



THE UNIVERSITY OF
NEW SOUTH WALES
SYDNEY · 2052 · AUSTRALIA

SCHOOL OF SURVEYING & SPATIAL INFORMATION SYSTEMS

GMAT 3210 - GIS 3

Course Outline – Session 1, 2009

*This document, and other material, is available at the Course Website:
<http://www.gmat.unsw.edu.au/gmat3210/>
(User name and password supplied in class)*

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1. Staff involved in the Course and their Contact Details

1.1 Lecturer(s): Dr Samsung Lim

Office: EE406 (Consulting hours: Before & after this course hours or by appointment)
Email: s.lim@unsw.edu.au Phone: 9385 4505

1.2 Lab/Tutoring Supervisor(s): Hongjoo Park

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Email: hj.park@student.unsw.edu.au Phone: 9385 4184

2. Educational Aspects of the Course

2.1 How this course relates to others in the program

This course requires GMAT 2210 as a prerequisite, which is designed for students to learn introductory level GI Systems in order to understand the basic principles behind GI Systems. GMAT3210 focuses on generic algorithms and fundamental theories as well as techniques and practical applications in GI “Science” – Science has been emphasized.

2.2 Aim of the Course

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.

2.3 Learning Outcomes

By the end of this session students should be able to develop simple GIS data models and their own GIS applications using the models. Theoretical learning outcomes include 1) to learn the different methods used for speeding up data access and compression, 2) to answer what steps they would take to limit the introduction of errors, 3) to explain the assumptions behind trend surface analysis and show how these may seriously affect the quality of the results, 4) to compare ordinary point Kriging and thin plate splines as methods for interpolating elevation data to make a DEM, 5) to work out a GIS-based system for the optimum location (of fire stations, for example), 6) to devise a suitable set of spatial analysis operations for deriving the best location (of hiking trails in a national park, for example), 7) to know the different methods that can be used to determine errors in spatial data, and 8) 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 GI science.

2.4 Teaching Strategies

This course is based on lectures (1 or 2 hours a week) plus labs (3 or 4 hours a week). Lectures are designed to teach generic algorithms and fundamental theories, tutorials and lab exercises are for students to learn basic techniques and practical applications.

2.5 Suggested Learning Methods

This course is multi-disciplinary. Mathematics, statistics, and computer skills (ArcGIS and Matlab) are seriously involved in the course activities. There are no specified textbooks, but many references available in the library (see 5.2 below). Students are asked to read corresponding chapters of references in order to have better understanding of lectures.

2.6 UNSW Graduate Attributes

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

3. Proposed Course Schedule

Any changes will be notified in the class and at the course website. *On-site summary report required.

Week No.	Labs Mon 1-4 EE401A	Lectures Wed 11am-1pm EE G24	Assignments
1 9/3	Course Information & Revision on ArcGIS	Data Models and Axioms	Black Bart Due 4pm Friday Week 4. Submit to the Lab Supervisor.
2 16/3	Assignment Work Working on Black Bart	Geographical Data in the Computer	
3 23/3	Term Project Planning (see Section 4.1)	Topology	
4 30/3	*Creating Continuous Surfaces (Interpolating DEM)	Creating Continuous Surfaces from Point Data	
5 6/4	Assignment Work Working on LIS	Land Information Systems	LIS Due 4pm Friday Week 8. Submit to the Lab Supervisor.
6 20/4	*Optimal Interpolation (Kriging)	Optimal Interpolation using Geostatistics	
7 27/4	Term Project Presentation: Proposal	The Analysis of Discrete Entities in Space	
8 4/5	*Spatial Analysis Spatial filtering. Using directional filters to estimate slope and aspect. Practical applications of the spatial analysis of continuous surfaces.	Spatial Analysis using Continuous Fields	
9 11/5	Assignment Work Working on GIS Applications	Databases	Term Project: GIS Applications Due 4pm Friday Week 12. Submit to the Lab Supervisor.
10 18/5	*Errors Errors resulting from rasterizing a vector map. Switzer's method. Bregt <i>et al.</i> 's method. Errors associated with digitizing a map, or with geocoding..	Errors and Quality Control	
11 25/5	Assignment Work Working on GIS Applications	Error Propagation in Numerical Modelling	
12 1/6	Term Project Presentation: Results	Summary	

