FACULTY OF SCIENCE

School of BEES

GEOS9016

Principles of Geographic Information Systems

Session 2, 2021

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Faculty of Science - Course Outline

1. Information about the course

NB: Some of this information is available on the UNSW Handbook

Year of Delivery	2021
Course Code	GEOS9016
Course Name	Principles of Geographic Information Systems
Academic Unit	School of BEES
Level of Course	Postgraduate
Units of Credit & Workload	6UOC The normal workload expectations of a student are approximately **25 hours per term for each UOC**, including class contact hours, other learning activities, preparation and time spent on all assessable work. Expected workload (**6 UoCx25)= 150 hours**.
Session(s) Offered	Session 2
Assumed Knowledge, Prerequisites or Co-requisites	Familiarity with the Windows operating system.
Hours per Week	Equivalent of 4 'contact' hours per week. One weekly activity is online synchronous (ie. video conference **via Microsoft Teams**). You can download Teams and other Microsoft programs at myIT.
Number of Weeks	10
Commencement Date	Week 1 (beginning 31st May 2021)

Summary of Course Structure (for details see 'Course Schedule')

Component	HPW	Time	Day	Location
Lecture	2	Wed 09-11 (wk 1-5)	Wednesday	Online
Laboratory	2	Thu 10-12 (wk 1-5)	Thursday	Bioscience G29: in person lab session & online synchronous
Lecture	1	Wed 10 - 11 (wk 7-10)	Wednesday	Online
Laboratory	3	Thu 10 – 13 (wk 7 -10)	Thursday	Bioscience G29: in person lab session & online synchronous
Special Details				

2. Staff involved in the course

Staff Role	Name	Contact Details	Consultation Times
Course Convenor	Prof Graciela Metternicht	Chat through MS Teams g.metternicht@unsw.edu.au.	By appointment for a one-on-one Zoom or MS Teams session.
Course Demonstrator	Sophia German and Graciela Metternicht	sophia.german@unsw.edu.au	Designated lab times only.

3. Course details

Course Description (Handbook Entry)	Approximately 80% of all data collected have associated geographic attributes, and there is an increasing need for people with the skills and abilities to manipulate and make sense of that information. This course provides an introduction to, and understanding of, the basic principles, structures, procedures and applications of geographic information systems and science. Topics covered in the course provide a comprehensive overview and practical experience in the analytical treatment of geographical information, including: information sources, data storage, representation and visualisation, projections and coordinate systems, the analysis of spatial data to generate new information, and the dissemination of such digital information through avenues including the internet.
Course Aims	The main objective of this course is to provide students with the principles of how to manage and use GI Systems and Science to deal with real world issues. This is both to aid in the management of those issues, and to gain a better understanding of those issues.
Course Learning Outcomes (CLOs)	• Create and edit maps using specialised software such as ArcGIS • Create models for geographic information systems analysis using specialised software such as ArcGIS, and apply these to project applications • Discuss the advantages and disadvantages of different data models, data structures and types, and map projections • Understand and apply basic spatial analysis techniques, including topographic analysis • Evaluate the main spatial information sources and data storage options for mapping data In terms of the UNSW **Science Faculty Graduate Attributes**, you will be expected to develop experience in attributes (1) Research, inquiry, and analytical thinking abilities, (2) Capability and motivation for intellectual development, (5) Teamwork, collaborative and management skills and (6) Information literacy.
Major Topics (Syllabus Outline)	Data models, data structures, types and sources Map projections Spatial interpolation Metadata Topology and geoprocessing Map algebra & fuzzy logic Topographic analysis Map making See the lecture sequence for timings.
Relationship to Other Courses within the Program	Almost any course in BEES, and many courses from outside BEES, will be dealing with spatial phenomena. The approaches we deal with in this course allow you to conduct spatial analyses in a consistent and repeatable manner, using geo-referenced data in vector and/or raster formats.

[3] http://learningandteaching.unsw.edu.au/content/LT/course_prog_support/course_outline_template.cfm?ss=2#Template

Graduate Attributes Developed in this Course		
Science Graduate Attributes[5]	**Select the level of FOCUS** *0 = NO FOCUS* *1 = MINIMAL* *2 = MINOR* *3 = MAJOR*	**Activities / Assessment**
1. **Research, inquiry and analytical thinking abilities**	3	*All will be achieved through the assessments*
2. **Capability and motivation for intellectual**	3	*As above*
3. **Ethical, social and professional**	1	*As above*
4. **Communication**	2	*As above*
5. **Teamwork, collaborative and management skills**	3	*As above*
6. **Information literacy**	3	*As above, plus in the software training*

