UNSW Course Outline

GMAT4220 Geospatial Information Science - 2024

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General Course Information

Course Code : GMAT4220
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Analysis of geospatial problems including components of data acquisition and database development, spatial analysis and display, and customising and performing advanced analysis using macro languages and integrating with other software. Management and institutional

issues including how the technology and data is used by various organisations and government departments. Database structures and database management. Data organisation in raster data structures. Visualisation of continuous surfaces. Methods for interpolation. Global prediction using classification models. Global interpolation using trend surfaces. Local deterministic methods for interpolation. Inverse distance interpolation. Digital Elevation Models. Basic Operations for spatial analysis with discretized continuous fields. Spatial analysis using square windows. Spatial approaches to error propagation in numerical modelling.

Course Aims

This course aims to introduce the theoretical concepts and technical principles that need to be understood to work effectively and critically with Geographic Information Systems (GIS). Topics in the course include concepts and definitions of spatial systems, coordinate systems, mapping and spatial issues with maps, data structures including vector, raster and surface modelling, components of the technology, database management in the context of spatial data, database design, data acquisition techniques including digitising, scanning, field survey and remote sensing, data conversion process, visualisation of geospatial data, cartography, colour and 3D views, analysis of geospatial problems, spatial analysis and display, customising and performing advanced analysis using macro languages and integrating with other software, using the World Wide Web to disseminate information.

Relationship to Other Courses

GMAT3220 is a prerequisite for this course.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Develop simple GIS data models and their own GIS applications using the models.
CLO2 : Answer what steps they would take to limit the introduction of errors
CLO3 : Explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results
CLO4 : Compare ordinary point Kriging and thin plate splines as methods for interpolating elevation data to make a DEM.
CLO5 : Devise a suitable set of spatial analysis operations for deriving the best location
CLO6 : Describe the different methods that can be used to determine errors in spatial data.
CLO7 : Explain how to go about measuring the width of geographical boundaries in practice.

Course Learning Outcomes	Assessment Item
CLO1 : Develop simple GIS data models and their own GIS applications using the models.	• CSI Project • LIS Project
CLO2 : Answer what steps they would take to limit the introduction of errors	• CSI Project • LIS Project
CLO3 : Explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results	• CSI Project • LIS Project
CLO4 : Compare ordinary point Kriging and thin plate splines as methods for interpolating elevation data to make a DEM.	• CSI Project • LIS Project
CLO5 : Devise a suitable set of spatial analysis operations for deriving the best location	• CSI Project • LIS Project
CLO6 : Describe the different methods that can be used to determine errors in spatial data.	• CSI Project • LIS Project
CLO7 : Explain how to go about measuring the width of geographical boundaries in practice.	• CSI Project • LIS Project

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

This is a project-driven course. There are two projects to be completed in this course: "Crime Scene Investigation (CSI)" and "Land Information Systems (LIS)". The main aim of the two projects is to put students in a situation where they should work as a GIS expert and analyse the given GIS data and report the outcomes to their supervisors who are in charge of action but aren't necessarily familiar with technical GIS skills. Therefore students should work without step-by-step instructions from their supervisors on how to process the data. In fact, they are required to develop their own data processing strategies/skills and apply them to the projects. The course coordinator and students meet on a weekly basis to review the progress of each project.

Other Professional Outcomes

By the end of the course students should be able to develop simple GIS data models and their own GIS applications using the models. Theoretical learning outcomes include 1) to answer what steps they would take to limit the introduction of errors, 2) to explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results, 3) to work out a GIS-based system for the optimum location (of fire stations, for example), 4) to devise a suitable set of spatial analysis operations for deriving the best location (of hiking trails in a national park, for example), 5) to know the different methods that can be used to determine errors in spatial data, and 6) to explain how they would go about measuring the width of

geographical boundaries in practice. This set of knowledge will be integrated to design and develop some useful GIS applications in the classroom. Such design and development will be students' unique experience in this course and let them have confidence in geospatial analysis.

Additional Course Information

This course is a recommended Professional Elective course for BE(Honours) in Surveying (Program code: 3707, Plan code: GMATDH3707) and BE Civil and B Surveying (Program code: 3776).

