Honours Projects Offered 2013

Contents

1. Project: Diabetes Advisor 2

Proposer: *Audrey Mbogho*

Abbreviation: *DA2*

Brief Description: *Last year an honours project developed Diabetes Advisor (DA), an expert system for diabetes management with a text-based user interface. Such an interface is highly deficient in terms of usability. In the 1970s, a landmark medical expert system known as MYCIN was developed at Stanford University. This system took five years to build and was a major achievement for the field of artificial intelligence. The user interface for MYCIN, however, was cumbersome, requiring up to 30 minutes of a doctor's precious time to enter patient data. This poor usability, more than any other factor, kept MYCIN from ever being used in practice (see http://en.wikipedia.org/wiki/Mycin). This shows that usability needs to be a key consideration for a medical expert system.*

The aim of this project is to create two user interfaces for DA2. One will be a Web-based graphical user interface, and the other will be a speech-based user interface that will allow users with poor literacy, poor computer skills, or certain physical disabilities to interact efficiently with DA2. In addition, this project will review the behaviour of DA in order to improve on it, extend it and update it with the latest guidelines in diabetes management. DA2 will not shy away from performing diagnoses and recommending treatment, in keeping with modern trends.

Computer Science Content: *Expert Systems, Human Computer Interaction, Graphical User Interfaces, Speech-Based User Interfaces.*

Specific Learning Outcomes: *Students will put into practice what they've learnt about system design and development, user interface design and development, and the evaluation of these.*

Skills Required by Team as a Whole: *Programming skills, understanding an existing system, user interface design, people skills for user evaluations.*

- ***Theory:*** *The theories about HCI research, some of the theory underlying speech to text and text to speech technologies, expert systems theory.*
- ***Implementation:*** *The project will involve forms of programming (speech, Android, expert systems) that might be unfamiliar. This is expected to present a moderate challenge.*

Facilities needed: *An Android device for developing the speech user interface.*

Supervision: *Weekly meetings.*

Number of Students: *3*

2. Project: Machine Translation for South African Languages

Proposer: *Audrey Mbogho*

Abbreviation: *MTSA*

Brief Description: *South Africa is a country with a rich cultural heritage, and this is reflected by the fact that eleven languages have been officially recognised. While English is the most commonly spoken language, being the language of business, politics and the media, it is only the fifth most spoken home language. In the interests of fostering multilingualism and increasing access to information and services for non-native English speakers, this project proposes to develop a statistical machine translation system for South African languages. It is envisaged that there are at least two compelling applications for this project: first to aid human translators, and second as part of a speech-speech translation system on a handheld device which could be used by medical staff in remote areas of the country. Although automatic translation could be very useful, all of the official South African languages, except English, are considered to be resource scarce languages and the availability of parallel text corpora is extremely limited.*

This project will have to start with a data gathering phase. Kato and Barnard (2007) and Groenewald and du Plooy (2010) have done some preliminary work, both extracting parallel corpora from government websites, and using copyrighted translation memories, some of which are available online (see http://autshumato.sourceforge.net/). Once a parallel corpus of a few language pairs has been created, then a baseline statistical machine translation system can be created using online tools (see http://www.statmt.org/moses/). Finally, there are a number of research questions which can be addressed. Considering the small amount of training data, the most important question is possibly "How does one improve the quality of the translation output given limited resources?"

Bibliography:

Ronald, Kato and Etienne Barnard. 2007. Statistical translation with scarce resources: a South African case study. SAIEE Africa Research Journal, 98(4).Processing Parallel Text Corpora for Three South African Language Pairs in the Autshumato Project , Hendrik J. Groenewald, Liza du Plooy, Alexandra Birch, Miles Osborne and Philipp Koehn (2008). Predicting Success in Machine Translation. In Proceedings of the 2008 Conference on Empirical Methods in Natural Language Processing, Honolulu, Hawaii.

Computer Science Content: *Statistical Machine Translation, Rule-Based Machine Translation, Machine Learning, Human Language Technologies.*

Specific Learning Outcomes: *Students will put into practice the theory they have learnt in courses such as Data Structures and Machine Learning. They will learn machine translation theory.*

Skills Required by Team as a Whole: *Research skills, experimental design skills.*

- ***Theory:*** *Machine translation.*
- ***Implementation:*** *Existing tools will be adapted. Human language technologies are a challenging field. Unwavering commitment will be required.*

Facilities needed: *Access to a grid environment may be required for computing with Gigabytes of data.*

Supervision: *The project will be co-supervised by Dr Alexandra Birch at University of Edinburgh whose expertise is in Machine Translation. The students will meet with me weekly and Dr Birch will be consulted via email or Skype.*

Number of Students: *2*

3. Project: Mobile Crime Reporting

Proposer: *Anne Kayem*

Abbreviation: *CRY-HELP*

Brief Description: The aim of this project is to empower people with a cost-free mobile application to report crime anonymously. There are two parts to this project – the first involves creating a graphical user interface to enable "one click type reporting" and to give the police or security personnel a graphical idea of the location of the reporter when assistance is required. The second component requires specifying a secure protocol to ensure that the messages are not intercepted or modified by malicious parties. The aim of the protocol is to ensure that the message is transmitted from the device to a backend server, securely and in real-time. The system you create will be tested on campus, first to validate your application and second, to create valuable data for the backend of the system, which we are currently working on.

Computer Science Content: *Graphical User Interfaces, Network Security Protocols*

Specific Learning Outcomes: *Mobile Network Security, Usable Security*

Skills Required by Team as a Whole:

- ***Theory:*** *None*
- ***Implementation:*** *Mobile Application and Security Protocol Programming*

Facilities needed: *Mobile handsets, Backend Server (will be provided)*

Supervision: *This is an active area of research for me. I have two students (1 MSc and 1 PhD) currently working on anonymization algorithms to support the backend of the system, and who would be able to provide input prototype implementation.*

Number of Students: *2*

4. Project: Graphical Authentication for Secure Social Networks

Proposer: *Anne Kayem*

Abbreviation: *GASSP*

Brief Description: *Graphical password schemes have been proposed as an alternative to text-based password authentication. The goal of this project is two-tiered: First, we will be implementing three graphical password schemes based on the principles of recall, recognition, and cued-recall. Second, these schemes will be compared to text-based schemes to evaluate usability in terms of password*

initialization, login, and password reset; and robustness to guessing and capture attacks. All testing and implementation will be done on a prototype social networking platform (http://hackmi2/). For more information on this idea, please refer to

http://dl.acm.org/citation.cfm?id=2333112.2333114&coll=DL&dl=ACM&CFID=184126865&CFTOKEN=58704508

for Biddle et al.'s paper on "Graphical Passwords: Learning from the First Twelve Years."

