Advanced Geographic Information Systems

Course Outline

Contact Information

Instructor: Peter Glenday,
                   Department of Geography and Environmental Management
Office: EV1-219
Office Hours: TBD
                   If you need to schedule an appointment outside of these drop-in hours, please contact me.
Phone: (519) 888-4567 ext. 30381
E-mail: pjglenda @ uwaterloo.ca
                   From Monday to Friday, I make every effort to answer emails within 24hrs. Email sent on the weekend
                   will normally be answered on the following Monday.

Teaching Assistants

Assistant	Email	Lab/Office hrs (Location)
TBD	TBD	TBD
TBD	TBD	TBD
TBD	TBD	TBD

Course Presentation

Lecture: EV3-1408
        Tuesdays, 2:30-4:20 pm

Reserved lab: EV1-240 Galileo
Reserved lab times:

Lab 101	Mondays	8:30 - 10:20 pm
Lab 102	Tuesdays	4:30 - 6:20 pm
Lab 103	Wednesdays	10:30 - 12:20 pm
Lab 104	Fridays	4:30 - 6:20 pm

Calendar Description

"Students learn theoretical and operational approaches to advanced spatial analysis using geographical information systems. Emphasis is placed on the use of automation procedures using models and programming to address a variety of topics that may include but are not limited to digital terrain modeling, suitability analysis, network analysis, and cell-based models. The domain of spatial problems explored may vary by instructor."

Course Description

Geospatial analysis and the resulting data and information is used in a wide variety of planning, facilities management, business operations, resource management, location based services, and academic research. The course builds on the knowledge and skills you developed in GEOG/PLAN 281 and focuses on using a GIS application to perform selected types of spatial analyses. Students will learn how to perform different types of geospatial analyses, identify the types of questions different analysis approaches can answer, critically evaluate the advantages and limitations of different approaches, and gain a better understanding of the use and capabilities of geospatial analysis.

The course is organized into four modules: (1) multi-criteria analysis using ArcGIS Model Builder; (2) customization of geoprocessing tasks using the python programming language; (3) network analysis, and; (4) using python for data management and spatial analysis.

This course is a prerequisite to the Geography / Planning 481 and 487 courses and part of the requirements for the *Diploma of Excellence in GIS*. <u>*Prerequisite:*</u> Successful completion of Geography or Planning 281.

Learning Objectives

Specifically, the objectives of this course are as follows:

1. To provide students with an introduction to the fundamental spatial analysis theory, concepts and techniques.
2. To introduce students to geospatial process modelling and the benefits of automation and repeatability
3. To provide students with experience spatial analysis, process modelling, programming and information production using a variety of software systems and tools, including:
   - ArcGIS, ArcCatalog ArcModeller
   - Python, ArcPy
   - Safe Software's Feature Manipulation Engine (FME)
   - Oracle Spatial & Graph, Oracle SQL Developer

Text and Readings

There is no required textbook for this course. Course notes and slides will be provided as electronic documents on Waterloo LEARN. Students are expected to make use of the online help files for the ArcGIS software, discussion groups in the online learning platform, and other web-based GIS resources. The following books cover part of the course and are suitable for further reading and available in the course reserves either electronically or at the Porter library:

De Smith, M.J., M.F. Goodchild & P.A. Longley (2007). *Geospatial analysis: a comprehensive guide to principles, techniques and software tools*. Matador.
   Available electronically at http://www.spatialanalysisonline.com
Greener S. and Ravada S., (2013). *Applying and Extending Oracle Spatial*. Packt Publishing.
Kothuri, R. and Godfrind A., (2007). *Pro Oracle Spatial for Oracle database 11g.* Apress.
Lloyd, C.D., (2010). Spatial data analysis: an introduction for GIS users. Oxford University Press.
Lutz, M. (2013). *Learning Python*. 5th edition, O'Reilly.
O'Sullivan, D. & D.J. Unwin (2010). *Geographic information analysis*. Wiley.
Wilson, J.P. & J.C. Gallant (2000). *Terrain analysis: principles and applications*. Wiley.

Schedule

The course comprises a 2-hour lecture held on Tuesdays from 2:30-4:20pm and a 2-hour lab. The lecture will be used to introduce the advanced geospatial analysis theory and concepts such as suitability and network analysis. In addition, lectures will demonstrate practical techniques that will aid the completion of lab assignments. Significant additional time will be required for independent and group study to complete assignments and develop necessary skills. The instructor reserves the right to make changes to the schedule and content as necessary throughout the term. If a change is made students will be notified during course lectures and via the news feed for the course on the course website.

#	Date	Type	Topic	Assignments/Tests
1	May 2	Lec	Course introduction Contemporary GIS defined; Applied GIS vs. GI Science vs. Geospatial IT Refresher on Geospatial Analysis and mapping	
2	May 9	Lec	Introduction to Multi-Criteria Evaluation MCE using ArcGIS Model Builder Assignment 1 Part A briefing	Assignment 1 Part A Released (10%)
3	May 16	Lec	Geoprocessing with Model Builder and how to report results and spatial patterns Assignment 1 Part B briefing	A1 Part A due 11:55am Assignment 1 Part B Released (10%)
	May 23		NO Lecture or Labs. Make up day for May 22 holiday	
4	May 30	Lec	Introduction to Geoprocessing using models and Python scripts Assignment 2 briefing	A1 Part B due 11:55am Assignment 2 Released (15%)
5	June 6	Lec.	Geoprocessing and scripting with Python continued. In-class written test	Test 01 (10%)
6	June 13	Lec	Introduction to Geospatial Network Analysis ArcGIS Network Analyst Tutorial Assignment 3 briefing	A2 due 11:55am Assignment 3 Released (20%)
7	June 20	Lec	Guest Lecture: Geospatial Asset Management and Network management at an Electric Utilities	
8	June 27	Lec	Big geospatial data Assignment 4 Briefing	A3 due 11:55am Assignment 4 Released (20%)
9	July 4	Lec	Big Geospatial data analytics and visualization Enterprise Geospatial Decision Support and Knowledge discovery	
10	July 11	Lec	Future Trends in GIS Course review	A4 due 11:55am
11	July 25	Lec	In-class written test	Test 02 (15%)

