School of Civil and Environmental Engineering

UNSW Engineering

GMAT4220

Geospatial Information Science

Term 2, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Linlin Ge	l.ge@unsw.edu.au			+61293854177

School Contact 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)

Course Details

Units of Credit 6

Summary of the Course

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, geo-spatial data issues for government and industry, standards, metadata, legal issues associated with these systems, intellectual property, copyright, liability, project management and implementation of these systems. 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. Ordinary Kriging. Basic Operations for spatial analysis with discretized continuous fields. Spatial analysis using square windows. Spatial approaches to error propagation in numerical modelling. Fuzzy sets and fuzzy objects.

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.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Develop simple GIS data models and their own GIS applications using the models.	PE1.1, PE1.2, PE1.5, PE1.6
2. Answer what steps they would take to limit the introduction of errors	PE1.1, PE1.2, PE1.3, PE1.4
3. Explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results	PE1.3
4. Compare ordinary point Kriging and thin plate splines as methods for interpolating elevation data to make a DEM.	PE1.3

Learning Outcome	EA Stage 1 Competencies
5. Devise a suitable set of spatial analysis operations for deriving the best location	PE1.1
6. To devise a suitable set of spatial analysis operations for deriving the best location (of hiking trails in a national park, for example).	PE1.3
7. To know the different methods that can be used to determine errors in spatial data.	PE1.2
8. To explain how they would go about measuring the width of geographical boundaries in practice.	PE1.3

Teaching Strategies

This course is based on lectures and hands-on labs. Lectures are designed to teach generic algorithms and fundamental theory, lab exercises are for students to learn basic techniques and practical applications. This course is multi-disciplinary. Mathematics, statistics, and computer skills (ArcGIS and Matlab) are seriously involved in the course activities. There is a specified textbook, but many references are available in the library. Students are required to read corresponding chapters of references in order to have better understanding of lectures.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Final Exam	46%	Not Applicable	1, 2, 3, 4, 5, 6, 7, 8
2. Mjr assigmnt - LIS	30%	05/08/2022 11:00 PM	1, 2, 3, 4, 5, 6, 7, 8
3. On-site lab work	24%	Not Applicable	1, 2, 3, 4, 5, 6, 7, 8

Assessment 1: Final Exam

There will be some multiple-choice questions but you need to explain the rationale of your choice.

A few questions will require short answers, some questions need medium-length answers, and there are a few big questions too.

Time allowed – 2 hours
Reading time – 10 minutes
This examination paper has 3 pages
Total number of questions – 6 (with subset q's)
Total marks available – 46
Marks available for each question are shown in the examination paper
All answers must be written in ink, except where they are expressly required, pencils may be used only for drawing, sketching or graphical work
Candidates may bring to the examination: 1 UNSW-approved electronic calculator

Assessment 2: Mjr assigmnt - LIS

Due date: 05/08/2022 11:00 PM

Assessment of LIS report (30 points) will be based on the following criteria:

- Written presentation 8 points
- Review of other work 6 points
- Quality of project work 8 points
- Results, Interpretation & conclusions 8 points

Assessment 3: On-site lab work

Students who perform poorly in the on-site lab assessments are recommended to discuss progress with the lecturer during the semester.

Assessment of on-site lab work (3%) will be based on the following criteria:

- *No output 0%*
- *Partial output 1%*
- *Full output but with incorrect results 2%*
- *Complete results 3%*

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date	Type	Content
O-Week: 23 May - 27 May		
Week 1: 30 May - 3 June	Lecture	Introduction to GIS and Map projections
	Laboratory	Introduction to ArcGIS and Map projections
Week 2: 6 June - 10 June	Lecture	Vector and Raster
	Laboratory	Digitisation
Week 3: 13 June - 17 June	Lecture	GIS Data Acquisition and Image Registration
	Laboratory	Image Registration
Week 4: 20 June - 24 June	Lecture	Inverse Distance Weighting and Natural Neighbours
	Laboratory	Interpolating DEM
Week 5: 27 June - 1 July	Lecture	Kriging
	Laboratory	Kriging
Week 6: 4 July - 8 July	Fieldwork	***Flexibility week for all courses (non□teaching)***
Week 7: 11 July - 15 July	Lecture	Database and SQL
	Laboratory	Database
Week 8: 18 July - 22 July	Lecture	Spatial Analysis Using Raster Data
	Laboratory	Spatial Analysis
Week 9: 25 July - 29 July	Lecture	Statistical Approaches to Error Propagation
	Laboratory	Data Format Conversion and Errors
Week 10: 1 August - 5 August	Lecture	Topology
	Laboratory	Assignment Work: LIS
	Assessment	Mjr assigmnt - LIS

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

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and Plagiarism

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

Academic Information

Final Examinations:

Final exams in T2 2022 will be held online between 12th - 25th August 2022 inclusive, and supplementary exams between 5th - 9th September 2022 inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): https://intranet.civeng.unsw.edu.au/student-intranet
- Student Life at CVEN, including Student Societies: https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://app.acuityscheduling.com/schedule.php?owner=19024765

Disclaimer

This course outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Mike Gal.

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	