UCT Department of Computer Science
Computer Science 1015F

Introduction to Computing

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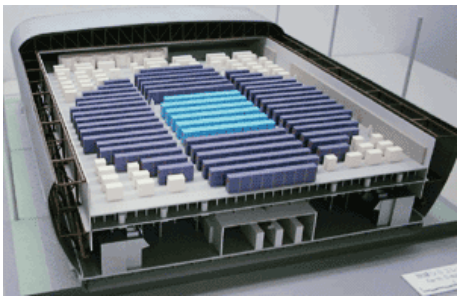
February 2007

What is Computer Science

Why Computing is Important 1/5

- Earth Simulator Centre in Japan provides advance notice of natural disasters to preserve human life!



Reference: http://www.es.jamstec.go.jp/esc/eng/

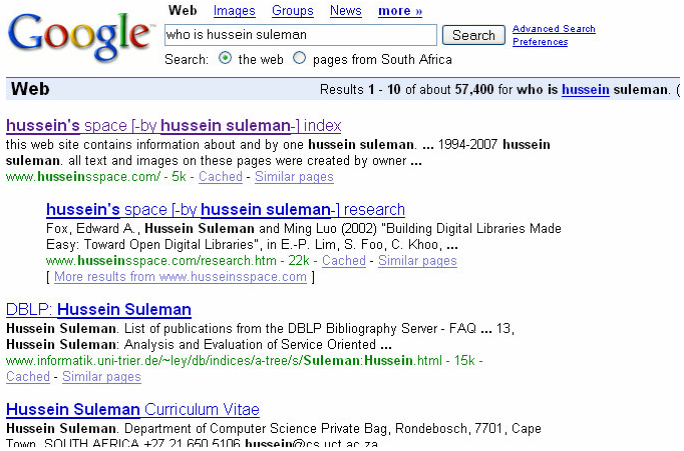
Why Computing is Important 2/5

- Computer Aided Tomography (CAT scans) are computer-reconstructed views of the internal organs that help in diagnosing patients.

Reference: Wikipedia

Why Computing is Important 3/5

- The world's information is available at our fingertips!



Why Computing is Important 4/5

- Games, Movies, MSN Messenger, Facebook …

Reference:
World of Warcraft,
The Burning Crusade,
Blizzard Entertinment

Why Computing is Important 5/5

- R1.8 billion was spent online in 2005 in South Africa just buying airline tickets!

Reference: Goldstuck Report, January 2006

What is Computer Science?

- Computer Science (CS) is the study of:
  - Computer software
  - Algorithms, abstractions and efficiency
  - Theoretical foundation for computation
- What you learn in Computer Science:
  - Principles of computation
  - How to make machines perform complex tasks
  - How to program a computer
  - What current technology exists and how to use it

Some areas in Computer Science

- Theoretical Computer Science
- Programming Languages
- Algorithms and Data Structures
- Software Engineering
- Computer Architecture
- Networking and Security
- Computer Graphics, Vision, Virtual Reality
- Parallel and Distributed Systems
- Information Management, Databases
- Usability, Socially-Aware Computing

5 Branches of Computing

- Computer Science
  - Foundations and principles
- Information Systems
  - Business processes & information
- Computer Engineering
  - Hardware and communications
- Software Engineering
  - Software development processes
- Information Technology
  - Application of computing

IT Prog. – Most specialisations

IT Prog. – Bus. computing

IS

IT Prog. – Computer eng.