Computer Science Content: *Authentication, Authorization, Graphical Password Design*

Specific Learning Outcomes: *Information Security, Usable Security*

Skills Required by Team as a Whole:

- ***Theory:*** *None*
- ***Implementation:***

Facilities needed: *Server (Provided)*

Supervision: *This is project is a part of some on-going work the Information Security Team (http://infosec.cs.uct.ac.za/) is doing on securing social networks. Last year a group worked on building the social network and applying threat models to evaluate and mitigate the inherent security vulnerabilities. Graphical passwords are an added step over our preliminary attempts at designing useful and dependable CAPTHAS for authentication purposes.*

Number of Students: *2*

5. Project: Internet-of-the-Things: Least Interference Beaconing Protocols

Proposer: *Antoine Bagula*

Abbreviation: LIBP

1. Brief Description:

Future ubiquitous sensor networking (USN) applications are predicting the deployment of sensor devices in thousands of computing elements into multi-technology and multi-protocol platforms, where access to the information will be available not only at anytime and anywhere, but also using anything in a first-mile of the Internet referred to as the "Internet-of-the-Things". The management of such a large-scale and heterogeneous network would benefit from some of the traditional IP-based network management techniques, which can be re-factored to achieve efficient routing of the sensor network traffic. As part of a bigger project aiming at developing 6LoWPAN routing protocols for the Internet-of-the-things, this project will revisit the "least interference optimization" paradigm previously proposed for MPLS networks to assess the relevance of its application in a "least interference beaconing" (LIB) model aiming to achieve efficient traffic engineering of the emerging IoT.

2. ***Computer Science Content:***

Wireless Sensor Networking, Network protocols, Clustering algorithms, Resource sharing, Auction mechanisms, Game theory.

3. ***Specific Learning Outcomes:***

Protocol design and Implementation, Network Planning, Design and Implementation, Data Mining and Machine learning programming.

4. ***Skills Required by Team as a Whole:***
   - ***Theory:*** *Network protocols, Resource sharing using auction mechanisms, Situation recognition using machine learning techniques.*
   - ***Implementation:*** *strong implementation of a wireless sensor network protocols. The implementation will be testbed related.*

5. ***Facilities Needed:***

Access to the ISAT MeshTestbed and another Testbed in Italy at ICTP.

6. ***Supervision:***

Regular meetings will be scheduled with the supervisor. Members of the ISAT group working on similar projects.

7. ***Number of Students****: 4*

6. Project: Smart Cities: A Crowd-Sourcing Public Safety System

Proposer: *Antoine Bagula*

Abbreviation: *CPSS*

1. ***Brief Description:***

When used in combination with mobile technology and different communication channels such as Facebook, Twitter, blogs, and text messages, crowdsourcing can become a powerful tool that can collect specific information from a crowd of people related to targeted topics or issues and enable processing, analysis and dissemination of this information in different forms, including geographically activity tagged maps. In the case of South Africa, relevant knowledge accumulated within the communities still needs to be collected in a continuous manner and reach decision makers in a more accessible manner. The integration of web services and mobile technology can be utilized as an information outreach and monitoring tool to facilitate better understanding of urban communities life style and assist researchers and stakeholders in understanding correlation between crime, poverty and inequalities. In collaboration with the Western province provincial government, this project aims at investigating the possibility of using web-based services and mobile technology in a crowdsourcing framework to enable public safety in smart cities.

2. ***Computer Science Content:***

Security, Machine learning techniques, Mobile programming & computing.

3. ***Specific Learning Outcomes:***

Mobile systems programming, Web-based services design and Implementation, Data Mining and Machine learning programming.

4. ***Skills Required by Team as a Whole:***

- ***Theory:*** *Statistical analysis methods, Neural networks, Bayesian Belief networks, Artificial Immune Systems, Genetic algorithms, Security protocols and encryption.*

- ***Implementation:*** *Implementation intensive project. Strong implementation of a prototype and deployment of a mobile sensor network on Shawco buses will be needed.*

5. ***Facilities Needed:*** *Cellphones, Laptops, Gas sensors, Alix boards*

6. ***Supervision:***
Regular meetings will be scheduled for interaction with the supervisor. Members of the ISAT group working on similar projects will also be involved. .

7. ***Number of Students****: 3*

7. Project: Internet-of-the-Things: A Participatory Healthcare System

Proposer: *Antoine Bagula*

Abbreviation: *PHCS*

1. ***Brief Description:***

The integration of the RFID and Sensor technologies is emerging as an important component of the first mile connectivity of the Internet allowing the information to be accessed not only anywhere and anytime but also using anyone to access any devices. A typical hybrid sensor/RFID networking scenario consists of a proactive monitoring system where a network of RFID tags attached to objects and readers attached to the sensor motes is used as the first mile to a WSN that collects the information on the status of these objects in real-time and conveys this information to a gateway where the information is processed and different services delivered to users based on this information. This may be applied for example in elderly healthcare to control the amount of medicine elderly patients require and assist them in taking the accurate amount of medicine. It can also be deployed in community healthcare management by having the vital signs of members of the community collected through healthcare centers and transmitted to a server where sorting is performed to enable treatment prioritization in a community depraved of medical practitioners. This project aims to implement a participatory health care platform for disadvantaged communities.

2. ***Computer Science Content:***

Network security, Distributed systems, Machine learning techniques, Sensor networks

3. ***Specific Learning Outcomes:***

Machine learning techniques, Network security, sensor systems.

4. ***Skills Required by Team as a Whole:***

- ***Theory:*** *Statistical analysis methods, Neural networks, Bayesian Belief networks, Artificial Immune Systems, Genetic algorithms, Security protocols and encryption.*
- ***Implementation:*** *Implementation intensive project.. Security mechanisms both at the encryption level and protocol levels will be designed and implemented. An intelligent middleware capable of sorting healthcare information based on vital sign parameters will also be designed.*

5. ***Facilities Needed:***

Mobile phones, Healthcare arduino kit, Alix boards used as gateways.

6. ***Supervision:***

Regular meetings will be scheduled for interaction with the supervisor. Members of the ISAT group working on similar projects will also be involved.