4. Rationale and strategies underpinning the course

Teaching Strategies	Online blended learning (synchronous and asynchronous) supported by flexible access to course materials, activities and assessments. In-person labs (Bioscience G29) and online synchronous lab sessions are provided. Online lectures and labs are delivered through the UNSW communication platform Microsoft Teams. Recorded sessions of lectures and tutorials are available on Moodle via a dedicated channel for GEOS9016 created in Microsoft Stream. Students are expected to interact in the online labs and other synchronous activities to be planned during the Term, as this provides a better learning environment (as opposed to being talked at for an hour). Lecture and laboratory notes are provided on Moodle as support material, along with a discussion forum. Relevant papers and other documents are accessible through the UNSW library website. **Synchronous learning?** This is a form of education where learning *occurs at the same time* (e.g., students connect to a video lecture on Wednesday from 9-11 am) but *not in the same place*. In the context of this course, the term is used to mean online learning in which students learn from instructors, or peers **in real time**, **but not in person**. For example, weekly labs via video conferences using Microsoft Teams, chat-based online discussions via Moodle Forums, and lectures that are broadcast at the same time[1]. **Asynchronous learning?** In this course it means instruction and learning that occurs *in different locations, at different times*. For example, prerecorded video lectures or labs made available via Moodle, email exchanges between lecturer and students, and online discussion boards. [1].
Rationale for learning and teaching in this course	GI Systems are fundamentally technical in nature, in that one needs to use software to achieve one's aims. However, while this course includes a software training section, its primary focus is not about teaching software. It is about the principles of GI Science (software changes rapidly, principles do not). Consequently, there are three elements that you should use for learning in the course. The recommended readings (textbook, notes) provide a broad overview of the course subjects, and are a good source of initial reference before you use the broader scientific literature. In

[1] From https://www.edglossary.org/synchronous-learning/

	the case of the software, there are detailed online manuals that should be referred to. These include both 'instructions and command references' and tutorials. Finally, there are your colleagues in the course. You are all working on similar problems, and you are encouraged to learn together. The Moodle discussion forum is provided to assist in this process. As with all postgraduate courses at university, you are expected to do much of the learning yourself. The lectures are used to give you an introduction to the subject area, and the labs are there to reinforce this. A more detailed understanding must be gained outside of class time, usually as part of your assessment tasks. The assessment tasks have been aligned with the expected learning outcomes as closely as possible. You are also strongly encouraged to delve further into the field of GIS and its applications, particularly as they relate to applications you are interested in.
Access to the lecturer	I am available via Microsoft Teams during the designated times of lecture, and the labs devoted to the projects. I am also available during in-person lab times. If you encounter a problem outside of the scheduled contact periods, then what you should do depends on the nature of the problem. **If your problem is conceptual**, then please contact me by email or via MS Teams to arrange a time to discuss it. I often have other meetings, so this will help manage your time and mine. If possible, please provide a short summary of the area or topic you need help with to allow me to prepare for the meeting. Many of the challenges in this course are technical in nature. In turn, many of these technical problems are common to the entire course. So, **if your problem is technical and related to the software**, then please follow these five steps. 1. **Stop and think**. You will often be able to solve the problem with a little of your own brain power. I have found that walking away from the computer and doing something else for half an hour is a very effective approach (let your subconscious mind do some work). 2. **Read the manual**. The manuals we are using have detailed explanations of many of the tasks you might wish to do. They should be your next point of call. It will take a bit of time initially while you get used to the mindset of the software developers, but once learnt they are very useful. The software also has an extensive online database of bug reports and solutions, and is available at http://desktop.arcgis.com/en/documentation/. 3. **Ask someone else (if you are in-person at the labs, or online using Microsoft Teams)** if they have encountered the same problem – they may know the answer (and it is good to talk to people…). If you are not familiar with the communication platform MS Teams read: https://student.unsw.edu.au/teams-students 4. **Post a question to the course Moodle discussion board or email the lecturer**, or send a message to the lecturer via MS Teams. Read the list of postings first, in case someone has already answered the question. The discussion board will be regularly checked (usually daily) to post answers and check factual accuracy of other answers. Where they are relevant to the whole course, email queries will be anonymously copied to Moodle. 5. **If your problem has still not been solved, then please contact the lecturer to make an appointment.** Don't stew on the problem forever. The five steps are actually the approach you will need to use in the workforce, so it is a good learning exercise in itself.

5 Course schedule and structure

The schedule/order of lectures may change as the course demands.