EE/CE

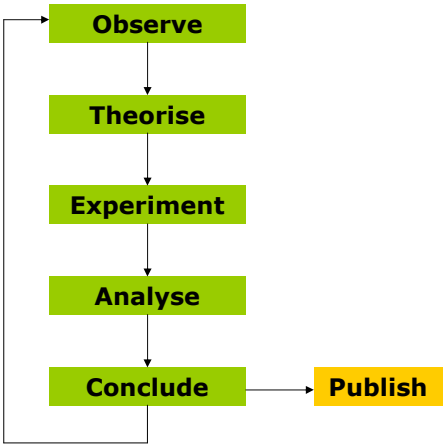
IS

CS Postgraduate

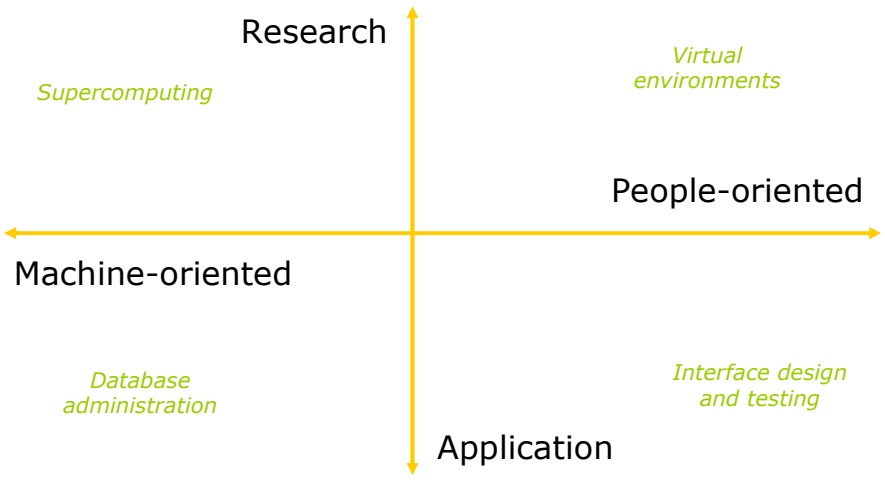
Reference: ACM Computing Curricula: Overview

What is a Researcher / Scientist?

- A researcher generates/locates knowledge.
- A scientist generates/locates knowledge using the scientific method.



Computing Dimensions



Careers in Computing 1/3

the business place

Database & Technical Manager

The Business Place is a young, dynamic organisation dedicated to helping clients start or expand small businesses. The successful candidate will have excellent database querying, project management and IT skills. They will also be a self-starter able to take their own initiative.

Key Deliverables

- Creation of standard & adhoc reports from database.
- User and technical support for database throughout TBP.
- Overseeing quality assurance of data in the database.
- Project managing renewal of TBP website.

Minimum Qualifications and Experience

- IT related qualification plus five years work experience in IT.
- Experience of relational databases, particularly querying, report writing and data management.
- Hands on and practical approach.

This position is based at the Marshall Street office of The Business Place with some travel to other sites nationally. It is a one year fixed term contract with the possibility of renewal.

Please email all CVs to: Julie Machin, juliem@tbp.co.za by Monday 19 February 2007. If you have not heard from us within 30 days, please accept that your application was unsuccessful.

Careers in Computing 2/3

February 2007.

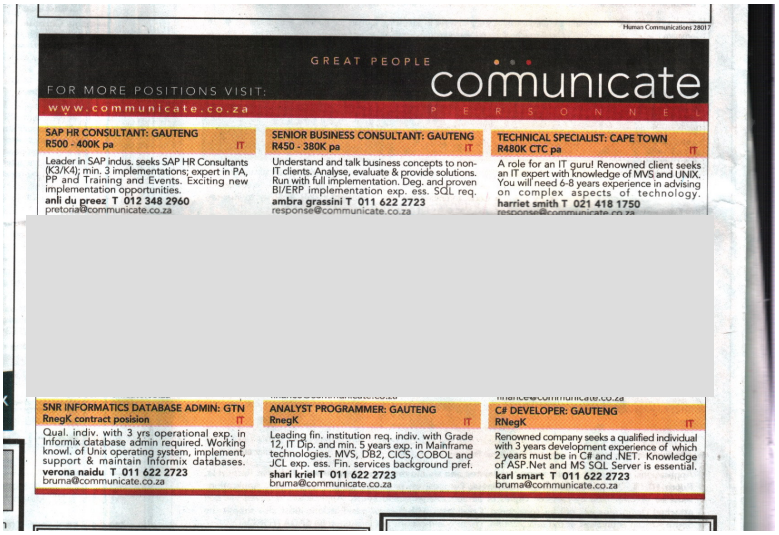
Adcorp Talent Resourcing 14996/07

MICROSOFT DEVELOPERS REQUIRED

Maintenance Developers to maintain and enhance web based Portal and Back Office application in an exciting and leading transactional environment - substantial opportunity for growth and enhancement. Strong brand in the motor industry. Candidates should have Visual Studio 2005, ASP.Net, SQL Server 2000/2005, TransactSQL experience. OO experience an advantage. Degree preferred, alternatively MS certified plus **minimum 2-3 years experience** on commercial applications.