Number of students*: 3*

8. Project: Authoring tool for SignSupport

Proposer: *Edwin Blake*

Abbreviation: *SignAuth*

Brief Description: *We work with the NGO DCCT to support Deaf people in communicating with official institutions by supporting their interactions via mobile phone based applications. So far we have developed designs for communicating with Doctors and Pharmacists. SignSupport provides for a scripted conversation flow between a Deaf person and a hearing person around a specific scenario. The sign language videos are stored on the phone and the Deaf user is prompted in the capturing of relevant data. The professional user then enters relevant information and this is presented to the Deaf user in sign language. We want to generalise the tool to be able to handle conversation flows for any given conversation scenario, e.g. visiting a police station, home affairs, etc. Each scenario will be loaded onto the phone depending on need.*

This project is about producing the authoring tool that will run on a computer which allows ***domain specialists*** *to construct the conversation flow and to populate the system with recorded videos and related text. The system will target an Android mobile phone. There are at least three aspects and possibly four:*

1. *Authoring Interface: A computer-based front end that allows the domain specialist to construct dialogues. This is a task for a user interface person who will investigate the needs of users who a highly skilled but not computer specialists.*
2. *Asset Manager: Tools to manage and add to a database of assets (videos, script chunks ...). This will include relevant metadata support and interfaces to video editing tools.*

3. *Dialogue Scripter: A scripting engine that runs on an Android handset that executes the dialogues and captures information. A version of this will have to run on the computer for testing purposes.*
4. *Mobile User Interface: (optional) A mobile phone front end that is tested with Deaf users and with domain specialists (e.g., pharmacists) to ensure that the scripted systems work effectively. Note: If this part of the project is not tackled then a simple phone interface will be needed to show that the system does work.*

(See also www.signsupport.org/ which needs updating! and my website, www.cs.uct.ac.za/~edwin/honsProj.html)

Computer Science Content: *ICT4D, Design for Interaction, Multimedia Databases, Dialogue Scripting, mobile computing, User centred design, usability testing*

Specific Learning Outcomes: *This project combines user-centred design and development with experimental evaluation with users. You will learn about authoring tools which are needed for content generation in a number of fields (e.g., computer games). The project is firmly embedded in an ICT4D context.*

Skills Required by Team as a Whole: *The team as a whole will have to have strong software development skills. An interest helping real users is also a requirement.*

- ***Theory:*** *Some background and willingness to learn about user-centred design; multimedia databases.*
- ***Implementation:*** *Solid system implementation skills, willingness to learn about development on Android mobile phones (probably one of the best ways to learn about mobile programming).*
- ***OTHER:*** *User Testing*

Facilities needed: *Android mobile phones, collection of sign language videos.*

Supervision: *The project is run in conjunction with UWC and the NGO DCCT (Deaf Community of Cape Town). Regular project meetings will be held and students will be expected to meet Pharmacy students at UWC and the Deaf users at DCCT in Heathfield.*

Number of Students: *3–4*

9. Project: Testing face recognition with computer games

Proposer: *Edwin Blake*

Abbreviation: *FaceGame*

Brief Description: *A phenomenon familiar to us from everyday life is the difficulty we have in learning and recognising faces of other races and populations. Face recognition researchers have measured the degree of recognition error in various locations, including South Africa, with some of the original work done by members of the Psychology department at UCT (e.g. Wright, Boyd & Tredoux, 2003).*

It is not clear why people are poor at recognising the faces of individuals from other groups, but theories suggest that it is some combination of i) history of perceptual contact, and ii) subjective

expected utility. Most data collected by researchers is correlational, though, and very few concerted attempts have been made to conduct experimental tests of hypotheses.

What we envisage in this project is the development of software that would allow hypotheses about the source of cross-group face recognition bias to be tested experimentally.

For the first experiment we would like to create a computer game in which users interact with two classes of objects. Objects would have attribute dimensions that make it possible to generate new individual instantiations with unique properties, in much the same way that human face populations vary on a number of attribute dimensions. Each interaction with an object would be useful to the player in some way. This will allow us to test whether recognition ability across groups of people varies as a function of utility.

If the first experiment is successful we would change to having highly realistic human faces from different populations instead of objects. A research team from the departments of Psychology, Computer Science and Mathematics, at UCT, developed software (ID) some years ago for generating highly realistic synthetic faces, but the problem for this project would be to incorporate these artificial faces within the computer game, as described above.

This project invites you to collaborate with a research team made up of members of the departments of Psychology and Computer Science at UCT, with additional researchers from departments of Psychology in the United States, and Egypt. The envisaged piece of software would give the research team an advantage over other face recognition research groupings in the world, especially with respect to testing theories about cross-group face recognition. There are a number of possible applications of this work, in addition, not the least of which would be the training of police officers to reduce levels of recognition bias across groups.

For more details see my website, www.cs.uct.ac.za/~edwin/honsProj.html

Computer Science Content: *Digital games, user experimentation.*

Specific Learning Outcomes: *You will learn how to work with an outside client and acquire valuable skills in user experiments.*

Skills Required by Team as a Whole: *At least one person must be experienced in game design and implementation. Experience with a 3-D modelling and animation tool would be a definite plus.*

- ***Implementation:*** *This project will demand strong technical skills from the majority of the team members.*
- ***OTHER:*** *It would be useful (but not essential) if at least one person has had some exposure to experimental methods in Psychology.*

Facilities needed: *PCs with good graphics capabilities, face generation software*

Supervision: *The project is co-supervised by Prof Colin Tredoux from the Psychology department.*

Number of Students: *2–3.*

10. Project: Praekelt Foundation ICT4D Projects

Proposer: *Edwin Blake*

Abbreviation: *Praekelt*

Brief Description: *The Praekelt Foundation (www.praekeltfoundation.org) is a private non-profit company that runs a number of large socially aware projects in Cape Town (and elsewhere).There are five very interesting projects possible.*

1. *YoungAfricaLive Data Mining: YoungAfricaLive is a mobile community that engages young people around the topics of Love, Sex and Relationships in the context of their social, cultural and economic situation. The platform was first launched in South Africa in December 2009, where it achieved unprecedented success and has recently been launched in Kenya and Tanzania.*

   For this project, students would be required to design an hypothesis which they would like to test and then mine the data available from the past 3 years to test this hypothesis. Outcomes of this test would then need to be displayed in a way that clearly communicates the hypothesis and the outcomes of the test to a person not familiar with the study. Data visualisation will be key for this.

