Department of Computer Science

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Computer Science
Graduate Student Handbook

2007

Our Mission

As the Department of Computer Science, our mission is to develop and impart knowledge and skills in the field of Computer Science.

Our Vision

The Department of Computer Science strives to be a department of the first rank in both an international and an African context,

- sustaining high respect for its research and post-graduate education;

- excellence in teaching in order to produce graduates who possess the skills that are needed whenever decision making or creative thinking takes place;

- an influential role in industry and the Information Technology community.

The University of Cape Town is committed to policies of equal opportunity and affirmative action which are essential to its mission of promoting critical inquiry and scholarship.

Contents

1. Introduction

The volume of that body of knowledge, which has become known as Computer Science, has grown exponentially since its beginning in the early sixties. A wealth of new concepts and techniques has been introduced, yielding a myriad of widely diverse applications.

Computer Science is one of the youngest sciences and it has only recently and gradually been assuming a clear identity. It has developed a clear experimental focus on top of a theoretical foundation based on Mathematics. Computer Science draws upon commercial practice and engineering design disciplines.

Daily, researchers worldwide are producing better algorithms, better software tools, more usable user interfaces, improved methods of software development and faster processors. In the marketplace, industry demand for Computer Science skills is unlikely to be met for decades to come.

2. Graduate Studies

Welcome to the Department of Computer Science of the University of Cape Town and congratulations on choosing one of the best Computer Science departments in the country for pursuing your graduate work. We are building up a stable group of well qualified researchers in this department and we believe we have brought together some of the best people in this country, with doctorates and experience from some of the world's leading Computer Science institutes. That alone does not make us great, but it does show that we are trying.

There is a significant, but subtle, difference between studies for an undergraduate and a graduate degree. It is assumed that if you register for the course, it is because you have an interest in your studies in general and Computer Science in particular. As a graduate student, you are expected to:

- be responsible for identifying much of your study material yourself and managing your own study programme;
- work largely unsupervised and independently;
- display evidence of independent and original thought;
- be prepared to evaluate, criticise and justify;
- show an appreciation of concepts and principles;
- communicate ideas clearly and succinctly;
- learn together with staff members.

This booklet contains details of the structure of the various graduate courses, covering the Honours Year (fourth year) Masters Degree and Doctoral Degree, as well as some information about the department itself.

The Honours year, in particular, is hard full-time work; we hope that you enjoy the course. The department wishes you every success for the year.

3. Role of the Department

In general the role of the Department is to

- produce graduates with knowledge and skills relevant to both the International and the South African Information Technology community;
- carry out innovative research which adds to basic understanding;
- produce service courses and provide research assistance in the fields of science and engineering;
- provide services to Industry through technology transfer and applied research;
- take an active part in the academic and governance affairs of the University;
- to provide opportunities and support for students from disadvantaged backgrounds to realise their potential;
- to promote, support and advise schools in the teaching of Computer Science Technology.

In our graduate programme our role is more specifically to produce individuals who are well read, articulate, and able to exercise critical judgement in the field of Information Technology. It's core function, therefore, is not that of providing vocational training, but to impart the fundamental skills that are needed whenever decision making or creative thinking takes place. These skills have to be nurtured in the special environment of the university, where orthodoxies can be challenged and ideas can be developed.

We therefore educate our students in the principles, theory and practice of Computer Science. We do not aim to train people how to use computers and become programmers, although you will learn those things as a matter of course. We want our students still to be useful scientists a decade from now, rather than be trained for the immediate demands of the marketplace.

4. The Department

4.1 Staff

The academic staff members are:

Ken MacGregor (Professor and Head of Department) studied at the University of Strathclyde in Glasgow, obtaining his B.Sc. in Mathematics in 1966. He then studied at the University of Glasgow where he obtained a Diploma in Computer Science in 1967, and his MSc in 1971. Professor MacGregor lectured Computer Science for three years at Glasgow University before joining UCT in 1972.

Sonia Berman (Associate Professor), who joined the department in 1980 after completing her Honours degree, obtained her MSc in Computer Science at UCT in 1983 and her PhD in 1991. She has served on the programme committee of numerous international conferences and is a member of several NRF Panels, including the Panel for Information and Communication Technology. A/Prof. Berman is part of the Advanced Information Management group, and has NRF support for her research.

Edwin Blake (Professor) holds a BSc in Physics and Applied Mathematics from UCT and honours in Applied Mathematics from Wits. In 1988 he completed his PhD in Computer Science at Queen Mary College, London University. He then worked for the Centre for Mathematics and Computer Science (CWI) in Amsterdam as a senior researcher in Interactive Systems. He joined the Department in 1992. Professor Blake is a member of the Collaborative Visual Computing Laboratory. He has NRF support for his research. He recently successfully led the multi-million Rand Innovation Fund research project on the Collaborative African Virtual Environment System (CAVES).

Pieter Kritzinger (Professor) obtained an MSc in Electrical Engineering from Wits in 1968 before going to Canada in August 1969. He completed his PhD 30 months later at the University of Waterloo, Canada, still considered one of the 10 best Computer Science departments in North America. He subsequently became an Assistant Professor at that university for 2 years. This was followed by 2 years of teaching at Imperial College, University of London, before returning to South Africa as a Senior Lecturer at Stellenbosch University where, inter alia, he was a co-founder of ITR, the Institute for Applied Computer Science. Professor Kritzinger spent 1984 on study leave at the IBM Zürich Research Laboratory (ZRL) before being invited to join UCT as a full professor in July 1985. He was Head of the Computer Science Department for 8 years starting in 1989. He spent 1992 on study leave at the Abteilung für Informatik at the Universität Dortmund and has visited the Universität Erlangen-Nürnberg for several shorter study periods since. During 2004 Pieter again spent 4 months at the ZRL and subsequently his research group entered a Joint Research Agreement with ZRL. Professor Kritzinger is a grant-holder in the NRF Information and Telecommunications Focus Area and the Telkom/Siemens Centre of Excellence programme. Pieter was elected a Senior Member of the American Institute for Electronic and Electrical Engineers in September

1998 and he is an invited member of IFIP Working Groups 6.1, 6.3 and 7.3. Pieter has published more than 43 research papers in peer-reviewed international journals or research conferences and has successfully supervised 25 Masters and Doctoral students to date.

Gary Marsden (Associate Professor) graduated with a first class BSc(Hons) in Computing Science in 1992 and a PhD in Human-Computer Interaction in 1998, both from Stirling University. After leaving Stirling, he worked for three years at the Interaction Design Centre at Middlesex University in London. Since moving to UCT in 1999, his work has focused mainly in the field of Mobile Interaction Design. He has conducted joint research projects with many universities and mobile telephone companies across the world and co-authored the first book on this subject in 2005.

Dr Andrew Hutchison (Adjunct Professor) obtained his MSc in Computer Science from UCT in 1991 and his PhD in Computer Science from the University of Zürich, Switzerland in 1996. He also holds a Higher Diploma in Education (with distinction) from UCT. Based with T-Systems, he is responsible for the Telecommunication Services division in South Africa. He has previously worked as a consultant, predominantly in information security. He has also worked as a software engineer for Netsys International, Pretoria and as a pre-doctoral researcher at the IBM Zürich Research Laboratory. Andrew was a full time senior lecturer in the department from 1996 to 2000, and continues to lecture on a part-time basis and conduct postgraduate student supervision.

Dr James Gain (Senior Lecturer) received his BSc(Hons) and MSc degrees in Computer Science from Rhodes University in 1994 and 1996, respectively. During 1996 he lectured part-time. Near the beginning of 1997 he joined the Rainbow Graphics Group at the University of Cambridge and, in 2000, obtained a PhD in Computer Graphics. He joined the Computer Science Department at UCT in October 2000. He is a member of the Collaborative Visual Computing Group.

Dr Michelle Kuttel (Senior Lecturer) completed a BSc in Chemistry (1995, UCT) and a BSc(Hons) in Computer Science (1996, UCT, followed by an MSc (1999, UCT) and a PhD (2003, UCT) in Computational Chemistry. She joined the Department in January 2003.

Dr Patrick Marais (Senior Lecturer) completed his BSc (Hons) in Applied Mathematics in 1991, before enrolling in the Computer Science Department at UCT to begin an MSc. He spent the last 3 months of his MSc working at the Centre for Mathematics and Computer Science (CWI) in Amsterdam. After completion of his MSc in 1994, he joined the Robotics Research Group at the University of Oxford. He completed his DPhil in medical imaging in 1998, and joined the Department in November of the same year.

Dr Hussein Suleman (Senior Lecturer) obtained his undergraduate and MSc degrees from the University of Durban-Westville. He then moved to Virginia Polytechnic Institute and State University to pursue a PhD, which he completed in 2002. He joined the staff at UCT in January of 2003.

Dr Anet Potgieter (Senior Lecturer) obtained her MSc in 1992 and her PhD in 2004, both from the University of Pretoria. She conducted software engineering as well as research in industry from 1982 until July 2002 when she joined UCT as a lecturer. She was part of the team that developed software for the health-monitoring unit and navigation system of the Rooivalk attack helicopter. She was part of the DTI consortium (Deloitte & Touche, ISIS) that engineered the Saldanha Steel scheduling system. She was involved in various military research projects combining artificial intelligence techniques with parallel processing to do real-time model-based image understanding. Anet is a grant-holder in the NRF Economic Growth and International Competitiveness Focus Area, specifically for research on Intelligent RFID tags.

Dr Audrey Mbogho (Senior Lecturer) obtained her BSc and MSc degrees from The City College of New York. She subsequently worked for 10 years at the City University of New York in a number of technical and research roles. She obtained her PhD in 2006 from The City University of New York and joined the department in April of the same year. Dr Mbogho hails from Kenya.

Donald Cook (Lecturer) studied a BSc (Hons) in Computer Science at UCT and also obtained a Teaching Diploma. He joined the department in 1989 after working at the Teaching Methods Unit at UCT. Donald spent a sabbatical at the University of Illinois Urbana Champaigne where he began work on his MSc in Computer Supported Collaborative Work.

Gary Stewart (Lecturer) lectures the Computer Science Academic Development (ADP) programme. It is an introductory bridging programme aimed at students from previously disadvantaged backgrounds, allowing them to complete their first year in Computer Science over two years. He graduated with a Bachelor of Science (Honours) in Computer Science from UCT in 1994, after which he went into industry, specialising in financial services and knowledge management and joined UCT as a lecturer in 2003.

Matthew West is the UNIX Systems Administrator in the department. He is currently completing his BSc in Computer Science at UNISA.

Samuel Chetty is a Systems Administrator in the department. He is a Microsoft Certified Professional.

The administrative staff consists of **Freda Parker**, **Eve Gill** and **Bernie Sam**. Ms. Parker is the departmental Administrative Assistant and is assisted by Ms. Sam. Ms. Parker is the first person to approach if you have an administrative query. Ms. Gill is the Administrative Assistant (Research) and manages all funding and administrative tasks pertaining to all the researchers in the department. Ms. Sam is responsible for the distribution of tutorials, lecture notes, and other course materials. She is a good source of information on the operation of the department.

Masters students may also be involved in the teaching of Honours students. Please enquire which Masters students are involved and their interests, since they can often give you invaluable advice about the course.

4.2 Brief Overview of the Research in the Department

The research activities in the department are informally grouped into laboratories. The current fields of interest include computer networks, database systems, interactive computer graphics, distributed systems, artificial intelligence, data visualization and high performance computing. Detailed descriptions can be found in Section 13. Research in the Department.

4.2.1 Advanced Information Management Laboratory (AIM Lab)

Sonia Berman, Ken MacGregor and Hussein Suleman.

The Advanced Information Management laboratory has a strong focus on the use of information, from computational, representational and distribution perspectives. This broad spectrum of research areas includes databases, knowledge management systems, distributed computing, Web-based systems, component-based systems, digital libraries and information storage, retrieval and visualisation.

4.2.2 Agents Laboratory (Agents Lab)

Anet Potgieter and Kurt April (GSB).

The research in the Agents Lab is focussed on the use of adaptive agents to cope with emergence, which is a system phenomenon that is outside of the scope of traditional software engineering approaches. The growing interconnectedness of systems and system components, their distributed nature and their interaction with dynamic and uncertain environments are giving rise to emergence. Emergence refers to the global behaviour of a system that cannot be understood from observing local behaviours between system components amongst themselves and their environment. Research involves agent-based engineering of emergence in: Sensor Networks including RFID tags and Video Surveillance, Social Networks, Ontologies, Gaming, Value Networks and Anomaly Detection in Security Applications.

4.2.3 Collaborative Visual Computing Laboratory (CVC Lab)

Edwin Blake, James Gain, Patrick Marais and Gary Marsden.

