FACULTY OF SCIENCE

School of BEES

GEOS2821

Introduction to GIS and Remote Sensing

Term 2, 2019

Table of Contents

Faculty of Science - Course Outline

1. Information about the Course

NB: Some of this information is available on the UNSW Handbook[1]

Year of Delivery	2019
Course Code	GEOS2821
Course Name	GIS
Academic Unit	School of BEES
Level of Course	2nd year
Units of Credit	6UOC
Session(s) Offered	T2
Assumed Knowledge, Prerequisites or Co-requisites	Familiarity with the Windows operating system.
Hours per Week	4-7 (see lecture sequence)
Number of Weeks	10
Commencement Date	Week 1

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

Component	HPW	Time	Day	Location
Lecture 1	*1*	*15:00-16:00*	*Monday*	*Mathews D*
Lecture 2	*1*	*11:00-12:00*	*Tuesday*	*Mathews D*
Lecture 3	*1*	*09:00 – 10:00*	*Wednesday*	*MathewsC*
Laboratory 1	*2*	*12:00-14:00 OR 15:00-17:00*	*Tuesday (not all weeks)*	*E26 Teaching Lab G5*
Laboratory 2	*2*	*11:00-13:00 OR 13:00-15:00*	*Thursday*	*E26 Teaching Lab G5*
Field trips		*Depart afternoon, 28June, return ~18:00, 30 June*	*28-30 June*	*Smiths Lake field station*
TOTAL				
Special Details				

2. Staff Involved in the Course

Staff	Role	Name	Contact Details	Consultation Times
Course Convenor		*A/Prof Shawn Laffan*	*9385 8093 Shawn.Laffan@unsw.edu.au Samuels G14G*	*By appointment*
Lecturer		*Prof Graciela Metternicht*	*9385 7761 g.metternicht@unsw. Samuels, G14D.*	*By appointment*
Course Demonstrator		*Yi Lu, Lauren Coyle*		*Labs only*

[1] UNSW Virtual Handbook: http://www.handbook.unsw.edu.au/current/index.html

3. Course Details

Course Description[2] (Handbook Entry)	There has been a rapid growth in the use of digital spatial data in many areas of resource management and the environmental sciences. The aim of this course is to provide both a solid theoretical understanding and a comprehensive practical introduction to the use of geographic information systems and remote sensing in the analysis of digital spatial data, simple modelling using digital spatial data, and in decision support using commercially available software. Topics covered in the course provide an overview of the use of digital geographic information and earth-resource imagery for a wide range of environmental applications including geology, vegetation and forestry, agriculture, oceanographic and regional and urban analysis.
Course Aims	The main objective of this course is to provide students with the principles of how to manage and use GIS and Remote Sensing to work with real world issues. This is both to aid in the management of those issues, and also to gain a better understanding of them.
Student Learning Outcomes	By the end of this course you will be expected to understand how and why it is that geographic data are input, stored and manipulated using a GIS, and how to obtain, process and analyse Remotely Sensed data. You will also be expected to understand the advantages and limitations of such approaches, as they are simplifications of reality. You will be able to properly use geospatial analyses for a wide variety of applications. 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

[2] UNSW Virtual Handbook: http://www.handbook.unsw.edu.au

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**
Research, inquiry and analytical thinking abilities	3	*All will be achieved through the assessment*
Capability and motivation for intellectual development	3	*As above*
Ethical, social and professional understanding	1	*As above*
Communication	2	*As above*
Teamwork, collaborative and management skills	3	*As above*
Information literacy	3	*As above, plus in the software training*

Major Topics (Syllabus Outline)	Data models, data structures, types and sources Sensor types Electro-magnetic radiation Reflectance & atmospheric attenuation Image processing: transformations and classification Post-classification and accuracy assessment Map projections Topology and geoprocessing Map algebra Fuzzy logic Topographic analysis Map making See the lecture sequence for timings.
Relationship to Other Courses within the Program	It is estimated that 80% of all data collected have some form of geospatial location information. 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 these analyses in a consistent and repeatable manner, using spatial data.

