.is/0TC8rq	Student Information Survey		ArcGIS Online: Get Started with Imagery (https://learn.arcgis.com/en/projects/get-started-with-imagery/) AND ArcGIS Online: Depict Land-Use Change with Time-Enabled Apps (https://learn.arcgis.com/en/projects/depict-land-use-change-with-time-enabled-apps/)
2	**Sept 7 MONDAY IS LABOR DAY**	EM Radiation & Imagery Basics; Interactions with Materials & Atmosphere	Weng, Chapters 1 and 2, parts 1 & 2 Read NASA Tour of the Electromagnetic Spectrum Watch NASA Videos Tour of the Electromagnetic Spectrum, watch Videos 1-6		Student Information Survey	Exploring RGB Images (https://drive.google.com/file/d/1LPjyufc-Q6-1WlA26K8L0hYV89SeIBB6/view?usp=sharing)
3	**Sept 14**	Aerial Imagery; Resolution & Extent; Geometry, Photogrammetry, Image Interpretation	Weng, Chapter 2, parts 3-5; Chapter 3 AND Watch ClimaByte What is photogrammetry? AND Watch NEON Spectral Remote Sensing Video			ArcGIS Pro: Download Imagery from an Online Database (Lesson) (https://learn.arcgis.com/en/projects/download-imagery-from-an-online-database/) AND ArcGIS Pro: Introduction to Image Classification (https://www.esri.com/training/catalog/5c0ff7155daae879f4879239/introduction-to-image-classification/)

			AND Watch iGETT Concept Module for Spectral Signatures Optional: Install Eyes on the Earth & Explore			AND ArcGIS Pro: Performing Unsupervised Pixel-Based Image Classification (https://www.esri.com/training/catalog/5c6caa568334bc4573a83335/performing-unsupervised-pixel-based-image-classification/)
4	**Sept 21**	Satellites; Landsat, MODIS & other Multispectral Sensors; Intro to Image Classification	Weng, Chapters 4 & 5 AND Read & Explore ArcGIS Imagery Chapter 3 AND ArcGIS Imagery: Chapter 4	**PS1**		ArcGIS Pro: Performing Supervised Object-Based Image Classification (https://www.esri.com/training/catalog/5c9a65e0190cf23eac628f9c/performing-supervised-object-based-image-classification/) AND ArcGIS Pro: Performing Supervised Pixel-Based Image Classification (https://www.esri.com/training/catalog/5c75869c65e21d6e2187b712/performing-supervised-pixel-based-image-classification/)
5	**Sept 28**	Image Classification	Weng, Chapters 6 & 7 AND Watch iGETT Concept Module for Spectral Signatures AND	**Final Project**		ArcGIS Pro: Detecting Objects with Deep Learning (https://www.esri.com/training/catalog/5cf6d9a5e8c1820501654ee3/detecting-objects-with-deep-learning/) AND

			Watch Band Combinations Playlist			ArcGIS Pro: Performing Accuracy Assessment for Image Classification (https://www.esri.com/training/catalog/5c9a727b190cf23eac62a78f/performing-accuracy-assessment-for-image-classification/)
6	**Oct 5**	Change Detection & Ground Truthing	Weng, Chapter 8 Read: Landsat 8 (L8) Data Users Handbook, parts 1 and 2 Read: Landsat 8 Bands Watch: Landsat Playlist For Reference: Quick Guide to Landsat 8 on Earth Explorer For Reference: Landsat 7 Data Users Handbook	**PS2**	**PS1**	ArcGIS Pro: Change Detection Using Imagery (https://www.esri.com/training/catalog/57630431851d31e02a43ee33/change-detection-using-imagery/)
7	**Oct 12 MONDAY IS INDIGENOUS PEOPLES' DAY**	Ocean Remote Sensing; SeaDAS & MatLab	Read: NASA Remote Sensing (of Ocean Color) Read: MODIS Brochure intro & section on Our Changing Ocean Watch Intro to MODIS Aqua			CHOOSE: SeaDAS or MatLab Software- Sea Surface Temperature Anomaly using MODIS Aqua Tutorial SeaDAS Version MatLab Version

8	**Oct 19**	Lidar & Other Active RS Systems; Intro to Global Mapper	Weng, Chapter 10 [Read & watch all embedded videos in NEON Basics of Lidar]		**PS2**	Global Mapper: Lesson 1 - Introduction to the Principles GIS (https://drive.google.com/drive/folders/1x95pXgj6sHK7QKolvITgUDaB4HoN6fKm?usp=sharing) AND Global Mapper: Lesson 2 - Generating a terrain surface and creating contours using LiDAR data (https://drive.google.com/drive/folders/1hQjaGz_I9xsS9bMY0n28VFLpDSQff6D?usp=sharing)
9	**Oct 26**	Lidar Processing	[Video Playlist on Lidar Processing with Global Mapper: Watch the first two; the rest are for reference]	**PS3**		Global Mapper: Lesson 4 - Rectifying an image file (https://drive.google.com/drive/folders/1Bdxg6qnhgwJINVziiLltInZa3-a5538C?usp=sharing) AND Global Mapper: Lesson 5 - Extracting vector features from a raster layer (https://drive.google.com/drive/folders/14zGQ36B5UQ0hTxHoxkLGGFIWsqhWtZVB?usp=sharing)
10	**Nov 2**	Intro to Google Earth Engine				Global Mapper: Lesson 7 - LiDAR Classification and Extraction (https://drive.google.com/drive/folders/1gTirFhP3ELl8Oym9-xZZG0ZAlnvmjB16?usp=sharing)
11	**Nov 9 WEDNESDAY IS VETERANS' DAY**	Image Processing with GEE			**PS3**	Google Earth Engine GEARS: Lab 1 - Getting started with Google Earth Engine (https://www.geospatialecology.com/intro_rs_lab1/) AND

						Google Earth Engine GEARS: Lab 2 - Understanding band combinations and image visualisations (https://www.geospatialecology.com/intro_rs_lab2/)
12	**Nov 16**	Thermal Land Imagery; Remote Sensing of Climate Change	Weng, Chapter 9			Google Earth Engine GEARS: Lab 3 - From spectra to indices, and finding the right image (https://www.geospatialecology.com/intro_rs_lab3/) AND Google Earth Engine GEARS: Lab 4 - Image Classification - part 1 (https://www.geospatialecology.com/intro_rs_lab4/)
13	**Nov 23 THANKS-GIVING BREAK BEGINS NOV 25**	No Class				Google Earth Engine GEARS: Lab 5 - Image Classification - part 2 (https://www.geospatialecology.com/intro_rs_lab5/)
14	**Nov 30 BEGIN ONLINE ONLY (REMOTE LAB ACCESS ONLY FOR ON-CAMPUS SECTION)**	Future of Remote Sensing; Project Work				Google Earth Engine GEARS: Lab 6 - Plotting spectral response curves (https://www.geospatialecology.com/intro_rs_lab6/) AND Google Earth Engine GEARS: Lab 7 - Classification validation and accuracy assessment (https://www.geospatialecology.com/intro_rs_lab7/)
15	**Dec 7**	Project Work				Project Work
Finals	**Dec 14**	**Finals: All Projects Due by 11pm on Thursday Dec 17th**				