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CHEMISTRY

FIELD: Inorganic Chemistry	TITLE: Function N-Heterocycle stabilised carbene ligands	SUPERVISOR(S): Graham Saunders	PROJECT # 25
<p>ABSTRACT: N-Heterocycle stabilized carbenes (NHCs) are a new class of ligands that have been found to enhance the stability and catalytic properties of metals. Additionally they have been found to give rise to interesting novel chemistry. Although several substituted NHCs have been studied, those bearing pendant functionalities are less well developed. Yet these ligands promise a range of desirable properties. This project will concentrate on:</p> <p>(i) NHC ligands with cationic derivatives that will allow easy characterization by electrospray mass spectrometry (this is in collaboration with Assoc. Prof. Scott McIndoe of Victoria University, Canada).</p> <p>(ii) Fluororayl NHC ligands that are susceptible to reaction with nucleophiles, allowing functionalization when coordinated to a metal. This builds on the results of a project last summer. These ligands are likely to be important in the development of chiral catalysts for stereoselective organic transformations - an ongoing project theme of the applicant.</p> <p>(iii) NHC ligands with pendant pyridines, which can enhance catalytic activity, allow pH switching of reactions and can coordinate to other metals, allowing dinuclear species.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • The student must be motivated and have sufficient synthetic skills and confidence in the laboratory. • A 3rd year or good 2nd year student majoring in chemistry should be of suitable experience. • The student should be familiar with spectroscopic techniques, especially NMR spectroscopy. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • The project will give results that will be important to a current research project of the applicant in collaboration with Assoc. Prof. Scott McIndoe of Victoria University, Canada. It is expected that the results will be used as the basis for one or two papers in journals such as The Journal of Organometallic Chemistry or Dalton Transactions, which will further enhance the reputation of the applicant. • The student will gain experience in synthetic inorganic chemistry, which involves ligand synthesis and the handling of air-sensitive compounds. The student will also use appropriate spectroscopic methods, such as ³¹P and ¹⁹F NMR spectroscopy, and mass spectrometry, and be trained to use these instruments. • The student will also gain training in the interpretation of NMR and mass spectra. Recording and interpreting spectra are essential skills for industrial, as well as academic, chemists and so will be invaluable to the student in pursuing a career in chemistry. • The student will also gain useful insight into optically active compounds and the application of chirality in organometallic chemistry 			

FIELD: Computational Organic chemistry	TITLE: Elucidating the structure of biochar	SUPERVISOR(S): Dr Joseph Lane	PROJECT # 26
<p>ABSTRACT:</p> <p>Biochar is produced by the slow pyrolysis of biomass in the absence of air. It is similar in many attributes to charcoal, which has been produced from ancient times. Recently there has been considerable interest in biochar in scientific and government circles, since it has been demonstrated that it has soil amelioration properties and also represents a possible method to sequester carbon. Biochars can be produced from varied sources including agricultural waste, waste paper, sewage sludge, animal litter etc and there is still no agreement on the optimum conditions of production relative to soil amelioration properties. The structure of biochar is poorly understood but a recent publication from joint work between University of Waikato and the Hawai'i Natural Energy Institute have demonstrated the presence of discrete stable entities visible in MALDI-TOF spectrometry at lower laser power than the graphitic carbon species exhibit ionisation. Work is underway to attempt to experimentally isolate one of these structures but the nature of biochar makes this work slow and difficult.</p> <p>The successful student will use high level computational chemistry methods to elucidate the dominant molecular entities in biochar. This project will initially require careful examination and interpretation of existing experimental data, including mass spectrometry and elemental analysis results. The student will then propose a series of different possible structures for biochar and calculate the relative stability of each using computational chemistry. Finally, the student will investigate positive and negative ions for each structure to ascertain any potential bias in the MALDI-TOF mass spectrometry results. All calculations will be carried out using the University of Waikato's High Performance Computing Facility 'Symphony'.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • The student should have a good general chemistry background particularly in the area of organic chemistry. • Basic computer skills are also required. Experience using the Linux operating system would be advantageous but is not a requirement. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • The results of this work will be published as a full journal article in Industrial & Engineering Chemical Research. • The student will develop an understanding of the interface between organic chemistry and computational chemistry. This cross-disciplinary approach leverages the advantages of both experiment and theory to solve chemical problems in a more efficient manner. The student will also gain experience using High Performance Computing (HPC) facilities, which is considered an invaluable tool in modern e-research. 			

ENGINEERING

FIELD: Electronics	TITLE: iDCC Trial	SUPERVISOR(S): Prof. Jonathan Scott	PROJECT # 27
<p>ABSTRACT:</p> <p>We have developed a user-interface design for a DCC system that we dubbed "iDCC" (imaginative digital communication and control), basically a radically different version of a model railway computer controller, in response to formative feedback obtained from interviews with potential users. The surprising results observed in the initial interviews suggest that the opportunity for radical change in the interface aspects of the system are on a par with the difference between a Mac and PC. This project intends complete the cycle by obtaining summative feedback from potential users based on their exposure to the radical design that came out of the previous work. This will involve producing commercial-quality prototypes of the design, and carrying out what amounts to a marketing trial.</p> <p>The first step will be for the student to become familiar with the previous research, and the NMRA DCC standard. Next they will take the existing design and prototype and construct a polished version that can be displayed and used in demonstrations. This will require ordering and populating commercial PCBs, making a robust, properly labelled case, and presenting the design as if it were a commercial product. The plan is to demonstrate to potential users and subsequently analyse their feedback. The aim of the analysis is to identify aspects of the design that surprise and appeal to users, and to confirm that the interface successfully relieves the user of the need to understand addressing and programming (identified previously as a barrier). If time permits, "marketing documentation" can be prepared that reflects the results.</p> <p>The project thus involves a mixture of hardware, embedded software, "customer interface", and marketing skills.</p> <p>Irrespective of the business outcome, I would like to achieve a write-up of the experience as a case study in usability design. The project offers the possibility of publication both of the novel aspects of the design, and of the experience of responding to surprising results obtained from formative feedback.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none">• Familiarity with microcontroller hardware and microcontroller programming. Any experience with product presentation and marketing, especially of electronic things, would be a bonus.			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none">• I expect to get summative feedback on the iDCC interface design. I would like to have some prototypes that can be trialled in marketplace conditions. At the best, I would like to have the materials in place to attract a manufacturer to partner with us in producing the units commercially.			

FIELD: Electronics & practical physics	TITLE: Harvesting electrical power without moving parts	SUPERVISOR(S): Dr Marcus Wilson & Prof. Jonathan Scott	PROJECT # 28
<p>ABSTRACT: Can we get usable amounts of power, enough to run electronics in a wireless device, purely from water flow, without any moving parts? It has been shown in the past that a needle probe develops a voltage proportional to the turbulence it causes (Varga and Seymour, 1986). At that time nobody was interested in the power available, but today researchers are hungry to run devices from fish tracking transmitters to domestic water consumption meters on power harvested from the environment. This has the potential to run equipment for longer, in a greener way, much as an automatic wristwatch beats one whose battery you have to keep changing. The student will construct the equipment and repeat and extend the measurements reported in the literature, for example by measuring available power instead of potential. The student will also investigate factors such as water velocity and conductivity. The student will gain experience using an Agilent E5270 Precision Measurement Mainframe for logging data for analysis. Varga, I. K., & Seymour, R. S. (1986) Observation of electrical effects with cavitating liquid flow. Journal of Physics D: Applied Physics 19, 2293-2300.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • First-year physics and computer programming required. Any experience with pipes, pumps and plumbing a plus! 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • We expect to at least build the equipment to duplicate the experiment previously reported. A good student will be able to write, with supervision, a paper and submit to an appropriate journal describing the measurements. 			

