Studying Geographical Information Systems (GIS) at the University of Waikato

GIS is described as the Geospatial Revolution as it is transforming the information infrastructure of many Government and private organisation, as well as changing the way we operate both in our private lives and in work. Route finding using Google maps is an example but many other examples can be viewed through the Geospatial Revolution online videos (www.geospatialrevolution.psu.edu).

GIS at the University of Waikato has an applied focus and students have the opportunity to link GIS to many different disciplines. These range from Human Geography applications, such as exploring population migration patterns, to Science and Engineering applications such as modelling ice melt in Antarctica or horticultural assessment using drones. Appendix 1 provides a list of the many different GIS projects we have completed over the years, which in many cases are world leading innovations. Our research has a strong emphasis on spatial analysis for solving real world issues, such as water quality monitoring, mapping crime hotspots for the NZ Police, and assessing population access to essential services such as hospitals and education. We also have a strong research profile in remote sensing, which includes mapping individual tree species from space, such as Pohutukawa, or using night lights to monitor economic activity in developing countries.

Graduates with GIS skills are highly employable and often employers request these skills even if the job is not a specialised GIS job. Just enter “GIS” in the Seek job search (www.seek.co.nz) to see how many GIS jobs there are. Soil scientists and ecologists are expected to understand GIS and have basic skills in using GIS data and software. Demography, population health, crime, planning, and Information Analysts all benefit from using GIS. GIS is an important part of the information infrastructure of many different Government and private organisations, including Land-use consultants, forestry companies, regional and local councils, DHBs, police, and the Department of Conservation. At the University of Waikato we offer education pathways to become a GIS specialist, or a GIS user for a particular disciplinary profession. We cater for students that are completely new to computing, as well as people with advanced IT skills. GIS is a fun way to learn about data, maps, file management, and even programming.

As well as standard on campus lectures and labs, all of the GIS papers we teach also offer online facilities so students can view previous lectures, submit assessments, and obtain reading material and lecture content, including data and software remotely using Moodle and Google Drive. Many students are now completing these papers from home or work. Assistance is provided in labs but students can choose to complete assignments off campus if they have an appropriate computer. The University provides ArcGIS software in labs or for installing on home computers. Assistance is also provided using virtual labs, so students can have help through online video conferencing with demonstrators. It is up to the individual student to decide whether they want to attend the lectures and labs or use the online lectures and support. Most taught papers consists of a two hour lecture each week plus a two hour lab with assistance available. GIS is a subject best learnt through practical applications and the labs are designed to provide increasing levels of complexity. Depending on the level of the paper, you will be able to complete reasonably sophisticated analysis, Since we all have diverse interests and backgrounds, the papers finish with a project so that you can demonstrate what you know on your choice of topic. At the undergraduate level, students are free to complete the labs and project in pairs, so people can learn from each other. The undergraduate papers have online tests, based on the content of the lectures and the labs. Below are the qualifications and papers that we offer in GIS.
Undergraduate GIS and the GIS Minor

A GIS minor is available for all undergraduate degrees.

To qualify for a minor in GIS, students must complete 60 points as follows:

- 30 points from ENVPL202 (Cartography and Spatial Analysis) or EARTH251 (Spatial Analysis in Geosciences) or POPST201 (Population Studies),
- 15 points selected from STATS111 (Statistics for Science), STATS221 (Statistical Data Analysis), COMPX101 (Introduction to Computer Science), COMPX102 (Object-Orientated Programming), or COMPX223 (Database Practice and Experience),
- GEOG328 (Geographic Information Systems) (15 pts).

There are two core GIS papers at undergraduate level – ENVPL202 – Cartography and Spatial Analysis, and GEOG328 - Geographical Information Systems. These papers can be taken as electives for any qualification.

ENVPL202 provides an introduction to GIS, as well as working with spatial data and basic spatial statistics. A key goal of this paper is to build student confidence with working with computers and data. Excel is an excellent platform for visualising and analysing large datasets, and students will learn how to use this software to summarise data into meaningful information that is useful to people. This includes generating graphs and basic statistics from population census data and environmental data sets. Linking Excel tables to GIS is easy, which means that tabular data can be transformed into maps. Becoming a cartographer can be learnt in a few hours and students will learn the fundamentals of cartography and apply these skills so that it become routine. Students will be expected to identify and critique the conceptual, spatial and temporal components of information. The paper consists of lectures followed by practical exercises in the computer lab using ArcGIS and Excel software, as well as Global Positioning Systems (GPS). Students demonstrate their GIS and analytical skills by completing a project of their choice.

GEOG328 builds on ENVPL202 but it is possible to enrol directly in GEOG328 if you are confident with computers and prepared to do some catch-up work. GEOG328 covers the full range of GIS functionality, including both raster and vector analysis, and remote sensing. The paper is designed to provide students with a broad overview of how GIS is used, including the importance of GIS organisation, and ethical issue surrounding privacy. The practical computer labs include: spatially integrating several different GIS layers that represent different themes using a map calculator; calculating the quickest driving route using network analysis; developing 3D visualisation; and visibility analysis to identify what places have a coastal view. GEOG328 is available in both Hamilton and Tauranga as taught papers, as well as a NET paper. It includes applications that are relevant to Human Geography, Environmental Planning, Biology, and Earth Science.