2. *YoungAfricaLive A/B Interface Testing: YAL as above. This project would require students to assess the user experience of the current portal and design and implement at least 2 alternative interfaces which can be tested to assess the changes in interaction of users based on the 3 different user experiences.*
3. *YoungAfricaLive user relationship model and gamification design: YAL as above. This would require students to conduct qualitative research with YAL users to understand and construct the relationship model. Students would then be required to design and implement the user profiles and gamification elements which will make moving through this relationship model possible.*
4. *txtAlert Data Entry Interface: txtAlert is a system that receives information from a Medical Record System at a clinic and uses this anonymised information to send out appointment reminders and CD4 counts to patients. For this project, you would be required to design and implement a simple online tool which allows a user at the clinic to upload the patient's anonymised details (e.g. telephone number, date of appointment, time of appointment and place of appointment). This should then populate a database which can be queried in order to send the relevant txtAlert messages.*
5. *Asynchronous ORM for Riak: Riak is an eventually-consistent distributed key-value database that provides built-in free text searching and secondary indexes. It was initially developed as a document store but it is increasingly being used in industry to store highly structured data for large systems that might have previously used a SQL database. This has created a need for declarative syntax for describing data stored in Riak -- something analogous to an Object-Relational Mapping (ORM) commonly used for interacting with SQL databases.*

Computer Science Content: *Multiple: Database, Mobile Design, Computer Games, Visualization, Data Mining. User Interface Design*

Specific Learning Outcomes: *Range from experimental work to advanced software design.*

Skills Required by Team as a Whole: *Since these projects are so diverse I strongly suggest that you discuss team composition with me, Edwin Blake.*

Facilities needed: *Diverse, supplied as needed*

Supervision: *The project is run in conjunction with the Praekelt Foundation. For more details see my website, www.cs.uct.ac.za/~edwin/honsProj.html and docs.google.com/document/d/1VrUZrBYMRoY5IIjJ6GrzqbQ1lzvmFTvUXODJDyFbW0A/edit?usp=sharing*

Number of Students: *2, 3, 4 depends on project, please discuss with me.*

11. Project: Sustainability of Rural Mesh Networks

Proposer: *Edwin Blake*

Abbreviation: *SusRuMes*

Brief Description: *As we solve the technical issues of deploying wireless mesh networks in rural areas, issues of sustainable usage arise and we need to look at business models for their deployment. Such mesh networks (using for example the MeshPotato from VillageTelco —wiki.villagetelco.org) can be used for both Voice (over IP) and data. They can be deployed in commercial farming areas (where they are likely to be used for both voice and data in conjunction with VSAT) or in deprived traditional rural areas where the predominant use initially is likely to be voice. In a commercial farming area the wide variety of different users (farmers, tourists and farm workers) has to be catered for. If it is to be deployed in a traditional rural community the issues of building community ownership and supporting rural entrepreneurs arise.*

The business plan will have to decide if there is any subscription charge granting access to local communication over the mesh and what the charges are for breakout over the public switched telephone network (PSTN) or, more likely, VOIP provider. The plan needs to show a clear understanding of the legal issues of interconnecting to a VOIP provider.

This project thus clearly has a business aspect but there is also the technical component of realizing the actual physical gateway. Such a gateway can either be a laboratory study or can be implemented in the field where we have access to sites of both kinds.

A gateway server will provide breakout and run a billing system (dev.villagetelco.org/trac). See villagetelco.org/2012/08/3-new-village-telco-entrepreneur-profiles/ for some ideas and examples of use. For more details see my website, www.cs.uct.ac.za/~edwin/honsProj.html

Computer Science Content: *ICT4D; Mesh Networks*

Specific Learning Outcomes: *This is a chance to learn about the issues in ICT-based rural development and sustainability*

Skills Required by Team as a Whole:

- ***Theory:*** *Networking*
- ***Implementation:*** *Building a physical gateway from the mesh network to an outside connection.*
- ***OTHER:*** *Obviously one person with skills in business planning is essential.*

Facilities needed: *MeshPotato, Ubiquiti Nanostation, VillageTelco software*

Supervision: *Regular meetings, possible field trips and collaboration with researchers at UWC.*

Number of Students: *3 (preferred), if you want a larger or smaller group please discuss with me before submitting the application.*

12. Project : Arduino Programming Language

Proposer: *Gary Marsden*

Abbreviation: *Arduino*

Brief Description: *Arduino is an open source hardware specification (www.arduino.cc) used by professionals to hobbyists to allow them to build and control embedded electronic systems. The hardware is controlled by a horrible version of C, or a library for Java (Processing). Neither of these are useful to programming novices. This project is about creating a new programming langauge for Arduino. Specifically a graphical language based on the dataflow metaphor. The project will have two parts: a graphics implementation part and an HCI part working with users to find out what kind of language they want.*

Computer Science Content: *This project is not so much about programming language design. It is primarily about (1) Dataflow visualisation and graphics programming (2) Interaction design and participatory design*

Specific Learning Outcomes: *Students will learn about design, the fundamentals of programming languages and psychology of programming.*

Skills Required by Team as a Whole:

- ***Theory:*** *(1) Visualisation and 2D graphics (2) HCI and participatory design*
- ***Implementation:*** *(1) Is a hard visualisation system the must generate Arduino C. (2) Is a complex design problem – designing a programming language for non-programmers*

Facilities needed: *I have a Spark-kit Arduino system which can be used. The rest is standard software*

Supervision: *I am involved with a bunch of artists at UCT who are using Arduino and a creativity project in London, using Makey-makey (Arduino Variant) to conduct research here and there. The biggest imposition to this work is the crappy Arduino language. I need it fixed and am willing to put time in to sort it out.*

Number of Students: *2 (3 at a push).*

13. Project : I CAN C U

Proposer: *Gary Marsden*

Abbreviation: *IcanCU*

Brief Description: *Cellular phones are flawed in that they assume we interact at a distance with each other. However, we use them more and more to intereact with people or locations which are physically proximate. This project is about building new handset software that allows people to share information with other people who are close by as well as the physical location. So this project will be in three parts. The first is to enable device-to-device sharing of data (e.g. sharing MP3s with friends). The second is to*

share data with the environment – imagine classrooms that broadcast timetables or bus stops that broadcast arrival times. The third part of the project is to look at network technologies such as uPnP and Bonjour that allegedly allow this type of peer-to-peer communication.