FIELD: Engineering	TITLE: Electric Car Development	SUPERVISOR(S): Dr Mike Duke	PROJECT # 29
<p>ABSTRACT: An electric vehicle is being developed for research purposes at the UoW. The aim of the research is to determine the feasibility of long range battery electric vehicles. The objective of the summer scholarship work is to:</p> <ul style="list-style-type: none"> • Get the electric car operational - This will require two students. The electric car needs a new canopy and opening mechanism. This will require some design work followed by manufacture of the new canopy from an existing mould. The new canopy will need installation and attachment of the opening and latching mechanisms. There are also a number of small improvements required such as installation of the foot throttle, new mounting brackets for the car panels. • Undertake testing to determine its performance. If all the changes can be completed on time the car will be taken to a test track for performance evaluation. This will require data collection using the on board data logger. • Data Analysis - The data from the testing to be analysed using Excel and collated in a report. 			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Mechanical engineering, should have completed 214/215 and 380 • Hands on practical students 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Development of rigs and operating over the summer and data collection 			

FIELD: Electronic Engineering	TITLE: Imbedded 3D range image processing	SUPERVISOR(S): Dr. Adrian Dorrington & Dr. Michael Cree	PROJECT # 30
<p>ABSTRACT: The Range Imaging Group develops technology for 3D camera systems and 3D data processing. The group has several specialised time-of-flight camera systems, including both off-the-shelf cameras and systems designed and built in-house. These cameras generate digital photograph and video like outputs where each pixel in the image contains the distance to the object in the scene as well as brightness information. Hence, the cameras can measure the shape, size, and location of objects in the scene. To generate a range image, the scene is illumination with intensity coded light. Several (typically four) images are taken using difference codes and processed to generate one range image. Then a perspective projection and calibrations steps are then performed to convert the range image into a real-world 3D point cloud. Sometimes multiple range images are required to overcome measurement imitations. All of these steps are currently performed on a PC. This project involves removing the reliance on the PC by investigation methods to do the processing on camera or developing new coding techniques, either using hardware on an FPGA and/or in firmware on an embedded Blackfin processor.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> VHDL and/or embeded microcontroller coding 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> Proof of principle of hardware/embedded range image modulation coding and/or image processing 			

FIELD: Engineering/Computer Science	TITLE: Computer Assessment of the distortion of the retinal field in human vision	SUPERVISOR(S): Dr Michael Cree	PROJECT # 31
<p>ABSTRACT: Some people suffer from warped vision due to distortions in the retina at the back of the eye. Such distortions are tested with the 'Amsler Grid Self Test' which is a simple rectangular grid of about 20 by 20 lines each 5mm apart. The project is to implement a deformable Amsler Grid on the computer screen and provide a simple interface to enable a user with distorted vision to distort the grid until they see the grid as square. A study is to be carried out to enable quantification and characterisation of distortions that people can have and to evaluate whether computer methods can assess the distortion more accurately than the Amsler Grid Self Test. If computer assessment is successful it could have major applications in research and clinical use for monitoring disease progression and the effect of treatment.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> Computer programming including GUI programming. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> A computer program that is easily user driven and assesses retinal distortion. Analysis proving the usefulness of the program. 			

FIELD: Materials/Chemical and Biological Engineering	TITLE: Bloodmeal and Clay Nanocomposites	SUPERVISOR(S): Dr Johan Verbeek, Dr Mark Lay & A Low	PROJECT # 32
<p>ABSTRACT:</p> <p>Traditional petroleum based plastics are cheap and easy to manufacture. However, due to increasing environmental plastic pollution (approximately 40% of all plastic is thrown away after a single use) and concerns over global oil levels, interest has grown in the bioplastic industry. Bioplastics have been produced from various sources such as corn and potatoes. These are also used in the food industry causing competition. Second generation bioplastics are produced from non human food polymer sources such as bloodmeal. Bloodmeal (dried blood) is produced in large volumes as a by product from the animal processing industry (one of New Zealand’s largest industries) and is currently only used as a fertiliser. The process used to turn bloodmeal into a biodegradable bioplastic was developed at Waikato University. This bioplastic is ideal for single use applications. Additional improvements to the bioplastic are currently being investigated to increase its range of applications. Incorporating as little as 2% bentonite into plastics to form nano-composites can improve mechanical properties by up to 20%. Nano reinforcing components can also introduce new behaviours not present in the original material. This project will involve manufacturing and characterising protein/clay nano-composites. Analysis will include electron microscopy and dynamic mechanical analysis.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • The successful student must have background knowledge in chemistry and biology. • Good background knowledge of proteins, protein structure and protein interactions will be helpful. • They should also be able to carry out literature searches independently and summarise the information. • The student will require good analytical laboratory skills. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Producing protein-based thermoplastics reinforced with varying levels of nano-clay. • The ability to successfully use the transmission electron microscope to analyse samples. 			

FIELD: Composite Materials	TITLE: Engineering structure for optimised toughness/stiffness for high performance composites	SUPERVISOR(S): AProf. Kim Pickering	PROJECT # 33
<p>ABSTRACT: Carbon fibre reinforced composites provide the best structural performance available for many applications including aerospace and sporting industries. However, their performance is generally a compromise between stiffness/strength and toughness. Although much effort has gone into optimisation within the aerospace industry, less so has occurred for particular sports products. This project aims to develop composites using advanced fibres including multifilament carbon and carbon nanofibres and assess the relationship between overall composite structure and performance in order to allow engineering for specific applications such as for bicycles. The structure including arrangement of fibres/nanofibres and method of manufacture will be assessed and the pressure and heat during processing.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Foundation in science/engineering and an ability to apply theory to a particular problem. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • A platform for the development of advanced composites for high performance applications 			

EARTH & OCEAN SCIENCES

FIELD: Volcanology	TITLE: Determining the controls of explosive volcanism	SUPERVISOR(S): AProf. Roger Briggs & Dr Adrian Pittari	PROJECT # 34
<p>ABSTRACT:</p> <p>The power of explosive volcanism is caused by two different mechanisms: (1) Magmatic or "dry" eruptions generated by the exsolution of magmatic gas originally dissolved in the magma, or (2) Phreatomagmatic or "wet" eruptions produced when magma comes in contact with a large volume of "external" water. The external water can be derived from a number of sources, for example water in a crater lake, an underlying highly permeable and porous groundwater aquifer, or sea-water. In the case of magmatic eruptions, the exsolution of magmatic gas and its abundance can be calculated by measuring the volume percent of vesicles in the fragments of the deposit, which represent bubbles of gas trapped in the volcanic fragments during the eruption. Our department has recently purchased a pycnometer which is an instrument for measuring the percent of vesicles, and is specifically designed for this purpose. It can also determine whether these vesicles are connected. In the case of phreatomagmatic eruptions, explosive volcanism will fragment and eject the wall rocks in the vicinity of the explosion site, which can result in the formation of tuff rings and explosion craters. Fragments of wall rocks are referred to as lithic fragments (or xenoliths if found in lavas), and if sampled from the deposits, they can provide data as to the depth of the explosion site if the depths of these rocks are known in the local stratigraphy of the area or from local borehole data.</p> <p>The aim of this project is firstly to take samples of scoria or pumice from a variety of sites, and to determine the volume percent of vesicles using the pycnometer, in order to measure the power of explosive volcanism. The second aim is to take samples of lithic fragments or xenoliths from a variety of sites, including the local stratigraphy or wall rocks, make thin sections of them in order to identify them, and hence to find out the depth of magma/water interaction.</p> <p>A variety of sites will be chosen, all of them being sites of present on-going research projects, including Mt Ngauruhoe, and a number of scoria cones and tuff rings in the South Auckland volcanic field.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none">• Undergraduate experience with geological field data collection and sampling• Completed an undergraduate volcanology paper• Prepared to learn skills in thin-section making and pycnometry• Is interested in pursuing a Masters Degree in volcanology			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none">• For the student involved, to develop a continuing interest in Earth and Ocean Sciences, particularly in the field of volcanology, and to enjoy undertaking research. The student should find that undertaking this research project, has many similarities to doing an MSc thesis study, including learning new techniques in the field and in the lab, and evaluating new data and new discoveries.• For the project supervisors, this project will lead to a better understanding of volcanic processes in recent eruptives of Mt Ngauruhoe and in determining controls on explosive volcanism in the South Auckland volcanic field. This will fit well and add new data for planned publication of scientific articles and conference proceedings during 2011, including the IUGG (International Union of Geodesy and Geophysics) meeting in Melbourne in June-July 2011.			

