

Geography / Planning 387

Spatial Data and Spatial Databases

Dr. Rob Feick
EV3-3237, Ext. 35493
rdfeick@uwaterloo.ca

Overview

Geographic Information Systems (GIS) are used increasingly to organise, display, and analyse data pertinent to a host of land / resource management and planning activities. To make effective use of the specialised capabilities of GIS, an in-depth understanding is required of the procedures that are used to create and maintain spatial databases and the broader social and managerial issues associated with spatial information technology use.

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*. Prerequisite: Successful completion of Geography or Planning 281.

Objectives

The objectives of this course centre on providing students with:

- 1) a strong foundation of spatial database design principles,
- 2) experience creating and editing a spatial database,
- 3) knowledge of fundamental spatial data quality and error measures,
- 4) experience using a variety of GIS and spatial database software (ArcGIS, PostgreSQL/PostGIS, QGIS),
- 5) an introduction to ArcGIS' commonly-used spatial analysis and database query procedures.

Upon completing this course, students will be able to:

- create, edit and document spatial datasets,
- develop and document a conceptual design of a spatial database for a specific applied problem,
- populate a spatial database through a variety of means (e.g. heads-up digitizing, GPS, geocoding, etc.),
- build and use key spatial database components (e.g. attribute domains, topology rules, relationship classes) to maintain data integrity and facilitate database queries.

Learning modes and course format

This course builds upon the understanding of GIS concepts you gained in Geog / Plan 281 through a series of compulsory lectures, lab sessions and tutorials. Lectures will be held in Arts Lecture 124 (Wednesdays, 11:30-02:20). On most days, we will use the first two hours of the class to discuss concepts related to spatial data construction, database design and spatial data use. The third hour will be used to cover additional lecture material, provide demonstrations of lab materials or for you to work on your assignments.

The lab assignments are designed to build your skills in using GIS software and to strengthen your understanding of how GIS can be applied properly to real world problems. You are required to attend your assigned lab sessions on Thursdays starting on Sept. 14. Hands-on work for lab sections 101 (9:30 – 11:20), 102 (11:30 - 1:20), 103 (4:30 to 6:20) and 104 (6:30 – 8:20) will take place in the John Geddes GIS lab (EV2-1002A).

Note that developing a strong understanding of GIS database 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 seriously other courses.

Course Resources

People

I will be available in my office for consultation during the hours posted on my office door (EV3-3237) or by appointment. In addition, our Teaching Assistants, Paul Donchenko (pdonchen@uwaterloo.ca) and Jaydeep Mistry (jrmistry@uwaterloo.ca), will have contact hours outside of regular lab hours to help you with the hands-on component of the course. See the class Learn site for more details.

Course Learn site

The course web site on Learn will be used to distribute lecture notes, class news, lab assignment updates and data and readings. You will also use this site to deposit digital copies of your lab reports. Check this site regularly.

Email Communication Notes:

I am happy to accept email from students concerning any aspect of the course. Since the email system built into Learn can only send, but not receive, messages, **all course-related emails to me or our TAs will need to use the uwaterloo system and include “GP387” as part of the email subject line.** Note that emails sent during the weekend will not be responded to until the following Monday, except in emergencies, and emails sent at night will not be responded to until the following day.

Readings

You are not required to purchase a textbook for this course. However, you are expected to complete readings that are in the form of: a) selected chapters in texts that are on reserve in the Dana Porter Library, b) digital files (e.g. Web links, pdfs. Word documents, etc.) that have been posted to our UW-Learn site and, c) software help and other associated web pages – See Learn. These readings will complement the lectures and help you to develop well-rounded answers to lab assignment questions and to prepare for the end-of-term test.

Evaluation

Evaluation will be based on four lab assignments and an end-of-term test. The test will focus on lecture materials, in-class discussions and assigned readings. Your grade on the assignments will be based in part on the results of your lab work (i.e. quality of the data sets and maps you create) and, more importantly, the quality of your written answers to lab assignment questions. See the attached Class Schedule for the dates when the lab assignments are distributed and are due. Any changes to due dates will be announced on UW-Learn and in class.

Course component	Description	Value
Assignment 1	Building spatial data	20%
Assignment 2	Designing, populating and using a spatial database	20%
Assignment 3	Working with PostgreSQL/PostGIS	20%
Assignment 4	Surface and temporal data; publishing to the web	20%
Final test	in-class test on November 29	20%

The Teaching Assistants are responsible for marking lab assignments based on my marking outlines. If you have questions concerning your lab marks, see the TA that is assigned to your lab section. Note that the TAs cannot modify the marking schemes or grant extensions to due dates. The TAs and I will mark the test together.