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
CSI Project Assessment Format: Individual	40%	Start Date: 27/05/2024 12:00 AM Due Date: 21/06/2024 11:59 PM Post Date: 27/05/2024 12:00 AM
LIS Project Assessment Format: Individual	60%	Start Date: 24/06/2024 12:00 AM Due Date: 02/08/2024 11:59 PM Post Date: 24/06/2024 12:00 AM

Assessment Details

CSI Project

Assessment Overview

The purpose of this project is to analyze GIS data and produce a display of the results using ArcGIS Pro.

Project description: a criminal was arrested in Katoomba. His crimes include harassing surveyors and stealing from tourists. At the time of his arrest his Garmin GPS receiver was seized. You have been asked to present evidence on a computer display of where he has traveled according to the waypoints stored in the GPS receiver.

Assessment of the project report (40 points) will be based on the following criteria:

- Written presentation - 5 points
- Review of other work - 5 points
- Quality of project work - 15 points
- Results - 10 points

- Interpretation & conclusions - 5 points

Course Learning Outcomes

- CLO1 : Develop simple GIS data models and their own GIS applications using the models.
- CLO2 : Answer what steps they would take to limit the introduction of errors
- CLO3 : Explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results
- CLO4 : Compare ordinary point Kriging and thin plate splines as methods for interpolating elevation data to make a DEM.
- CLO5 : Devise a suitable set of spatial analysis operations for deriving the best location
- CLO6 : Describe the different methods that can be used to determine errors in spatial data.
- CLO7 : Explain how to go about measuring the width of geographical boundaries in practice.

Detailed Assessment Description

The approach used in marking is based on Biggs' (2003) Structure of the Observed Learning Outcome (SOLO) taxonomy (Table 1). There is also a set of words that describe the grades and marks (Table 2). Reading these tables should aid your understanding of what the lecturer is looking for in your report in relation to the specific marking criteria.

Table 1. Biggs' SOLO taxonomy. This is a hierarchical taxonomy, listed from lowest to highest level. Achieving a higher level implies exceeding the lower levels. There is also no direct translation between grades and SOLO levels, as it depends on the level of the course and the nature of the assignment.

Level	Verb examples
Prestructural	Misses the point
Unistructural	Identify, do simple procedure
Multistructural	Enumerate, describe, list, combine, do algorithms
Relational	Compare/contrast, explain causes, analyse, relate, apply
Extended abstract	Theorise, generalise, hypothesise, reflect

Table 2. Grade and mark interpretation

Grade	Mark	Description
High Distinction	85+	Work of exceptional quality showing clear understanding of the subject matter and appreciation of issues; well formulated; arguments sustained; maps and diagrams where relevant; relevant literature referenced; marked evidence of creative ability; solid intellectual work.
Distinction	75-84	Work of very high quality showing strong grasp of subject matter and appreciation of dominant issues, though not necessarily of the finer points; arguments clearly

developed; relevant literature referenced; evidence of creative ability; solid intellectual work.
Credit 65-74 Work of solid quality showing competent understanding of subject matter and appreciation of main issues, though possibly with some lapses and inadequacies; arguments clearly developed and supported by references, though possibly with minor red herrings and loose ends; some evidence of creative ability; well prepared and presented.
Pass 50-64 Adequate answers; reasonably relevant and accurate. Sufficient to merit a bare pass to safe pass mark.
Fail <50

Assessment Length

Minimum 3,000 words. Minimum 15 pages. Maximum 30 pages.

Submission notes

All assignments should be submitted with a signed assessment cover sheet that includes your declaration of non-plagiarism. You can download CVEN's cover sheet from: https://www.engineering.unsw.edu.au/civil-engineering/sites/civil/files/uploads/forms/assignment_cover_sheet_individual2014.pdf. You are required to submit an electronic copy of your report in MS Word file format via Moodle. A zip file of data, maps and reference documents, etc. should be submitted too.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

LIS Project

Assessment Overview

The purpose of this project is to develop a LIS database and query it.