FIELD: Pest mammal ecology & behaviour	TITLE: Interactions between ship rats and house mice	SUPERVISOR(S): Dr Carolyn King	PROJECT # 35
ABSTRACT: <p>Ship rats (<i>Rattus rattus</i>) and house mice (<i>Mus musculus</i>) are introduced pests that are widespread in New Zealand and have a negative impact on native biodiversity. For this reason they are often controlled and monitored. Rats in particular are targeted because they are known predators of nesting birds and have contributed to the decline of many species. It has been noted that removal of rats often leads to higher numbers of mice being detected by monitoring techniques. This indicates that the two species interact in some way. However, the nature of this interaction is not well understood. Do mice and rats compete for food? Do the larger rats act aggressively toward mice or even prey on them? Do mice increase in numbers when rats are gone, or simply change their behaviour so that they appear more numerous? The aim of this project is to work toward answering these questions, as they could have important implications for how these animals are managed and monitored.</p> <p>One way in which the interaction between ship rats and house mice is being investigated is through a study of mice during a rat control operation at Pureora Forest Park. Mice are trapped, individually marked and released with the hope of recapturing them in order to measure their abundance and survival rates. Data are collected from areas where rats are controlled and areas where they are at normal abundance in order to make comparisons. A student is required to assist a PhD candidate to carry out this field work. This will involve staying in Department of Conservation bunkroom accommodation at Pureora and working in the bush on marked grids. Work will include checking traps, helping to process captured animals and, to a lesser extent, helping to maintain gear in between trapping sessions. Up to six weeks may be spent in the field in total, but this will take place in several seven-day blocks with breaks in between. The majority of the field work will be carried out in November and late January/early February. When not at Pureora, the student will help with another approach that is being taken to investigate the research question, which involves examining the behaviour of captive rats and mice toward stimuli of the opposite species. Specifically we wish to test whether food influences the aggressive response of ship rats to house mouse stimuli. This work will consist of helping to care for animals, setting up experimental trials and analysing video footage.</p> <p>The student will gain an understanding of what is involved in small mammal research and learn relevant skills. They will experience working in the field using monitoring techniques that are widely implemented by organisations such as the Department of Conservation as well as working in the laboratory setting up experiments and observing animal behaviour.</p>			
REQUIRED SKILLS: <ul style="list-style-type: none">• Keen interest in animal ecology and behaviour• Must enjoy working in the bush and be prepared to do a reasonable amount of walking over tough terrain in all weathers• Should be motivated, responsible, organised and happy to live and work alongside others in the field.• Flexibility in hours and days of work is important and it is preferable for the project to begin in early November.			
EXPECTED OUTCOMES OF PROJECT: <p>This is the second year of monitoring house mice at Pureora. In the first year we found that house mice showed a numerical increase on grids in areas where ship rats were suppressed, most notable in autumn. This was not due to increased survival of mice occupying home ranges within grid areas, as there was high turn over of individuals. Instead it appears that there was high recruitment or immigration of juvenile mice on to grids along with some immigration of adults. This year, the rat control regime has been reversed at Pureora so that rat control grids will become non treatment grids and vice versa. This is a great opportunity to more rigorously test our hypotheses and collect more data. It also means that a summer scholarship student would be joining a field project that is already well established and organised. We expect that mice will respond similarly to the treatments this year. The captive animal work we will be doing is also an extension of earlier projects and as such has a similarly well established basis. In earlier studies we found that ship rats behaved aggressively toward house mice when they came into contact either side of a wire mesh divider and that mice showed avoidance of ship rats in foraging trials. We wish to expand on these investigations by looking at whether food availability affects the aggressive response of ship rats toward house mice. We expect that differential response of rats toward mice depending on whether the mouse is positioned close to a food source or not will provide information about the nature of the interaction between these two species.</p>			

FIELD: Biological Sciences - Marine	TITLE: Elucidating the origin and ecology of TTX: The phantom marine toxin	SUPERVISOR(S): Prof. Craig Cary & Dr Susie Wood	PROJECT # 36
<p>ABSTRACT:</p> <p>Tetrodotoxin (TTX) is an extremely potent neurotoxin that blocks sodium channels thus inhibiting the propagation of action potentials in muscle and nerve cells. This effect is fatal in humans with ingestion of < 2mg of toxin is ingested. TTX is perhaps most infamous as the lethal toxin that causes puffer fish poisoning but is now known to occur in many different species of fish and other organisms including; arthropods, echinoderms, a dinoflagellate, mollusks and worms. Despite the wide distribution of TTX among genetically unrelated animals and it's extreme individual, regional and seasonal variability "the exact origin of TTX in the food chain remains unknown". The source of TTX is one of the most highly contentious paradoxes in marine biology today. There are advocates for endogenous production and conversely compelling evidence for exogenous fabrication, with researchers postulating that bacteria are responsible for producing TTX, with the host accumulating TTX symbiotically or via food chain transmission. Investigating the production and fate of TTX throughout the life cycle of most TTX organisms has been intractable, but there is now a unique opportunity to solve this mystery in New Zealand.</p> <p>In 2009 we investigated a series of dog poisonings on beaches in Auckland, and discovered TTX in the grey sided-gilled sea slug - Pleurobranchaea maculata. Our finding was the first identification of TTX in NZ, the first detection of TTX in an opisthobranch, and some of the highest concentrations recorded in any organism. We have recently begun to develop techniques to raise individuals from egg to juvenile where we have demonstrated that all developmental stages surveyed to date contain TTX. We have also shown that eggs, juveniles and adult P. maculata collected from another New Zealand region are toxin free.</p> <p>We recently submitted a proposal to the Marsden Fund to begin research to resolve the origin of TTX throughout the life history in a tractable marine. We have successfully made it though the first Marsden round and await results pending the second round review. Our intent for the summer scholar is to assist in the design, development, and testing of a large P. maculata rearing system that will be critical for the planned experiments. The student will be required to work at the Cawthron Research Institute in Nelson for the duration of the scholarship. The student is to be supervised jointly by Dr, Susie Wood (Cawthron) and Prof. Craig Cary (Waikato), who are the collaborators on the current Marsden in review. The student will work closely with the aquaculture specialists at Cawthron to develop and test the system to maintain and rear P. maculata. This will include testing various food items, antibiotic treatments, and rearing conditions that produce healthy individuals at each life stage.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Basic skills in biological sciences, marine ecology and biology • Interest in animal husbandry and aquaculture. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • The expectation would be that a culturing system would be designed, built and tested 			