The CVC lab brings together expertise in graphics, interface design and psychology. Typical areas of research include: virtual modelling, visualisation, mobile computer interfaces, scene rendering and collaboration in virtual environments.

4.2.4 Data Network Architectures Group (DNA Group)

Pieter Kritzinger and Andrew Hutchison.

This group was founded in 1986 and over the years has focused on the functional and temporal analysis of discrete, reactive systems, in particular computer networks and their protocols. Research concerns all aspects from the design, specification, and analysis to the implementation of such systems and computer security is an important aspect of the work this group does.

Current emphasis is on wireless mesh networks and ways of Connection Admission Control (CAC), security in such a highly vulnerable environment and general aspects of Admission, Authentication and Accounting in wireless networks.

The group has collaborators in Germany, France and the United Kingdom which involve mutual exchange of staff, post-graduate students and software tools and knowledge in general.

4.2.5 High Performance Computing (HPC Lab)

James Gain, Michelle Kuttel, Patrick Marais, Audrey Mbogho and Hussein Suleman.

The High Performance Computing (HPC) laboratory is a new research collaboration in the department, which is focussed on the development of HPC expertise and parallel applications in Computer Science.

4.3 Individual Research Interests

Students are encouraged to become involved in projects undertaken by the staff.

Professor Blake's research is experimental and centres on the interaction of people with computers. His current research interests include authoring and effectiveness of Virtual Environments and how to use Information Technology for Social and Economic Development.

Professor Kritzinger is a member of the Data Network Architectures group and his specific area of research is computer networks, in particular the specification and modelling of wireless mesh networks, including mobile networks.

Professor MacGregor's areas of interest and research cover two and three tier client/server computing, object technology, particularly distributed objects, and operating systems.

Professor Berman's interests include databases, conceptual modelling, peer-to-peer systems, web information systems and XML data management.

Dr Gain's interests lie primarily in Computer Graphics. He is currently researching improvements in virtual sculpting (the computerised design of free-form shapes), compression of geometric models, and interfaces to generating procedural environments (fractal landscapes).

Dr Kuttel's research interests are in Computational Science, visualization, simulation and High Performance Computing. She is interested in the application of parallel algorithms to time-consuming scientific simulations, particularly in the fields of Molecular Modelling and Structural Bioinformatics.

Dr Marais' interests include 3D model compression and level of detail representations for realistic rendering. Other areas: medical imaging/image analysis, 3D deformation/modelling and compression in general.

Dr Marsden's interest is in why technology can be hard to use and how we, as computer scientists, can design systems which are easier to use. His interests lie in hand held computers (looking at problems from portable Web browsing to cellular telephone interfaces) and virtual reality (creating interesting and engaging environments).

Dr Suleman comes from a background in the emerging discipline of Digital Libraries. In this field, he works primarily on system architecture and interoperability issues as they are related to networked information systems. He also is interested in computer networking and network protocols, Web services, information retrieval, artificial intelligence and high performance computing.

Mr Cook is interested in computer supported education, approaches to teaching computing, and the interaction of people with computers. He is currently researching the application of computers in collaborative work and learning environments.

Dr Potgieter's research centres on the engineering of emergence in complex adaptive systems. This includes artificial intelligence and the engineering of agent-based systems consisting of agents that collectively learn and reason in order to adapt to uncertain and dynamically changing environments.

Dr Hutchison's area of research interest is computer networks, focusing in particular on performance modelling and security issues. Recent work has addressed group authentication protocols, security protocol analysis, smartcards, biometrics and intrusion detection.

To Do: Audrey *'s research interests.*

Gary Stewart's research interests include Computer Science Education, Online Learning Environments, Virtual Environments, Human Computer Interaction (HCI) and Digital Divide issues – essentially making computing more accessible, particularly to under resourced communities.

4.4 Computing Resources

Computing resources include servers and workstations running FreeBSD, OpenBSD, NetBSD, Sun Solaris, Ubuntu Linux and other Linux distributions, Microsoft: Windows XP Professional, Windows 2003 Enterprise Server Edition.

Software resources for teaching and development are drawn from Public Domain offerings, third party releases (e.g. IBM Rational Suite) and the Microsoft Developer

Network Academic Alliance software program. Laser printers are available for printing.

Specialized hardware peripherals cater for Virtual Reality applications and include Head-Mounted Displays, magnetic trackers, stereo glasses and spatial/surround sound. Advanced graphics hardware is available to drive these. A range of PDA computers are available for research into the wireless and mobile computing environment.

Computers are connected to 100Mb switched network, whilst servers are connected via 1Gb links. A wireless infrastructure provides connectivity for 802.11b wireless peripherals and notebook computers.

5. Honours in Computer Science Programme

The Honours programme in Computer Science, CSC4000W/4016W, is designed to provide students with the basis for a career path in the computer industry, and/or to embark upon a research programme at Masters level.

The course rounds off your training as a computer professional and provides further advanced study in some selected topics of Computer Science. A key aspect of the programme is to enable you to function both independently and in teams. By the end of the course you are able to read relevant literature and formulate research and development proposals. You will gain practical experience in team work by initiating and managing a major project. Emphasis is placed on the effective communication of ideas and results.

5.1 Admission Requirements

The number of places in the Honours programme is limited and students are selected on merit from the list of applicants each year. Criteria for selection are your Computer Science mark achieved in each of your three years of undergraduate studies and, to a lesser degree, the marks achieved in mathematics. Students who have not achieved at least a 65% average in their final year of Computer Science will only be admitted in exceptional circumstances.

5.2 Honours Module Credits

A honours course work credit corresponds to 12 lectures worth of material. A 2 credit course would thus correspond to 24 lectures on the university timetable. In order to take account of the heavy practical demands of certain modules, the number of lectures may be reduced. This does not affect the final credit allocation for that module in any way. For a practical module, the standard 2 credit allocation is 16 lectures of course work, with the remainder given over to practicals / assignments.

5.3 Structure

A total of 28 credits must be obtained during the course of the academic year. These credits are awarded as follows:

- Elective Modules (minimum 16 credits, maximum 20 credits)
- Major Project 10 credits
- Research Methods 2 credits

Research Methods is a compulsory module that must be completed by every Student. You may select any remaining module as an elective, subject to the credit limits cited in
5.4 Course Work.

5.3.1 Work Load

This is an intensive full time course and may not be taken together with other courses or employment without the permission of the Programme Coordinator.

For each lecture hour you should allocate at least two hours of extra work to review material and for the associated tutorials and practicals[1]. For some modules credits can be obtained with proportionally fewer lectures since they have a necessary, and compensating, heavier practical load (see 5.2 Honours Module Credits above).

Approximately 6 weeks has been reserved in the final term to allow students to focus entirely on their Honours Project. All lectures and practicals will be concluded before this period commences.

Although this 6 weeks project block is available, you should allocate at least 3 hours per week to supervisor meetings, planning your project, reading background material etc.

You should also allocate one hour per week to attend departmental colloquia. Please note that attendance of at least 50% of the colloquia on offer is mandatory. A register will be kept if necessary.

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[1] These two hours could be allocated as one hour of theory review and one hour of practical work for a standard module or some other appropriate combination for a more practical or theoretical module

Your weekly work load (before the project period commences) will therefore be at least:

Lecture hours	11	hours (average of 14 lectures)
Practicals and review of material	28	(minimum)
Colloquium	1	
Major Project	3	
Total	43	

5.4 Course Work

The department offers sufficient modules at Honours level for you to fulfil your course work requirement. You may take modules from other departments, provided they are of an appropriate level and have some relevance to Computer Science. A list of typical Computer Science modules is provided in

8. Honours Modules.

To fulfil the course work requirement the following rules apply:
1. You must complete the compulsory Research Methods for 2 credits
2. You must obtain at least 16 credits of *elective* material (you may take at most 20)
3. The best 20 course work credits (including Research Methods) will count towards your final mark. *Of these:*
   a) At least 12 credits must be from Computer Science Honours
   b) At least 16 credits must be from either Computer Science Honours or Mathematics of Computer Science Honours.
   c) At most 4 credits from outside the department will be taken into consideration.

Students are urged to take at least one module outside the department to broaden their education. Note, however, that any module you register for outside the department must be approved by the programme coordinator and will be weighted according to its relevance to computing in general.

5.4.1 Lecture Periods

Lectures are scheduled for periods 2-5. The timetable is drawn up in consultation between students and lecturers to best accommodate the lecture commitments of both. Computer Science colloquia are normally held during the lunch hour. Please note that courses which are 3 credits or more will have at least some lectures scheduled after lunch.

5.4.2 Module Registration

A list of the actual modules available for the year will be handed out before registration. At registration you will be given a module registration form on which to indicate your choice of modules. You may not register for more than 24 course credits. Only the registered modules will be considered in calculating your final mark.

Additional modules for credit may be offered during the year to take advantage of the expertise of visiting lecturers.

Apart from such additional modules you may only drop or add a module with the approval of the lecturer concerned and the programme coordinator. Such approval must be requested and given in writing and will not be granted if more than 1/6th of the lectures have already been given in the module concerned.

5.4.3 Examinations

Modules are usually examined during the University examination periods (May/June and October/November). However, the Department is free to schedule examinations at any sensible time after the completion of the relevant coursework. Examinations

written outside the department are scheduled by the department in question. There is typically one two-hour examination per two credit module in Computer Science Honours. Open book and take-home examinations are preferred by some lecturers. Modules with a substantial practical component may have up to 50% of the final mark derived from the practical work.

The examination timetable is the responsibility of the class representative(s) in consultation with the class and lecturers concerned and is drawn up shortly before the examination period.

After the mid-year examinations, students may be given an *indication* of how they performed. *Note that* only a provisional symbol is released after the mid-year examination as
1) it is University policy to release only a single mark for the whole Honours course and
2) the exam papers will not have been seen by the external examiner at this stage.

5.5 *The Major Project*

Students are required to complete a major project under the supervision of a member of staff. The project topics will be presented to students during the first term. A block of approximately 6 weeks has been set aside in the last term, to allow students to work solely on their projects. However, students are expected to meet weekly with their project supervisors throughout the year. Time should also be allocated to properly plan for the project period, and to read background material etc.

The honours project allows students an opportunity to develop a substantial piece of software according to sound software engineering and design principles. Projects involving multiple students are encouraged, but will only be permitted if the project has *readily identifiable components which each individual can design and implement*. In the case of group projects, integration of the various components will be paramount and students will be heavily penalized if they do not engineer a well integrated solution. Note that each student project must constitute a piece of work that can be *independently assessed*.

Students may submit their own written project proposals. The department welcomes proposals from students on condition that the project has significant Computer Science content and that a staff member can be found to oversee the project, possibly in conjunction with an outside supervisor. The proposal must also be approved by the programme coordinator and the department reserves the right to reject a proposal. The written proposal must follow the format of the departmental project proposals.

It is your responsibility to discuss the proposed projects with the supervisors concerned. Once you are satisfied with your choice you should fill in the required form and list your preferences. The form must contain a list of the other members of your proposed

group. You have about two weeks in which to make your choice after receiving the list of projects. As soon as possible thereafter the projects will be allocated. Every attempt will be made to accommodate your wishes and queries in this regard should be directed to the programme coordinator.

A great deal of importance is placed on making regular progress throughout the project period. A detailed list of milestones has been drawn up to help you plan your work. It contains deadlines and specifications of what has to be handed in or presented. The list is handed out when the projects are assigned.

Each project group is required to produce a formal project proposal which will be vetted by the staff. A poster and web page are also required. Guidelines for each of these will be distributed once the projects have been approved.

The final project report must be handed in to the Honours convener no later than the specified due date. A maximum of 3 days beyond the official hand in time is permitted, but the project/document will be penalized by 5% per day. Extensions are only granted if the delays in completing the project are beyond the reasonable control of the student(s) concerned.

The project report should constitute a comprehensive description of your project, detailing both the software engineering and technical aspects of your work. The former will cover issues such as specification and design, whilst the latter will provide a detailed description of the theoretical/research issues you considered. A document detailing what such a report should contain will be handed out when the projects are allocated. **No report may be submitted without the prior approval of the project supervisor**. The supervisor may require alterations and so the final draft must be available in good time for it to be read by your supervisor and revised by you. The final project presentations will be scheduled soon after the hand in date.

The deliverables of the project will be:
- a formal project proposal and presentation;
- a marked prototype deliverable;
- a poster;
- a project web page;
- the final presentation;
- the project report.

5.6 GSB Entrepreneurship/Business Planning Module

The UCT Graduate School of Business (GSB) offers a course on entrepreneurship tailored to suit the needs of future Computer Science entrepreneurs. The course provides the skills necessary to prepare a successful business plan to launch a new company. The course outline is supplied by the GSB and will be available prior to the commencement of the course.