Project description: Your task is to answer the following questions and queries using the GIS system.

1. Show which parcels have more than 1 owner.
2. Show which owners own more than 1 parcel of land
3. Who owns land affected by a 15m easement on each side of a sewerage easement line defined in the shapefile EASE?
4. What are the owner's addresses of the affected land?
5. What is the area of the land parcels affected?
6. What is the total value of the parcels affected?
7. How many and which owners of these parcels do not live at the parcel address?
8. What are the zones for the affected parcels?
9. How long is the sewerage line?

10. What is the maximum slope of the land the easement passes through?

Assessment of the project report (60 points) will be based on the following criteria:

- Written presentation - 10 points
- Review of other work - 5 points
- Quality of project work - 20 points
- Results - 15 points
- Interpretation & conclusions - 10 points

Course Learning Outcomes

- CLO1 : Develop simple GIS data models and their own GIS applications using the models.
- CLO2 : Answer what steps they would take to limit the introduction of errors
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Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

General Assessment Information

CSI Project: Assessment will be based on a demonstration and a report.

The final result will be a demonstration on ArcGIS.

1. Show the places that the criminal has been in 3D.
2. Include the times and order of travel.
3. Show a cross-section view indicating his movements vertically. Note: If he took a walk, it is

reasonable to assume the pathway has smooth curvature. If he took a car or a train, then it is necessary to digitize the road or the railway.

4. The final result must be using the MGA2020 projection.

The report should conform to the general format of reports (i.e. look at the course outline: submission of reports on lab work). The report will:

1. Describe using a data flow diagram the coordinate conversion processes that are required to display the data for your answers.
2. Describe the places, roads and pathways the criminal has most likely traveled and visited. Note: There are some errors in position where waypoints are near cliffs etc. Keep this in mind when working out where the criminal traveled.
3. Include a discussion on what map issues (projections, datums, etc) have been considered in your preparation of the display, including a comment on how accurate the results are and why? Include the RMSE of your georeferencing results.
4. Include a cross-section view of his movements vertically.
5. Indicate how long this assignment takes to do.

LIS Project: Assessment will be based on a demonstration and a report. Your report should contain:

- A conceptual design of the database, that is a diagrammatic description of what is in the database and how the geographical and attribute data is related. Modified Entity-Relationship diagrams are acceptable.
- A written explanation of how the database should be designed to handle m:n relationships between owners and parcels of land.
- Data definitions for the tables (i.e. outline what is in each table).
- Example listings of the attribute data.
- The answers to the textual queries below with a brief explanation of how you found them (using the GIS!). The explanation must include a data flow diagram of the analysis steps.
- A description of the errors found in the database (tables and geographic).
- A plot of the maps in the LIS database (lots and TIN from contours)
- How long this assignment takes to do.

Grading Basis

Standard

Requirements to pass course

To pass this course, you should score a minimum 20 points of CSI Project and a minimum 30

points of LIS Project.

Course Schedule

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

General Schedule Information

The course coordinator and students will meet in Computer Room CE601 at 9am on Wednesday every week to review the progress of each project.

Course Resources

Prescribed Resources

Textbook:

Peter A. Burrough and Rachael A. McDonnell, Principles of Geographical Information Systems, Oxford University Press, 1998

References:

Paul A. Longley et al., Geographic Information Systems and Science, John Wiley & Sons, Inc. 2001

Tor Bernhardsen, Geographic Information Systems: An Introduction, 3rd ed., John Wiley & Sons, Inc. 2001

Recommended Resources

You are required to use ArcGIS Pro (https://pro.arcgis.com/en/pro-app/latest/get-started/get-started.htm) or QGIS (https://www.qgis.org/en/site/) in order to complete the projects throughout the course.

Additional Costs

None.

Course Evaluation and Development

Student feedback has been gathered through the class forum in Moodle. The two projects given in this course have been modified on the basis of the past feedback.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Samsung Lim		CE411	x54505	Wednesday only	No	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient

time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

Final Examinations

Final Exams in T2 2024 will be held on campus between the 9th - 22nd August, and Supplementary Exams between the 2nd - 6th September 2024. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.