FIELD: Molecular Biology	TITLE: Engineering protein-protein interfaces for new binding properties	SUPERVISOR(S): AProf. Vickery Arcus	PROJECT # 37
<p>ABSTRACT:</p> <p>Molecular recognition is central to biological processes, from high-affinity protein-ligand interactions to the more transient protein-protein recognition events of signal transduction pathways. Such events depend on the versatility of proteins, which have been adapted to new roles as organisms have evolved. We have explored this phenomenon using a widely-distributed, small protein domain, the OB-fold, originally named for the observed functions of oligonucleotide and oligosaccharide binding (OB). The OB-fold is a small, stable protein domain that presents a concave β-sheet as an external binding face. The versatility of this domain can be seen in nature where OB-fold domains are found in a wide variety of proteins from species as diverse as humans, yeast and bacteria. In the array of proteins which contain an OB-fold, the domain binds a broad range of ligands, including proteins, oligonucleotides and oligosaccharides, which suggests that the OB-fold is ancient, tolerant to mutation, with a versatile binding face that is easily adapted to specifically bind a range of targets. Examples of the diversity of OB-fold proteins include single stranded DNA binding in the oncogene BRCA2, tRNA anticodon-binding in the aspartyl- and lysyl-tRNA synthetases, telomere end binding on chromosomes for the yeast protein Cdc13 and cell-surface oligosaccharide binding for the shiga toxin from E. coli and Shigella dysenteriae. OB fold domains also mediate a range of protein-protein interactions in superantigens in the bacterial attack on the human immune system. These observations suggest that the versatility of OB-fold proteins might be emulated in vitro through protein engineering for tailor-made molecular recognition. Antibodies are the gold standard in the field of protein molecular recognition. To capture a foreign antigen, a small number of antibodies from the immune system's naive library recognise the antigen and bind to it with moderate affinity. Selection and maturation then introduces further mutations to generate the tight, highly specific binding required to eliminate the antigen. In this way a staggering array of binding modes can be grafted on to the basic antibody scaffold, to sequester targets varying from small molecules to whole cells. This process can be recreated in the laboratory and new antibodies directed against therapeutic targets have recently entered the market - Herceptin is the most widely known example. Herceptin is an antibody which has been engineered in the lab to target the Her2 receptor on the surface of breast cancer cells.</p> <p>Our project is attempting to achieve the same goals with another protein domain - the OB-fold. We have made very large libraries of OB-fold proteins and we would like to pick specific binders from our libraries. Once we have chosen particular binders, we need to characterise the binding: How tight is the binding? How specific? This will be the work undertaken by the summer student. It will involve the latest techniques in molecular biology including cloning, protein expression and purification and using a Biacore instrument to quantify binding. To describe our engineered OB-fold protein domains, we have coined the term OBodies.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Some knowledge of basic biochemistry would be an advantage. • The position is also open to good chemistry students who would like to learn molecular biology 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • The project will produce valuable quantitative data concerning the binding affinities of engineered OB-fold domains. 			

FIELD: Biology/Botany	TITLE: Evolution of the basal angiosperm family Winteraceae on Zealandia	SUPERVISOR(S): Dr Chrissen Gemmill	PROJECT # 38
<p>ABSTRACT:</p> <p>The oceanic islands of New Zealand and New Caledonia are cut from much the same cloth: they are both off cast fragments of Gondwana, have endured dynamic and transformative geological processes including periods of submergence, and have been isolated from any other landmasses in the southern Pacific ocean for similar time frames. Furthermore, these islands are intimately connected as they both rest upon the sunken former continent of Zealandia. Evidence of this shared history is reflected by the numerous flowering plant families which are found on both of these sister- archipelagos. This study focuses on the evolution of the iconic plant family Winteraceae of Zealandia, and specifically on the sister genera Pseudowintera and Zygogynum (sensu lato). Winteraceae are an ancient, mostly Southern Hemisphere angiosperm family of evergreen trees, known for their vessel-less wood, peppery scent, remarkable flowers and excellent fossil record.</p> <p>Winteraceae are represented in New Zealand by a single genus Pseudowintera (horopito) with four extant endemic, well-known species. The case is quite different for the New Caledonian taxa which reveal a complex taxonomic history. The most recent revisions by Vink were highly radical, placing all members of four previously recognized genera into a single broadly defined genus Zygogynum comprising of 18 endemic species, within which he also recognized 13 subspecies and 3 varieties for a total of 30 taxa. It is not clear whether the characters used to delimit these infraspecific entities are constant or if they are phenotypically plastic and hence taxonomically artificial and uninformative. To test Vink's taxonomic hypotheses and resolve relationships among these taxa, comprehensive, fine-scale studies based on multiple collections for each taxon are needed.</p> <p>The goal of this study is to contribute to our larger systematics research project on the Winteraceae of New Zealand and New Caledonia. The student will learn to extract DNA, amplify target regions via the Polymerase Chain Reaction (PCR), and DNA sequencing and phylogenetic analyses. We will begin sequencing the biparentally inherited nuclear ribosomal Internal Transcribed Spacer Regions (ITS). The student will also be involved in trialling new loci to be sequenced, e.g. the uniparentally inherited chloroplast markers (e.g. trnL-trnF introns). PCR products will be sequenced at the University of Waikato DNA Unit and edited by eye using Sequencher. Multiple sequence alignments will be optimized using Seaview 4 software with MAFFT and einsl modes. Maximum likelihood and Bayesian analyses will be conducted using GARLI and PHYCAS respectively. These skills are broadly applicable to any molecular ecology or molecular systematics study, be it on plants, animals, or bacteria.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Enthusiastic about botany in general • Basic knowledge of plants • Interested in learning modern genetic techniques such as PCR and DNA sequencing. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Contribute data to an ongoing international collaboration on the evolution of the floras of Zealandia. Results will be published in high-quality international journals and be presented at conferences. 			

FIELD: Microbial Ecology	TITLE: Lignin transformation by Huhu grub fungi	SUPERVISOR(S): Prof. Hugh Morgan	PROJECT # 39
<p>ABSTRACT:</p> <p>We have been investigating the microflora of the Huhu grub in an effort to characterize the dominant fungal and bacterial species in the gut and in particular those involved in lignocellulose (wood) breakdown. Thomas Williams has successfully cultured small colonies of Huhu grubs grown on either wood, cellulose or starch and by difference we are endeavouring to pinpoint those gut species specifically adapted to growth on wood. Some putative species are under cultivation and when pure cultures are obtained their identity and function can be confirmed. Fungal isolates in particular, are of interest since many fungi are prolific in nature as agents of decay in dead trees.</p> <p>Thomas Williams is making excellent progress on this research project but will need to suspend his involvement in the lab close to the end of November in order to submit his thesis for MSc examination. The summer student will continue to progress this research and maintain the colonies of Huhu grubs. My expectation is that we will have isolated and possibly identified several species of fungi which are predominantly present only in Huhu cultured on wood, and these would form the basis of the student project. The immediate aim would be to confirm that they possess lignolytic activity. This will involve growth yield studies, modification of model lignin substrates and possibly direct confirmation of altered lignin structure by pyrolysis. Part of the rationale of my visit to York University in October is to test run a pyrolysis method for lignin structural analysis, and if successful then this could be conducted at Waikato.</p> <p>In addition, it is quite likely that dominant species of bacteria in the gut of wood feeding grubs will have been identified and/or isolated. While bacteria generally are not regarded as primary agents of lignin degradation it would certainly be important to confirm their response to lignin substrates. They might well play an important role in cellulose breakdown and the student would be expected to measure and compare rates of hydrolysis over the range of isolates obtained.</p> <p>An application to the Marsden fund for support for this project narrowly failed to make the cut to the second round in 2010, and the Marsden panel suggested that a further application be made in the 2011 round. We have substantially more information to support an application now than previously including an extensive 454 sequencing of total gut DNA. This confirms our hypothesis that the lignin content of the grub diet has manifest effects on the microflora composition - our research effort from now on will be to characterize these differences to the greatest degree possible to support the 2011 application. The summer student will be able to contribute to this goal in continuance of Thomas Williams' efforts.</p> <p>Thomas Williams presented a poster at the recent NZ BIO conference in Auckland and the poster was awarded third prize. He will also present a poster on his research at the International Symposium for Microbial Ecology in Seattle, USA in August.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Preferably passes in third year microbiology and genetics courses • Some familiarity with analytical chemistry procedures would be advantageous 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ol style="list-style-type: none"> 1) A successful bid to the Marsden Fund to support future research on this project 2) Publications formally describing microorganisms habiting the Huhu grub intestine and a description of the role they play. 			