5.7 Credit Requirements

5.7.1 Computing the Final Mark

The final course mark will be computed as follows:
- The project mark counts 1/3 of the total.

The remaining 2/3 of the mark is calculated from the 20 best courses. The modules which come into consideration for this mark are specified in

- 5.4 Course Work.

5.7.2 Subminima

The following subminima are applied for the Honours in Computer Science programme:

1. At least 40% must be achieved in the project.
2. At least 40% must be achieved in the research methods module, including full participation in the professional communications module and attendance at least half of the departmental colloquia and other research meetings for Honours students.
3. An average mark of 50% must be attained in the modules making up the best 20 course credits.
4. No module will be considered for course credits unless a student has obtained at least 40% in that module.
5. The final mark, which will be calculated as explained in 5.7.1 Computing the Final Mark, must be not less than 50%.

A student who achieves each of the above subminima will pass the course. Students are reminded that the University does not allow a student to repeat an Honours course.

6. Honours in Mathematics of Computer Science

The departments of Mathematics and Computer Science offer a joint Honours degree in the Mathematics of Computer Science in the School of Mathematics, course MAM4007W. The Programme convener for this course is Prof Vasco Brattka, of the Mathematics Department.

This specialized programme provides the background for a further research career in theoretical Computer Science. A wide range of advanced modules are offered and by the end of the course you will be able to read the relevant literature and formulate further research proposals. Adequate experience and appreciation of the practice of Computer Science is provided by the project which all students have to complete. Emphasis is again placed on the effective communication of ideas and results.

The entrance requirements and available modules are listed in the Mathematics Department Prospectus.

Further Study

The Honours degree could lead to a Masters degree either in the Department of Computer Science or the Department of Mathematics.

7. Honours Programme Miscellaneous

7.1 Programme Coordinator

The programme coordinator is Dr Anet Potgieter, Room 314, Computer Science Building (email: anet@cs.uct.ac.za). There will also be class representatives to whom satisfaction, complaints or otherwise must be addressed. Apart from the issues mentioned above which must be resolved in consultation with the programme coordinator, any queries regarding the programme should first be addressed to the departmental administrative assistant; if the matter needs to be brought to the attention of the programme coordinator, she will do so.

7.2 Financial Assistance

Financial assistance is available for prospective Honours students-enquiries should be directed to the Postgraduate Scholarships Office, Cottage No. 4, Lovers' Walk. The NRF provides a *limited* number of bursaries to South African citizens, while the University offers similar bursaries to non-citizens. The amount of the NRF bursary is the same as the tuition fees for the institution. No guarantee of a bursary can be given, unlike in the past. Unsuccessful NRF applicants who had a third year average of more than 70% have in the past been automatically considered by UCT for assistance. The closing date for NRF bursaries is usually around the 30 September; the notification date is February of the next year. A number of other bursaries are also available. You are advised to apply for all bursaries as early as possible.

In addition to these bursaries, some members of the department have funds available for research purposes, which may be available to students involved in projects undertaken by these members of staff. Students with legitimate financial difficulties may also receive departmental support. Any queries in this regard should be addressed to the programme coordinator.

8. Honours Modules

Modules offered at the Honours level vary from year to year depending on the interests of the staff. The following list of modules is provisional. An updated list will be placed on the honours web site if amendments are necessary. Additional modules offered by the Department of Mathematics and Applied Mathematics are listed in their departmental handbook.

8.1 Compulsory Module

The research methods module is compulsory for all Computer Science honours students.

8.1.1 Research Methods

Prerequisites: None

Course Objectives: The research methods module forms part of your practical training as a researcher and computer professional. The course emphasizes communication skills and introduces basic research methodology.

Credits: 2 credits

Lecturer or Convener: Prof. Edwin Blake

Course Content: The course covers the following topics:
- communication and presentation skills (PCU – see next section)
- project management
- scientific and technical writing
- experimental design and validation

The practical aspects of the work will be evaluated through an exam and the Professional Communications course.

Please note that you must obtain at least 40% for this module in order to continue with honours.

The final module mark will be composed of the PCU module mark (25%) and any examinable material (75%).

Prescribed Book: Notes will be distributed.

8.1.2 Professional Communication Unit (PCU)

The general aim of the course is to equip you with essential theory and practice in oral and written communication so that you can communicate more effectively at university and also in your chosen professional career. Your PCU course will precede some of your other modules and provide a foundation for the tasks you will be set later in the year.

Lecturer or Convener: Terri Grant

Objectives and Outcomes:

You will be expected to:
1. plan and present oral presentations. These presentations are expected to be of a professional standard in terms of:

   - format and organisation
   - appropriateness to audience
   - tone, language and style
   - visual aids

2. function effectively in small-group activities. Team work is essential in university as well as professional life and you will be introduced to the following concepts:

   - interpersonal, non-verbal and intercultural communication
   - perception and listening
   - small-group communication
   - problem solving and decision-making

3. gather information, plan and write selected documents according to acceptable
   standards. These documents are expected to:

   - conform to acceptable research methods, formats and referencing requirements
   - be suitable for target readers in content, style, tone and vocabulary
   - be well-planned, logically set out and argued
   - include appropriate, professionally executed and well-integrated graphic aids.

Course Outline:

Written Communication Course Content:
- selecting a document
- gathering information
- planning a document
- selecting appropriate style, tone and vocabulary
- writing logically and persuasively
- evaluating formats and layout (principles of readability)
- integrating verbal and non-verbal (graphic) communication aids
- documenting accurately
- applying professional standards of presentation

Oral and Group Communication Course Content:
- communicating effectively - a two-way process
- listening actively
- considering differences in perception
- assessing verbal and non-verbal cues
- planning an oral presentation

  - integrating visual aids
  - checking timing and balance
  - handling questions
  - handling stress/anxiety

- introducing group dynamics
- problem-solving and decision-making

Course Material:
Communicating @ Work is the prescribed text. This, together with exercise material, will be handed out in the first session. You must provide your own writing and visual aid materials for exercises/assignments/orals.

8.2 Elective Modules

These modules may be taken as long as you satisfy any listed module prerequisite.

8.2.1 Agents

Prerequisites: None

Course Objectives:
The course introduces the key concepts of Artificial Intelligence (AI). It highlights the differences between the deliberative and reactive approaches to AI, including overviews on Neural Networks, Machine Evolution and Robot Vision.

Credits: 2 credits

Lecturer or Convener: Dr. Anet Potgieter

Course Content: The course will cover material in the following areas:
1. Overview
   • Agents
   • Description of Concepts
2. Reactive Agents
   • Stimulus-Response Agents (S-R) Agents
   • S-R Agents in the Star-Ship Combat Simulator Practical
   • Neural Networks
   • Machine Evolution
   • State Machines
3. Deliberative Agents
   • Knowledge Representation and Reasoning
4. Adaptive Agents
   • An Overview on Learning Heuristic Functions
   • An Overview on Using Bayesian Learning and Inference to adapt in uncertain environments
   • An Overview on Adapting in Uncertain Environments using Complexity Theory

The course will consist of 16 lectures, tutorials, a practical, and an exam.

Prescribed Book: No prescribed book, notes and handouts will be provided.

8.2.2 Computer Graphics for Gaming (CSC3020H)

Prerequisites: basic first year mathematics (matrices, vectors and geometry)

Course Objectives: This course provides a basic foundation in the principles of computer graphics. The primary objective is to introduce students to the concepts required to appreciate the fundamental operations performed by hardware and software to produce the rendered images we see in, for example, games and animated features. We will use the non-proprietary openGL API to explore these ideas.

Credits: 2 credits

Lecturer or Convener: Dr. Patrick Marais

Course Content: The course will cover material in the following areas:

1. Introduction: the graphics pipeline, graphics architectures, primitives and viewing, intro to openGL, interaction and

2. animation;
3. Basic 3D graphics: homogeneous transformations, viewing, perspective, shading;
4. Practice: renderer implementation, hidden surface removal, texturing, hierarchical and object modelling, scene graphs,
5. revision (or advanced topic investigation, time permitting).

Assessment:
The course will consist of 20 lectures with openGL practicals appropriate for game development. Some written work and and exam will also be used as part of the assessment.

Prescribed Book: E. Angel, Interactive Computer Graphics: A Top-Down Approach with OpenGL (4th Ed.) Addison-Wesley, 2003.

8.2.3 Network and Internetwork Security

Prerequisites: none

Course Objectives: The objective of this course is to introduce cryptographic techniques and protocols for secure exchange of information on networks and internetworks, and to examine the deployment of these in emerging technologies.

Credits: 2 credits - 16 lectures. An optional 1 credit may be taken based on additional (afternoon) seminars and research work on specific topics which will be covered after the NIS module has completed. This latter programme will be largely aimed at students who may wish to pursue further post-graduate studies in the area of security.

Practicals and Assignments: A practical involving deployment of cryptographic algorithms will be conducted (in groups). An essay covering a selected topic in the field of information security and/or cryptography will be set (to be written individually).

Assessment: In addition to the coursework, a 2 hour written examination will be used to evaluate the course.

Lecturer or Convenor: Adjunct Professor A Hutchison

Course Contents: The course covers security services; conventional encryption (classical encryption techniques, DES/AES, key distribution, key generation); public-key cryptology (RSA algorithm, key management, certification hierarchies); authentication and digital signatures; LDAP directory services for authentication & authorisation ; intruders, viruses and worms (intrusion detection); cryptographic algorithms (MD5, SHA, IDEA, SKIPJACK); authentication and key exchange (Kerberos, Diffie-Hellman). Deployed security solutions such as SET (secure payment), PGP (secure messaging), SSL (secure transport layer) and WS-Security (secure web services) will also be studied.

Prescribed Book: *Network Security Essentials* by William Stallings, Publisher: Prentice Hall; 2nd edition (November 20, 2002) , ISBN: 0130351288

8.2.4 Parallel Computing

Prerequisites: No specific course prerequisites. However, knowledge of Linux/Unix and C/C++ is assumed.

Course Objectives: Parallel High Performance Computers are becoming increasingly important for solving large computational problems in many field, such as finance, biochemistry and engineering. Parallel computers are also becoming more prevalent, a local example being the Centre for High Performance Computing (CHPC) in Rosebank, Cape Town, which will have it's first phase of a 160 node cluster installed by April 2007. However, some knowledge and experience is required in order to use a parallel computer effectively.   This course provides an introduction to parallel architectures, programming techniques and applications, with the emphasis on message passing approaches to parallel programming.

Credits: 2 credits

Lecturer or Convener: Dr Michelle Kuttel

Course Content: The course covers material in the following areas:
- Parallel architectures
- Parallel programming models
- Parallel programming using the Message Passing Interface (MPI)
- Parallel applications
- Performance evaluation, load balancing and benchmarking of parallel applications
- Parallel file systems and parallel IO.

Assignments: Two assignments together comprise 60 % of the year mark.

Final Exam: The final exam is 2 hours long and contributes 40% of the final mark.

Prescribed Book: No prescribed book, notes and handouts will be provided.

Recommended Books:
1. Parallel Programming, B. Wilkinson and M. Allen, 1999,Prentice Hall
2. Using MPI, 2nd Ed., W. D. Gropp, E. Lusk, and A. Skjellum,(MIT Press, 1999)

8.2.5 Distributed Computing

Prerequisites: None

Course Objectives: To expose the students to the concepts of writing distributed component applications and exposing them to the different types of middleware.

Credits: 2 credits - 16 lectures.

Practicals: Two programming exercises.

Lecturer: Prof. K MacGregor

Course Contents: Overview of the models of distributed computing, Features required in distributed component systems. Implementation of distributed component middleware. Wireless Middleware and its uses. Cluster middleware.

Prescribed Book: Course Notes by K MacGregor

8.2.6 Introduction to Image Processing and Computer Vision

Prerequisites: Familiarity with basic mathematics such as linear algebra and calculus. Ability to draw pixels/lines using some API.

Course Objectives: The course introduces concepts from image processing and computer vision, and applies these to tasks such as segmentation (the extraction of a required part of a data set from the whole data set), filtering (for smoothing of data and the detection of interesting features) and image compression.

Credits: 2 credits (16 lectures and practical work)

Lecturer or Convener: Dr. P. Marais

Course Content: The course covers selected topics in the following areas:
- One and two dimensional Signal Processing
- Image Transformations
- Shape and Data Descriptions
- Feature Detection
- Segmentation of 2D and 3D structures
- Genetic Algorithms for Computer Vision

The practicals will allow students to implement and investigate a number of the techniques covered in the course. A number of topical papers will also be discussed and will form part of the course assessment.

Prescribed Book: Notes will be distributed.