4. Rationale and Strategies Underpinning the Course

Teaching Strategies	The primary teaching strategy used in this course will be "chalk and talk", where students do most of the talking. This will be supported by other media. Students are expected to interact in the class, 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, as is a discussion forum. Relevant papers and other documents are accessible through the UNSW library web site. There are also scheduled tutorial times during the course – attendance at these is optional.
Rationale for learning and teaching in this course	Geospatial analyses 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 GIS and Remote Sensing (software changes rapidly, principles do not). Consequently, there are three elements that you should use for learning in the course. The textbooks provide a broad overview, and are a good source of initial reference before you use the broader scientific literature. In the case of the software, there are detailed online manuals that should be referred to. These include both 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 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, normally 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 geospatial analysis and its applications, particularly as they relate to applications you are interested in.
Access to the lecturer	I am available immediately after the lecture, and the labs are devoted to the projects. 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 telephone to arrange a time to discuss it. I often have other meetings or am away from the university, so this will save you long periods of waiting outside offices trying to find me. 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 port 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 ArcGIS software also has an extensive online database of bug reports and solutions, and is available through the web. https://doc.arcgis.com/en/. The ENVI software has an extensive online help http://www.harrisgeospatial.com/docs/using_envi_Home.html where you can search by keyword or themes. 3. **Ask someone else in the lab** if they have encountered the same problem – they may know the answer (and it is good to talk to people…) 4. **Post a question to the course Moodle discussion board or email the lecturer**. Read the list of postings first, in case someone has already answered the question. The discussion board will be regularly checked (usually twice 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 that approach you will need to use in the workforce, so it is a good learning exercise in itself.

5. Course Schedule

Some of this information is available on the Handbook[3] and the UNSW Timetable[4]. The schedule is also subject to change as the course progresses.

Week # Date starting	**Lecture 1** Mon, 15-16	**Lecture 2** Tue 11-12	**Lecture 3** Wed 09-10	**Lab 1** Tue 12-14, 15-17	**Lab 2** Thu 11-13, 13-15	**Key dates**
1 3-Jun	Course introduction [SL]	Data models, data structures, types and sources [SL]	Introduction to remote sensing [GM]	*No lab*	Intro to ENVI software, RS data visualisation and analysis	
2 10-Jun	*No lecture*	Map projections [SL]	Electromagnetic radiation theory and reflectance [GM]	Copying GIS data and setting coordinate systems	Image processing: image transforms	
3 17-Jun	Image transformation techniques [GM]	Geospatial error and accuracy assessment [SL]	Sensor types & applications [GM]	Geospatial error	Image processing: classification	Software training 1&2 by Friday, 09:00
4 24-Jun	Image Transform / Image classification [GM]	Raster data processing [SL]	Image classification [GM]	*Self-directed*	Image processing: post-classification & accuracy assessment	Field trip weekend 29-30 Jun.
5						
6 8-Jul	RS Q&A [GM]	Fuzzy logic [SL]	Topology and geoprocessing [SL]	*Self-directed*	Fire model	RS data analysis report due mid week 6
7 15-Jul	Making a map [SL]	Terrain analysis [SL]	Metadata [SL]	Conservation, inundation and building models	Major project	Software training 3 by Friday, 09:00
8 22-Jul	Linking geographic and attribute data [SL]	Remote sensing for environmental applications [Guest]	Georeferencing [SL]	Model combination	Major project	
9 29-Jul	Network analysis [SL]	Q&A [SL]	*No lecture*	*Self-directed*	Major Project	
10 5-Aug	*No lecture*	*No lecture*	Course summary and things you would love to know about the exam	*No lab*	*No Lab*	Major Report due Monday of week 10

Notes:

1. The labs marked “major project” have no specific instructions, and are to continue work on the models from the preceding labs.
2. The self-directed labs mean that you have priority access to the computer lab, even though there will not necessarily be staff in them.