FIELD: Molecular & Microbiology	TITLE: Environmental survey and isolation of Novel Archaea from a geothermal spring	SUPERVISOR(S): AProf. Ian McDonald & Xochitl Morgan	PROJECT # 40
<p>ABSTRACT:</p> <p>Discovering and characterizing new species is a fundamental aim of biology. Eukaryotes, bacteria, and archaea constitute the three domains of life, but archaea were not recognized as a separate domain from bacteria until 1977. Thus, the isolation and characterization of new species of archaea has lagged behind the other domains, and the discovery of novel archaea is of great interest to the microbial ecology community.</p> <p>We have recently begun to study the microbial population of a geothermal pool (70C, pH 7.4) located near Rotorua, New Zealand. Preliminary 16S rRNA environmental surveys, which measure the genetic diversity of environments, have shown that it contains a remarkable variety of microbes, including several bacterial candidate divisions, as well as novel, uncultured classes of archaea with 16S rRNA sequences only ~80% similar to any known archaeal species. These may be ammonia oxidizers, methanogens, cellulose degraders, or something else entirely.</p> <p>We propose to conduct archaeal 16S rRNA surveys of microenvironments (wood, water, anaerobic mud) within this geothermal pool and to isolate and characterize new species of archaea from these environments. The successful student will collect field samples, extract DNA, and use it to construct clone archaeal clone libraries. In parallel, the student will use a variety of culturing techniques to enrich and isolate archaea from field samples. As these archaea are quite novel, successful isolates will be a valuable contribution to the field of environmental microbiology and will be further characterized.</p> <p>This project would be based at GNS Science, Wairakei, where co-supervisor Dr Xochitl Morgan is based. We already have a number of collaborative MSc student projects and this is seen as an opportunity to develop an interesting idea with a view to a GNS funded MSc studentship in the future. There is also a possibility that Dr Morgan may be able to fund a Summer Scholarship. Dr Morgan and Associate Professor McDonald are currently co-supervising a Ph.D. student, and this summer scholarship is seen as further development of the GNS university of Waikato relationship.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> The successful student would need some practical experience in Microbiology and/or molecular biology, but would be given the necessary supervision to learn all the techniques required for this project, including DNA extraction, PCR, cloning, restriction digestion, sequencing and sequence analysis, as well as microbial cultivation. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> We expect to provide training to the student in a number of widely applicable techniques, produce data that will contribute to a publication in a leading microbial ecology journal, encourage students to continue research through to a Masters programme, and provide hands-on laboratory experience for students with supervision. Depending on the data generated by this research, the PI's anticipate that this research may form the basis of a Marsden Fund proposal. 			

FIELD: Molecular Biology/Ecology	TITLE: Barcoding New Zealand Freshwater Zooplankton	SUPERVISOR(S): Jonathan Banks, Ian Hogg & Ian Duggan	PROJECT # 41
<p>ABSTRACT:</p> <p>The accurate identification of species is crucial for understanding New Zealand's biodiversity and biosecurity as well as for the management of ecosystems and their component species. Traditionally, species identification has been based on morphological characters, and restricted to a limited number of taxonomic experts with the necessary background and knowledge. This has been particularly challenging for invertebrate life which makes up over 98% of the species on the planet. However, the use of genetic sequences ("barcoding") is rapidly becoming a viable alternative for the routine identification of specimens.</p> <p>The overall goal of our project is to develop the genetic tools to identify the zooplankton communities in New Zealand's freshwater lakes. Zooplankton are a critical component of lake ecosystems and respond quickly to environmental changes such as nutrient inputs and/or pollution. In the short-term, we will use this knowledge to monitor the outcome of conservation management interventions such as the removal of pest fish from selected lakes. The scholar's role in the project will be to photograph zooplankton specimens that have previously been identified by a recognised expert (I. Duggan), and extract DNA from the specimens and then to produce sequences for the cytochrome oxidase c subunit 1 (COI) gene that will be used to genetically identify the specimens. These data, including the photographs and collection information, will then be added to an international database (Barcode of Life Data systems -- BOLD) for comparison with other freshwater ecosystems globally. Full training will be given in the use of the database and DNA barcoding. There will likely be opportunities to participate in field work such as specimen collection and electrofishing. However the project will be predominantly lab based. The project will contribute to the Lake Ecosystem Restoration Project being undertaken at the University and partially funded by the Foundation for Science Research and Technology.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • General laboratory skills essential. • Meticulous record keeping. • Some familiarity with genetic techniques (polymerase chain reactions) and an interest in invertebrate identification would be an advantage. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Contribution of specimen photographs, collection data and cytochrome C oxidase subunit 1 sequences from NZ freshwater zooplankton to the International Bar Code of Life database. 			

FIELD: Molecular Microbiology & Evolution	TITLE: Elucidating novel ribosomal gene sequences of prokaryotes found in geothermal soils on Mt. Erebus, Antarctica	SUPERVISOR(S): Dr Craig Herbold & Prof. Craig Cary	PROJECT # 42
<p>ABSTRACT:</p> <p>Tramway Ridge, located near the summit of Mt. Erebus, Antarctica, is the most geographically isolated geothermal environment on Earth. Our laboratory is conducting a multi-year Marsden-funded research programme aimed to discover and characterize unique prokaryotes found in the hot soils of Tramway Ridge. Clone libraries built using 16S ribosomal RNA (rRNA) genes collected from Tramway Ridge have revealed a unique microbial community that is likely endemic and possibly subsurface in origin. Additional work, using high-throughput PCR amplicon pyrosequencing of hypervariable regions of the 16S rRNA gene, revealed several additional sequences, presumably belonging to novel lineages of bacteria and archaea, which were not observed in our original clone libraries. One particular lineage of archaea which was absent in the original clone libraries dominates the subsurface community. Preliminary phylogenetic analysis of a 400 bp fragment of the 16S rRNA gene suggests that this lineage is deep-branching within the archaea and may represent a new phylum that commonly used PCR primers fail to amplify. The goal of this project is for the student to determine and characterize the full 16S rRNA gene sequence for this novel lineage of archaea. The student will be required to use information from the literature and data collected by our lab to design new PCR primers targeted at these archaea. They will use these new primers to amplify PCR products from environmental samples, build clone libraries and obtain full-length sequences of the 16S rRNA gene from this novel archaeal lineage. The student will finish the project by using advanced phylogenetic reconstruction methodology to characterize the evolutionary relationship of the Tramway Ridge archaea to known archaeal sequences from other habitats. The student will learn molecular techniques common in molecular biology and microbiology research while conducting cutting edge research aimed at the discovery of novel prokaryotic lineages. The student will also be introduced to bioinformatic techniques commonly used in comparative analyses of the 16S rRNA gene. This project provides a complete discovery-based research experience for an advanced undergraduate interested in a career in microbiology and has the potential to lead to a highly-cited publication in a peer-reviewed scientific journal.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Students interested in this project should be self-motivated and knowledgeable of basic microbiological and molecular laboratory practice, especially sterile technique. • Prior cloning experience is preferred. • Applicants are not expected to have previous computational biology experience but must be willing to learn. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • We expect that the PCR primers designed by the student will be a major advance for microbial ecology research, contributing to our ongoing Marsden-funded work on subsurface microbial biogeography and enabling complete comparative studies of other geothermal subsurface environments. Since these findings will be of great interest to the greater research community, we expect this research will lead to a publication for the student. 			

