UCT Department of Computer Science
Computer Science 1015F

Introduction to Computing
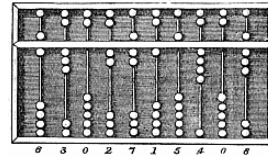
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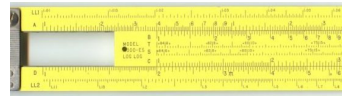
History of Computing

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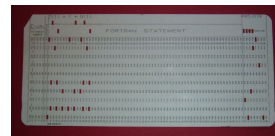
Slide rules performed multiplication and division using logarithms – in popular use until about 1970.

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 different 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.
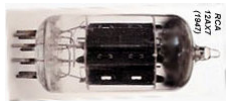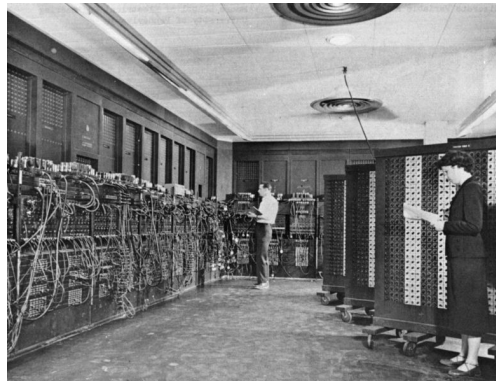
1960s to Present

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)

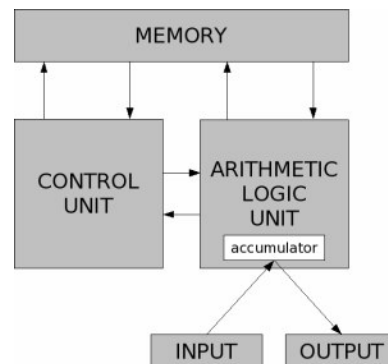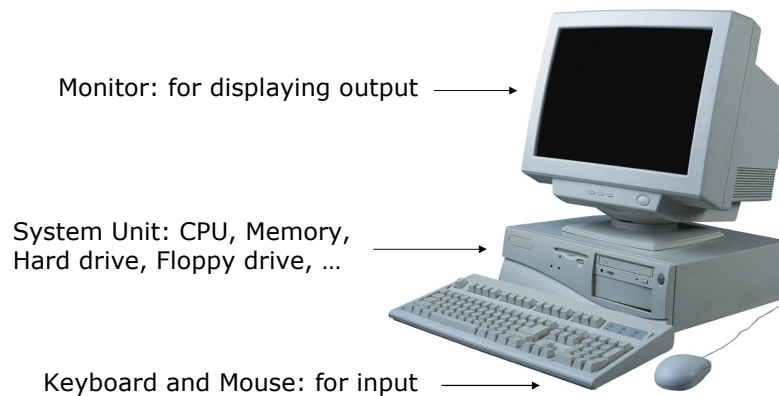department of Computer Science

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 →

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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.

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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

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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

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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!

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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");
    }
}
```

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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.

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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.

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