[3] UNSW Handbook: http://www.handbook.unsw.edu.au/
[4] UNSW Timetable: http://www.timetable.unsw.edu.au/

6. Assessment Tasks and Feedback

Task	Knowledge & abilities assessed	Assessment Criteria	% of total mark	Date of		Feedback		
				Release	Submission	WHO	WHEN	HOW
Software training	Basic GIS principles and software familiarity.	See below	10	Week 1	Ongoing	Laffan	Immediate	Marks
Remote sensing image processing and analysis	See the Student Learning Outcomes section.	See below	15-20	Week 1	Mid week 6	Metternicht	Week 7	Marks
Major project	See the Student Learning Outcomes section.	See below	45-50	Week 1	Start week 10	Laffan	End week 10	Marks
Examination	See the Student Learning Outcomes section.		30	Per exam schedule	See exam timetable when released	Laffan, Metternicht	Exam period	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.

If your mark for the major project is higher than that for the remote sensing image analysis then the weighting will be 15% for the RS analysis report and 50% for the major report. Otherwise the weight will be 20% for the RS analysis report and 45% for the major report.

7. Additional Resources and Support

Text Books	These will not be used as standard textbooks we follow in the course. They are reference texts to begin a search across the broader literature. **Primary references:** **Burrough, P.A., McDonnell, R.A. and Lloyd, C, 2015.** Principles of Geographical Information Systems, 3rd edn. Oxford University Press. **Delaney, J. and Van Niel, K.P., 2007.** Geographical Information Systems, An Introduction, 2nd edition. Oxford University Press. **CRCSI (2017)** Earth Observation: Data, Processing and Applications. (Eds: Harrison, B.A., Jupp, D.L.B., Lewis, M.M., Forster, B.C., Mueller, N., Phinn, S., Coppa, I., Hudson, D., Smith, C., Grant, I., Anstee, J., Dekker, A.G., Ong, C., and Lau, I.) CRCSI, Melbourne. Open source, online. http://www.crcsi.com.au/history-2/earth-observation-series-2/ . We will use: Volume 1A, Volume 1B, volume 2A. **Other references:** **Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W., 2005.** Geographic Information Systems and Science. Wiley. **Krygier, J. and Wood, D., 2005.** Making maps – A visual guide to map design for GIS. The Guilford Press. **Richards, J.A. and Jia, X., 2006**. Remote sensing digital image analysis: an introduction. 4th Ed. Springer Verlag. **Tempfli, K., Huurneman, G., Bakker, W., et al., 2009.** Principles of remote sensing: an introductory textbook. ITC, The Netherlands. **Lillesand and Kiefer, 2015**. Remote sensing and image interpretation (7th edition). Wiley.
Course Manual	Lab instructions and course notes will be made available on Moodle.
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	The computer lab (E26 G5) will be available outside of teaching hours by swipe card access once some final modifications to the space have been completed. Do not enter a lab if it is being used for teaching another course. You also have remote access to the software via http://myaccess.unsw.edu.au/ and will be able to download a student copy of ArcGIS (Windows operating system only)

8. Required Equipment, Training and Enabling Skills

Equipment Required	N/A. Computers are available in the labs. A student version of ArcGIS will be made available to you, and it can also be accessed through http://myaccess.unsw.edu.au/ Note that ArcGIS only works on the Windows operating system.
Enabling Skills Training Required to Complete this Course	Additional training modules for the ArcGIS software are available if you wish to take them. Check the Web Courses list for the ArcMap product at http://training.esri.com Many of these are free for UNSW students (after logging in), and you can access them directly if so.

9. Course Evaluation and Development

Mechanisms of Review	Comments or Changes Resulting from Reviews
CATEI	This course is a merger of the introductory GIS and Remote Sensing courses (merged in 2016). The broad structure is from the introductory GIS which evolved over twelve years of delivery at UNSW, and was developed from a GIS course taught at a university down the highway which itself evolved over a decade prior to that. The major changes in the merger are the removal of content. In terms of assessment, the interpolation and metadata lab components have been replaced by the remote sensing image analysis. The major report components have also been reduced and simplified to allow more space for the RS image analysis and interpretation. 2010: The software training was added to the GIS course in 2010 because software skills were identified as a major limiting factor for students in the course. 2018: Software training was divided into subsections with rolling deadlines instead of a monolithic course with a single deadline. The overall time required for this has also been reduced (approximately halved). 2019: Additional Q&A sessions added, software training reduced to three components (from four). One additional remote sensing lecture was added, total lecture and formal lab contact hours otherwise remain unchanged from 2018.