FIELD: Molecular Microbial Ecology	TITLE: Resolving the relationship between bacterial communities and the geology of Antarctic Dry Valley soils	SUPERVISOR(S): Dr Charles Lee & Prof. Craig Cary	PROJECT # 43
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ABSTRACT:

The McMurdo Dry Valleys of Antarctica contains an extraordinary cold desert ecosystem where the influences of abiotic factors, such as soil salinity and the geological composition of mineral soils, play dominant roles in determining the structure and function of microbial communities. This is in contrast with temperate climate ecosystems, where the foodwebs are much more complicated and microbial communities are largely reflective of the macrofauna and macroflora present. Therefore, the Dry Valleys is the perfect environment for examining the influence of abiotic factors on microbial communities without the complications associated with a complex ecosystem. In order to definitively resolve the potentially causal relationship between Dry Valley soil microbial communities and abiotic environmental variables, we performed a series of "transplant" experiments during the '09-'10 Antarctic field season, where we extracted microbial communities from select soil types and transplanted them onto several distinct types of sterilized mineral soils commonly found in the Dry Valleys. The transplanted soil samples were incubated in individual containers in the field for over eight weeks and preserved for DNA extraction.

The successful applicant will be responsible for performing DNA extractions from the preserved samples using techniques developed by our research group and carrying out 16S rRNA gene-based genetic fingerprinting using methodologies such as automated ribosomal intergenic spacer analysis (ARISA) and terminal restriction fragment length polymorphism (tRFLP). The resulting data will be analysed using statistical methods developed within our research group to reveal the extent to which microbial communities are influenced by the geological properties of underlying soil substrates. The student will also be expected to familiarise him/herself with basic knowledge of Dry Valley geology (with help from the advisor) in order to fully understand and interpret the findings from this project. The successful applicant will be expected to produce a report before or immediately following the conclusion of the project, which will form the basis of a research paper for eventual publication (again with guidance from the advisor).

The laboratory techniques acquired during this study will be directly applicable for future molecular biology research, but the emphasis will be on developing the student's ability to think and perform data analysis independently, skill critical for long-term career developments.

REQUIRED SKILLS:

- Applicants should have basic understanding of molecular genetics and be familiar with common laboratory practice such as sterile techniques and liquid handling (i.e., using micropipettes)
- Experience with DNA extraction and other molecular biology techniques is preferred but not required
- Independent thinking ability, reasonable writing skills, and basic understanding of statistics are expected.

EXPECTED OUTCOMES OF PROJECT:

- The outcome of the study will answer one of the longstanding questions in microbial ecology of the Dry Valleys and contribute directly to our ongoing work funded by FRST, which aims to resolve the driving forces behind Dry Valley soil microbial communities. The results will also have important implications in understanding how soil geology affects bacterial communities in general and how similar cold desert ecosystems (e.g., the Tibetan plateau, Bolivian Desert, Utah Desert, and the High Arctic) are shaped by their environments. Apart from learning the laboratory techniques required for the study, emphasis will be placed on data analysis and composing the results in a logical and critical manner, skills critical for a successful future research career. Long-term interactions with the advisor will be expected during the preparation of a project report and research paper.

FIELD: Animal Behaviour and Pest Biology	TITLE: Trap selectivity of western mosquitofish	SUPERVISOR(S): Brendan Hicks & Nick Ling	PROJECT # 44
<p>ABSTRACT: The western mosquitofish, <i>Gambusia affinis</i>, is one of the world's most widespread pest fish species causing significant ecological impacts in many countries. Other than completely poisoning a water-body, few effective techniques are available for the eradication of gambusia. This project will build upon previous research supported by the summer research scholarship programme and will involve investigations of trap avoidance/selectivity in gambusia. Initial stages of the project will examine trap shyness/avoidance by gambusia and the effects of time-of-day on trapping success. Further trials will examine trap attraction using baits and Judas fish (male and female caged fish). Some field trails undertaken in the University of Waikato campus lakes will extend the laboratory studies to validations in the field.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • The student should be generally interested in animal behaviour and in the broader issues of protecting New Zealand native biota from invasive fish • Willing to do field work (live-trapping gambusia) at the start of the project and thereafter to be responsible for regular feeding and caring for them for the duration of the project, including holidays. • He/she must be well-organised and good at keeping records • Be self-disciplined • Capable of carrying out set procedures unsupervised • Preferably also practical and handy, and good at dealing with unexpected events. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • We aim to use the data derived from this project, in combination with the results of Toni Johnston's summer research project, to construct a paper on trapping methods for gambusia that could potentially be acceptable to a high-profile international journal. This research will have widespread appeal given the worldwide spread of gambusia and their ecological impacts, especially in the USA, Europe and Australia. 			

INTERNATIONAL GLOBAL CHANGE CENTRE (IGCC)

FIELD: Environmental	TITLE: Land use decisions for adapting to climate change in the kiwifruit industry.	SUPERVISOR(S): Prof. Janet Bornman & Dr Wei Ye	PROJECT # 45
<p>ABSTRACT:</p> <p>Kiwifruit accounts for up to 2.5% of New Zealand’s merchandise trade and over 60% of the nation’s total fruit export. As an export-oriented industry, New Zealand’s competitive advantage relies on being able to produce market required quality fruit for lucrative export markets. The industry’s ability to secure future supply of fruit depends on the domestic and overseas orchard production available for marketing by ZESPRI International Limited. To meet the industry target of year-round (52/7) global fruit supply by the year 2018, one of the questions the industry needs to address at the industry level is: What short, medium and long-term factors affect how the land area under kiwifruit cultivation will change?</p> <p>The commercial varieties of interest include the Hayward (<i>Actidinia deliciosa</i>), Hort16A (<i>Actidinia chinensis</i>) and any future new varieties based on these two species. Growing regions include: Northland (6%), Auckland (4%), Waikato (3%), Bay of Plenty (77%), Gisborne (2%), Hawke’s Bay (2%), Wellington (1%) and Nelson (5%). Land area under crop production is projected to be impacted by climate change because: (a) shifts in climatic suitability and seasonal changes in winter chilling temperatures affect bud-break in some growing regions, (b) climate variability causes fruit damage and loss, (c) future irrigation potential is dependent of water security in key growing regions; and (d) increasing consumer demand for low-carbon agricultural products. It is in the industry’s interests to consider the types of land-based adaptation (and mitigation) strategies it will employ.</p> <p>This summer project will produce a preliminary assessment of how the industry currently makes its projections about the ‘area under crop production’ for existing varieties, to meet export market demand and how it will plan for future shifts in production in key growing regions. The student will: (1) compile a review of literature on factors that have influenced expansion of orchard numbers and land area under kiwifruit production in New Zealand (by variety and growing region); (2) conduct up to 5 informal interviews with ZESPRI, industry and other stakeholder (such as Regional Council) personnel to compile preliminary information on factors influencing orchardists’ decisions to establish and disestablish orchards, to relocate or switch varieties (to understand if climatic factors are a part of the rationale for such decisions) (3) collect spatial information of future growth areas for agricultural production in key growing regions for kiwifruit, (4) collect information on other factors affecting site selection for new orchards (based on Long-Term Community Council Planning and other planning processes and any historical land contamination from previous land uses). This information will be compiled into a Written Report. Appropriate supervision of these tasks will be provided by the International Global Change Centre (IGCC).</p>			
<p>REQUIRED SKILLS:</p> <p>The student should have:</p> <ul style="list-style-type: none"> • a good academic background in any of the following disciplines: environmental sciences, geography and planning, ecology or earth sciences; • an interest in climate change-related research; • good academic writing and oral presentation skills; • ability to work with Excel spreadsheets and datasets; • the ability to work independently and in collaboration with the supervisor; • a clean and current driver's licence; • It would be beneficial if the student has taken the paper ENVS522 Climate Change Adaptation, and/or have prior knowledge or experience of the kiwifruit or other horticultural industries, however these are not requirements. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • A report comprising: (1) A literature review on historical projections of 'area under production' statistics for the key commercial kiwifruit varieties in New Zealand; (2) projections for future 'area under production' per commercial variety, based on industry interviews and information (3) projections of land use zoning for agricultural/horticultural production in existing and emerging growing regions (4) ancillary information on previous land uses to establish any possible issues for site selection for new orchards. 			