4. Assessment in the Course

Assessment for the course includes:

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|--|-----|------------------------------|
| • Lab reports (5% each x 4) | 20% | Weeks 4, 6, 8, 10 |
| • Assignment: Black Bart
(writing skills 5% + analytical/laboratory work 5% + visualisation 5%) | 15% | Report due Week 4 |
| • Assignment: LIS
(writing skills 5% + analytical/laboratory work 5% + visualisation 5%) | 15% | Report due Week 8 |
| • Term project: GIS Applications
Proposal Presentation 5% | 30% | Report due Week 12
Week 7 |
| Final Presentation 5% | | Week 12 |
| Web Publication 5% | | Week 12 |
| Report 15% (writing skills 5% + analytical/laboratory work 5% + visualisation 5%) | | |
| • Final Exam | 20% | |

4.1 Term Project

The term project aims to develop a working demonstrator of GIS by utilising knowledge and skills that were obtained from GIS courses. The project is designed for group work of two students, however, individual work is possible. Students will form their group on their own and choose their project topic by co-planning with their group members. Each group's topic should be different from others, therefore each group should be aware of others' activities. In case of clash, it is recommended to resolve the problem by negotiating with relevant group(s).

Sample topics about using GIS to understand real world problems are: global warming, biodiversity, biomass, bush fire, traffic information, air pollution, health, etc.

For example, one of the past well-performed projects is:

"... to evaluate an appropriate route for a railway line between Chatswood and Epping using various GIS techniques and statistical data. Spatial data was obtained from a variety of sources e.g. ABS, Department of Lands and Dr. Samsung Lim. This data was then transformed into a common coordinate system and clipped so that only the area of consideration was included in the data. Images were obtained from Google Maps, Department of Lands spatial portal, rectified and combined with other spatial data. The proposed railway line for this project already existed however based on our queries and analysis an alternative route was formulated. This route was based on information obtained from ABS regarding transport habits and population densities in suburbs that were in the region of the proposed railway line. ArcGIS 9.x provided the facilities to combine spatial data together with the statistical data and integrate them into a seamless model, which then allowed queries to be performed to determine this most suitable path for the railway line."

Another good project in the past:

"... The next step in this project was to identify the queries that we could perform in ArcMap that would allow us to find the health information that we required. We had the intention to use this data to find the occupations that had the most people that did not have health cover. Using the data we could then find out what type of employment these people had in what industry and if it was casual or full time etc. By also querying what industries had had the most accidents in the last four weeks we could also determine whether the industry was the risky enough to consider getting health insurance. Using queries to then find the most common age groups and sex in these criteria we would then be able to combine this data with our other results to determine what demographic should be targeted in each area for a company selling health insurance."

Submission:

Email the following material to the lab supervisor if the file size is less than 2MB, or use a USB stick to pass the file onto the lab supervisor.

- Proposal Presentation (PPT) due 4pm Monday Week 7
- Final Presentation (PPT) due 4pm Monday Week 12

Submit a CD-ROM or DVD-ROM that includes all of the following material.

- Final Report (MS Word) due 4pm Friday Week 12
- Web publication (HTML) due 4pm Friday Week 12
- Spatial data, maps and reference documents, etc. due 4pm Friday Week 12

5. Course Resources

5.1 Lecture Material (check the course website):

<http://www.gmat.unsw.edu.au/gmat3210/>

The Powerpoint lecture slides are available for download as [PDF files](#) at the course website.

5.2 Text and Reference Books

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

5.3 Computational Aids

Computer software relevant to this course and available in the School's Computer Room EE401A, includes ArcGIS v9.2 and Matlab R14.

6. Administrative Matters

6.1 Expected work load

At UNSW, the normal workload expectations of a student are 25-30 hours per session for each unit of credit, including class contact hours, preparation and time spent on all assessable work.