Learning modes and course format

This course builds upon the understanding of GIS concepts you gained in Geography / Planning 281 through a series of compulsory lectures, tutorials and lab sessions. Lectures will be used to discuss concepts, principles and techniques of geospatial analysis, design and implementation coupled with access, query, and reporting processes using data held in a database.

Hands-on work with ArcGIS, FME and Oracle Spatial, SQL Developer/Modeler will take place in the Galileo lab (EV1-240). The lab assignments are designed to build your skills in using GIS and database software systems and tools to strengthen your understanding of how geospatial analytics can be properly applied to real world problems. The Galileo lab (EV1-240) has been reserved GEOG/PLAN 381. See above for dates/times.

Note that developing a strong understanding of geospatial analysis theory and concepts and the corresponding practical skills necessary to complete the assignments requires a significant investment of time. **In addition to the scheduled class and lab time, students should expect to spend at least 5 hours per week working on course assignments. *These time requirements will vary from student-to-student***. Students who are unwilling or unable to make this time commitment should consider other courses.

Evaluation

Lab assignments will account for 75% of the final mark and will be weighted as indicated in the course schedule table. There will be an in-class mid-term test (10%) and an in-class final test (15%) which in aggregate will be 25% of the final mark in the course.

Item	Format / Topic	Due Date	Contribution
Assignment 1A	Geoprocessing with Model Builder Part 1	May 16 11:55am	10%
Assignment 1B	Geoprocessing with Model Builder Part 2	May 30 11:55am	10%
Test 01	In-class test	June 06 2:30pm	10%
Assignment 2	Geoprocessing with Python	June 13 11:55am	15%
Assignment 3	Network analysis	June 27 11:55am	20%
Assignment 4	Group Project: TBD Case Study building on knowledge/skills learned to date	July 4 11:55am	20%
Test 02	In-class test	July 25 3:00pm	15%
			100%

Assignments must be submitted to the appropriate digital drop box on the course website by 11:55 a.m. on the specified due date. Late assignments will not be accepted and will receive a mark of 0. The assignments have been designed to be completed in the allotted timeframe. Exceptions may be made for documented medical reasons following the UW Academic policies listed below.

Resources

Computer Labs

Make use of your scheduled lab time in the Galileo (EV1-240). You can also use the Geddes (EV2-1002A) lab for practical work when it's not booked for other courses.

Note: No food or drink is allowed in the labs. Failure to abide by this rule may result in your computer accounts being suspended.

Course Website

A website for this course has been created as part of the **Desire2Learn** (D2L) system. Students in the course can access the course website by going to the D2L homepage (http://learn.uwaterloo.ca) and entering their WATIMAID and password in the logon form displayed on this page. Once you are logged on to D2L, you will see a list of courses that you are registered in. Click on GEOG/PLAN 381 to select this course.

Getting Help

Students are expected to get into the habit of using the on-line resources as the first source of problem solving and help. I will be available in my office for consultation during regular office hours or by appointment. Additional help is available during the scheduled lab sessions and from the MAD help desk.

University Academic Policies

Academic Integrity: To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/Policies/**policy70**.htm

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline, http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm

Appeals: A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals, http://secretariat.uwaterloo.ca/Policies/policy72.htm

Ethics: The University of Waterloo requires all research conducted by its students, staff, and faculty which involves humans as participants to undergo prior ethics review and clearance through the Office of Research Ethics (http://iris.uwaterloo.ca/ethics/). The ethics review and clearance processes are intended to ensure that projects comply with the guidelines established through Tri-Council Policy Statement (TCPS).

Note for students with accessibility needs: AccessAbility Services, located in Needles Hall, Room 1132, collaborates with all academic departments/schools to arrange appropriate accommodations for students with accessibility-related needs without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

Illness or other emergency: Students with an illness, or other emergency, that prevents them from handing in an assignment on time or attending a test, must contact you to notify you of this problem prior to the deadline or test date (or as soon afterwards as is reasonably possible). Students with an illness must document evidence of that illness with a note from a doctor. For other emergencies, such as the death of a family member, students should be asked to meet with you as soon as possible in order to make arrangements to make up any missed assignment or test. Any questions or concerns that you have regarding these matters should be directed to the Department Chair or Associate Chair.

Religious Observances: Please inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

Turnitin Software: Plagiarism detection software (Turnitin) may be used to screen assignments in this course. This is may be done to verify that use of all materials and sources in assignments is documented. Students will be given an option if they do not want to have their assignment screened by Turnitin. In the first week of the term, details will be provided about arrangements and alternatives for the use of Turnitin in this course.

Annotated bibliography: For advice on how to prepare an annotated bibliography, see:
https://uwaterloo.ca/writing-centre/