Computer Science Content: *This is basically a mobile programming exercise. Two of the projects will be more high-level with some interface design; the third will be more at the application level. I would like to do two projects using Android and one on Window Mobile.*

Specific Learning Outcomes: *Moble programming, inteface design, peer-to-peer networks.*

Skills Required by Team as a Whole:

- Theory: *Everyone needs to be able to program mobile. 1 person needs to be good at networks. The other two at interaction design*
- Implementation: *Fiddly rather than hard.*

Facilities needed: *All mobile hardware will be supplied.*

Supervision: *This is the major focus of my research at the moment. I have two PhD and one MSc student working on versions of this problem. All of us will be able to help.*

Number of Students: *3*

14. Project : Stroking not Poking

Proposer: *Gary Marsden*

Abbreviation: *Poking*

Brief Description: *With the advent of touch screens, we currently have a mixture of interface interactions to negotiate. Some interfaces are purely analogs of the old style, where we poke buttons and select menu items. Others are gesture based, where we stroke the screen and interact in a more fluid way. My reading of cognitive psychology and the early work on Direct Manipulation is that the stroking approach is better. However, there have been no experiments to directly compare. Therefore, in this project, we plan to build two interfaces to an application; one interface built using gestures and stroking, the other purely on button poking. The application can be anything from a calendar to an MP3 player. These interfaces will have to be compared, preferably using a controlled longitudinal study.*

Computer Science Content: *Interface programming and design on mobile*

Specific Learning Outcomes: *Mobile programming; experiment design*

Skills Required by Team as a Whole:

- ***Theory:*** *Interaction design and the psychology research methods course would be useful, but not essential. Failing that, some statistics.*
- ***Implementation:*** *Implementation is tricky rather than hard.*
- ***OTHER:*** *Experiment design will be hard*

Facilities needed: *All mobile hardware will be supplied – probably Android*

Supervision: *I have a student doing his PhD on this topic, so both he and I will be available.*

Number of Students: *2 preferably (3 at a push)*

15. Project : Python Learning Environment

Proposer: *Gary Stewart*

Abbreviation: *PyLE*

Brief Description: *Electronic resources for learning programming, or anything else – e.g. videos, text-based tutorials/textbooks, quizzes, online learning environments and electronic marking systems are all dispersed and complicate the process of learning. Attempts to integrate all these elements often lead to a cluttered interface. The idea is to create an elegant interface which follows the natural flow of the learning process.*

Most popular amongst these learning resources are lecture slides or video presentations of these lecture slides which are essentially screencasts. These video screencasts allow easy digestion of the information, but don't allow note taking as with annotations for pdf files. The first major component of the system is to allow note taking annotation on the screencast video and synchronise that with the pdf and visa-versa.

The second major component of the system is to develop a test engine which would be a repository for a wide variety of test questions across topics and learning objectives as outlined in Blooms taxonomy. These questions would then need to be issued to the appropriate student as and when necessary.

It is envisaged that this will be a stylus friendly tablet based application based interface, with handwriting recognition features. So this comes with some interesting challenges, including

- *can the video note annotation be accurately captured with a stylus with proper handwriting recognition*
- *what is the optimal way for the user to input coding questions*

Mobile device are becoming increasingly accessible, particularly in the developing world. Technology is progressively becoming an enabler of learning and education. The trend is also to make educational resources open and accessible. This project is able to make a significant contribution in this regard.

Computer Science Content: *ICT4D, Computer Science Education, Human Computer Interaction (HCI)*

Specific Learning Outcomes: *mobile development, understanding the education/learning process, meeting particular end-users needs.*

Skills Required by Team as a Whole: *Mobile Development (Java for Android) and basic understanding of Python*

- ***Theory:*** *Mobile Interaction Design*
- ***Implementation:*** *The challenge for the whole system is developing a useable interface for users who may be relatively new to computing. The tablet-based component will involve mastering the usability complexities of mobile interaction design for relatively inexperienced users.*

Facilities needed: *PCs and Tablets*

Supervision: *Regular meetings with supervisor, approximately every two weeks.*

Number of Students: *2*

16. Project : Adapting Group Behaviour for Network Protection

Proposer: *Geoff Nitschke*

Abbreviation: *AdGroB*

Brief Description:

This project investigates using Neuro-Evolution (NE) approaches to model collective problem solving behaviour in very large agent teams. NE is the adaptation of Artificial Neural Networks with Evolutionary Algorithms. In this case, the efficacy of NE methods will be tested in a simulation environment, where the agents are tasked with resource protection on large scale networks. In this task "defender" agents must traverse the nodes of a network protecting node resources before they can be damaged by "adversarial" agents. The research focus is to use NE to adapt individual agent interactions and thus adapt agent (defender) group behaviour. This project aims to address two main questions:

1) Can NE recombination operators based on behavioural similarities effectively evolve problem solving group behaviour?

2) Is behaviour based NE recombination more effective than genetic based NE recombination?

Computer Science Content: *Artificial Intelligence (neuro-evolution).*

Specific Learning Outcomes: *Drawing conclusions (within a problem specific context) via an analysis of comparative research questions supported by empirical data.*

Skills Required by Team as a Whole: *Capability to implement a simulation environment that models a large scale network; Capability to implement an agent based system, and adaptive agent controllers using machine learning techniques.*

Theory: *Evolutionary computation, artificial neural networks.*

- ***Implementation:*** *Java programming.*
- ***OTHER:*** *Some networking knowledge is desirable, but not mandatory.*

Facilities needed: Desktop PCs running Linux or Windows.

Supervision: All supervision by Geoff Nitschke. Weekly meetings.

Number of Students: *3.*

17. Project : Communication versus Behavioural Diversity

Proposer: Geoff Nitschke

Abbreviation: *ComBeD*

Brief Description:

This project takes inspiration from anthropological studies that try to elucidate how the emergence of language influenced the formation of societies and vice versa. An agent based system is used to study how communication between agents diversifies (much as natural languages have diversified into

dialects) given the agents' spatial relationships (locations in the environment), and similarities between their behaviours. An evolutionary algorithm is proposed as the method to adapt agent behaviour over the course of many artificial generations in the agent society. The agent based system will simulate a hunting and gathering task. Some of the agents must explore the environment (hunting for enough food to supply the society). Other agents must search the environment for resources necessary to build structures that accommodate a growing agent population. Communication (signaling between agents) is mandated to increase task performance (hunting food or gathering building resources).

One question that this project aims to address is: Does behavioral diversity (for example, hunting versus gathering) emerge as a result of different agents communicating about different things (for example, how to hunt versus how to gather), or rather is diversity in communication driven by behavioural diversity?

Computer Science Content: *Artificial Intelligence (evolutionary algorithms, agents, agent based communication).*

Specific Learning Outcomes: *Drawing conclusions (within a problem specific context) via an analysis of comparative research questions supported by empirical data.*

Skills Required by Team as a Whole: Capability to implement an agent based simulation environment (that models an artificial society); Capability to implement an agent based system, and adaptive agent controllers using machine learning techniques.

Theory: *Evolutionary computation / agent based systems.*

- ***Implementation:*** *Java programming.*
- ***OTHER:*** *Some agent based systems knowledge would be helpful.*

Facilities needed: Desktop PCs running Linux or Windows.

Supervision: All supervision by Geoff Nitschke. Weekly meetings.