COMPUTER SCIENCE

FIELD: Machine Learning/Visualisation	TITLE: Visualisation plug-ins for a machine learning framework	SUPERVISOR(S): Prof. Geoff Holmes	PROJECT # 46
<p>ABSTRACT: As the saying goes, “a picture says more than a thousand words”. This is especially true when analysing data sets or evaluating the performance of machine learning algorithms. Textual output of performance statistics is a good basis, but visual representations allow the researcher to better interpret these findings. The student will at first familiarise themselves with the ADAMS machine learning framework and its workflow engine, evaluating the statistical and graphical components that are already available. The student will develop any missing components in order to implement these visualisation techniques: box plots for visualizing the attributes of data sets loaded into the system; scatter plots, like attribute vs. attribute to determine the correlation between score plots, based on the predictions of a generated model, also to evaluate the quality of the model. Finally, the student will integrate these newly developed components to make them available in the framework not only as standalone tools, but also as components to be used within the workflow engine.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Good understanding of the Java programming language • Some basic statistics knowledge 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Visualisation plug-ins that aid the researcher in the statistical evaluation of machine learning algorithms. 			

FIELD: Interactivity, Graphic Design, HCI, Publication Design	TITLE: Interactive properties of children's books	SUPERVISOR(S): Nicholas Vanderschantz & Claire Timpany	PROJECT # 47
<p>ABSTRACT:</p> <p>For a child, the act of reading can be a very interactive process. There are many published books that encourage the young reader to interact with the printed book and to experience and explore the narrative of media in a deeper way. The types of interaction that these books encourage from the reader are greatly varied; from books that encourage the reader to develop their own storyline through to books where the physical interaction with the book is deeply involving.</p> <p>This research continues on going research into children's reading being conducted by staff in the Department of Computer Science Graphic Design Group. The primary purpose of this research is to identify a wide range of books for children that incorporate different types of interactivity and classify them according to the interactive properties that they employ.</p> <p>Through their research the student will develop an understanding of interactivity in children's book and why interactive environments are important for children. Their research will involve applying knowledge of interactive environments and HCI to printed media.</p> <p>The second stage of the research will involve identifying and analysing a range of children's books which employ interactive techniques, from the commonly referred-to, through to the experimental. This stage will involve documenting, in an appropriate manner, the details of each of the books for future reference. Once a significant quality of books have been analysed the student will be required to categorise these books according to their target audience as well as consider the interactive properties of the books to develop a categorisation system for them.</p> <p>Following the categorisation system development, analysis of the properties of this system will be conducted to learn how best to develop interactive learning aids in books for children's reading and learning.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • An interest in both interactivity and children's books. • Some understanding of both HCI and book design. • Good organisational and research skills. • Ability to record information accurately and objectively. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • A database of a wide range of children's books that incorporate interactive elements for children. • A classification system for determining the types of interactivity employed by different children's books. • Potential publications will also result from this research, titled along the lines of "Surveying modes of interactive engagement in children's books." • The collection of this research will also form a strong basis for continuing future research into the development of theory for both print and screen based interactive books for children. • It is expected that conference and journal publications from this research will result. Targeted journals and conference's include: The International Journal of the Book, The International Conference of the Book, Journal of Interactive Media in Education, Journal of Interactive Learning Research and ACM SIGCHI Conference. These papers will help the student to build a greater understanding of the research environment and will help to expand the body of information available for future research in this area. 			

FIELD: Computer Science(Digital Libraries)	TITLE: Improving the Performance of Greenstone 3 Digital Library Software	SUPERVISOR(S): AProf. Steve Jones & AProf. David Bainbridge	PROJECT # 48
<p>ABSTRACT:</p> <p>Greenstone 3 (GS3, www.greenstone.org/greenstone3-home) is the Java-based 'next generation' of free, opensource digital software developed in the UoW Computer Science Department. Its predecessor Greenstone 2 is widely used around the world by organisations such as the United Nations. Strengths of GS3 include its modular architecture and its use of XML/XSL to provide flexibility in how underlying data is presented to end users. Whilst GS3 uses efficient indexing and retrieval techniques, a performance bottleneck in the current system is the generation of the HTML content delivered to a user's web browser. The goal of this summer project is to reduce or eliminate this bottleneck. GS3 HTML pages are dynamically generated from data represented in XML. This includes information about the GS3 system set up, the features of each collection of documents in the system, user interface preferences, document metadata and user interface 'skins'. A transformation process dynamically builds an XSL stylesheet for the page to be generated and then applies it to the XML data, creating the HTML document. This turns out to be an expensive process.</p> <p>The project will therefore include the following activities:</p> <ol style="list-style-type: none"> 1) performance analysis to identify server-side code 'hotspots' - the parts of the code that account for most of the execution time - focusing primarily on the HTML generation process 2) optimisation of GS3 code/algorithms to reduce the effect of hotspots 3) Implementation of the capability for GS3 to hand XSL processing off to the web browser. XSL transformations can be applied in web browsers once they have loaded the XML and stylesheet documents from the server. This presents the opportunity to share the work of HTML generation between the GS3 server-side code and the user's web browser 4) Analysis of the performance impact of client-side versus server-side XSL processing. Further performance improvements may be achieved by focusing on the nature of the HTML documents processed by the browser. Numerous performance rules for web sites are now well established (eg developer.yahoo.com/performance/rules.html), and include simple techniques such as structuring HTML documents in particular ways. Therefore the project will also involve 6) Analysing GS3 HTML pages with respect to web site performance rules, identifying potential improvements and implementing them GS3 makes little use of AJAX - asynchronous requests from the browser to the server that enable parts of a page to be updated without a complete page reload. AJAX has the potential to significantly improve the user's experience of GS3. Therefore the project will also involve 7) Investigation of how AJAX can be integrated into the GS3 framework and implementation of a proof-of-concept example <p>This project provides the opportunity to work on an internationally renowned open source project and have a positive impact on the experience of Greenstone users around the world.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Strong Java and programming skills are required. Experience of XML/XSL is desirable. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Integration of the performance improvements into the free, open-source Greenstone 3 digital library Software platform distribution. • Enabling of other research projects requiring these improvements (such as Deployment of Greenstone 3 to mobile devices) that will lead to publication. Previous summer scholar work on Greenstone has led to refereed publications, including an international conference (ICADL 2008) Best Paper award. 			

