School of Civil and Environmental Engineering

Term 2, 2021

GMAT4220 GEOSPATIAL INFORMATION SCIENCE

COURSE DETAILS

Units of Credit	**6**	
Contact hours	6 hours per week	
Lecture & Workshop	Tuesday, 14:00 – 17:00	online
Lab	Thursday, 14:00 – 17:00	CE611/online

Course Coordinator and Lecturer	Samsung Lim email: s.lim@unsw.edu.au office: CE411

INFORMATION ABOUT THE COURSE

GMAT4220 is designed for students to learn principles, algorithms, techniques and applications in geospatial "Science" whereas GMAT3220 is to learn introductory level Geographic Information Systems. Topics for GMAT4220 include data acquisition and database development, spatial analysis and display, and customising and performing advanced analysis using macro languages and integrating with other software.

HANDBOOK DESCRIPTION

See link to virtual handbook:

https://www.handbook.unsw.edu.au/undergraduate/courses/2021/GMAT4220/

OBJECTIVES

This course aims to provide the theoretical and technical principles that need to be understood to work effectively and critically with 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 digitizing, scanning, field survey and remote sensing, data conversion process, visualization of geo-spatial data, cartography, colour and 3D views, analysis of geospatial problems, spatial analysis and display, customizing and performing advanced analysis using macro languages and integrating with other software, using the World Wide Web to disseminate information.

This course provides an environment that fosters in our students the following attributes is listed:

- the skills involved in scholarly enquiry: Significant
- an in-depth engagement with relevant disciplinary knowledge in its interdisciplinary context: Significant
- the capacity for analytical and critical thinking and for creative problem solving: Significant
- the ability to engage in independent and reflective learning: Significant

- the skills to locate, evaluate and use relevant information (Information Literacy): Significant
- the capacity for enterprise, initiative and creativity: Significant
- an appreciation of and respect for, diversity: Significant
- a capacity to contribute to, and work within, the international community: Some
- the skills required for collaborative and multidisciplinary work: Significant
- an appreciation of, and a responsiveness to, change: Significant
- a respect for ethical practice and social responsibility: Some

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.

Private Study	• Review lecture material and textbook • Do set problems and assignments • Join Moodle discussions of problems • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle
Lectures	• Find out what you must learn • See methods that are not in the textbook • Follow worked examples • Hear announcements on course changes
Workshops	• Be guided by Demonstrators • Practice solving set problems • Ask questions
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Laboratory Work	• Hands-on work, to set studies in context

EXPECTED 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, PE2.1, PE2.3*
2.	Answer what steps they would take to limit the introduction of errors.	*PE1.2, PE1.6, PE2.3*
3.	Explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results.	*PE1.3, PE2.1, PE2.3*
4.	Compare ordinary point Kriging and thin plate splines as methods for interpolating elevation data to make a DEM.	*PE1.4, PE2.2, PE3.3*
5.	Devise a suitable set of spatial analysis operations for deriving the best location.	*PE1.5, PE2.4, PE3.3*

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

COURSE PROGRAM

Term 2 2021

Date	Topic	Lecture Content	Demonstration Content
31/05/2021 (Week 1)	Introduction to GIS and Map projections	Introduction to GIS and Map projections	*Introduction to ArcGIS and Map projections
07/06/2021 (Week 2)	Vector and Raster	Vector and Raster	*Digitisation
14/06/2021 (Week 3)	GIS Data Acquisition and Image Registration	GIS Data Acquisition and Image Registration	*Image Registration
21/06/2021 (Week 4)	Inverse Distance Weighting and Natural Neighbours	Inverse Distance Weighting and Natural Neighbours	*Interpolating DEM
28/06/2021 (Week 5)	Kriging	Kriging	*Kriging
05/07/2021 (Week 6)	***Flexibility week for all courses (non-teaching)***		
12/07/2021 (Week 7)	Spatial Analysis Using Raster Data	Spatial Analysis Using Raster Data	*Spatial Analysis
19/07/2021 (Week 8)	Database and SQL	Database and SQL	*Database
26/07/2021 (Week 9)	Statistical Approaches to Error Propagation	Statistical Approaches to Error Propagation	*Data Format Conversion and Errors
02/08/2021 (Week 10)	Topology	Topology	Assignment Work: LIS

ASSESSMENT

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below.

- On-site lab assessment (3% each x 8) 24% Weeks 1-5, 7-9
- Assignment: LIS 30% Report due 11pm Friday Week 10
- Final Exam 46% Will be formally arranged by Exams Dept.