Number of Students: *3.*

18. Project : Meme Propagation: Is an Idea Spread by Like Minds?

Proposer: *Geoff Nitschke*

Abbreviation: *Meme*

Brief Description:

This project will examine the question of how memes (ideas) are spread through populations, and why some memes are widely adopted by a population and others are adopted by relatively small sub-groups, or not at all. One example is the spread of Christianity after the fourth century, its widespread adoption by many populations, and the displacement of existing religions. A more modern example is the widespread success and use of social network services such as Facebook.

The project will use a simulation of an agent population where each agent in the population represents one meme. An evolutionary algorithm will be used to simulate many agent lifetimes (generations), so that some memes will be spread throughout the population, displacing others, while other memes will be adapted to become new memes. To investigate meme propagation, the impact of individual versus

group (kin) selection will be investigated. Individual selection is the recombination of the fittest memes with themselves or with other unrelated memes (that is, agents with unrelated ideas). Group selection is the recombination of a group of related memes (that is, agents with similar ideas).

Computer Science Content: *Artificial Intelligence (evolutionary / cultural algorithms, agents).*

Specific Learning Outcomes: *Drawing conclusions (within a problem specific context) via an analysis of comparative research questions supported by empirical data.*

Skills Required by Team as a Whole: Capability to implement an agent based simulation environment (that models an artificial society); Capability to implement an agent based system, and adaptive agent controllers using machine learning techniques.

Theory: *Evolutionary computation / agent based systems.*

- ***Implementation:*** *Java programming.*
- ***OTHER:*** *Some agent based systems knowledge would be helpful.*

Facilities needed: Desktop PCs running Linux or Windows.

Supervision: All supervision by Geoff Nitschke. Weekly meetings.

Number of Students: *3.*

19. Project : Infinite Real-time Procedural Landscapes on Graphics Hardware

Proposer: *James Gain*

Abbreviation: *PROCLAND*

Brief Description: *The creation of digital terrain has many applications in Computer Graphics – for Visual Effects, Games, Training and Simulation. Being able to automatically generate such landscapes on the fly at run time has the benefit that there is very low storage overhead (typically a single random seed is required) and varied terrain of large (possibly infinite) extent can be created. This project proposes creating the underlying geometry that provides the shape of the landscape; generating textures to provide detailed colouring for different land usages, such as snow capped mountains, forest, cities and rendering the composited results. This should be done at multiple scales, so that a user can zoom seamlessly from an orbital perspective of the procedural planet all the way down to a surface viewpoint at human height.*

Keywords – procedural landscapes, perlin noise, terrain synthesis

Reference – J Schneider, T Boldte and R Westermann, "Real-time Editing, Synthesis and Rendering of Infinite Landscapes on GPUs", In Vision, Modeling and Visualization 2006, pp. 145-152.

Computer Science Content: *Computer Graphics (Procedural Terrain Generation, Texturing and Rendering), Parallel Computing (GPGPU), Applied Mathematics (Multiresolution Noise Functions)*

Specific Learning Outcomes: *Technical mastery of computer graphics and parallel programming, including an understanding of the trade-offs involved in performance optimisation. Research skills in evaluating exsisting procedural methods and developing new methods where required.*

Skills Required by Team as a Whole: The project naturally divides into modelling (multiresolution fractal terrain generation), texturing (procedural image generation) and rendering (combining geometry and textures in a rendering pipeline to display the landscape). These require related skills in Computer Graphics, Parallel Computing and Applied Mathematics.

- ***Theory:*** *moderate [understanding computer graphics algorithms]*
- ***Implementation:*** *moderate to hard [implementation of multiresolution procedural architecture on GPU in C++ with CUDA, with optimisation required]*

Facilities needed: *A standard PC with recent NVIDIA graphics card.*

Supervision: *James Gain. Weekly meetings with supervisor expected, occassional attendance and presentation at research group meetings may also be required.*

Number of Students: *2 (3 allowed but not encouraged)*

20. Project : Accelerated Processing of Streamed Radio Astronomy Data

Proposer: *James Gain*

Abbreviation: *HPCAstro*

Brief Description: *The South African MeerKAT radio telescope array (a precursor to the Square Kilometer Array) will vastly improve our view of the sky in the radio spectrum. However, the concomitant dramatic increase in output of observational data necessitates development of scalable software solutions to replace processes that have, in many cases, until now been performed serially or even manually. Typical CPUs (even in clusters) are unable to cope with such high volumes of data. One alternative is to use larger numbers of processing cores as offered by modern Graphics Processing Units and the new Intel Many Integrated Core architecture. This project will focus on a specific, relatively simple, portion of the pipeline (probably either radio interference detection or data stream compression) and compare the suitability of GPGPU and Intel MIC solutions with respect to speedup over a CPU implementation.*

Keywords – Intel MIC, GPGPU, Radio Astronomy, Interferometry

Reference – https://casper.berkeley.edu/astrobaki/index.php/Main_Page

Computer Science Content: *Parallel Computing (GPGPU, Multi-core Architectures), Computational Science (Radio Astronomy)*

Specific Learning Outcomes: *Technical mastery of parallel programming, including an understanding of the trade-offs involved in performance optimisation. Research skills in learning a new field (radio astronomy) and applying Computer Science techniques to it.*

Skills Required by Team as a Whole: *Some familiarity with astronomy and parallel computing would be useful but not essential. One team member will focus on a GPGPU implementation of the streaming algorithm, while the other will consider its adaptation to the Xeon-Phi chip.*

- ***Theory:*** *moderate [understanding radio astronomy pipeline]*

- ***Implementation:*** *moderate to hard [implementation of streaming radio astronomy processing on GPU in C++ and CUDA or Intel MIC in C++, with optimisation required]*

Facilities needed: *Two high-end PCs, one with a recent NVIDIA graphics card and the other with a Xeon-Phi chip will be provided.*

Supervision: James Gain. Weekly meetings with supervisor expected, occassional attendance and presentation at research group meetings may also be required*. Additional support will be provided by a member of the MeerKAT project.*

Number of Students: *2 (3 allowed)*

21. Project : Practical Financial Engineering

Proposer: James Gain

Abbreviation: *GPUFin*

Brief Description: *"Derivatives are financial weapons of mass destruction" –Warren Buffett*