FIELD: Data Mining	TITLE: Mining Twitter Data	SUPERVISOR(S): Dr Bernhard Pfahringer	PROJECT # 49
<p>ABSTRACT: Twitter is a brilliant measurement device regarding currently noteworthy topics, news, but also more subtle information like user sentiment towards companies, products, events, and so on. After learning and researching what others have already done using Twitter, you will then build an interactive web-based application using our stream-data mining software suite MOA (http://www.cs.waikato.ac.nz/~abifet/MOA/) as a backend. Given user input specifying a set of keywords your system will have to collect, cluster, and present in a coherent fashion, such tweets that are relevant for this set of keywords. This Summer project can potentially be extended into an Honour's project (COMP520) for 2011 for a student who qualifies for doing a BCMS(Honours) in that year.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Good java programming skills • Some background in data mining, machine learning or statistics 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • a web-based prototype allowing users to interactively mine twitter feeds 			

FIELD: Interdisciplinary – Education, Reading, Psychology, Graphic Design, HCI	TITLE: Colour in children’s On-screen reading	SUPERVISOR(S): Claire Timpany & Wendy Carss	PROJECT # 50
<p>ABSTRACT:</p> <p>This research continues on-going work into children’s on-screen reading research within the Computer Science Department and the Arts and Language Education Department at the University of Waikato by a small research team consisting of Nicholas Vanderschantz, Claire Timpany, David Whitehead and Wendy Carss.</p> <p>Pedagogical practices in formal educational settings together with the nature of communication technologies in the media and elsewhere mean that children will encounter on-screen typography and screen-based learning opportunities in both formal school settings and during their daily recreational pursuits. Internationally, there is a lack of research informing what good reading practice might look like when teachers use reading material in a screen-based environment. More specifically, there is a lack of research around best practices for the design of this material for children.</p> <p>This research sets out to determine how colour combinations can affect errors and self corrections in children’s on-screen reading.</p> <p>To aid this larger investigation, this Summer Research Scholarship will specifically involve data collection which extends the current pilot study regarding children’s on-screen reading and the effect of adjusting colour variables. The researcher will conduct a number of user studies using the Running Record Methodology used within the NZ education system. This data will directly result in journal and conference publications which build on the 2 journal submissions which resulted from the initial pilot study in 2009.</p> <p>A large portion of this Scholarship is intended to be conducted during the 2010 primary school year and thus will begin earlier than other summer scholarships. It is intended that this scholarship would begin directly after final exams for a final year teacher with a starting date of approximately October 25, 2010.</p> <p>The student will benefit by the development of key research skills for use in Education, HCI and graphic design research and practice. This will include development of analysis skills and the ability to use this feedback to develop design solutions and produce academic publications. This project will provide a stepping-stone to further postgraduate research opportunities as the student will be introduced to experiment design considerations and results analysis.</p> <p>The student will be jointly supervised by an expert from the Computer Graphic Design field and an expert from the Education field. This will enable the student to gain core knowledge and guidance to assist with the development of fundamental understanding within this research area.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Competency in recording and analysing Running Records using standard conventions • Ability to work within a primary school environment. • Sound research practice and organisation. • Own mode of transport will be significant advantage. • Ability to begin scholarship earlier than advertised project start date. Aproximate date October 25, 2010. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • Data Collection & Analysis • series of 20 minute observational user studies conducted within local primary schools using running records • analysis of running record results • data input of results • It is expected that conference and journal publications from this research will result. Targeted journals and conference’s include the top tier journal - Reading Research Quarterly. A previous pilot study utilising a similar methodology and a very small sample has resulted in 2 journal papers and a conference presentation from the data to date. It is expected that the significant increase in data produced by this study as well as the refinement of this methodology will result in more substantial journal submissions with the ability to interpret and publish various statistical interactions. At least 2 journal publications are expected from the data with the potential for further conference and journal submissions over and above. 			

FIELD: Computer Graphic Design/Human Interaction	TITLE: Creating interactive graphics from range image information	SUPERVISOR(S): Simon Laing, Bill Rogers & Adrian Dorrington	PROJECT # 51
<p>ABSTRACT:</p> <p>The Range Imaging Group develops technology for 3D camera systems and 3D data processing. The group has several specialised 'time of flight' camera systems including both off the shelf cameras and systems designed and built in-house. These cameras generate digital photograph and video like outputs where each pixel in the image contains the distance to the scene as well as brightness information. Hence the cameras can measure the shape size and location of objects in the scene.</p> <p>A student working on this project will be expected to develop graphics for a system using the data received from the range image camera. For example in an interactive performance situation, the position and actions of a performer provide a basis for generating visual response. A performance may then be augmented with additional virtual content - possibly additional players mirroring or copying movements, or leaving trails or extending gestures.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Computer graphic design, with some programming experience. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • A preliminary understanding of issues around motion correction in range image data. 			

FIELD: Computer Science	TITLE: Medical image recognition and classification using handheld devices	SUPERVISOR(S): Dr Masood Masoodian	PROJECT # 52
<p>ABSTRACT:</p> <p>Small handheld devices such as iPhone and many other mobile phones are becoming reasonably powerful computing devices, incorporating several useful input mechanisms such as a high-resolution digital camera, GPS, touchscreen, etc. It is now becoming possible to develop practical mobile applications for these devices in a range of fields which would have been unrealistic a few years ago. One particularly important area of research is the use of handheld devices in medical applications.</p> <p>The aim of this project is to investigate the use of handheld devices in assisting medical practitioners in remote locations with the identification of skin infections and diseases that they are not familiar with. The idea is to allow a user to take photographs of the affected skin area, which the system could analyse using image-processing techniques, to be used along with the GPS data it has about the user's location, to provide suggestions on possible diseases common in that area which may be causing the skin problem or infection. Because the handheld device can store large volumes of data, it would be possible to retain all data collected for later analysis - providing both case instances for refining machine learning models and epidemiological information for monitoring the spread of diseases.</p> <p>In this project we will develop a prototype tool for a suitable handheld device (e.g. iPhone). The system will combine image-processing and machine learning techniques to allow classification of skin infections and diseases. Initially we will utilise existing images of skin diseases for testing our prototype tool.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none"> • Programming skills in C++ or Java is a pre-requisite. • Knowledge of WEKA and/or machine learning would be valuable. 			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none"> • A prototype software tool will be developed for a suitable handheld device (e.g. iPhone). 			

MATHEMATICS

FIELD: Pure Mathematics	TITLE: Defining sets in cyclic Latin squares	SUPERVISOR(S): Dr Nicholas Cavenagh	PROJECT # 53
<p>ABSTRACT:</p> <p>A Latin square is an $n \times n$ array in which each symbol from a set of size n occurs once in each row and once in each column. Latin squares are an area of discrete mathematics with common applications in the efficient design of statistical experiments as well as computer science. Despite this, we know very little about their fundamental structure. For example, we do not know the least number of filled-in entries required to uniquely determine a Latin square. This project will examine the specific problem of locating defining sets in Latin squares in a restricted case: when the Latin squares are orthogonal to a cyclic Latin square (equivalently, each symbol also must occur once along each cyclic diagonal).</p> <p>The student will first locate small examples by hand and/or by computer. The next stage involves studying these examples to find patterns which may be generalizable. The third stage will involve making conjectures based on the empirical evidence. Finally the student will find mathematical proofs of some of these conjectures, if necessary making extra restrictions so that solutions are viable. It is recommended but not necessary that the student has done either MATH258 or COMP235. This project may involve some programming; again this optional. Apart from this no background is needed: any extra theory will be taught where necessary.</p> <p>The problem is easy to state and does not require complex theory to work on; moreover it is a problem which has not been studied before. Therefore it is an ideal problem to enable a talented student to experience some postgraduate-style research.</p>			
<p>REQUIRED SKILLS:</p> <ul style="list-style-type: none">• MATH102 is a pre-requisite. It is recommended but not necessary that the student has also done either MATH258 or COMP235.			
<p>EXPECTED OUTCOMES OF PROJECT:</p> <ul style="list-style-type: none">• This project will help gain insight into a specific problem about defining sets of Latin squares, thus learning more about their structure. In the process a talent student will gain valuable experience in the process of mathematics research.			