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The final exam is worth 46% of the final mark. The class work is worth 54% of the final mark. A mark of at least 15 points out of the total 46 points in the final exam is required before the class work is included in the final grade.

Assessment criteria

Assessment of on-site lab work (3 points per week for 8 weeks) will be based on the following criteria:

- No output 0 point
- Partial output and/or incorrect results/answers 0.5-2.5 points
- Complete and correct results/answers 3 points

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

Marking criteria for the assignment report

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	

References

Biggs, J. (2003) *Teaching for Quality Learning at University*, second edition. Society for Research into Higher Education & Open University Press, Buckingham, UK.

In terms of Biggs' SOLO taxonomy, a High Distinction is Extended Abstract, while a Pass is Multistructural. More generally, to achieve a pass you must implement the models as instructed and show that you understand what you have done. To achieve a High Distinction you must have implemented some innovations of your own (gone beyond the instructions). Very well written reports that clearly show an understanding of what has been done, but that contain no innovations, will receive a maximum grade of Distinction.

Throughout your assignment report you are expected to demonstrate an understanding of:

1. the meaning of your results,
2. the rationale for doing it,
3. potential sources of error and their impact on your conclusions.

The lecturer will also be looking for:

1. *Clarity*
   Clear, simple, grammatical language used. All terms are explained.
2. *Argument and structure*
   Is the argument clearly and logically developed through the report? Are the points in the appropriate sequence (do your points build on previous points presented)?
3. *The wider scope*
   Do you place your work in the context of the broader, peer reviewed, literature? You should have no fewer than ten references.
4. *Map composition and diagrams*
   Are they clear and do they display the desired information? Are they used to support your arguments and not purely as decorative material? Do your maps have a scale bar, north pointer and legend? Are appropriate and consistent colour schemes used?
5. *Innovation*
   This is the degree to which you go beyond the instructions given in the lab handouts, for example assessing the sensitivity of the model to parameter variations or implementing better models.
6. *Referencing*
   Appropriate use of the Harvard referencing system. There are several formatting variations with the Harvard system. Have a look at a sample of journals to get an idea, for example the International Journal of Geographical Information Science. I do not mind which one you use so long as it is consistent throughout the report. One exception to this is that you do not list all authors in the main text where there are three or more authors (e.g., Use "Border et al., 1999" rather than "Border, Taylor, Waugh, and Ponting, 1999"). Such a long style is awkward and unwieldy when there are more than three authors. However, you must list all authors in the reference list at the end of the document. Please see http://www.lc.unsw.edu.au/onlib/ref.html for a good introduction, albeit their use of inverted commas for book and journal titles is tedious and unnecessary. It is far easier to use a system that does not require them. Please also note that the EndNote bibliography management software is freely available to UNSW Staff and students. See http://www.it.unsw.edu.au/services/procurement/software/. Learning how to use this software will make writing assignments much easier, and will solve most of your problems with referencing formats (so long as your database is correct). Most online databases now allow you to export references directly into EndNote, so constructing a database is reasonably simple.

Be careful when using web sites as a source of information. If they summarise another piece of work, then you should read and cite the original piece of work (the primary reference). This applies to lecture notes – DO NOT USE LECTURE NOTES AS REFERENCES. Use the references provided in them. In general, you should not use web sites unless they are an official publication. Wikipedia is a good example here. It is an excellent resource for locating further information, but it is not a primary reference. The same principle applies to any printed encyclopaedia.

Supplementary Examinations for Term 2 2021 will be held on Monday 06th September – Friday 10th September 2021 (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not to make any personal or travel arrangements during this period.

PENALTIES

Reports may be submitted at any time prior to the due date and time. Late submission will get 10% deduction of the assignment mark for each day late – up to a maximum of five days. After five days, the assignment will receive zero.

ASSESSMENT OVERVIEW

Item	Length	Weighting	Learning outcomes assessed	Assessment Criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
1. 8x lab exercises	48 hours	24%	GIS skills	Basic GIS techniques and practical applications	Weeks 1-5, 7-9. Show the results to the lab supervisor	After 5 days	After 1 week
2. LIS assignment	40 hours	30%	Spatial analysis	Writing skills, analytical and laboratory work	Electronic copy report due 11pm Friday Week 10	After 5 days	After 2 weeks
3. Final exam	2 hours	46%	GIS knowledge and skills	Theory, concepts, definitions, and components of GIS	Centrally managed	Centrally managed	

RELEVANT 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

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

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

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 ADVICE

For information about:

- Notes on assessments and plagiarism;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

Refer to Key Contacts on the Faculty website available at:

https://www.unsw.edu.au/engineering/student-life/student-resources/key-contacts

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (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