Financial derivatives [1] form a large and important part of the world's financial system but are often misunderstood and misused, giving them something of a notorious reputation. The more common, or vanilla, derivatives are actively traded in the market where their prices are determined by the forces of supply and demand. Financial institutions, such as investment banks or insurance companies like Old Mutual, will also sell more complicated derivatives like exotic options and investment guarantees. These derivatives are less widely traded and so we must determine the price using parametrised models that are calibrated to the prices of the vanilla derivatives that can be observed. Once the price can be calculated, the sensitivity of the derivative to different market factors can also be determined and managed by buying and selling other instruments in the market in an activity known as hedging. One key numerical technique employed in pricing derivative contracts is Monte Carlo integration. This allows us to tackle some otherwise analytically and computationally intractable problems. However, due to the complexity of the models, runtime is a significant limiting factor - delays in receiving results can have a large financial impact. Fortunately, this class of problems is embarrassingly parallel and so performance gains can be achieved through efficient use of grids of commodity computers, multi-core CPUs and massively parallel GPUs. The project involves replicating the procedure followed by a bank in pricing a path-dependent derivative contract (such as a look-back option [2]). Both the calibration and Monte Carlo pricing should be implemented to run on GPU hardware to determine the speed gains that may be achieved. A secondary aim may be to demonstrate that the pricing and hedging works successfully by running a "back-test" over a historical period – performing theoretical hedging to determine how much profit or loss would have been achieved. A final component is a means of visualizing the pricing of the derivatives. This will involve dealing with the information overload inherent in thousands of price lines.

Keywords – derivatives, computational finance, Monte Carlo methods

References –

[1] http://en.wikipedia.org/wiki/Derivative_(finance)

[2] http://en.wikipedia.org/wiki/Lookback_option

Computer Science Content: *Parallel Computing (GPGPU), Applied Mathematics (Numerical Methods)*

Specific Learning Outcomes: *Technical mastery of parallel programming, including an understanding of the trade-offs involved in performance optimisation. Research skills in understanding the necessary numerical methods and validating the implementation.*

Skills Required by Team as a Whole: *Familiarity with GPU programming would be advantageous. Some background knowledge of finance would be helpful but is by no means required.*

- ***Theory:*** *moderate [understanding financial instruments and associated numerical methods]*
- ***Implementation:*** *moderate [implementation on GPU in C++ and CUDA, with optimisation required]*

Facilities needed: *A standard PC with recent NVIDIA graphics card. Graphics cards, market data and references to relevant finance theory will be provided.*

Supervision: James Gain. Weekly meetings with supervisor expected, occassional attendance and presentation at research group meetings may also be required*. Additional support will be provided by David Jacka, Old Mutual.*

Number of Students: *3 (2 allowed)*

22. Project : Fast and accurate triangle mesh simplification for large heritage models

Proposer: *Patrick Marais*

Abbreviation: *SIMPLIFY*

Brief Description: *The Zamani project (www.zamaniproject.org) at UCT uses laser scanning to capture huge 3D models of buildings and terrain for digital preservation and analysis. In order to reduce the size of the models, they would like to simplify them, so that they retain important structural information while retaining their original appearance. There are two methods that will be utilised: simplification with normal maps, and feature preserving simplification. Normal maps approximate missing detail by means of shader-based techniques and can produce compelling results with low triangle counts. Feature-preserving approaches tend to reduce the number of triangles required to represent less complex regions, and only keep high detail where it is really required in the model. Once simplification is complete, the visual fidelity of the result must be assessed. This can be done by means of a visualisation front-end which shows the distribution or error caused by simplification. Various visual fidelity metrics can be used to quantify the simplification error too. A major challenge for simplification will be dealing with models that are very large and cannot fit into memory: this will require an 'out-of-core' solution.*

Computer Science Content: *Data structures and algorithms for 3D mesh representations - specifically those which are memory efficient; computer graphics and visualisation; computer vision/image processing.*

Specific Learning Outcomes: *Understanding of 3D model manipulation, display and processing; basic understanding of visualisation principles; general algorithmic optimisation for memory efficiency and speed.*

Skills Required by Team as a Whole: *The project will consists of 3 components: 2 which implement different simplification schemes in an out-of-core manner and a third which can be used to sensibly visualise and quantify the error caused by each of the simplification schemes. Consequently, the two algorithmic projects will require good coding and optimization skills and the visual project will require knowledge of rendering APIs and a willingness to learn visualisation techniques.*

- ***Theory:*** *(Avg to hard) 3D meshes and geometry; simple geometric operations on meshes; visualisation; 3D rendering.*
- ***Implementation:*** *(Avg to Hard)The techniques used will require extensive reading and are not trivial to implement. Some techniques are better implemented using libraries. You might consider CGAL for geometric operations and VTK for visualisation. These are both Open Source/available for academic use. Out-of-core optimizations can also be complex, depending on how closely you manage disk access.*
- *You will need to read up on popular mesh simplification and methods as well as methods to construct normal maps. Papers and suggested readings will be provided by your supervisor.*

Facilities needed: *Standard computer lab equipment should suffice although more server space may be required for the model files, which are large. The visualisation component will require access to a computer with a decent graphics card.*

Supervision: *This projects will require interaction with Prof Ruther and his group at the UCT Geomatics Dept. The students and supervisor will meet weekly initially and then bi-weekly to ensure progress is adequate.*

Number of Students: *3. This projects can be reduced to 2 people if required.*

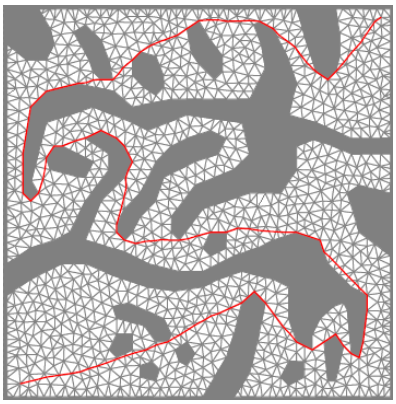
23. Project : Adaptive Field D* Pathfinding

Proposer: *Patrick Marais*

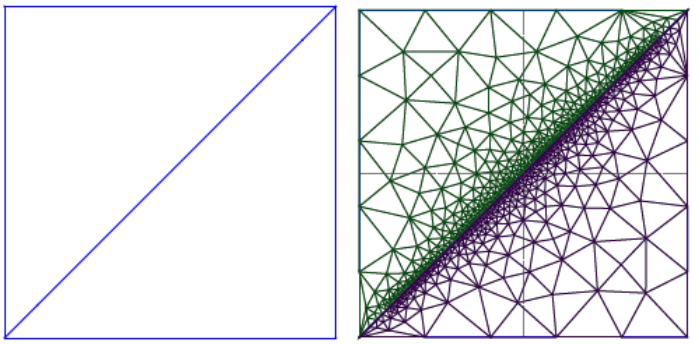
Abbreviation: *PATHFIND*

Brief Description: *Path planning is an essential part of giving a machine or computer agent the ability to navigate successfully between two points through a complex environment. One can represent the world internally as a grid or some more complicated data structure such as a triangle mesh. The latter has the benefit of better approximating environmental obstacles and objects and can lead to better (shorter, more optimal) paths.*