Recommended Book: *Algorithms for Image Processing and Computer Vision*, J. R. Parker, Wiley Computer Publishing, 1997.

8.2.7 Internet Interoperability

Prerequisites: CSC305: Web-based computing.

Course Objectives: Interoperability is one of the latest buzzwords in system design, especially in the Internet arena where standardisation is critical. This course will present various approaches to interoperability - philosophies, problems, solutions and case studies - from the perspective of using the Internet to collect, store, manage and disseminate information in a rapidly evolving and massively distributed community.

Credits: 2 credits (16 lectures and practical work)

Lecturer or Convener: Dr. H. Suleman

Course Content: The course will cover material in the following areas:
- What is Interoperability: Definitions and concepts
- Semantic and syntactic interoperability
- Data-level interoperability
- Metadata and metadata repositories
- Protocol-level interoperability
- OAI-PMH
- RSS
- Information retrieval interoperability: SRW/SRU
- Google and Amazon
- Component-level interoperability
- The Semantic Web
- Preservation through interoperability
- IPR and interoperability
- Future trends and research directions

The practicals will give students hands-on experience in using, evaluating and building interoperable tools and systems.

Prescribed Book: Notes and pointers to relevant material will be available online.

Recommended Book: *Digital Libraries*, William Y. Arms, MIT Press, 2000. Available from http://www.cs.cornell.edu/wya/DigLib/new/index.html

8.2.8 Second Course in Database Systems

Prerequisites: CSC303S module in Database Systems

Course Objectives: The aims of the course are to introduce new developments in database systems, to study how to use such technology effectively and to provide an understanding of established techniques as well as research issues in these areas.

Credits: 2 credits - 16 lectures.

Practicals: 1 assignment.

Lecturer: Assoc. Prof S Berman

Course Contents: Object-Relational and object-oriented systems; Distributed databases; Data warehousing, OLAP and data mining; Spatial and temporal data management, Peer-to-peer systems, Web-based information systems.

Prescribed Book: *Database System Concepts*, Silberschatz Korth and Sudarshan (4th or 5th ed), McGraw-Hill 2001, supplemented by notes available from the Department.

8.2.9 Interaction Design: how to design and implement usable and useful computer systems

Prerequisites: None

Course Objectives: Equip programmers with design ideas and evaluation techniques for interactive computer systems.

Credits: 2 credits (16 lectures and practicals)

Practicals: Evaluation will be by submission of a report, a code simulation of an interactive device and by examination.

Lecturer or Convenor: A/Prof G Marsden

Course Contents: So you have developed a system using strict development standards to produce a quality, robust implementation. But this is only half the story. Ultimately, real users will have to be able to work the system, otherwise it will fail.

This course is about providing you with sound design ideas and evaluation techniques to ensure that you build useful systems that users can use. Although the techniques apply to almost any computer system, the majority of examples and case studies will be from the realm of mobile computing.

8.2.10 Advanced Computer Systems (EEE536F)

Prerequisites: Introductory Networks course or equivalent

Course Objectives: The objective is to familiarize students with important aspects of computers systems for which the under-graduate curriculum could not allow.

Credits: 2

Lecturer: Pieter Kritzinger

Course Contents: Students taking this course should ideally want to continue with a Masters Degree program in that there is an emphasis mathematical and formal methods where these apply to practical.
- Systems we shall learn about:
    1. Cellular networks in general.
    2. GSM, GPRS and EDGE or 2.5G networks.
    3. UMTS and CDMA
    4. Wireless networks, including WiFi and WiMax
    5. Mesh networks
- Theory and tools to learn about:
    1. Markov theory and queuing theory.
    2. Formal specification methods, including Stochastic Petri nets

This is a courageous endeavour for a mere 12 hours and we reserve the right to change topics; limit the material to only part of that planned etc, depending on the class and the general progress.

8.2.11 Effective Virtual Environments

Prerequisites: A basic understanding of Interactive Computer Graphics will be useful but is not essential. Doing the honours course on Interaction Design will add depth to some of the issues addressed.

Course Objectives: This course introduces Virtual Environments (VEs) with an emphasis on making such environments useful and engaging to users. It will convey the essential theory and concepts. It will train participants in practical skills for creating and evaluating such environments.

Credits: 2 credits (16 lectures and practicals).

Practicals: Designing and Creating a virtual environment and performing a simple test of its effectiveness.

Lecturer or Convener: Prof E H Blake

Course Contents: This course has been given in a number of versions and draws on the work of many collaborators. The latest version is based on the practical experience in VR authoring with the CAVES project run by the Collaborative Visual Computing (CVC) laboratory of the Department. Practicals will be based on popular open source graphics engines such as Irrlicht.

This will be an advanced course given by Prof Edwin Blake with possible guest lectures by other members of the CVC lab.

The topics are still being finalized and will be drawn from the following:
1. Introduction
   - What are VEs?
   - VE Systems
   - Low-cost VR Platforms
2. Authoring and Scripting
   - Methodologies for designing VR.
   - Managing VR Projects
   - Modelling
   - Using the Irrlicht graphics system to create CVEs
3. Presence & Co-Presence
   - Presence and Perception
   - Shared (Collaborative) VEs and Co-Presence
   - Measurement of Presence in VEs
4. Multi-modality and Spatialized Audio
5. Applications of VR, for example, in Culture Representation (with a focus on African Culture and Storytelling), VR therapy (including HIV/Aids counselling), and education.

Prescribed Book: There is no prescribed book, selected readings and notes will be provided.

8.3 Mathematics of Computer Science Modules

Additional information can be obtained from the Department of Mathematics. Only certain courses will be considered for credit, specifically those dealing with the foundational aspects of computing or other pertinent topics such as quantum computing. These courses are usually counted as 4 credits within the department (36 lectures + pracs).

The courses available are:

- Advanced Topics in Computability and Complexity: Quantum Computing
- Computability and Complexity Theory

Further courses will be added.

9. The Masters Programme

It is possible to study for a Masters degree in the Department by either coursework and dissertation or by dissertation alone. The normal duration of the course is two years, although it may be completed in one year. It is also possible to do the course on a part-time basis; see 11.2 Part-Time Study below.

Further details on general requirements can be found in 11. General Requirements for Masters and Doctoral Studies.

9.1 MSc in Computer Science by Dissertation

The degree of Master of Science may be conferred after the satisfactory completion of a dissertation embodying research under the guidance of an approved supervisor. This choice is known as CSC5000W. The guidelines for the dissertation are that it must be a detailed report on the conduct of a research project and the analysis of the results produced. It isn't essential that it be a contribution to knowledge nor does the project necessarily have to be original, although if this is the case then the degree is likely to be awarded with distinction.

The examiners are asked specifically to say if the dissertation indicates:
- sufficient knowledge of the relevant literature;
- familiarity with research methods in science;
- satisfactory presentation;
- that the candidate has originality and has advanced the field of knowledge of Computer Science;
- it is worthy of publication in recognized international journals in Computer Science.

9.2 MSc in Computer Science by Coursework and Dissertation

The degree of Master of Science may be conferred after the satisfactory completion of an advanced course of study (CSC5001W) as well as a dissertation (CSC5002W) embodying research under the guidance of an approved supervisor. The guidelines for the dissertation are that it must indicate that the student
- has sufficient knowledge of the relevant literature;
- is familiar with research methods in science;
- moreover, the dissertation must be satisfactory presented.

9.3 Admission Requirements

A student is not normally be admitted to the either Masters program unless (s)he has completed an Honours degree in Computer Science and achieved at least an upper second or has demonstrated academic maturity in some other way. Admission is moreover subject to the student finding
1. a suitable research topic acceptable to an approved supervisor, who
2. has to ensure that adequate computing equipment is available to the student to carry out the proposed research.

Where practical, no student will be admitted without a personal interview with the Committee for Graduate Studies comprising the Head of Department and senior staff members.

9.4 M.IT - Conversion Masters in Information Technology

This programme is aimed at those who wish to participate in the current Information Technology revolution but do not possess formal undergraduate IT, CS or IS qualifications. It will equip the student in understanding how various IT technologies can impact and be applied to a wide variety of problems.
It is aimed primarily at students who:
- want to work in the IT field and want a broad overview of current technology rather than hone in on one area.
- already work in the IT field and would like to fill in gaps in their knowledge, update their knowledge and/or obtain a formal qualification in IT.
- work in a non-IT field but would like to learn more about IT in order to apply this knowledge to their work.

This programme is not suitable for students who:
- want to do Computer Science or programming-intensive research.
- want to progress to a PhD in Computer Science.

As prerequisites, it is required that:
- You must have at least an undergraduate degree, in a subject other than Computer Science. Students with more than one year of Computer Science education will have their applications reviewed on an individual basis. Note that you do not need to have a degree in a scientific discipline - as long as you have a degree.
- You will need access to a computer and Internet connection.
- You will need to be able to attend UCT at the start and end of each semester for registration and examination purposes. This is not a distance education course and will not be administered as such.

The course comprises eight coursework modules taken over two semesters in the first year:

1. Object Oriented Programming in Java,
2. Advanced Programming,
3. Web Programming,
4. Cyberlaw and Ethics,
5. Computer Networks,
6. Database Systems,
7. Human Computer Interaction and
8. Software Engineering.

The second year is devoted to a year-long research module, including a course on Research Methods in the first semester if no such course has been taken in a prior degree (usually in an Honours degree).

Material for coursework modules is delivered via CDROM and the World Wide Web. Module content, software required for accessing the content and software for completing the coursework is provided on CDROM for easy and inexpensive offline access. Additional learning resources, particularly interactive resources and updates to notes, are provided through an Online Learning Environment. Email and discussion fora and chat-room facilities are used extensively by the students for interaction with staff and peer to peer communication and collaboration.

Assessment for most modules is a combination of coursework and unseen written examinations, which take place at the end of each semester on site at UCT. Coursework in these cases entails individual written assignments or programming assignments. The research module is assessed on the basis of your final dissertation, by a team of examiners, both internal and external. This is in keeping with standard procedures for Masters degree examinations.

Finally, upon completion, if you already possess an undergraduate B.Sc. degree, you will be awarded a MSc (Information Technology) - otherwise you will be awarded an MPhil (Information Technology).

10. The Doctoral Programme

Supervision for PhD study is provided by the academic staff in their areas of research. This course is known as CSC6000W, PhD in Computer Science.

10.1 Admission Requirements

A student is not normally be admitted to the Doctoral programme unless she or he has completed a Masters degree in Computer Science and demonstrated that she or he is an exceptionally good researcher who should benefit from further study in their chosen area of Computer Science. A proposal of the proposed research has to be submitted the Doctoral Degrees Board of the university.

Admission is moreover subject to the student finding
1. a suitable research topic acceptable to an approved supervisor, who
2. has to ensure, where applicable, that adequate computing equipment is available to the student to carry out the proposed research.
3. approval by the Doctoral Degrees Board of the proposed research proposal.

Where practical, no student will be admitted without a personal interview with the Committee for Graduate Studies comprising the Head of Department and senior staff members.

The Dean of the Faculty of Science may allow a student registered for the Masters degree to change his or her registration to that for the Doctoral degree.

11. General Requirements for Masters and Doctoral Studies

Note that these sections about Doctoral and Masters studies supplement, and do not replace, the *Rules for degrees* in the Faculty of Science handbook. The Faculty of Science has also produced an informative booklet for MSc and PhD students which can be obtained from the Science Faculty Office.

11.1 Queries

Any queries in concerning post-graduate study in the Department of Computer Science should be addressed to the Chair, Committee for Graduate Studies (currently Prof. Edwin Blake).

> Department of Computer Science
> University of Cape Town
> Private Bag
> RONDEBOSCH
> 7700
>
> Telephone: (021) 650 2663
> e-mail: dept@cs.uct.ac.za
> URL: http://www.cs.uct.ac.za

Application Procedures for Students from other Universities

Applications from students who have not completed their previous studies at UCT must be submitted *in writing* to the Chair, Committee for Graduate Studies and must include
1. the academic record of the applicant,
2. an indication of the research area of interest, as well as
3. a motivation from the student in his or her own words as to his or her reasons for wishing to study towards the MSc/PhD degree at UCT.

Students should also apply to the University for admission in the normal way
(See URL: http://www.cs.uct.ac.za/newstudents/postgrad.html).

11.2 Part-Time Study

The Department encourages part-time study with a strong industry involvement provided satisfactory commitment to the study is evident. The following would constitute such a commitment and should be
guaranteed in writing:

- A contract is entered into where the student spends at least 60% of his or her time on degree studies. This can take the form of a contract where the student spends 20 weeks per year with the company of which 10 weeks are in the University summer vacations.
- When the student is not working for the company concerned then he or she must be on campus.