10. Administrative Matters

Expectations of Students	Most School of BEES policies can be found at http://www.bees.unsw.edu.au/current-students You are expected to attend all lectures and laboratories. Failure to submit assignments may be used as grounds to exclude you from the examination.		
Assignment Submissions	**Hardcopies of the project reports are to be submitted** via the School assignment box at the BSB Student Office (ground floor, Biosciences building). You **must** also submit a copy through Moodle. Whichever is first will be used as the submission time. **Do not email them to the course convenor or lecturer.** **Extension requests** need to be discussed well 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[5]	http://www.bees.unsw.edu.au/health-and-safety		
Assessment Procedures[6]	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[7]	**School Contact**	**Faculty Contact**	**University Contact**
	BEES Grievance Officer A/Prof Scott Mooney s.mooney@unsw.edu.au	Dr Chris Tisdell Associate Dean (Education) cct@unsw.edu.au Tel: 9385 6792 or Dr Gavin Edwards Associate Dean (Undergraduate Programs) g.edwards@unsw.edu.au Tel: 9385 4652	Student Conduct and Appeals Officer (SCAO) within the Office of the Pro-Vice-Chancellor (Students) and Registrar. Telephone 02 9385 8515, email studentcomplaints@unsw.edu.au University Counselling and Psychological Services[8] Tel: 9385 5418

[5] UNSW Occupational Health and Safety: http://www.ohs.unsw.edu.au/
[6] UNSW Assessment Policy: http://www.gs.unsw.edu.au/policy/documents/assessmentpolicy.pdf
[7] UNSW Student Complaint Procedure: https://www.gs.unsw.edu.au/policy/documents/studentcomplaintproc.pdf
[8] 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

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.

Marking criteria for the software training

The online courses can be accessed through https://www.esri.com/training/catalog/search/ (after logging in). Set the FORMATS option to “Web Courses” and PRODUCTS to “ArcMap”.

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. Building Models for GIS Analysis Using ArcGIS

The training includes multiple choice quizzes at the end of each component.

Marks will be assigned based on completion by the assessment date in the timetable. For example, if you have successfully completed two of the three components by their respective due dates then you will be awarded 2/3=66.7% of the total marks for this piece of assessment.

If you are not sure how many sections you have completed then you can access it through https://www.esri.com/training/my-activity-record/ . This can also be accessed through the training web site using the link My Academy -> My Learning Activity.

Any components not completed by their due dates must still be completed by the end of term.

Access to the training will be allocated via an invitation to the UNSW organisation on the my.esri.com system, after which you can self-enrol in the course. Completion status will be assessed during the labs.

Please do not go back and re-do the quizzes after you have completed them, as that will reset them. Please wait until your marks have been collated.

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

You should also look at the editing section of the ArcGIS help, as it will be useful later in the course.
http://desktop.arcgis.com/en/arcmap/10.6/manage-data/editing/a-quick-tour-of-editing.htm

Marking criteria for the Remote Sensing Image Analysis report

Details will be provided on Moodle.

Marking criteria for the major 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 I am looking for in your projects 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 project 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.

I 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*. More than this number is provided to you in the lab notes so it is a simple target to achieve.

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 a 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 (eg. 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 https://student.unsw.edu.au/referencing 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 https://www.it.unsw.edu.au/students/software/index.html. 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.

You should provide a minimum of ten peer-reviewed references. These include journal articles, peer reviewed book chapters or research monographs. Web sites and other sources should be cited if used, but will not count towards this total.

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 and Wiley. The same principle applies to the Wiley system. Google Scholar indexes articles across the quality spectrum, including some of very low quality, so care needs to be taken.

Journals: available online at https://www.library.unsw.edu.au/

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/
MODSIM series
http://www.mssanz.org.au/
IGARSS
http://ieeexplore.ieee.org/xpl/conhome.jsp?punumber=1000307