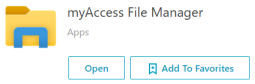
Week	Week Starting	Hours	Lectures Wed (9 – 11am week 1-5) (10 – 11am week 7-10)	Hours	Labs Thurs (10 – 12pm week 1-5) (10 – 1pm week 7 – 10)	Assessment Due Dates
1	31 May 2021	2	Introduction: Data models, data structures, types and sources	2	Lab 1: Intro to ArcGIS, import data for project Overall explanation of labs and major project.	
2	07-Jun-2021	2	Map projections	2	Lab 2: Map projections Explanation of requirements for the DEM Report.	Lab 1 questions due Wed 9th June ESRI Software training 1 (Getting started with GIS) by end of week.
3	14-Jun-2021	2	Metadata Spatial interpolation	2	Lab 3: Spatial interpolation	Lab 2 questions due Wed 16th June
4	21-Jun-2021	2	Error Topology	2	Lab 4: Metadata (4a) & Error (4b)	Lab 3 questions due Wed 23rd June ESRI Software training 2 (Using Raster Data for Site Selection) by end of week
5	28-Jun-2021	2	Map Algebra Geoprocessing: raster and vector	2	Self-guided lab to complete the DEM report	Lab 4 questions due Wed 30th June ESRI Software training 3 (Building Models for GIS Analysis Using ArcGIS) by end of week.
6	05-Jul-2021		Flexible week - NO LECTURES or LABS			**DEM Report Due Wed 7th July**
7	12-Jul-2021	1	Spatial Analysis: Fuzzy logic	3	Major Project	ESRI Software training 4 (Map design fundamentals) by end of week
8	19-Jul-2021	1	Cartographic modelling	3	Major Project	
9	26-Jul-2021	1	Model verification & validation. Basics of making a map	3	Major Project	**Major Project due Friday 30th July**
10	02-Aug-2021	1	Course summary. Reflective writing Q&A		Self-guided lab to complete reflective writing	**Reflective writing short essay due Friday 6th August**

6. Assessment Tasks and Feedback: summative assessments

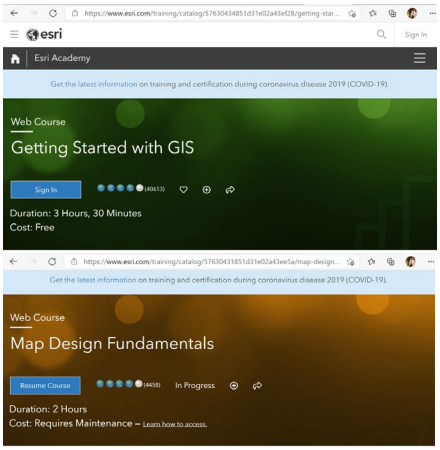
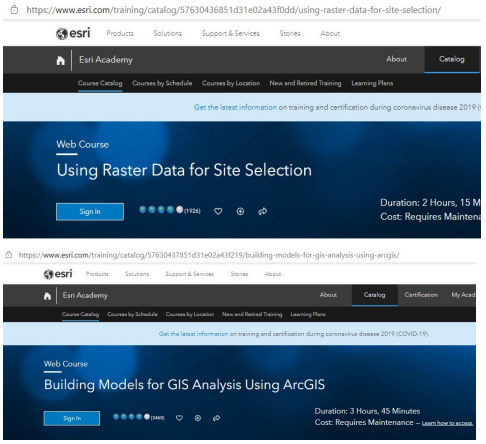
Task	Knowledge & abilities assessed	% of total mark	Date of		Feedback		
			Release	Submission	WHO	WHEN	HOW
Labs (individual)	See the Course Learning Outcomes section.	25 (5 marks each Lab)	Weekly (weeks 1 to 5)	Lab 1: Wed 9th June Lab 2: Wed 16th June Lab 3: Wed 23rd June Lab 4: Wed 30th June	German	One week after submission.	Marks
Software training, and production of a DEM report (individual)	Basic GIS principles and software familiarity. See the CourseLearning Outcomes section.	25 (15% for the DEM and 10% for the online training)	Week 1	DEM report Wed 7th July Online software training 1 by end of week 2 2 by end of week 4 3 by end of week 5 4 by end of week 7	German	DEM report: Monday of Wk 8 Online software training (one week after submission)	Marks
Major project (group work)	See the course Learning Outcomes section.	30	Week 2	End of week 9	Metternicht and German	Week 11	Marks
Reflective writing (individual)	See the course Learning Outcomes section.	20	Week 3	End of week 10	Metternicht	Week 12	Marks

