Remote Sensing and Geographic Information Systems

This course focuses on the use of Geographic Information Systems (GIS) and Remote Sensing (RS) for solving a range of scientific problems in the environmental sciences and describing their relationship with - and applicability to - other fields of study (e.g., geography, computer science, engineering, geology, ecology, and biology). Topics include (but are not limited to): spatial data types, formats, and organization; geo-referencing and coordinate systems; remotely sensed image manipulation and analysis; map production.

Course lectures	Mondays @ 12:00 PM EST
Instructor	Haydn Lawrence
Email	haydn.lawrence@utoronto.ca (office hours in Discussions)
TA – Syed Bukhari	sajidb.bukhari@mail.utoronto.ca (office hours in Discussions)
TA – Alex Neumann	alex.gudimov@utoronto.ca (office hours in Discussions)

Tutorial Sections:

PRA0001	Mondays, 2:00 – 4:00 PM EST	BV 471
PRA0002	Mondays, 2:00 – 4:00 PM EST	BV 469

Prerequisites:

EESA06H3 and 0.5 credit at the B-level in EES courses

Assessments:

Assignments x 3	15%, 15%, 20%
Midterm (in class Week 8, after Reading Week)	15%
Final Exam	35%

All assignments will be submitted through Quercus. Do not email your assignments, as they will not be marked. Late assignments will be assessed a 5% penalty for each weekday/weekend (Saturday and Sunday count as one day) up to one full calendar week, after which they will not be accepted.

START EARLY as these concepts and software will be new for many in this course, and therefore you should leave time to account for this inexperience. Additionally, back up all of your work as often as possible. Extensions will not be given for issues with your personal computer as the school labs have the necessary software installed.

Due dates are showing in Quercus. These may change, but will never be moved ahead, only extended. Assignments will be made available after the first lecture covering the initial topics has finished.

Course Communications:

The syllabus, lecture slides, and assignments will be available in Quercus. Discussion threads will be created for the pertinent topics that will arise, but don't be afraid to create a new topic if your question differs in theme from these. Please use Quercus for questions. If your question is about course material or assignments, often other students will have the same question and using the discussion boards will answer the question for everyone. If your question is of a more specific or personal nature (e.g., grading questions, extensions, …) then don't hesitate to contact me through email anytime. If it is not, I may ask you to ask the question in Quercus instead. Always use your utoronto.ca email. Personal emails often end up in the spam folder which will cause delays in responses. When you email me, please include EESC03 in the subject line as I have several classes, and this will speed up my response to the email.

Lecture Topics:

Lecture topic	Dates	Readings
L1: Introduction to GIS	W1 – Jan 10	Longley et al, pp. 152–172 (Chapter 7)
What is GIS, remote sensing, raster and vector data representations		
L2: Datums, Projections, 3D representations	W2 – Jan 17	Longley et al, pp. 86–95 (§4.7 - §4.9)
Datums, Projections, Coordinates, GPS		
L3: Vector and Raster Analysis	W3 – Jan 24*	Longley et al, pp. 290–303 (§13.1 -§13.2); ESRI 2021a; 2021b; 2021c; 2021d;
Vector and raster operations, raster calculator, errors, ModelBuilder, python scripts		
L4: Data	W4 – Jan 31*	Longley et al, pp. 173–192 (Chapter 8); Longley et al, pp. 198–202 (§9.3 - §9.4); Longley et al, pp. 206–212 (§9.7)
Types of data, primary/secondary data sources, spatiality of data, attribute tables, SQL queries		
L5: Data Visualization	W5 – Feb 7*	Longley et al, pp. 237–265 (Chapter 11); Dent et al. (2009, pp. 102–109); Dent et al. (2009, pp. 131–143)
Choropleth and proportional mapping, 2D surfaces		
L6: Spatial Analysis	W6 – Feb 14*	Longley et al, pp. 304–313 (§13.3); Longley et al, pp. 319–328 (§14.1 - §14.3)
Spatial autocorrelation, distance decay, Moran's I/Geary's C, zonal statistics		
No lecture or tutorials	W7 – Feb 21	
Reading Week		
No lecture or tutorials	W8 – Feb 28	
Midterm		
L7: Introduction to Remote Sensing	W9 – Mar 7*	NASA 2021a; NASA 2021b; Handout 1 (all); Handout 2 (§2.1 - §2.10)
Introduction to RS tools and methods, satellites and types of data available		
L8: The EM spectrum and Imagery	W10 – Mar 14*	Handout 2 (§2.11 - §2.13); Handout 3 (§3.1 - §3.2)
The EM spectrum and its analysis		
L9: Image Interpretation and Processing	W11 – Mar 21*	Handout 4 (all)
Restoration, correction, and enhancement		
L10: Image Classification	W12 – Mar 28*	Campbell & Wynne, pp. 335–381 (Chapter 12)
Unsupervised, supervised, machine learning		
L11: Course Review and Exam Preparation	W13 – Apr 4	
Course review and exam tips		

* Green weeks (weeks with an asterisk) are tutorial weeks.

Readings:

Longley, Paul A., et al. *Geographic information science and systems*. John Wiley & Sons, 2015.

Dent, Borden, J. Torguson, and T. Hodler. Thematic map design. 6th ed., New York, New York, NY: McGraw-Hill, 2008.

Campbell, James B., and Randolph H. Wynne. Introduction to Remote Sensing. 5th ed., Guilford Press, 2011.

ESRI (2021a). *Raster Calculator (Spatial Analyst)*. Available at Raster Calculator (Spatial Analyst)—ArcGIS Pro | Documentation, accessed Dec. 2021.

— (2021b). *What is ModelBuilder?*. Available at What is ModelBuilder?—ArcGIS Pro | Documentation, accessed Dec. 2021.

— (2021c). *ModelBuilder vocabulary*. Available at ModelBuilder vocabulary—ArcGIS Pro | Documentation, accessed Dec. 2021.

— (2021d). *Create a model tool*. Available at Create a model tool—ArcGIS Pro | Documentation, accessed Dec. 2021.

NASA (2021a). *What is Remote Sensing*. Available at [What is Remote Sensing? | Earthdata (nasa.gov)](#), accessed Dec. 2021.

— (2021b). *Remote Sensors*. Available at [Remote Sensors | Earthdata (nasa.gov)](#), accessed Dec. 2021.