To assist students with the organisation of their studies, the expected workloads of the various components of the course are listed below. It is strongly suggested that students use the listed hours to plan their work during session.

Lectures (12 x 1.5hr)	18hr
Labs (4 x 4hr)	16hr
Lab assignments (6 x 4hr)	24hr
Tutorial (1 x 4hr)	4hr
Presentations/Demos	4hr
Project assignments (approximately 12wks x 5hr)	60hr
Revision of Lectures, preparation of practical/tutorial reports, background readings (approximately 12wks x 2hr)	24hr
Total	150hr

6.2 Rules

Students should read the University Calendar or Student Guide for details of University Rules and special considerations.

Students are reminded that the University regards academic misconduct as a very serious matter. Unauthorised material must not be taken into a test or examination. Any work submitted for assessment must be entirely the student's own work. The penalty for any suspected academic misconduct ranges from zero mark for the assignment or exam involved, through failure of the subject, to expulsion from the University. If absent from an examination, class test or practical, students must submit written documentation to the University, via the Student Centre in the Chancellery.

If a student is unable to submit on time due to illness or other legitimate reason, then a brief written explanation must be given to the lecturer for consideration as soon as is feasible. In some cases the lecturer may grant an extension to the submission date provided he has been contacted before the due date.

Further assessment may be granted in this course at the lecturer's discretion. If further assessment is granted then performance in tutorials may be considered as well as an oral exam including use of a computer.

If students attend less than 80% of their possible classes they may be refused final assessment.

6.3 Grievances

In the first instance all grievances should be discussed with the lecturer involved. If the problem cannot be resolved, students should contact the School's Grievance Officer in writing.

6.4 Rules for lab/tutorial classes

The lab/tutorial exercises form an important part of the subject. A good deal of time and care has gone into the organisation of these classes to ensure that you get the maximum benefit from the time that you spend and the software which is available. All lab/tutorial reports require individual work. Students are required to read the supplied instructions well before the exercise is commenced.

SUBMISSION OF REPORTS ON LAB/TUTORIAL WORK

Time: Reports may be submitted at any time prior to the due date. Late submission will get 10% deduction of the assignment mark for each day late – up to a maximum of seven days. After seven days, the assignment will receive zero. Reports should be submitted to your lab/tutorial supervisor.

Contents of Reports: Your report should have a front/title page, then a summary of results page, then the rest of the report including computations and plans. The front cover of all submissions should include: Course No. and Name, Student No. and Name, Title of Exercise

Further information about the labs will be distributed during the lectures, and are available on the class web site. Rules for labs are given in the following section.

All assignments and assessment items should be submitted with a signed Assessment Cover Sheet:

<p>I declare that this assessment item is my own work, except where acknowledged, and has not been submitted for academic credit elsewhere, and acknowledge that the assessor of this item may, for the purpose of assessing this item:</p> <p>Reproduce this assessment item and provide a copy to another member of the University; and/or,</p> <p>Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).</p> <p>I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.</p> <p>Signed:date: <input type="text"/><input type="text"/><input type="text"/><input type="text"/><input type="text"/><input type="text"/></p>
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All students **repeating** the subject are advised as below:

1. To apply for exemption from practicals submit your details in writing to the Course Administrator.
2. If exemption from practicals is granted, assessment in the subject will be based only on the written examinations and the assignment.
3. The contents of the written examinations may include material from practical exercises.

Plagiarism

Plagiarism is the presentation of the thoughts or work of another as one's own.*

Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or

progression of ideas of the original;

- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism. Knowingly permitting your work to be copied by another student may also be considered to be plagiarism. An assessment item produced in oral, not written form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University online resource for staff and student information on plagiarism and academic honesty. It can be located at:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students 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 items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

† Adapted with kind permission from the University of Melbourne.

Please visit the School's Plagiarism Statement: <http://www.gmat.unsw.edu.au/currentstudents/general/plagiarism.htm> for the key information on the new plagiarism policy. From the page the students can download the policy document (as a PDF), and the assessment cover sheets (as DOC or PDF).