Email CV to **jobs@Gallardo.co.za** or call **011 575 6528** (o/h) for a confidential discussion.

Careers in Computing 3/3



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FOR MORE POSITIONS VISIT: www.communicate.co.za

PERSONNEL

SAP HR CONSULTANT: GAUTENG IT
R500 - 400K pa
Leader in SAP indus. seeks SAP HR Consultants (K3/K4); min. 3 implementations; expert in PA, PP and Training and Events. Exciting new implementation opportunities.
anli du preez T 012 348 2960
pretoria@communicate.co.za

SENIOR BUSINESS CONSULTANT: GAUTENG IT
R450 - 380K pa
Understand and talk business concepts to non-IT clients. Analyse, evaluate & provide solutions. Run with full implementation. Deg. and proven BI/ERP implementation exp. ess. SQL req.
ambra grassini T 011 622 2723
response@communicate.co.za

TECHNICAL SPECIALIST: CAPE TOWN IT
R480K CTC pa
A role for an IT guru! Renowned client seeks an IT expert with knowledge of MVS and UNIX. You will need 6-8 years experience in advising on complex aspects of technology.
harriet smith T 021 418 1750

SNR INFORMATICS DATABASE ADMIN: GTN IT
RnegK contract posision
Qual. Indiv. with 3 yrs operational exp. in Informix database admin required. Working knowl. of Unix operating system, implement, support & maintain Informix databases.
verona naidu T 011 622 2723
bruma@communicate.co.za

ANALYST PROGRAMMER: GAUTENG IT
RnegK
Leading fin. institution req. indiv. with Grade 12, IT Dip. and min. 5 years exp. in Mainframe technologies. MVS, DB2, CICS, COBOL and JCL exp. ess. Fin. services background pref.
shari kriel T 011 622 2723
bruma@communicate.co.za

C# DEVELOPER: GAUTENG IT
RNegK
Renowned company seeks a qualified individual with 3 years development experience of which 2 years must be in C# and .NET. Knowledge of ASP.Net and MS SQL Server is essential.
karl smart T 011 622 2723
bruma@communicate.co.za

Spectrum of Qualifications/Degrees

- Diploma
  - Learn about core technology and application
- Bachelors
  - Learn about principles and core technology
- Bachelors (Honours)
  - Learn about advanced technology and how to interpret research
- Masters
  - Learn how to do research
- Doctorate
  - Make significant new contribution to human knowledge
- Industry Certifications : CCNA, MCSE, etc.
  - Learn about specific technology and application
- Computing College Diplomas
  - Learn about core/specific technology and application

Computing at UCT

- Department of Computer Science (Science Faculty)
  - Offers BSc degrees in Computer Science (with various specialisations)
- Department of Information Systems (Commerce Faculty)
  - Offers BCom degrees and BBusSci degrees in Information Systems
- Department of Electrical Engineering (Engineering Faculty)
  - Offers BSc (Eng) degrees in Electronic Engineering or Computer Engineering

Computer Science @UCT

- Website: www.cs.uct.ac.za
- Location: 3rd floor, Computer Science Building
- Staff: ~15 academics, 2 tech staff, 4 admin staff
- Students: 1st year (500), 2nd year (120), 3rd year (100), Hons (40), MSc (80), PhD (20)
- What academics do: original research (1st priority), teaching, admin, community service

Academic Staff in CS

- Head of Department and Professor
  - Ken MacGregor
- Professors
  - Edwin Blake, Pieter Kritzinger
- Associate Professors
  - Sonia Berman, Gary Marsden
- Senior Lecturers
  - James Gain, Michelle Kuttel, Patrick Marais, Anet Potgieter, Hussein Suleman
- Lecturers
  - Donald Cook, Audrey Mbogho, Gary Stewart
- Contract Staff
  - Andrew Hutchison, Mike Linck

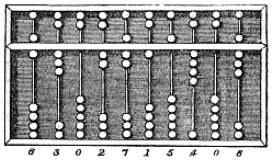
Current Research Groups

- Advanced Information Management
  - Databases, digital libraries, distributed computing
- Agents
  - Artificial intelligence, complex adaptive systems
- Collaborative Visual Computing
  - Graphics, usability, virtual environments
- Data Network Architectures
  - Networking, software engineering
- High Performance Computing
  - Scientific computing, cluster/grid computing
- Security
  - Network security

History of Computing

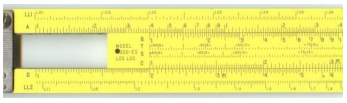
Early Calculation 1/2

Early Chinese abacus can be used to add, subtract, multiply and divide.



Mechanical calculators invented by Schickard, Pascal, Leibniz, etc. used cogs and wheel to compute.

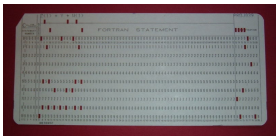
Slide rules performed multiplication and division using logarithms – in popular use until about 1970.



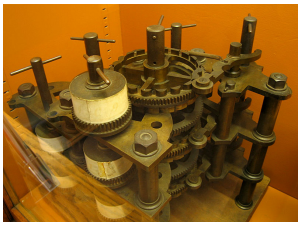
Reference: Wikipedia

Early Calculation 2/2

In early 1800s, Jacquard used punched cards to control a loom.



Hollerith used punched cards for the 1890 US census (his company eventually became IBM!).



Babbage's difference engine (1830) calculated tables of polynomial values.

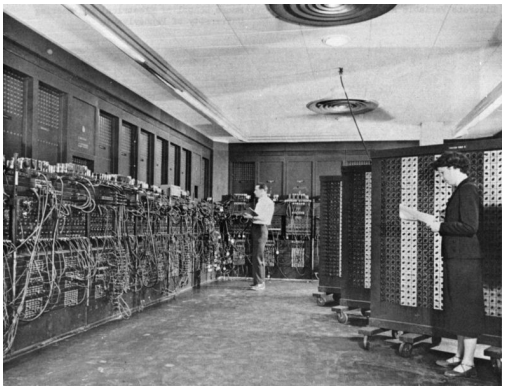
Analogue Computing

Babbage designed (but never built) the first general-purpose programmable computer – the analytical engine.

Vannevar Bush (1930) built a differential analyzer that used wheels/discs to perform integration.

Vacuum Tubes

ENIAC (1945) was one of many early programmable digital computers, using vacuum tubes for computation and patch cables for manual programming.



1960s to Present

First transistors and integrated circuits and finally microprocessors, revolutionised computing, made them small, cheaper and more general-purpose.

ZX80 (1980)

IBM PC (1980)

Apple MAC (1985)

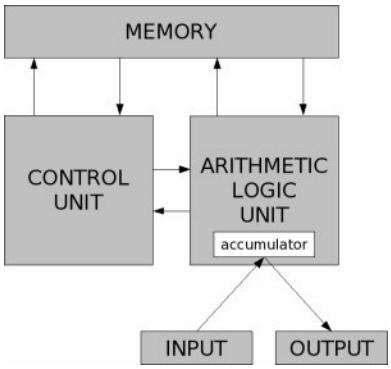
Hardware and Software

Hardware

- **Hardware** refers to the physical parts of the computer.
  - Hardware is sometimes referred to as computer components and peripherals.
  - E.g., Motherboard, Hard Disk/Drive
- **Software** refers to the set(s) of instructions given to the computer to execute one or more tasks.
  - Software is sometimes referred to as programs.
  - E.g., Microsoft Office, Firefox

The Von Neumann Architecture

- This describes how a conceptual computing device works:
  - Memory stores data and instructions.
  - Control Unit (CU) obtains and executes instructions.
  - Arithmetic Logic Unit (ALU) does calculations.
  - Accumulator is internal ALU storage for some data.
  - Input is process of getting data into machine.
  - Output is process of obtaining data from machine.
- Most modern computers are Von Neumann machines!

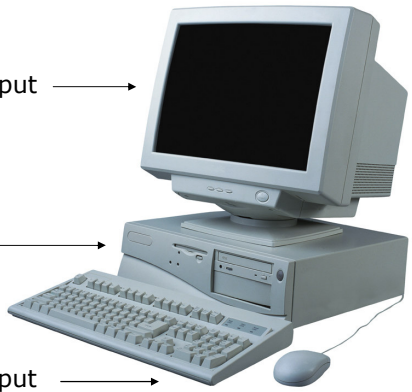


Parts of a Modern Computer 1/2

Monitor: for displaying output

System Unit: CPU, Memory, Hard drive, Floppy drive, …

Keyboard and Mouse: for input



Parts of a Modern Computer 2/2

- **Central Processing Unit (CPU)**: microchip that performs core computation. It usually contains the ALU and CU.
- **Memory** (**primary storage**): microchips that store data which can be accessed while computer is switched on.
  - **Random Access Memory (RAM)** is volatile and modifiable.
  - **Read-Only Memory (ROM)** cannot be changed.
- **Hard drive**, **Floppy drive** (**secondary storage**): store data on magnetic discs permanently i.e., the data is not lost when the computer is switched off.
- **Input/Output devices**: transfers data from operator to machine and vice versa.

- **Operating System**: software system that manages resources on computer and executes application programs, e.g., Windows XP, Ubuntu Linux.

Algorithms

- An **algorithm** is a sequence of steps performed to accomplish a task.
- Everyday tasks require algorithms but we usually do not think about them.
  - E.g., putting on shoes
- Algorithms usually have 3 properties:
  - A sequence of steps
  - Some decisions that are made at some steps
  - Repeating of parts of an algorithm

Algorithm to Boil Water in Kettle

1. Take the lid off kettle
2. If there is enough water already, go to step 7
3. Put kettle under tap
4. Open tap
5. Wait until kettle is full
6. Close tap
7. Replace lid on kettle
8. Plug kettle into power outlet
9. Turn kettle on
10. Wait for water to boil
11. Turn kettle off
12. Remove plug from power outlet

Algorithm to Take Minibus Taxi to Town

1. Make sure you have enough money
2. Wait at bus stop
3. Flag down taxi as it approaches
4. Get into taxi (somehow)
5. Collect fare from behind you, add your money and pass it forward
6. Shout at driver to stop
7. When taxi stops, prod other passengers to make them move out
8. Get out of taxi
9. Give thanks for a safe trip!

Programs

- A **program** is a set of instructions given to a computer, corresponding to an algorithm to solve a problem.
  - The act of writing a program is called **programming**.
- Programs are written in a precise language called a **programming language**.
- Sample Program (in Java):

```
class HelloWorld
{
   public static void main ( String [] args )
   {
      System.out.println ("Hello World");
   }
}
```


Classes of Programming Languages

- The language directly understood by a computer is called **machine language**.
  - E.g., B4 4C CD 21 terminates a program on a PC
- **Assembly language** is a low-level language with mnemonics (codes) used for each instruction to make programming easier for humans.
  - E.g.,
    MOV AH,4Ch
    INT 21h
- **Low level languages** are languages geared towards machines (computers).
- **High-level languages** are languages that are easier for humans to use.
  - E.g., Java, C++, Pascal

Popular Programming Languages

- C++
  - Can be used by engineers and scientists for high performance applications.
- Pascal
  - Can be used for teaching computer programming.
- Perl, Python
  - Can be used for rapid application development.
- PHP
  - Can be used for Web-based applications.
- C#
  - Can be used for Windows applications.

Tools for Programming

- A **compiler** is a program that converts/translates a program from a high-level language (what we can understand easily) to a low-level language (what the computer can understand).
- The low-level program is then executed by the CPU directly (if it is already in machine code) or via an **interpreter** or **virtual machine**.
- A **debugger** is a special tool to help find errors in a program.

Java

- There are many different types of computer languages, and many different languages.
- This course is based on Java.
- Java is a general-purpose object-oriented programming language invented in the mid-90s by Sun Microsystems.

Using Java at UCT