Requirements, Grade Penalties and Special Considerations:

1. All lab reports are to be completed individually.
2. Backup your work (data, reports) more frequently than you think you should.
3. The lab assignments have been crafted to parallel "real" problems that are challenging in thought and time. Do not wait until the "last minute" to complete your assignments.
4. A printed hardcopy of your completed lab report must be submitted to your TA at the start of your lab sessions by the dates indicated in the assignment scripts (see Course Schedule). A digital copy of your document must be copied to the appropriate Learn dropbox. Name your digital files (e.g. Word docs, datasets) appropriately (e.g. YourName_Lab1.doc).
5. Students are expected to present well organized, and properly written work. Penalties of up to 20% may be applied in cases where readability and/or clarity are inadequate.
6. A late penalty of 10% per day is assessed for late lab reports except in cases of illness that is documented by a doctor's note. Weekends are counted as one day. Assignments that are more than 5 days late will not be accepted and will be graded as zero. Teaching Assistants cannot change due dates.
7. Requests for compassionate considerations are to be discussed with the professor in advance.
8. All students are required to be in class for the end-of-term test. **If you do not attend class on November 29, a grade of 0 will be assigned for the test unless a doctor's note indicating illness is submitted.** In that case, alternative arrangements for the test will be made.
9. See #2.

To pass the course, students are expected, but not required, to pass each graded course component. The professor will examine each student's achievements and may adjust their final grade in light of extenuating and compassionate circumstances as well as the student's general pattern of achievement in the course.

Important notes:

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

www.uwaterloo.ca/academicintegrity/

Consequences of Academic Offences:

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>

Within ENV, those committing academic offences (e.g. cheating, plagiarism) will be placed on disciplinary probation and will be subject to penalties which may include a grade of 0 on affected course elements, 0 on the course, suspension, and expulsion. Students who believe that they have been wrongfully or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance, <http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm>

Students who are unsure what constitutes an academic offence are requested to visit the on-line tutorial at <http://www.lib.uwaterloo.ca/ait/>

Unclaimed assignments

Unclaimed assignments will be retained for one year after final grades are posted to Quest. After that time, they will be destroyed in compliance with UW's [confidential shredding procedures](#).

Research Ethics: Please also note that 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 Director, Office of Human Research and Animal Care (Office). The ethics review and clearance processes are intended to ensure that projects comply with the Office's Guidelines for Research with Human Participants (Guidelines) as well as those of provincial and federal agencies, and that the safety, rights and welfare of participants are adequately protected. The Guidelines inform researchers about ethical issues and procedures which are of concern when conducting research with humans (e.g. confidentiality, risks and benefits, informed consent process, etc.). If the development of your research proposal consists of research that involves humans as participants, the please contact the course instructor for guidance and see <https://uwaterloo.ca/research/office-research-ethics>

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

Mental Health: The University of Waterloo, the Faculty of Environment and our Departments consider students' well-being to be extremely important. We recognize that throughout the term students may face health challenges - physical and / or emotional. **Please note that help is available.** Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services <http://www.uwaterloo.ca/counselling-services> is an inclusive, non-judgmental, and confidential space for anyone to seek support. They offer confidential counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

Religious Observances: Student needs to 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.

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, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please contact your Undergraduate Advisor for details.

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 – (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm

Intellectual Property: Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

Class Schedule

Week	Lecture and tutorial topics	Assignments
Sept. 13	Course overview Nature of spatial data, database and spatial database concepts	<i>Heads-up digitizing tutorial (not marked)</i>
Sept. 20	Spatial data models and representation Lab 1 – Vector spatial data creation methods, geodatabase introduction	Lab 1 out
Sept. 27	Spatial databases, SQL introduction Lab 1 – Part 2	
Oct. 4	Conceptual database design methods Lab 2 – Part 1	Lab 1 due Lab 2 out
Oct. 13	Spatial database design tools – <i>Note date change due</i> Lab 2 – Part 2	
Oct. 18	Analysis using Spatial SQL, spatial data processing Lab 3 – Introduction to PostgreSQL / PostGIS	Lab 2 due Lab 3 out
Oct. 25	Spatial database administration, data quality, documentation Lab 3 – Working with PostgreSQL / PostGIS Spatial database design tools	
Nov. 1	Raster data management Going beyond 2D: 3D surfaces and temporal data	Lab 3 due Lab 4 out
Nov. 8	OpenStreetMap / Volunteered Geographic Information workshop	
Nov. 15	Enterprise spatial databases Enterprise spatial database workshop	Lab 4 due
Nov. 22	Geospatial data on the web - data structures, sources and sharing	
Nov. 29	Final test (in class)	

Notes: Changes to the lecture topic sequence and content are not anticipated, but may be required. Any changes will be announced in class and/or posted on the GP387 Learn site.