11.3 Progress Reports

As soon as possible, but within no more than six months of first registering, a student is expected to submit a research proposal spelling out their planned study programme for that year and the milestones they expect to achieve by the end of June and the end of December of that year. This proposal must be approved by the supervisor and signed by both the student and the supervisor.

The Committee for Graduate Studies in consultation with the supervisor will decide whether the proposal is acceptable and milestone reports will be called for in time for the deadlines in June and December.

If in June, a student has not made sufficient progress according to the milestones set, the student will be warned that unless he or she achieves (the possibly revised) milestones for December, the Department will not approve his or her re-registration.

In the event that the student concerned then does not achieve these milestones the student is automatically excluded from the Department.

11.4 Financial Assistance

Financial assistance is available for full-time students registered for the Masters or Doctoral degree in Computer Science at the University of Cape Town. As far as is possible, we try to ensure that no student is prevented from studying for financial reasons.

Failure to Graduate

Successful applicants are expected to complete the degree for which the bursary was awarded within the normal time-frame, otherwise the bursary will have to be refunded.

NRF Bursaries

The National Research Foundation (NRF) provides bursaries to South African citizens or holders of permanent residence permits who are accepted as full-time students. The amount of the NRF bursary is not fixed, but will be determined on the basis of each application.

The NRF has two mechanisms of student support: grantholder-linked bursaries and free-standing prestigious bursaries. A grantholder is someone who has received research support and funding for bursaries from the NRF for an approved research project. The grantholder-linked bursaries will be the major source of student support.

In 2007 a maximum amount of R20 000 may be awarded for Masters and R35 000 for Doctoral students. The value of NRF bursaries will be determined on the basis of the financial circumstances of each applicant.

Furthermore, Computer Science students qualify to apply for an additional NRF ``Scarce Skills'' or a ``Prestigious'' scholarship which could substantially increase the NRF award.

Research Related Funding

Some members of the Department have funds available for research, which may be available to students involved in projects undertaken by these members of staff.

Temporary Employment

Opportunities to work in the Department as teaching assistants and tutors (for a maximum of 9 hours per week) are available to Masters and Doctoral students. Such students will earn at least R6 000 per annum (currently a study permit does allow foreign students to perform such duties that are related to their study).

Foreign Students

The University has very limited resources for supporting Foreign Students. The amounts awarded are usually related to, but somewhat lower than, the equivalent NRF bursaries. There is a firm deadline of the 30th September for applications for such bursaries. Students should consult the International Office and the Post-graduate Funding Office.

Applications for Financial Assistance

Applications for NRF prestigious scholarships and equity scholarships should be submitted via the Department. The closing dates are generally in mid-August and students should enquire beforehand and in good time from the Department. Very few such bursaries are awarded.

Financial support from members of the department, and this includes the grantholder-linked bursaries from the NRF, should be discussed with the individuals concerned.

Enquiries about UCT merit scholarships and bursaries should be directed to the Postgraduate Scholarships Office, Cottage No. 4, Lovers' Walk, where booklets

describing the relevant *Student Fees* and *Financial Assistance for Postgraduate Study* are available.

11.5 Departmental Colloquia

A number of research colloquia will be held during the course of the year. Attendance at these colloquium meetings is compulsory for **all graduate students**. Students who cannot attend must get permission from the departmental administrative assistant who will keep a record of the student's reasons for non-attendance.

Students are invited to participate in the colloquia by speaking about their own research and projects.

12. Post-Doctoral Study

Positions are available for post-doctoral fellowships, and NRF funding may be applied for. Internships are also possible, this is where funded post-doctoral students gain practical experience by working in industry for extended periods so as to aid the interchange between universities and the community.

13. Research in the Department

Research in the Department is loosely organized into five well-equipped groups funded by international, governmental and industrial sponsors. These are:
- Advanced Information Management (AIM)
- Agents
- Collaborative Visual Computing (CVC)
- Data Network Architectures (DNA)
- High Performance Computing (HPC)

All postgraduate degrees require research to be undertaken. Research advances the discipline, and, in Computer Science, research can be developing and verifying innovative solutions to unsolved problems; research can also involve deducing and proving new theoretical insights. With a masters the study is more research training, while a PhD must result in an original contribution to the discipline.

All masters and doctoral study is done under the personal supervision of a member of the academic staff. The Department offers leading computer scientists working in well-funded laboratories. Our staff members have a number of specialties and interests which are outlined below.

Please read the research descriptions given in this document and identify those areas which interest you and where you feel qualified to make a contribution. You should then contact the Chair of the Committee for Graduate Studies (Prof. Edwin Blake) or one of your potential supervisors if you need more information. You may suggest other fields of study yourself, but in the end you will have to find a member of staff who is willing to supervise you in your chosen field.

Below is a description of the research laboratories within the department and the interests of the researchers in each group. Students will usually be affiliated to one of these groups.

13.1 Advanced Information Management Laboratory (AIM Lab)

The Advanced Information Management laboratory has a strong focus on the use of information, from computational, representational and distribution perspectives. This broad spectrum of research areas includes databases, knowledge management systems, distributed computing, Web-based systems, component-based systems, digital libraries and information storage, retrieval and visualisation.

Staff associated with the laboratory are: A./Prof. Sonia Berman, Prof. Ken MacGregor and Dr Hussein Suleman.

Particular examples of the very much current and relevant research conducted within the group include investigations related to Web infrastructure and Web-based systems, peer-to-peer databases and interoperability of online systems.

13.1.1 Dr Hussein Suleman

Hussein's primary research area is digital libraries, with current focus on the architecture of highly distributed interoperable and scalable information systems. "Digital libraries" is a relatively new research area, at the intersection of Computer Science, computer networking and information sciences. From a Computer Science perspective, there are various technical issues that need to be resolved to support the ultimate aim of enabling simpler access to more information of a higher quality to all users of online and electronic systems. Hussein works closely with the Open Archives Initiative (http://www.openarchives.org) and the Networked Digital Library of Theses and Dissertations (http://www.ndltd.org), thus collaborating with institutions and individual researchers on a wide and distributed scale. Specific topics of interest follow:

Digital Library Architecture

In attempting to move closer to the goal of making information readily available to users, managed and flexible information systems must be placed within the grasp of all institutions and archivists. As such, the architecture of digital libraries needs to be simple but flexible. Ongoing research in this area, at UCT and with various international collaborators, is producing component models, frameworks, visual interfaces and specification languages for the construction of custom digital libraries without the need for custom software development. There is still much scope for additional work in these aspects as well as methodologies for component packaging and user interface workflow definition that is relevant not only to digital libraries but all online systems.

Web-based Component Testing

With the rapid acceptance of Web Services and Web-based technology, there is a growing proliferation of services that can be accessed remotely through well-defined interfaces. Past experience in protocol development has shown that well-defined interface specifications are not sufficient to ensure compliance with a standard and this usually results in multiple non-conformant interpretations and, generally, problems for human and machine users of the services. The incompatibilities among Web browsers is possibly the best contemporary example that illustrates why standards-compliance and compliance-testing are crucial in networked environments. In the digital library community, Hussein has worked with the Open Archives Initiative in developing protocol testing tools such as the Repository Explorer (a local mirror is at http://re.cs.uct.ac.za) and this has greatly influenced the success of the standard it tests. This is, however, a first generation testing tool. Much work remains to be done in generalising the testing framework so that testing tools can be automatically generated or driven by specifications. In an ideal environment, any Web-based protocol should be specified formally, in order to generate testing tools and test cases automatically. This work can have a major impact on the success of emerging digital library protocols and standards based within the Web Services initiative in general.

Innovative Document Management

Currently, there are a number of digital repository software toolkits to support centralised archiving of electronic resources. However, all of these tools require user intervention where users are required to explicitly submit items with associated descriptions. This has long been recognised as the bottleneck in acquiring and archiving material. Innovative techniques are required to support users and incorporate archiving (and sharing when appropriate) into their routine tasks by integrating document management into desktop software and other systems. An example of such a system would be one that transparently and efficiently archives all versions of a word processor document at the level of the file system. An example from a different extreme would be a system to replace photocopying for archival purposes with a scanner and software to automatically tag, organise and manage short-term and long-term duplicate copies of documents. Personal archiving is very relevant in an age where we produce a growing number of digital artefacts such as email messages, digital photos, PDA schedule entries and electronic documents – how do we effectively manage such fluid information in a connected world where digital photos may be shared on one website, research documents on others and everything related to an individual must be periodically archived?

Next Generation Information Services

Traditionally, designers of information systems have concentrated on basic textual search and retrieval functionality. However, as these are being standardised, there is growing interest in non-standard metaphors for finding and accessing information. 2-D, 3-D and multi-dimensional navigation mechanisms are still in their infancy. Some research has delved into the retrieval of digital objects by similarity of sound and image but there is much scope for refinement of these techniques, application to real-world data collections and generalisation of the interfaces to connect such novel services into a general framework. Summarisation is still a rarity in production information systems – when a collection of data is displayed on Google, shouldn't there be an overall picture of the most relevant results so that users need not have to visit the first 20 websites to get a summary? How does one summarise a single image, a collection of images or an audio stream automatically? How do users interact with information systems beyond the desktop computer – using PDAs, mobile phones, video cameras, sketchpads and custom-built IO devices, such as sensors to detect human presence or co-presence and activate information seeking and notification systems appropriately (e.g., switch on an audible email notification when an employee enters her/his office or let a person at a cocktail party know who they should be talking to based on common concepts dynamically mined from information about individuals)?

Open Source Usability

Open Source Software has unique usability problems that are created because of this "openness". For example, when a software package is installed, the installer can obtain and install dependencies automatically since the dependencies are themselves free. Also, since there are no restrictions on seat numbers, a tool could have multiple instances operating simultaneously and owned by multiple users (think

Web servers on different ports). Some of these concerns are being addressed by package managers and OSS software design. There is still scope to look into the applicability of generic OSS package management to popular digital library tools (e.g., DSpace) – in fact any discipline where OSS is used by non-IT specialists could benefit enormously from simpler management of software. A larger problem is that of the design of core OS tools – is it possible to port OSS system software to a clean class/instance/registry component model? Ultimately, can we create network servers and clients as easily as documents but with better management?

Hussein is interested in working with motivated postgraduate students who share his somewhat idealistic passion for improving the lives of people by removing barriers to information and computing. The ideas listed above are far from exhaustive and all wild and wacky ideas are welcome and encouraged.

13.1.2 Prof Sonia Berman

Prof Berman is looking for PhD and MSc students in the areas below.

XML Databases

The goal of this research is to facilitate the integration of two disparate kinds of information, namely databases and semi-structured XML documents, so that users can access both kinds of information source in simple, flexible and efficient ways. Effective techniques for storing, querying, updating, mapping and distributing XML and hybrid data systems need investigation. One MSc student in the group is currently working on temporal XML databases, another on querying of hybrid systems; a number of related issues are open for study.

Peer-to-peer Database Systems

In a peer-to-peer system a number of autonomous databases join together, for different intervals of time, in a system which has no global schema and no central administration authority, yet is usable as if it were a single store. Aspects to investigate include network topologies, replication, clustering and routing policies, query evaluation and issues of trust in P2P systems. A current MSc student in the group has built a prototype peer-to-peer database system which can be used as a basis for experiments in this field.

Advanced Database Applications

Suitable models and tools are essential for databases to be easily and effectively exploited in complex application systems. Some examples are given below.
- As the amount of online information rapidly escalates, we need to provide better knowledge management systems to organize this more effectively and make finding and sharing information simple and efficient. Knowledge sharing by trusted individuals with common interests should be an important benefit of the Web, but we have a way to go to ensure this is done using appropriate structures, tools and collaboration approaches.

- With the increasing use of personal information devices, we need to address the issue of how to provide an information-centric experience for the end user across devices. Code deployment, personal databases, and the ability to update replicated information from many devices while connected or disconnected, poses challenges for applications running on the small devices and also for central management of such systems.
- In a GIS (Geographic Information System) the spatial and temporal nature of data affords new challenges as regards modelling, design, storage, visualization and analysis of large data sets. Research in this field can range from engineering methodologies for GIS design through to indexing structures for spatio-temporal data. Recent MSc graduates, and some current thesis students, have developed models and tools to facilitate working correctly with maps and related GIS data, and we have several partner organizations involved in this work with us.

Web-based Information Systems

Database research is now being applied to the World Wide Web in order to improve information access and management for this enormous and rapidly growing resource. Data management in this field covers both the Surface Web and the Deep or Hidden Web, which includes over 25 million databases for which query forms exist on the Web. Better approaches are needed for locating, integrating, querying and personalising access to this vast store of information.

Object Store Engineering

Research in this area concentrates on developing better techniques for object databases/object stores. Since the structure and use of such stores is very different from that of the simpler relational model, new mechanisms and approaches are needed to handle distribution, store organization, query optimization, compile-time optimization, code in databases, class evolution, etc. Recent MSc graduates produced an object store and caching mechanism which can be built upon if you wish. If you are interested in working at this level, another avenue of research is main memory database systems. Main memory can now be so large that accommodating entire structures such as indexes or database partitions in memory is a viable option. This requires very different approaches to indexing, caching, store organisation, etc. which have yet to be explored.

Note: Prof Berman is willing to look at other ideas for post-graduate work in the database field if you have specific interests.

13.1.3 Prof. Ken MacGregor

Prof. MacGregor's area of research covers distributed computing in all its aspects, that is, the distribution of applications between different computer systems, irrespective of the network type. With the growth of network technology especially the Internet and wireless communications, the use and development of distributed applications in

rapidly increasing, however tools for the development and analysis of such applications are still not properly understood. The techniques used to develop commercial client/server systems across corporate networks are not necessarily suitable to implement distributed applications over inherently unreliable networks. In South Africa with its wide geographic distribution of population and shortage of skills this area of computing has many particular sociological advantages and challenges. The research covers three specific areas in which Prof MacGregor is looking for PhD and MSc students. These are:

Wireless Middleware

Middleware is the name given to the software that enables the communication between distributed applications. In a wireless world where connections can be intermittent and unreliable, a greater emphasis is placed on the functioning of the middleware. Different requirements exist for synchronisation of diaries in wireless devices as distinct from non-idempotent transactions. This research considers the requirements of wireless middleware and efficient communication between wireless clients and servers.

Open Source Operating Systems

The purpose of this research is to adapt the available Open Source Software and make it more user friendly and generally usable. The research is currently looking at a number of areas:

- Operating Systems – the LINUX family from full LINUX on a server to mLINUX on a PDA or cell phone.
- Application development tools for ease of usage
- Desktop software

Peer-to-Peer File Systems

The increasing availability of bandwidth presents new opportunities for distributed computing. Instead of the traditional message passing paradigm, which puts an additional overhead on the application, the more natural peer-to-peer paradigm could be adopted. In this method of distribution the application can discover what file resources are available on other computers and access them as if they were on their own systems. In this type of environment many user applications can cooperate accessing this common shared file system. The project is implementing a peer-to-peer wireless file system, consider its limitations, investigating the algorithms for ensuring the concurrency and integrity of the data, and researching the effects of bandwidth on the implementation. The software is being developed on a standard Open Source operating.

13.2 The Agents Laboratory (Agents Lab)

The research in the Agents Lab is focussed on the use of adaptive agents to cope with emergence, which is a system phenomenon that is outside of the scope of traditional software engineering approaches. The growing interconnectedness of systems and system components, their distributed nature and their interaction with dynamic and uncertain environments are giving rise to emergence. Emergence refers to the global behaviour of a system that cannot be understood from observing local behaviours between system components amongst themselves and their environment. Research involves agent-based engineering of emergence in: Sensor Networks including RFID tags and Video Surveillance, Social Networks, Ontologies, Gaming, Value Networks and Anomaly Detection in Security Applications.

The members of the lab are: Dr. Anet Potgieter and Prof. Kurt April of the UCT Graduate Business School.

3.2.1 Dr. Anet Potgieter

Adaptive agents are the basic building blocks of a complex adaptive system. These agents act together, interact with each other and the environment, and collectively adapt to changing environmental conditions. This technology is poised to transform the way we model the enterprise and build intelligent information systems.

My research interests include the development of simple agents that achieve adaptivity through collective behaviour. These agents form agencies that are distributed in open environments such as the Internet to perform complex intelligent tasks. Each agent can perform only simple operations. When joined together in agencies, intelligence is achieved.

3.2.2 Prof. Kurt April

Prof. April's research areas covers leadership, diversity & inclusion, and knowledge management, with particular focus on business applications. Recent research, under the banner of knowledge management, include social network analysis, virtual teamwork & discretionary effort within collective behaviour, and competitive intelligence techniques. Opportunities exist to develop software-based leadership development tools, using insights from complexity theory. Additionally, Prof. April is interested in enhancing the body of knowledge relating to the 'measurement of diversity & inclusion' within organisations, for competitive advantage. Globally, this is an under-developed field, with very few software applications which are underpinned by analytical rigour (such as structural modelling using Bayesian techniques, specifically for diversity & inclusion).

3.2.3 Research Areas

We would like to invite MSc and PhD students to join research, in any related area of their choice. Example research areas include:

Complex Adaptive Enterprises (Anet Potgieter and Kurt April)
The complex adaptive enterprise can learn from and react to global events faster than the competition because of its self-awareness and its ability to adapt. An enterprise is self-aware if it understands the interdependencies between its own resources and how these resources and interdependencies contribute to its own competitive advantage. The complex adaptive enterprise then uses this understanding to adapt its business processes and strategies in order to sustain its competitive advantage. In this project, we will research how simple software agents can be integrated into the enterprise in order to enable the enterprise to function as a complex adaptive enterprise. These agents can be integrated into distributed data sources and sensors such as RFID tags.
Anet and Kurt are grant-holders in the NRF Economic Growth and International Competitiveness Focus Area, and have available funding for research on Intelligent RFID tags.

Adaptive Value Networks (Anet Potgieter and Kurt April)
Most leading companies are rapidly trying to develop the ability to leverage scale, outsource key functions and to make products to customer demand, in the most flexible way possible. Current software offerings do not integrate process, value management and intelligence in a way that can exploit opportunities within markets, across business functions, and between businesses in a value network, and cannot fully enable these new ways of doing business. This project will allow a unique combination of adaptive agents, cost and value management, and collaboration across processes that will drive significant, sustainable competitive advantage.

Adaptive Knowledge Management (Anet Potgieter and Kurt April)
Knowledge management is concerned with issues involved with identifying, collecting, storing, evaluating, indexing, structuring, extracting, and presenting knowledge used to improve an organization's productivity. This project will research how adaptive agents can contribute to adaptive knowledge management by collecting knowledge and presenting knowledge in a just-in-time fashion.

Machine Intelligence (Anet Potgieter)

Machine Intelligence, a subfield of Artificial Intelligence (AI), is concerned with the study and the development of beautiful algorithms to mimic nature for problem solving. Machine learning is an important aspect of this research which involves finding useful models and statistically meaningful patterns out of massive datasets. Emphasis in machine intelligence is on computational intelligence, inductive machine learning, Bayesian learning and reasoning, data mining, and neural networks. Some

applications of this research include <u>stock and financial market</u> analysis, anomaly detection, <u>medical diagnosis</u>, bioinformatics and object (speech, face, or handwriting) recognition.

Emergence in Command and Control Applications (Anet Potgieter)
Bursaries Available from CSIR Electronic Warfare and Radar Division.

Modelling Emergence in Ecosystems (Anet Potgieter)
Bursaries Available from CSIR Stellenbosch.

Agent-based SensorWeb Applications (Anet Potgieter)
Anet is a member of the SensorWeb Alliance http://www.sensorweb-alliance.org and has funding available from industry for research in this area.

13.3 Collaborative Visual Computing Laboratory (CVC Lab)

The CVC lab is focusing on four major research themes:

Geometry Interest Group (Dr James Gain and Dr Patrick Marais)

This group addresses fundamental issues in computer graphics, particularly those relating to the efficient manipulation and representation of surface meshes. Current work involves mesh compression, level-of-detail rendering, 3D modelling and applications of spatial deformation techniques.

Socially Aware Computing (Prof Edwin Blake and Prof Gary Marsden)

The CVC group is involved in practical research whose outcomes address the development of the underprivileged areas of our country. This work produces practical applications and content (for example, novel ways of accessing digital libraries in remote

areas) and policy implications of new developments in Information Technology (IT). The emphasis is on involving the end users in the design process (by using techniques such as Action Research and participatory design) and assessing the impact of IT based interventions on a community.

VR Methodology (Prof Gary Marsden and Prof Edwin Blake)

The creation of useful content for advanced computer applications such as Collaborative Virtual Environments (CVEs) is complicated by the gap that exists between the creative people who develop novel technology and the creative people who can provide the content for that technology. This group is developing ways of bridging the gap by understanding how people create new content for CVEs and then capturing that as a set of guidelines for content creators and software designers.

VR Interfaces (Dr James Gain and Prof Edwin Blake)

This group pursues the twin aims of developing good tools and interfaces for authoring Virtual Environments (VEs) and demonstrating the success of the systems by evaluating specially selected applications for their impact on target users.

13.3.1 Prof Edwin Blake

My research covers various aspects of interactive systems, including the fields of Virtual Environments (VEs), Computer Games and Visualization, as well as the use of Information and Communications Technology (ICT) for socio-economic development. There are interesting areas of overlap between the fields. Another way of viewing this is that my research would interest anyone who wants to develop insights and skills about People and our relation to Computers. On the whole I adopt the approach of building applicable systems and then reflecting on the implications: a method that is also known as Experimental Computer Science.

During 2007 I would particularly like to investigate two areas, but I would encourage prospective masters and doctoral students who are interested in related topics within the general areas outlined above to discuss possibilities with me: a really passionate interest is important. Funding and bursaries are available for these projects.

ICT for Development

CyberTracker

I would like to continue with further follow up studies on our very successful project, the CyberTracker. This project enabled animal trackers to use a PDA and GPS system to record field observations; it made their expertise available to science and improved their position. One possible extension we are considering is to allow section rangers to view and query the location of animals and other field observations interactively on a handheld device (via WiFi or GPRS). This device would be aware of the location of the ranger and will allow operations previously only possible on the workstations at the base offices. By implementing this section rangers would be able to stay in the field without the need to go back to the office. The work would involve field trips.

Rural Telehealth

How can we develop software for rural and disadvantaged communities? This research builds on pervious work in rural tele-health that set out to develop and deploy useful systems for these kinds of users. We build systems that will enable us to have a useful and sustainable impact. This project is well funded by Dutch and Canadian funders. It would involve site visits and possible travel to neighbouring countries to demonstrate replicability of the work.

Mobile-Phone Electronic Wallets

The ubiquity of cell phones makes them attractive platforms for safe financial and other commercial services. The South African government is promoting the notion of "Banking the Unbanked" and ICT can assist in this. Currently the cash based economy makes people vulnerable to crime and suffers from the physical bottleneck of having to get large sums of cash to collection points. Initiatives to use cell phones for funds transfer currently rely on support staff to handle queries from the semi-literate users. We can reduce costs by providing more suitable interfaces.

Games and Virtual Environments

Presence and Virtual Environment Applications

Collaborative Virtual Environments (CVEs) provide new possibilities for communication and collaboration, with a lot of potential and enhancements for the way we work and exchange information. For such systems to be successful they must provide participants with a high sense of presence; giving them a sense of 'being there' in the place specified by the virtual environment rather than just seeing images in the lab.

13.3.2 Dr. James Gain

Dr. Gain is looking for Masters and Doctoral students in the following areas but is willing to consider students with their own topics in Computer Graphics and Virtual Reality:

Compressing Mesh Geometry and Connectivity

(to be co-supervised with Dr. P. Marais)
Despite steady increases in the storage capacity of computers this has been outstripped by the growth in the size of geometric models. For instance a scan of Michaelangelo's "David" produced a 500GB model. With limited transmission bandwidth (especially in a South African context) compressing these models is increasingly important. One area for potential compression is the connectivity (edges between vertices) of polygon-mesh models.

Dynamic Capture of Hand Positions using Image Processing Techniques

(to be co-supervised with Dr. P. Marais)
Using 3D input mechanisms (datagloves and position trackers) for 3D tasks has distinct advantages over conventional 2D input (keyboard, mouse). However, these 3D input devices tend to be both cumbersome and expensive. The use of the whole hand as an input device by tracking its position, orientation and relative morphology using digital cameras is an ideal solution to these problems. We envisage that a user will wear white gloves with markers positioned at key locations and that several relatively inexpensive digital cameras will be used to locate the 3D position of the markers. This research involves developing efficient image processing algorithms for recovering the hand parameters from camera images.

Sketch-Based Design of Parametric Scenes

There is a need in Virtual Reality for a means of generating compelling 3-D environments. However, creating them in a standard modeling package (e.g. 3DstudioMax, Maya) is a time-consuming and specialized task. One means of improving this situation is to employ database amplification of parametrized models. For example, parametrized L-systems allow the generation of a wide variety of plant structures given a relatively small set of seed values. Similarly, a variety of complex fractal landscapes can be generated with a few inputs. Unfortunately, there are two problems:
  a. The number of parameters can become unmanageably large
  b. The relationship between the input parameters and the effectiveness of the final scene is difficult to predict
This project proposes adapting the art of landscape painting to the task of parametric scene design. The user of the envisaged system will be able to "paint" landforms, water features and tree groupings from a selected viewpoint using the mouse.

Point Cloud Analysis for African Archaeological Heritage

(to be co-supervised with Prof. Hein Rüther, Geomatics)
The Geomatics department is involved in an initiative to create an integrated database of architectural cultural heritage sites in Africa. The condition of these sites is

deteriorating and given their importance in understanding and interpreting humankind's history, a permanent digital record is essential.

Photogrammetric capture of architectural structures and entire towns produces a dense cloud of textured points. These point clouds require special-purpose analysis and rendering. The focus here will be on identifying features (e.g. sharp corners and surface detail) in the original data to aid visualisation.

Virtual Sculpting

(to be co-supervised with Dr. P. Marais or Dr. G. Marsden)
Incorporating elements of traditional clay sculpting has long been recognized as a means of shielding a user from the complexities inherent in computer-based free-form shape design. This research is aimed at developing software tools, which automatically generate manipulations that mimic real world sculpting devices, such as throwing wheels, smoothing spatulas or a sculptor's hands. This will be combined with the use of Virtual Reality I/O devices to enable Virtual Sculpting.

There are three projects in this area:
1. Traditionally deformation techniques have been applied to vertex data but a recent volumetric shape representation, Adaptive Distance Fields, has proven compact and versatile. This project will investigate applying Spatial Warping to Adaptive Distance Fields.
2. There are a wide variety of techniques for Virtual Sculpting but no comprehensive usability comparison has been made of their relative effectiveness. This project will involve building basic versions of a number of methods and comparing them with user trials.
3. Virtual Sculpting tends to emphasise the transformation of shape but most models also require colour and/or texture information. This project will explore painting metaphors for applying colour and texture to a digital shape model.

13.3.3 Dr. Patrick Marais

Dr Marais' research interest are in the area of surface mesh compression, level of detail techniques and 2D/3D image analysis. A list of possible projects is provided below – please note that this list is not exhaustive. Suggestions for projects in related areas are welcome.

Image Processing and Computer Vision

There is a great deal of scope for useful research in this area. Some possible projects are listed below:

iThemba Medical imaging projects

iThemba labs (formerly the National Accelerator Centre) are interested in the development of techniques and algorithms for their new Robot Patient Positioning System (PPS). The PPS will be used in conjunction with a new proton treatment facility

to allow faster and more accurate treatment of cancerous tumours. Specific projects would depend on the centres current needs and the interests of the students.

Fast Image Analysis for Electron Microscopy (with Dr M. Kuttel)

There is a great deal of interest in constructing accurate 3D models from noisy electron microscopy data. The techniques used to accomplish this typically involve expensive 3D image processing and computer vision algorithms. Our interest is in developing fast alternative approaches, perhaps using parallel computing or high-end commodity GPU (graphics processing unit) parallelisation on a single system equipped with a modern graphics card.

Computer Graphics

Work in this area currently focuses on two main areas: mesh compression and level-of-detail rendering techniques.

Compressing Geometry and Connectivity (with Dr J Gain)

We are particularly interested in combining a new connectivity encoder we have developed with a robust geometry encoder. The main issues revolve around the full and efficient use of available geometric and connectivity data to derive compact codes for vertex positions. The connectivity encoding paradigm can also be improved.

Point-Based Modelling and Rendering (with Dr J Gain)

Point-based rendering is rapidly gaining prominence as an alternative to traditional triangle-based approaches. We are interested in developing techniques to allow realistic modelling or sculpting of 3D shapes composed of point primitives. This needs to happen in real-time and preserve the accuracy of the point representation.

13.3.4 Dr Gary Marsden

Dr Marsden is looking for masters and PhD students in the broad area of Mobile Interaction Design. He has specific projects in the following areas:

Mobile Computing Interaction

This is a project funded by Microsoft Re- search to investigate interaction between cellular handsets and large shared electronic displays such as electronic notice boards. The idea is that users can upload content from their handsets to the screen or download content from the screen to their handsets.

Ambient Interfaces

This is an NRF funded project looking at informing people about the status of systems they are using. To start with, we are looking at building new types of electricity meter

which give real-time feedback about the status of the electricity grid and how the user's consumption is affecting the grid. Students should have an interest in visualisation, fine art or interaction design.

HCI Methodologies for the Developing World

Most work in HCI has taken place in the developed world. The output from this research has advocated user centred design methods, where the users are consulted at all stages of interface design. Underlying these techniques is the assumption that the users understand the technology. In the developing world, this is not the case. We are therefore looking to develop new usability techniques which empower users who are less familiar with technology.

Mobile Access to Virtual Environments

The Department is currently working with the District Six Museum to build a virtual recreation of District Six. We want visitors to the museum to be able to access this environment using mobile devices such as PDAs. Ultimately, visitors could walk around the physical space of District Six, but use the PDA to view how that spot would have looked in 1965.

Usability of Routers

The number of ADSL users in South Africa is growing daily. Many of these users are not experts in configuring computer networks, yet are required to configure routers in order to set up their home network in a usable yet secure fashion. This project would be conducted in
conjunction with Telkom and look at using visualisation techniques to improve router configuration for novice users.

13.4 Data Network Architectures Group (DNA Group)

This group comprising Professors Pieter Kritzinger and Andrew Hutchison (part-time) three full-time or part-time academic staff conducts research and teaching in the area of computer networks and telecommunications systems since 1986. With a wide network of international collaborators the group does not believe that science knows national borders, only applications do. Since the first objective of graduate research is to train excellent individuals in the techniques of scientific research the focus of the group is external to overseas groups from whom the DNA group can benefit through collaborative research and graduate courses.
The Group conducts research which in particular relates to
  • The modelling, design and security of computer networks, including
  • Wireless mesh-networks
The group also receives funding from the Telkom Centre of Excellence and the National Research Foundation (NRF) Please refer to the website of the Group

(www.cs.uct.ac.za/~research/DNA) for the most recent information concerning available projects and so on.

13.4.1 Dr Andrew Hutchison

Goal Oriented Protocol Generation

The Security Protocol Engineering and Analysis Resource (SPEAR and SPEAR II) work has been a focal point for security protocol related projects in the DNA group. Various projects have addressed protocol specification, analysis and code generation. Projects relating to analysis (incorporation of Strand Space modelling/analysis technique) and code generation (verification of protocol code) are underway in 2003–2004 as Masters projects. The intention of this project is to provide an expert 'front-end' to the security protocol engineering process that enables users of the SPEAR tool to define and achieve a set of goals in a particular protocol. The benefit of such an approach is that it ensures that the protocol engineering activity is consistent with what the protocol should achieve. A possible scenario for achieving this is to incorporate libraries of existing protocols, and to select from these according to the goals stated by the user. Explicitly describing protocol goals would also allow the cryptographic logic / strand-space analysis modules to be pre-configured for checking certain traits and attributes of a protocol.

Web Services Security

Web Services are increasingly being recognised as a means to provide system interoperability, and also as an attractive way to 'wrap' legacy and/or proprietary systems. In such an approach, encapsulation of an existing system presents the opportunity to incorporate additional security components as part of an overall web service. Specifically, the concept of this is to introduce a 'mediation layer' between the existing system and the web service interface. Of particular interest is the extent to which IDS/A (host based intrusion detection, as developed by PhD student Marc Welz) can be deployed as part of such a secure web service. The associated rules and/or anomaly detection module would have to be defined and developed. In addition this module could also act as a reference monitor for the web service, if appropriate. Other components of such a mediation layer could also be provided, for example to handle privacy, information security policies (e.g. compulsory encryption depending on content labelling) etc.

Identity Management as Enabler of Secure Enterprise Environment

Identity Management is a concern for enterprises. This project should consider what information is required for an authentication and authorisation model in support of enterprise identity management. The links (and automatic account management) between an identity management module and underlying LDAP repositories should be considered. The OpenLDAP system could be used as an experimental system in this regard. Consideration should also be given to how cryptographic key management can / should be co-ordinated within an enterprise, and in particular how this can be associated with the greater identity management activity. Use of cryptographic keys,

associated with authenticated & authorised principals, should also be brought within the consideration of this project. In this way a unified approach to enterprise security can be pursued. Deployment for tasks such as secure communication (between pairs or groups) over an Instant Messaging mechanism could also be considered as an example environment.

The challenge of the project is to address each of the three aspects (identity management, key management, secure communication) individually, but also to look at the intersections, and how these topics can inter-relate to achieve a secure enterprise environment.

13.4.2 Prof Pieter Kritzinger

Please refer to the website of the DNA Group (www.cs.uct.ac.za/~research/DNA) for the most recent information concerning available projects.

Analysis of disk drive storage requests

With the increased commoditization of computing, storage service providers are becoming more relevant. The onus of backup and security is outsourced to the application storage provider who has to ensure the security and integrity of the data. Doing this efficiently and reliably is not a simple task. The workloads these systems carry is varied however and the I/O-traffic shows very similar behaviour to that of Webserver traffic. This project has as the objective of analyzing extensive I/O-request data of various kinds and, on the basis of that to develop an I/O-request trace generator taking into account various inter-arrival time distributions, bulk-arrival distributions and locality of reference patterns. The project is a companion project to an existing project in the group which is to build an Enterprise Storage System workbench using a mixture of simulation and analytic models.

Ad-hoc Network   Modelling and Analysis

While UMTS was considered the ultimate solution to Mobile Computing only a few years ago, it is increasingly challenged by other wireless networks. In particular a mixture of IEEE 802.11 in its various forms with the IEEE 802.16 WiMax technology. This fusion of the two wireless technologies in networks where users can join or leave in a ad-hoc fashion brings with it many and challenging research questions. Generally known as Admission, Authentication and Accounting (AAA) control the ad-hoc network environment has many unique problems. The group is involved in the modelling and analysis and security of such ad-hoc networks. In its work it relies on previous experience in the application of stochastic theory to the modelling of systems, such as the very successful analytic model of W-CDMA and various software tools which the group have built for the purpose over the years.

Traceability in Software Engineering

Tracing constituent artifacts in manufacturing from the source of raw material to manufacture, to delivery, to the client is essential in many industries, such as in the pharmaceutical world. For software development this is equally true although the

emphasis is different. Software projects are notorious for failing because the requirements were ill understood by the stake holders, but even if well specified, changes may have occurred along the life cycle of the project; changes made by technical or design people to the software or product description. A well matured software development organization usually has proper procedures in place for controlling change, but the problem remains as to which of the software artefacts are affected by a proposed chance since the relationships may be latent and not direct. We use the application of a technique based in linear algebra and known as Latent Semantic Analysis or Latent Semantic Indexing (LSI) for tracing a change though the corpus of artefacts which constitute the product documentation and detecting which artefacts are likely involved. Once so alerted, is then up to the owners of the artefacts concerned to interpret the implications of the changes made elsewhere and alert everyone should these violate the original requirements or cannot be localized in the design or implementation. We have a pilot project to which applies LSI to software which was developed in the group to implement VOIP over the local network of an organization.

13.5 High Performance Computing Laboratory (HPC Lab)

The High Performance Computing (HPC) laboratory is a new research collaborative in the department, which is focussed on the development of HPC expertise and parallel applications in Computer Science.

The staff membership of this laboratory comprises: Dr James Gain, Dr Michelle Kuttel, Dr Patrick Marais, Dr Audrey Mbogho and Dr Hussein Suleman.

13.5.1 Dr. James Gain

Dr. Gain is looking for Masters and Doctoral students in the following areas but is willing to consider students with their own topics in Distributed Computing:

Distributed Simulation for Visual Effects (with Dr. M. Kuttel and Dr. P. Marais)

Simulation of natural phenomena such as water, fire and object collision and fracture is widespread in the Visual Effects industry. However, such simulation tends to be extremely compute intensive especially as the number of simulated particles is increased in order to ensure realism. Visual effects studios are often under intense time pressure and these simulations would thus benefit from execution on a cluster of computers. Fortunately, such clusters are already in use as "render farms". This project seeks to parallelise simulations in order to create an effective "simulation farm".

13.5.2 Dr Michelle Kuttel

Dr Kuttel has interdisciplinary research interests in the fields of computational chemistry, structural bioinformatics and parallel computing. Computational chemistry broadly encompasses to the use of numerical methods to solve chemical problems, with applications such as molecular dynamics simulations of proteins in solution. These simulations are often extremely expensive computationally and thus are prime candidate problems for running on parallel supercomputers.

