GMAT4220 Geospatial Information Science

Semester 2, 2016

Never Stand Still | Faculty of Engineering | School of Civil and Environmental Engineering

COURSE DETAILS

Units of Credit	6	
Contact hours	5 hours per week	
Class	Tuesday, 11:00 – 13:00	Mathews 312
Workshop	Thursday, 10:00 – 13:00pm	Civil Engineering 611
Course Coordinator and Lecturer	Samsung Lim email: s.lim@unsw.edu.au office: CE411 phone: x54505	

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 in order to understand the basic principles of GIS.

HANDBOOK 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, 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 organization in raster data structures. Visualization 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.

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 theories, 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
Assessments (multiple choice questions, quizzes, tests, examinations, assignments, laboratory reports etc.)	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Laboratory Work	• Hands-on work, to set studies in context

EXPECTED 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 geospatial science.

ASSESSMENT

Assessment for the course comprises:

- On-site lab assessment (2% each x 8) 16% Weeks 2-6, 8-9, 11
- Assignment: Black Bart 20% Report due 4pm Friday Week 7
  (= writing skills 10% + analytical/laboratory work 10%)
- Assignment: LIS 30% Report due 4pm Friday Week 13
  (= writing skills 10% + analytical/laboratory work 20%)
- Final Exam 34%

There are two major assignments involved in this course: Black Bart and LIS. The main objective of the assignments 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 hypothetical "boss" who is in charge of action but isn't necessarily familiar with technical GIS skills. Therefore students should work without step-by-step instructions from their boss on how to process the data. In fact, they are required to develop their own data processing strategies/skills and apply them to the assignments.

Assignment Report Submission:
Email the following material to the lab supervisor if each file size is less than 2MB, otherwise use a USB stick to pass the files onto the lab supervisor:

- Final Report (in Microsoft Word format) **AND**
- Data, maps and reference documents, etc. that you produced or obtained during the course of the assignment, except the data given to you from the lecturer.

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.

ASSIGNMENTS

1.	Assignment 1: Black Bart	issued on: Week 3	due on: Week 7
2.	Assignment 2: LIS	issued on: Week 8	due on: Week 13

The lab exercises form an important part of the subject. A good deal of time and effort has been made 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 reports require individual work. Students are required to read the supplied instructions well before the exercise is commenced.

SUBMISSION OF REPORTS ON LAB 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 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:

> 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:

Reproduce this assessment item and provide a copy to another member of the University; and/or,

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).

I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.

Signed: .....date: ☐☐ ☐☐ ☐☐

COURSE PROGRAM

A table of lecture and workshop or practical class topics for each week, indicating the name of lecturer involved (where multiple lecturers teaching in course), online activities, such as discussion forums, and relevant readings from textbook and other reference material identified for the course.

SEMESTER 2, 2016

Week	Date	Lectures Tuesday 11:00-13:00 Mathews 312	Labs Thursday 10:00-13:00 Civil Engineering 201	Assignments Due
1	25 Jul	Introduction to GIS	No lab	
2	01 Aug	Open Source GIS	*Introduction to ArcGIS	
3	08 Aug	Map projections	*Map projections	
4	15 Aug	Inverse Distance Weighting	*Digitisation	
5	22 Aug	Natural Neighbours	*Interpolating DEM	
6	29 Aug	Kriging	*Kriging	
7	05 Sep	Metadata	Assignment Work: Black Bart	**Black Bart** report due 4pm **Friday Week 7**
8	12 Sep	Spatial Analysis Using Raster Data	*Spatial Analysis	
9	19 Sep	Database and SQL	*Database	
Mid-session break (24 Sep - 2 Oct)				
10	03 Oct	Topology	Assignment Work: LIS	
11	10 Oct	Statistical Approaches to Error Propagation	*Data Format Conversion and Errors	
12	17 Oct	Course summary and Sample final exams	Assignment Work: LIS	
13	24 Oct	No lecture	Assignment Work: LIS	**LIS** report due 4pm **Friday Week 13**

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://my.unsw.edu.au/student/resources/KeyDates.html

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,
- School policy on Supplementary exams,
- Special Considerations,
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

Refer to Academic Advice on the School website available at:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice