

NEWS



**Nelson Mandela
Metropolitan
University**

for tomorrow
Port Elizabeth & George

The talking head

The Department of Computing Sciences is a vibrant department with staff members who are passionate about what they do. Our growing number of academics with PhD qualifications, as well as registered masters and doctoral students, has provided the capacity for us to make great strides in research over the past decade.

This brochure provides an overview of the diverse research activities within the department. Our students have the privilege of working in well-equipped laboratories using cutting edge equipment to address practical challenges. Various projects focus on improving education, not only within our own lecture halls but also in schools.

Our research on mobile tourism and evolutionary robotics are examples of work that draws interest at prominent national and international conferences, while our postgraduate programmes and modules have attracted students from as far afield as Germany and France.

Finally, we pride ourselves on our postgraduate students making a real difference in industry after completing their studies.



We look forward to welcoming you!

Prof Jean Greyling
Head of Department

Our postgraduate students make a real difference in industry after completing their studies

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BRIGHT FUTURES ... Prof Jean Greyling and former student Baxter Mabinya gave high school pupils Neil Reeder (Framesby) and Lazola Sokutu (Mzantsundu Secondary) sound career advice.

NMMU is one of the best universities in South Africa in the fields of commerce and technology

Building a career in computers

Citing his personal experience, former student Baxolile 'Baxter' Mabinya gave the 250 high school pupils attending annual NMMU Computing Career Day an inspiring glimpse into the bright future Computing Sciences offers.

NMMU MCom graduate Mabinya is the chief solutions architect for Internet Solutions, which has been acquired by Nippon Telegraph and Telecommunication (NTT) Corporation, one of the largest telecommunications companies in the world.

He confessed that he "wasn't really into computers" at school, but decided to study the subject because "whether you like it or not, technology forms part of everything we do".

He told pupils he believed NMMU was one of

the best universities in South Africa in the fields of commerce and technology and highlighted the shortage of people with postgraduate qualifications in these industries.

"Your degree certificate is only a ticket to the game... the working world is where you have to start playing the game," said Mabinya, who is currently working on his MBA.

In industry, graduates not only apply their research skills and knowledge of technology but also learn to work with people and develop vital business management skills.

Department head Professor Jean Greyling said he was continuously inspired by the success of students such as Mabinya.

"This makes pursuing a career in academia worth it," said Greyling.

World Cup scores foreign students

The 2010 Fifa World Cup had positive spin-offs for the Computing Sciences department, with seven French students and one from Germany enrolling for courses to coincide with the start of the European academic year.

"There could be no better place for them to soak up the excitement," said Julie Pidell, international relations officer for Epitech Paris, a university of technology, computer science and engineering.

It is compulsory for fourth year Epitech students to study at a foreign partner university – and NMMU was judged to be an attractive and safe destination.

"We had a careful look at the Computing Sciences

courses and they seemed like a great match," said Pidell.

University of Oldenburg (Germany) student Daniela Hans is on a research scholarship from the 'Developing Sustainability' network.

The foreign students also have the opportunity to develop their English language skills.

A fact-finding mission to Epitech led by Dr Nico Jooste, director of NMMU's Office for International Education, played a key role in cementing what is hoped will be a long-term relationship. This was followed up by a visit to Paris by the department's Prof Janet Wesson.

Cutting edge computing

Touching tomorrow

Investment by the Computing Sciences department in high-tech equipment gives staff and students opportunities to push the boundaries of technological research.

The new multi-touch surface system, the latest addition to the Computing Sciences department's collection of high-tech equipment, allows multiple users to work simultaneously on the same computer.

Originally developed for use on US Navy battleships and aircraft carriers, multi-touch surface computing represents a whole new way of interacting with a computer.

Where personal computers are designed for a single user, multi-touch surfaces are larger, allowing for collaborative work.

"The main advantage of multi-touch technology is that it is extremely intuitive to use," said Ivan Sams, an MSc Computing Sciences student conducting research in the field of Human-Computer Interaction.

He clarified this point by explaining, "The objects on the screen react in a very similar way to how objects react in real life."



WORKING TOGETHER ... Ivan Sams (left), Gianni Twigg and Benjamin Le Cun show how easy collaborative projects are with multi-touch surface computing.

Sams' masters degree project focuses on improving multi-touch interaction techniques for teams of users engaged in collaborative information retrieval.

Multi-touch computing can be operated with ease by people who are not computer literate.

The system has a wide range of applications from gaming to sharing business documents. It is particularly useful for collaborative design, such as animation and automotive design.

Virtually anything is possible

The recent acquisition of virtual reality equipment puts the Computing Sciences department at the forefront of technology.

Virtual reality (VR) refers to computer-simulated environments that either replicate real world places or create imaginary worlds. These highly visual 3D environments can be used for recreational gaming and practical simulations such as pilot training or exposure therapy for phobia sufferers.

The department's VR equipment includes a pair of wired data gloves that capture the user's finger movements. To determine how the hands are moved and oriented in space, each glove has a tracking sensor. The helmet-like head-mounted display unit detects head movement and orientation.

"It renders a truly 3D image for the person wearing it," said senior lecturer Dr Dieter Vogts.

At honours level, the virtual reality module requires students to use and write programs for the equipment. This creates scope for further cutting edge postgraduate studies.



ANOTHER DIMENSION ... Wearing state-of-the-art virtual reality equipment, student Jonathan Schmidt prepares to enter the 3D world.

Revolution in robotics

Research by the Computing Sciences department in evolutionary robotics and neural networks is bringing the biological and technological sciences into an increasingly interdependent relationship.

"This is frontier research," said Head of Department Prof Jean Greyling.

Masters student Christiaan Pretorius specialises in evolutionary robotics – programming robots to function autonomously. These robots can carry out real world tasks such as searching for human survivors in the aftermath of natural disasters.

Pretorius was awarded top honours for Best Research Paper at the annual research conference of the South African Institute for Computer Scientists and Information Technologists (SAICSIT).

Another burgeoning field is artificial neural networks. These are programming constructs that mimic the properties of biological neurons in the nervous system.

Neural networks have a wide range of problem-solving applications. Currently, in collaboration with Eskom, research is being conducted into forecasting electricity demand.

An eye on the future

The Usability Laboratory in the Computing Sciences department is conducting research into how users interact with technology, using eye tracking equipment that records eye movements.

Under the auspices of the industry-sponsored NMMU/Telkom Centre of Excellence (CoE), its mission is to increase the usability of software systems and websites.

Designed specifically for usability evaluations, the lab consists of an observation room where testers observe participants and record data, and a testing room where participants interact with the software.

The testing room uses an eye tracker computer, two ceiling mounted cameras and microphone systems to record the user's movements, body position, interaction with the computer and comments or questions.

The eye tracker records eye movements, providing heatmap and gaze path data. It identifies areas of interest to the user.

"The information provided by usability evaluations allows developers to improve software and websites to suit users' needs," said CoE head Professor Janet Wesson.

Postgraduate students learn to perform usability evaluations as part of the Usability Engineering module.

Recent eye tracker research for a marketing company determined whether or not viewers looked at advertising boards and sponsors' logos during televised soccer sports matches.

"We hope to conduct further research in the field of website and mobile usability. Very few software tools exist to assist with the analysis of eye tracking data in this field," said Wesson.



ON TRACK ... Student Candice Whiteley prepares to have her eye movements recorded and analysed by the eye tracker computer.

Teaching in action

As part of the Computing Sciences department's ongoing efforts to improve teaching and learning, associate professor Charmain Cilliers is researching the effectiveness of computerised teaching and learning tools.

"The common thread is whatever is done should be useful to educators and learners alike," she said.

The department has developed a number of tools to assist students learning to program. One in particular was picked up by Makerere University in Kampala, Uganda. Cilliers' research investigates its effect at both Makerere and NMMU.

"One of my PhD students is currently assessing the introduction of similar types of tools into the secondary school IT curriculum," said Cilliers. "Her findings will be very helpful to the Department of Education."

In work also related to teaching, Leda van der Post's PhD investigates the Computing

Whatever is done should be useful to educators and learners alike



CLICK AND LEARN ... Professor Charmain Cilliers' students are learning to program with the help of computerised tools.

Studio method, which has become the focus for an Action Research project. This has resulted in interesting research into the impact on the learning experience and personalities of the students and lecturers. Instead of being passive recipients of information, students are required to actively and critically engage with new content themselves. This research is revolutionising the way lectures are presented in the department.

Industrial relations a catalyst for research

The fostering of good working relationships between the Computing Sciences department and industry partners, specifically those that employ our graduates, has resulted in an active Industry Advisory Board that meets twice a year, and has given rise to a number of industry-related research projects.

ICT skills

Prof André Calitz's DBA research investigates the skills shortage in the information and communications technology (ICT) field.

"Modern business practices require the implementation of new technologies supported by a workforce with current and specific ICT skills," said Calitz. "However, acquiring these skills has become a difficult task."

At school level, fewer learners are studying IT-

Modern business practices require the implementation of new technologies supported by a workforce with current and specific ICT skills

related subjects due to a flawed curriculum, under-prepared teachers and lack of facilities.

Tertiary institutions are experiencing a decline in student enrolments and declining pass and throughput rates. Industry is holding tertiary institutions responsible for not providing the 'correct' ICT skill sets and passing enough quality ICT graduates.

ERP systems

"Worldwide the increased popularity of

enterprise resource planning (ERP) systems has led to a demand for, and shortage of, ERP consultants with industry relevant skills and knowledge," said Brenda Scholtz.

Her PhD research identifies a comprehensive set of competencies required by ERP consulting companies.

Scholtz is also investigating what tertiary institutions in South Africa are doing to provide these skills and address the skills shortage.

NMMU's Computing Sciences department is using popular ERP systems SAP R/3 and SYSPRO for instructional purposes in its third year Management Information Systems course.

Agile Software Development

Janine Nel's masters degree research focuses on the inclusion of Agile software development practices in the senior undergraduate systems development project. Agile methods encourage teamwork and an organised project management approach.

Students learn soft skills such as writing and executing project plans, reflecting on the results and potential improvements and engaging in peer reviews.

Second Life

The use of Second Life (SL) for evaluating business skills creates interesting research opportunities for the department. SL is a virtual world, accessible on the Internet, in which users interact with each other socially and trade in virtual goods and services.

Previously only used for entertainment, many institutions now use these virtual worlds for educational purposes.

The cream of the conferences

NMMU's Computing Sciences department leads the way in producing relevant research in South Africa.

The department maintains a strong presence at research conferences both nationally and abroad. In 2009, 26 papers were presented – a number that is growing every year.

"A major calendar highlight is the South African Institute of Computer Scientists and Information Technologists (SAICSIT) conference, the premier research conference for our discipline," said Professor André Calitz.

Six full-length papers and two short papers submitted by the Computing Sciences department were accepted for SAICSIT 2010.

The department maintains a strong presence at research conferences both nationally and abroad

Our students and staff regularly present papers at the Government e-Skills Summit in Cape Town, the Southern Africa Telecommunication Networks and Applications (SATNAC), the Southern African Institute for Management Scientists (SAIMS) and the Southern African Computer Lecturers' Association (SACLA) conferences. These conferences address the educational and skills development challenges and opportunities in Southern Africa today.

Internationally, delegates represented the department at conferences like the Human Computer Interaction Symposium in Australia, the International Business Conference in Zanzibar and as far afield as Uganda, Sweden, Hong Kong and Spain.



STOCKHOLM SYNDROME ...
Prof Janet Wesson attended the Interact conference on Human-Computer Interaction in Sweden.

Movers in mobile tourism



MOBILE MAPS ... Award-winning PhD student Bradley van Tonder with his mobile map application MapExplorer, which uses tilt interaction technology.

Taking full advantage of the fact that South Africa is the fourth fastest-growing mobile phone market in the world, research by post-graduate students is pushing the boundaries in tourism and mobile-based map technology.

Ryan Hill's mobile preference-based search tool, POInter, was developed to search for a city's points of interest (POI) based on the user's preferences and constraints.

His MCom research further improved the usability of POInter with an adaptive user interface. The adaptive prototype, called A-POInter, uses adaptive interaction techniques to manipulate maps provided by the Microsoft Live Virtual Earth web service.

BSc Honours student Gianni Twigg is extending A-POInter to develop a location-based mobile tourist guide that uses interactive maps from a third party web service and provides tourist information for POIs in South Africa.

The system monitors the user's behaviour and adapts the application to provide a better user experience. Twigg is currently developing additional location-based services such as accommodation searches.

PhD student Bradley van Tonder's MapExplorer – a prototype mobile map-based application – uses a mobile phone's accelerometer sensors, which detect tilting movements, to pan and zoom on Microsoft's Bing Maps.

Tilt interaction overcomes the usability problems associated with manipulating maps using keypads or touch screens.

"By the end of 2011, 80% of mobile phones will be equipped with GPS sensors, which enables these applications to take the user's current location into consideration when planning routes, navigating and searching for points of interest," said Van Tonder.

POSTGRADUATE DEGREE PROGRAMMES

Honours Degree Programmes

BCom Hons
(Computer Science and Information Systems)

BCom Hons
(Information Systems)

BSc Hons
(Computer Science and Information Systems)

BSc Hons
(Computer Science and Applied Mathematics)

Masters Degree Programmes

MCom
(Computer Science and Information Systems)

MSc
(Computer Science and Information Systems)

Doctoral Degree Programmes

PhD
(Computer Science and Information Systems)

HONOURS MODULES

Data Warehousing

Understand, design and implement data warehousing for the storage of electronic information, as well as applying and reflecting on various data mining techniques.

Electronic Commerce

Gain an in-depth understanding of the issues involved in e-commerce, the Internet and the World Wide Web.

Algorithmics 4

Acquire a detailed understanding of dictionaries, tables, mathematical graphs, representative graph algorithms and genetic algorithms.

Computer Graphics

Examine and utilise various algorithms, techniques and tools used in the modelling, viewing and rendering of both 2D and 3D objects.

Usability Engineering

Design, implement and analyse usability studies to evaluate the usability of interactive systems, including web-based, multimodal and mobile systems.

Automata Theory

Introduce and define formal languages and some grammars that generate different classes of languages, eg. regular, context-free and context-sensitive.

RESEARCH AREAS

Research Area (ACM Category)	Topics
Information Systems (H.3.5)	Online information systems • Data sharing • Web-based services
User Interfaces (H.5.2)	Adaptive user interfaces • Information visualisation Mobile interaction • Multimodal interfaces • Multi-touch surface computing • Usability evaluation
Problem Solving, Control Methods and Search (I.2.8)	Dynamic optimisation • Evolutionary robotics
3D Graphics (I.3.7)	Virtual reality • Gaming
Computing Education (K.3.2)	Computer science education • Content delivery • Creative design Curriculum design • IS education • Technological support

Information Systems Project Management

Acquire a detailed understanding of IT project management and apply the principles and techniques in the honours project.

Evolutionary Computing

Study adaptive mechanisms to facilitate intelligent behaviour in complex or changing environments by covering topics such as artificial neural networks and swarm intelligence.

Design in the Digital Domain

Develop a sound understanding of design thinking, processes and methodologies specific to digital products and systems.

Business Intelligence

Learn to organise and analyse enterprise data, explore concepts and methodologies, and investigate the development of key performance indicators, dashboards and scorecards.

Functional Programming

Introduces functional programming, in which the primary method of computation is the application of functions to arguments, using the modern functional language Haskell.

Compiler Construction

Investigate the development of programming languages, including fundamental compilation techniques e.g. scanning, parsing, symbol-table handling and code generation.

Virtual Reality

Introduces the concepts and technologies in the field of (interactive) 3D Virtual Reality systems, as well as various aspects of Game Programming.

Project

Students work on a developmental / research project and a related treatise.

Undergraduate programmes available on request.

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