Graduate GIS

At the graduate level we offer the GIS Specialisation for people who want to have a career in GIS and become the GIS champion for an organisation. This specialisation is added to your academic record and can be combined with a range of qualifications which are listed below in Appendix 2, along with the completion requirements. We also cater for people new to GIS. There are many people who discover GIS for the first time after they have completed an undergraduate degree, or they simply did not have the chance to study GIS previously. For these people, who are relatively new to GIS, we offer GEOG558 – Applied GIS for Research and Planning. This paper is co-taught with the
undergraduate GEOG328 paper and has the same content. The assessment is different because it is a graduate paper and students are expected to be more reflective in their approach to GIS. GEOG558 is an excellent paper for students who would like to use GIS for their Masters or Ph.D.

For people who want to advance their GIS knowledge we offer two taught papers – GEOG538 – Automated Spatial Analysis using GIS (15pts) and GEOG548- Advanced GIS Modelling (15pts), as well as a range of self-directed papers – GEOG589 – Special Topic (15pts), GEOG590 - Special Topic (30pts), GEOG591 – Dissertation (30pts), GEOG592 – Dissertation (60pts), GEOG 593– Dissertation (90pts), and GEOG 594– Dissertation (120pts).

GEOG538 - Automated Spatial Analysis using GIS, introduces students to the use of Python programming so that GIS analysis can be automated. Students are not expected to have any prior knowledge of programming and this is an excellent paper for learning the basics of coding. It is amazing how much more productive GIS is when Python programming is used. Coding allows analysis to be repeated for different locations as well as for different time periods. Repetitive tasks can be completed just by clicking “Go”. Many employers expect GIS graduates to have coding skills. Programming is not difficult and the basics can be covered in a few hours, but it takes a bit of practice to combine GIS analysis and programming. There is nothing more rewarding then instructing a computer to complete complex analysis while you take a break for a few hours, and then returning to see that all the analysis is complete. It is about working smarter not harder, but in reality people with coding skills are given heaps more work because they are productive. Hardly fair, but what is their pay like? GEOG538 will be taught as a block course, which involves a week of classes just prior to the start of B semester, followed by time to complete a project over the following six weeks.

GEOG548- Advanced GIS Modelling, provides an overview of modelling and an introduction to spatial statistics. Understanding the different types of models and how they are used is really interesting. Descriptive models, dynamic models, and stochastic models are all part of the fun. GIS is a powerful tool for deriving data on all aspects of society and the environment. Using some statistics to identify spatial patterns and possible causes of these patterns is highly useful to many clients (with deep pockets). For example, are crime events clustered or evenly distributed, and is there a relationship between alcohol outlets and crime intensity? Or can we predict the habitat of stoats or humans? Applying spatial analysis using GIS to real world problems is very satisfying. GEOG548 will be taught as a block course, which involves a week of classes mid-way through the A semester, followed by time to complete a project over the following six weeks.

The directed study papers, range from 15 points to 120 points, and can contribute to a Postgraduate Diploma or Masters qualifications. These papers provide flexibility in the types of GIS that can be studied and it is up to the student to develop a topic. Project based learning, using a topic that you are interested in, and / or you are being paid for, is a great way to learn GIS. The GEOG589 and GEOG590 (Special Topics) can be project based and provide outputs that demonstrate technical capability rather than just a conceptual dissertation. These Special Topic papers also provide the opportunity for students to have work experience with a potential employer. The 60-120 point directed study papers are intended for students completing a 180 point Masters.

Appendix 1: GIS Projects at the University of Waikato

- Using satellites to analyse land-cover change in Nepal – Annapurna region
- Mapping water availability in Antarctica using hydrological modelling
- Monitoring water quality and temperature from satellites
- Using Remote Sensing for mapping wetlands
- Natural Character Assessment
- Identifying suitable sites for wind farms
- Mapping Crime
- Landscape Character Classification using GIS
- Modelling net migration in NZ – why do some towns and cities grow and other decline?
- Modelling stoat habitats
- Hazard modelling – Tsunamis, Lahars, Liquefaction, Landslides, and Earthquakes

Appendix 2: GIS Specialisation Regulations

The GIS specialisation is available for:

BSocSc(Hons)(Geog) - 120 points,
PGDip(Geog), PGCert (Geog), PGDip(Dem) – all 120 points,
Master of Social Science (subjects: Geography, Demography, Anthropology, Economics) - 180 points,
Masters of Information Technology (http://www.waikato.ac.nz/study/qualifications/master-of-information-technology) - 180 points,
Master of Environment and Society - 180 points, and
Master of Management Studies (subject: Economics) - 180 points.

In addition to completing the requirements of the degree, students must complete 30 points from:

GEOG538 - Automated Spatial Analysis using GIS (15 points)
GEOG548 - Advanced GIS Modelling (15 points)
AND 30 points from:
Any 590 - Directed Study (30 points)
Any 591 - Dissertation (30 points)
Any 592 - Dissertation (60 points)
Any 593 - Thesis (90 points)
Any 594 - Thesis (120 points)

The 590, 591, 592, 593, and 594 must comprise a research topic involving a substantial component of GIS and must be developed in consultation with the programme convenor for the subject and the GIS specialisation coordinator.

Students who have not completed GEOG328 - Geographic Information Systems or equivalent will be required to complete GEOG558 - Applied Geographic Information Systems for Research and Planning (15 pts).