To pass the course, students must achieve a mark of at least 40% for the major report and complete the software training by the end of Term. Penalties apply to completion of software training after the due date

7. Additional resources and support

Text Books	**Primary references:** 1 **Delaney, J. and Van Niel, K.P., 2007.** Geographical Information Systems, An Introduction, 2nd edition. Oxford University Press. 2 **Burrough, P.A., McDonnell, R., McDonnell, R.A. and Lloyd, C.D., 2015.** *Principles of geographical information systems*. Oxford university press. These will not be used as standard textbooks we follow in the course. They are reference text to begin a search in the wider literature. You can buy them from UNSW Bookshop. Free GIS online textbooks: https://volaya.github.io/gis-book/en/gisbook.pdf https://www.gislounge.com/two-arcgis-books-free-esri/ Principles of geographic information systems : an introductory textbook. https://research.utwente.nl/en/publications/principles-of-geographic-information-systems-an-introductory-text-4 Documentation for ArcGIS: https://doc.arcgis.com/en/ And https://pro.arcgis.com/en/pro-app/tool-reference/main/arcgis-pro-tool-reference.htm **Other references that can be accessed online at UNSW Library** 3 Essentials of Geographic Information Systems (2011). Jonathan Campbell, UCLA, MIchael Shin, UCLA. ISBN 13: 9781453321966. Online access through UNSW library. 4 Tomaszewski, Brian. Geographic Information Systems (GIS) for Disaster Management. CRC Press, 2015 5 Johnson, Lynn E. E. Geographic Information Systems in Water Resources Engineering. CRC Press, 2016. 6 Tomaszewski, Brian. Geographic Information Systems (GIS) for Disaster Management. Taylor and Francis, 2014. 7 Lawhead, Joel. Learning Geospatial Analysis with Python : an Effective Guide to Geographic Information System and Remote Sensing Analysis Using Python 3. 2nd ed., Packt Publishing, 2015. 8 Favorskaya, Margarita N., and L. C. Jain. Handbook on Advances in Remote Sensing and Geographic Information Systems : Paradigms and Applications in Forest Landscape Modeling. Springer International Publishing, 2017.
Course Manual	Lab instructions and course notes will be made available on the Moodle system.
Readings	These are listed in the lecture notes and on the course web site on Moodle. Others are available, or will be made available, through the library's Leganto platform (see the link on the course Moodle site).
Recommended Journals and Conference Proceedings	See below.
Societies	Surveying & Spatial Sciences Institute (SSSI) http://www.sssi.org.au
Computer Laboratories or Study Spaces	You will have remote access to the software via http://myaccess.unsw.edu.au/ . (https://www.myaccess.unsw.edu.au/user-guides In connecting remotely it is advisable that you get the app myAccesss File Manager 

8. Required equipment, training and enabling skills

Equipment Required	For those completing the online labs a computer with sufficient internet bandwidth to run remote desktop software (citrix receiver). A student version of ArcGIS will be made available to you, and it can also be accessed through http://myaccess.unsw.edu.au/
Enabling Skills Training Required to Complete this Course	Additional training modules for the ArcGIS software are available if needed. Check the self-directed ESRI Virtual Campus courses for ArcGIS Desktop at http://training.esri.com Many of these are free for UNSW students. The courses to enrol in, and the order in which they are to be completed, are: 1. Getting started with GIS 2. Using Raster Data for Site Selection 3. Map design fundamentals 4. Building Models for GIS Analysis Using ArcGIS   These can be accessed via https://www.esri.com/training/catalog/search/ (once you have your login). Some additional courses that might be of use, but which are optional and not part of the assessment, are: 1. Basics of Geographic Coordinate Systems 2. Distance Analysis Using ArcGIS; Suitability Modeling: Creating a Weighted Suitability Model

9. Course evaluation and development

Mechanisms of Review	Comments or Changes Resulting from Reviews
CATEI and My Experience	This course has evolved over fifteen years of delivery at UNSW, and it has been developed from a GIS course taught at a university which itself evolved over a decade. The software training was added in 2010 because GIS software skills were identified as a major limiting factor for students in the course. This was converted from a monolithic course with a single deadline to a series of rolling deadlines in 2018. The overall duration for this component is now also shorter. In 2018, the DEM report has been changed to a more standard report plus metadata, where previously the content was to be entirely in the metadata format. In 2020 the course was adapted to be delivered fully online. In 2021 the course has been adapted for in-person and online delivery of lab sessions. The assessment weightings have been modified to align with the UNSW assessment design procedures approved in 2020 (i.e., maximum of four summative assessment tasks; and group assessments with a single product or performance, and for which the contributions of individual students are not assessed separately, can't constitute more than 30% of the overall course result). Furthermore, the course no longer has a final examination