The scheme we will be looking at is called Field D - it is more general than the well known A* path planning algorithm, can find paths across a graph cell (triangles in our cases) and has dynamic re-planning abilities. It was used in the Mars Rover to provide the Rover with navigation planning across the complex Martian terrain. It can also be used to provide more direct paths across a triangle mesh, which includes moving over the surface or 3D mesh objects, or across 2.5D meshed height maps for example.*



The basic Field D scheme works on static geometry: the mesh is assumed to be fixed during path computation. The purpose of this project is to investigate adaptive re-meshing with the view to reducing path computation cost. In this case, we want to perform an initial crude approximation to the path on a coarse input mesh, and then refine this by adding new triangles around this path and re-estimating the path costs where necessary. This should produce better paths without the need to triangulate the environment to a very fine level. This is novel and may well result in a paper, which would be really great for an honours project.*



The work broadly entails: implementing the basic Field D algorithm, including support for path re-planning; implementing the Field D* cost function and path extraction for general triangulations and the investigation and design of suitable adaptive meshing strategies.*

Computer Science Content: *Data structures; graph algorithms; algorithm optimization*

Specific Learning Outcomes: *understanding of a complex graph searching algorithm for practical applications such as robotic path planning; understanding of graph search optimization;*

Skills Required by Team as a Whole: *Knowledge, or a willingness to learn, of a graph-based path-finding algorithms; Algorithmic design skills and optimization;*

- ***Theory:*** *Moderate to hard. Basic graph theory (as taught in CS2) and knowledge of search algorithms like A*. Understanding of mesh data structure and path planning algorithms;*
- ***Implementation:*** *Moderate. The implementation will be based on C++ and should make use of BOOST and CGAL library since these will ease development. Simon has extensive experience with these and can help with any confusion that may arise.*

Facilities needed: *No special hardware is required.*

Supervision: *Simon Perkins will provide co-supervision and will make code available for reference purposes. Meetings will take place weekly or bi-weekly depending on the projects phase.*

Number of Students: *3; the project could be reduced to 2 people.*

24. Project : Display of massive meshes

Proposer*: Patrick Marais*

Abbreviation*: BIGVIS*

***Brief Description**: Laser range scanning allows models to be captured and reconstructed in massive detail, using billions of triangles. However, rendering such a massive model is challenging, as it cannot even be held in memory all at once. The batched multi-triangulation technique has addressed this problem, but the pre-processing is extremely slow. This project aims to accelerate the process, possibly by exploiting existing structure in the triangulations.*

***Computer Science Content**: Computer graphics, specifically level-of-detail representations, external memory management. Parallel programming will also be important.*

***Specific Learning Outcomes**: algorithm design for scalable data processing; rendering techniques for large models; out-of-core algorithms.*

***Skills Required by Team as a Whole**:*

- *Theory: Moderate. Some knowledge of 3D graphics. Half the project will require writing a command-line pre-processing tool and will benefit from the Hons Advanced Graphics course and familiarity with linear algebra. The other half will involve rendering and will require an understanding of OpenGL or some other rendering API.*
- *Implementation: Hard. This is a challenging project that will require the ability to write high-performance code and use of complex data structures to represent multi-resolution models.*

***Facilities needed**: Data files will be provided. Large amounts of disk space (up to 1TB) will be needed, along with a reasonable graphics card for rendering.*

***Supervision**: The project will be co-supervised by Bruce Merry. Meetings will be held weekly or bi-weekly depending on the project phase.*

***Number of Students**: 2*

25. Project : Drug Stock-out Monitoring system

Proposer: *Sonia Berman*

Abbreviation: *STOCKOUT*

Brief Description: *Public health facilities often run out of essential drugs with serious consequences. Health activists have been reporting drug stock-outs on an ad-hoc basis to the Department of Health. A systematic approach is needed; several organisations are working together on this. We need a system for nurses, patients or members of the public to report stock-outs to a central office. The system must track all reports and all efforts to resolve these, and show statistics and maps. The central office must be able to determine if information is public or confidential and public information must be viewable on a website, so a reasonably sophisticated and granular data authorization system needs to be in place. The system must be free/open-source and mobile friendly and possibly even have an interface for SMSs, because many stock-outs will be reported by people whose only access to the Internet is a mobile phone, not necessarily a smart one. A friendly user interface that takes into account people with very limited computer or phone literacy is crucial. There is demand for this in Africa and South Africa; a good system has the potential to be a long-term project with funding. Good software engineering is needed to accommodate future maintenance and change, or perhaps even adaptation for reporting other community problems to other authorities.*

Computer Science Content: *HCI, databases, software engineering.*

Specific Learning Outcomes: *Requirements analysis and design; experimentation and evaluation; and system development and implementation are all expected outcomes and will all contribute to the project assessment.*

Skills Required by Team as a Whole:

- **Theory:** *This is not a theoretical project*
- **Implementation:** *One student will design and implement the frontends and the other will do the backend. The former will thus be someone keen on participatory design and the latter on system development.*

Facilities needed: *Mobile phones will be provided.*

Supervision: *Nathan Geffen will co-supervise.*

Number of Students: *2*

26. Project : School computers for Help2Read

Proposer: *Sonia Berman*

Abbreviation: *READHELP*

Brief Description: *This project will be done in conjunction with an NGO in Rosebank called Help2Read who assist grades 2-4 school pupils with reading difficulties. They have many (physical) resources such as books, puzzles and games. They also train volunteers in the community to do paired reading with these learners at their schools. The aims of this project are to see whether school computers can be used for improving the reading of learners with reading difficulties, for better incentivising such learners to read, and to explore new ways in which the volunteers can engage with and help the pupils. Since ethical clearance for designing and testing with youngsters is unlikely to be given, the design and evaluation will be restricted to the staff and volunteers at Help2Read.*

One student will focus on creating games/tools for making words (the Montessori method e.g. is based on learning to write before you read) and the other will focus on games/tools for paired reading. For example, it would be interesting to see if incentive improves with Facebook-like material or community-relevant material instead of school books.

Computer Science Content: *HCI, databases, software engineering.*

Specific Learning Outcomes: *Requirements analysis and design; experimentation and evaluation; and system development and implementation are all expected outcomes and will all contribute to the project assessment.*

Skills Required by Team as a Whole:

- **Theory:** *This is not a theoretical project*
- **Implementation:** *While much of the time will be spent in design, it is important to also implement an integrated system.*

Facilities needed: *No special facilities needed.*

Supervision: *Weekly meetings with supervisor.*

Number of Students: *2*