Flexible Docking of Molecules into Electron Micrographs

Low-resolution 3D models of molecular complexes can be obtained using cryo-electron microscopy (EM). However, though these maps provide very useful information for the overall shape of a complex, their resolution is too low to provide insight into the molecular interactions within a complex, which are of great importance for the interpretation of molecular function and mechanism. To obtain a pseudo high-resolution structure for a complex, molecular components may be docked as puzzle pieces into an EM map of the complex. The more sophisticated docking methods allow for conformational changes of the molecular components as part of the docking process. The aim of this project will be to develop a novel method incorporating Molecular Dynamics simulations for docking of atomic models into EM

graphs. This is a challenging and exciting project, incorporating physical experimental data, molecular modelling techniques and software development.

Molecular Visualization

A 2004 Honour's project (**Rendering Carbohydrate Cartoons** *by Anton Burger, Ian Eborn*) developed two novel algorithms for visualizing carbohydrate molecules. This work has been published and the algorithms are currently being incorporated into the molecular visualization package VMD (http://www.ks.uiuc.edu/Research/vmd/). However, much scope remains for developing, implementing and testing new visualizations.

Dr Kuttel also has research possibilities in molecular modelling of carbohydrates and the simulation of Levy processes for molecular evolution. The latter project is in conjunction with Dr Peter Ouwehand of the Mathematics Department at UCT and would hence only be suited to a student with a mathematical background.

13.5.3 Dr. Patrick Marais

Dr. Marais is looking for Masters and/or Doctoral students to work on the following project. Related topics in distributed rendering may also be considered as possible research areas:

Grid-based Rendering (with Dr J Gain)

Distributed rendering has been an active area of research for some time. The advent of Grid computing, with its promise of massive computational power, has led to the need for new architectures and algorithms to exploit the loosely coupled and (potentially) unreliable nodes which form part of the Grid.

13.5.4 Dr Hussein Suleman

Hussein's primary research area is digital libraries, with current focus on the architecture of highly distributed interoperable and scalable information systems. "Digital libraries" is a relatively new research area, at the intersection of Computer Science, computer networking and information sciences. From a Computer Science perspective, there are various technical issues that need to be resolved to support the ultimate aim of enabling simpler access to more information of a higher quality to all users of online and electronic systems. Hussein works closely with the Open Archives Initiative (http://www.openarchives.org) and the Networked Digital Library of Theses and Dissertations (http://www.ndltd.org), thus collaborating with institutions and individual researchers on a wide and distributed scale. Specific topics of interest follow:

Large Scale Information Management Systems / Terascale IR

Current research in information management systems has progressed to the point where many large repositories of information are publicly accessible. However, high quality services based on this information are still rare. This is partly due to the complexity of building search engines and other information services based on massive quantities of constantly evolving data. There is a dire need for mechanisms to deal with the problems of a) how to build efficient dynamic indexing mechanisms
b) how to parallelise algorithms for information management and
c) how to increase the availability of popular services.
Solutions may lie at the intersection of data warehousing, grid computing, agent technology and cluster computing, but little research has been done in this area to date. In the new information arena where rapidly changing data collections are no longer part of the "hidden Web", can we discover/locate such data easily, and can such solutions eventually be applied to personal and community memory libraries as they emerge in the future?
Very specifically, can we build information retrieval systems to deal with terabytes of information? How do we design index/query algorithms differently to cater for ever-expanding collections of data? How do we parallelise such algorithms? How do we deal with the incremental update problem? Google cannot be the only organisation with a terascale IR facility – as more data collections emerge, we need general tools and techniques to deal with this problem.

Computing like Water

Grid computing is the broad term used to describe how computers in a wide area network work collaboratively to solve problems that require massive computing power. Current state-of-the-art in grid computing makes it possible to solve many scientific problems using tools and APIs such as Globus. At UCT there is currently a large research community, across multiple faculties, dedicated to solving problems that were previously considered too difficult for computers. At present most such groups use dedicated Beowulf clusters with limited capacity (typically 16-64 machines). Ideally, it should be possible to harness all unused student laboratories, spare capacity on some clusters and even idle secretaries' machines (otherwise used to play solitaire) for useful computing, such as HIV infection simulations. To reach such an end, there is much work needed to make grid computing tools easily deployable (as easy as, say, SETI@home). At the same time, it must be easy for researchers to make use of these facilities – it should be as simple as opening a tap. Analogously, the owner of any set of machines should have full control and be able to assert exclusive use as necessary. This project is about tools and algorithms to monitor and manage resources effectively, to build a strong support base without which some of the research in other disciplines (like Physics, Economics and Medicine) is not even possible.

Hussein is interested in working with motivated postgraduate students who share his somewhat idealistic passion for improving the lives of people by removing barriers to information and computing. The ideas listed above are far from exhaustive and all wild and wacky ideas are welcome and encouraged.

14. Research Programmes

The major cooperative research programmes within the Department are:

Centre of Excellence in ATM & Broadband Networks and their Applications

The objective of the Centre of Excellence (CoE) is to promote research, development and dissemination of technology in high bandwidth networks and their applications. The major supporters of the project are Telkom SA Limited, Siemens Telecommunications Limited, and the Technology and Human Resources for Industry Programme (THRIP), a joint programme of the NRF and the Department of Trade and Industry.

The CoE incorporates activities of all three research laboratories of this Department, as well as the Communications Group Laboratory in the Department of Electrical Engineering at UCT, and the Department of Computer Science at Stellenbosch. The details of the proposed research can be found under the programmes of the individual researchers and laboratories.

Interfacing to Virtual Environments

The full title of this research programme is "Creating Effective Scalable Interfaces for Complex Collaborative Virtual Environments". The team members on the project are Edwin Blake (Principal Grantholder), James Gain, Patrick Marais, Gary Marsden and Bill Tucker (UWC).

The key issues are twofold, firstly to give users with different expertise and infrastructure access to the sophisticated information rich collaborative environments and secondly give a wide variety of authors access to tools and methodologies to create such environments. Along the way we will tackle some key applications and produce marketable products.

Comprehensive Data Management

One research direction in the AIM laboratory is object database engineering and its application in GIS, knowledge management and distributed systems. Prof Sonia Berman and Prof Ken MacGregor are grantholders of an NRF funded research project

on "Comprehensive Data Management" which investigates models, methodologies and tools for effective use of databases and distributed applications.

The Internet has created a need to integrate information across enterprises and between individuals. This research investigates ways to make it possible to share information effectively without needing to understand the format, organisation or query mechanisms of each other's data sources. In the year 2002 alone, we generated 5 exabytes of new information, or about 800MB each (world population 6 billion), of which 92% was on electronic media. Advances in database research and distributed data management need to be adapted to enable vast quantities of varied kinds of electronic information to be effectively organised and accessed.

SANPAD Project

The South Africa - Netherlands Research Programme On Alternatives In Development (SANPAD) is funding research on "Voice over IP to Build Bridges across the Digital Divide in South Africa".

The Digital Divide refers to the tendency of Information and Communications Technologies (ICTs) to enhance the advantages of the advantaged and further disadvantage the already disadvantaged. Our hypothesis is that this effect is not always and necessarily a natural consequence of the technology. We propose to conduct an action research intervention to discover if a particular technology, namely Voice over IP (VoIP - essentially the use of voice over internet-type connections), can be used, within an appropriate application and with appropriate content, to bridge the digital divide.

We wish to reflect critically on the ramifications of using VoIP technology in the face of proposed South African Government communication policies which severely restrict its usage. Our research could have a major critical function with respect to the proposed communications policies.

Our research should also form part of an ongoing critique of the technological measure of "Quality of Service" (QoS) that is used in modern data networks. QoS currently refers to low level technical measures such as bandwidth, latency and packet loss. This measure seems not to describe the needs of users adequately and need to be extended or embedded within an analysis of wider user requirements.

15. Recent MSc and PhD Graduates

The following masters and doctoral degrees were awarded since 1999.

15.1 PhD graduates

2000 Mason, A.E.W. ``Predictive Hierarchical Level of Detail Optimization'' (E.H. Blake)

2003 Nirenstein, S. ``Fast and Accurate Visibility Preprocessing'' (E.H. Blake)

2003 Welz, M. ``Modulating Application Behaviour For Closely Coupled Intrusion Detection'' (A. Hutchison)

15.2 MSc graduates

2000 Nelte, M.A. ``Using Fingerprints on Smartcards for Personal Authentication'' (A. Hutchison)

2000 Nuñez, F. ``An Extended Spreadsheet Paradigm for Data Visualisation Systems, and its Implementation'' (E.H. Blake)

2001 Azbel, I. ``Epistemology as the Basis for a Corporate Memory Model'' (S. Berman)

2001 Casanueva, J. (Distinction) ``Presence and Co-presence of Collaborative Virtual Environments'' (E. H. Blake)

2001 Davies, I. (Distinction) ``Symbolic Techniques for the Performance Analysis of Generalised
Stochastic Petri Nets'' (P. Kritzinger)

2001 Godfrey, A. ``Distributed Shared Memory for Virtual Environments'' (E. H. Blake/K. MacGregor)

2001 Saal, O. ``Visualisation of ATM Network Connectivity and Topology'' (E. H. Blake)

2001 Saul, E. (Distinction) ``Facilitating the Modeling and Automated Analysis of Cryptographic Protocols'' (A. Hutchison)

2001 Voges, E. ``A Framework for Building Spatiotemporal Applications in Java'' (S. Berman)

2001 Yavwa, Y. ``Investigating Cost Effective Communication Alternatives for Geographically Hostile Regions'' (P. Kritzinger)

2002 Feng, J. ``Visualisation of ATM virtual path connection networks'' (E.H. Blake)

2002 Johns, C. ``The spatial learning method: facilitation of learning through the use of cognitive mapping in virtual reality'' (E.H. Blake)

2002 Schulz, M. ``Garbage collection of the plava object store'' (S. Berman)

2002 Southern, R. ``Quality control tools for interactive rendering of 3D triangle meshes'' (E.H. Blake, P. Marais)

2002 Williams, J. (Distinction) ``Extraction of surface texture data from low quality photographs to aid the construction of virtual reality models of archaeological sites'' (E.H. Blake, H. Rüther)

2003 Nunez, D. ``A Connectionist Explanation of Presence in Virtual Environments'' (E.H. Blake)

2004 Marte, O. (Distinction) ``Model driven segmentation and the detection of bone fractures'' (P. Marais)

2004 Perkins, S. ``Identification and Reconstruction of Bullets from Multiple X-Rays'' (P. Marais)

2004 Lesoana, M. ``Interactive Storytelling'' (Edwin Blake)

2004 Lifson, F. ``Specification and Verification of Systems Using Model Checking and Markov Reward Models'' (P. Kritzinger)

2004 Lyness, C. (Distinction) ``Perceptual depth cues in support of medical data visualisation''' (E.H. Blake and P. Marais)

2004 Mwelwa, C. ``A methodology for analysing power consumption in wireless communication systems'' (P. Kritzinger)

2004 Steyn, B. ``Topology alteration of meshes using directly manipulated free-form deformations'' (J. Gain)

2004 Walters, L. ``Web browsing workload for Simulation'' (P. Kritzinger)

2004 Wong, B. ``Using access information in the dynamic visualisation of web sites'' (G. Marsden)

2005 Bierowski, C. ``The Use of Floorplans in Creating Virtual Environments'' (G. Marsden)

2005 Chetty, M. (Distinction) ``Developing locally relevant applications for rural South Afica: a telemedicine example'' (E. Blake)

2005 De Wet, N. (Distinction) ``Model Driven Communication Protocol Engineering and Simulation based Performance Analysis using UML 2.0''   (P. Kritzinger)

2005 Eyambe, L. ``A Digital Library Component Assembly Environment''   (H. Suleman)

2005 Hamza, S. ``The Subjective Response of People Living with HIV to Illness Narratives in VR'' (E. Blake)

2005 Hendricks, Z. ``A meta-authoring tool for specifying behaviour in VR environments'' (E. Blake)

2005 Landman, J. (Distinction) ``Analytical Models of IP Traffic on UMTS Mobile Networks''   (P. Kritzinger)

2005 Malan, K. ``Visualising Uncertaintity'' (G. Marsden)

2005 Ryndina, K. (Distinction) ``Improving Requirements Engineering: An Enhanced Requirements Modelling and Analysis Method''   (P. Kritzinger)

2005 Schroder, R. ``Laid Back Searching'' (G. Marsden)

2005 Tangkuampien, J. (Distinction) ``A Virtual Environment Authoring Interface for Content-Expert Authors''(G. Marsden)

2005 Tobler, B. (Distinction) ``A Structured Approach to Network Security Protocol Implementation''   (A. Hutchison)

2006 Rouse, C. (Distinction) ``Schema Matching in a Peer-to-peer Database System''
(S. Berman)

2006