10. Administrative matters

Expectations of Students	Most School of BEES policies can be found at http://www.bees.unsw.edu.au/current-students • The normal workload expectations of a student are approximately 25 hours per term for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Expected workload (6 UoCx25) = 150 hours. • Review the course outline carefully and create a work and assignment schedule in relation to your other courses to stay on track. Do not go a whole week without connecting with the course – experience from other courses show that students who do this generally get low marks or sometimes fail. • The major project requires group work. Learning and working effectively as part of a team or group is an extremely important skill, and one that you will refine and use throughout your working life. Group projects are a valuable and rewarding learning experience, and the University provides guides to orient your group work.		
Assignment Submissions	**The project reports are to be submitted through Moodle. Do not email them to me.** **Extension requests** need to be discussed with me at least one week in advance of the due date. **Late Submission**: *The school policy is 10% (of the assignment mark) for each day late – up to a maximum of seven days after which assignment will receive 0.* *Consideration for relief from this rule can be given only for documented reasons (and the student should submit documentation through Student Central).*		
Occupational Health and Safety[8]	http://www.bees.unsw.edu.au/ohs		
Assessment Procedures[9]	As per UNSW policy. http://my.unsw.edu.au		
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 convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or http://www.studentequity.unsw.edu.au). 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. Information on designing courses and course outlines that take into account the needs of students with disabilities can be accessed via http://www.studentequity.unsw.edu.au/disability-services		
Grievance Policy[10]	**School Contact**	**Faculty Contact**	**University Contact**
	BEES Grievance Officer A/Prof Scott Mooney s.mooney@unsw.edu.au	Associate Professor Alison Beavis Deputy Dean (Education) UNSW Science a.beavis@unsw.edu.au	Student complaint procedures at https://www.gs.unsw.edu.au/policy/documents/studentcomplaintprocedure.pdf University Counselling and Psychological Services Kensington Level 2, East Wing, Quadrangle Building T: +61 (2) 9385 5418 E: counselling@unsw.edu.au Office Hours: 9:00am - 5:00pm Monday to Friday

[8] UNSW Occupational Health and Safety: http://www.ohs.unsw.edu.au/
[9] UNSW Assessment Policy: http://www.gs.unsw.edu.au/policy/documents/assessmentpolicy.pdf
[10] UNSW Student Complaint Procedure: https://www.gs.unsw.edu.au/policy/documents/studentcomplaintproc.pdf
[11] University Counselling and Psychological Services

11. UNSW Academic Honesty and Plagiarism

What is 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.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that 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.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

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

12. BEES Academic Honesty and Plagiarism

Please note:

In addition to the UNSW Policy on Academic Honesty and Plagiarism, the School of Biological, Earth and Environmental Sciences (BEES), also considers any work submitted that has been produced outside of a given course in a given year to be plagiarism i.e:

- Work produced for a third party e.g. your place of employment, is considered intellectual property of the third party, and as such if such work is submitted in place of a required course work, it is deemed plagiarism.
- All work submitted for assessment must be created specifically for the given assessment task in the given year. Work produced in previous years or for other assessments is not acceptable.

13. **Useful Journals and Conference proceedings**

GIS is a rapidly developing field, and so many useful references are available in journals and conference proceedings. Fortunately for you, these are often on the web. Most lectures will have references in the notes.

This is not a complete list, and you should search for other references using databases like Scopus and Web of Science (available through http://www.library.unsw.edu.au). These are particularly useful because they allow you to track citations to papers, and thus see who has been developing an idea (or maybe has debunked it). Please note that ScienceDirect only searches Elsevier journals, and ignores other publishers such as Taylor and Francis or Wiley. The same principle applies to the Wiley Interscience system. Google Scholar indexes articles across the quality spectrum, so care needs to be taken.

Journals

International Journal of Geographic Information Science
Transactions in GIS
Geographical Analysis
Journal of Geographical Systems
Environment and Planning, Series A
Computers and Geosciences
Mathematical Geology
Ecological Modelling
Environmental Modelling and Software
Remote Sensing of Environment
Photogrammetric Engineering and Remote Sensing
International Journal of Remote Sensing
Remote Sensing Reviews
Geocarto International
Remote Sensing

Conferences with online proceedings

Geocomputation series
http://www.geocomputation.org/
GIScience series
http://www.giscience.org/
MODSIM series
https://www.mssanz.org.au/conferences.html (look for the GIS and environmental modelling sessions)