Computer Hardware: 2500 BC - wood

Abacus invented Sumeria c. 2500 BC,
Computer Hardware: 100 BC - brass

Antikythera mechanism
Analog computer used to predict astronomical positions and eclipses

images/Antikythera.jpg
Analytical Engine designed by Charles Babbage 1835 - never built.
General purpose programmable computer using punch cards and steam power
The first Coder: 1835

Ada Lovelace - mathematician who wrote the first programs.
Hollerith tabulating machine used for calculations in the US census, company eventually becomes IBM
Colossus: arguably first first programmable, electronic, digital computer.
Designed by Tommy Flowers for WWII codebreaking.
PDP-1 first computer in Digital Equipment Corporation’s successful line.
Successors were first machines C and Unix used on.
PDP-11 computer using large-scale integrated circuits containing thousands of transistors.
Intel 4004 4-bit microprocessor - computer on single chip - 2300 transistors.
Intel “Pentium” 32-bit microprocessor - computer on single chip
- 1000000+ transistors.
What makes up a working computer?

- **hardware** (motherboard, CPU, RAM, HDD, etc.)
- **bootstrapping code** (BIOS)
- **device drivers**
- **operating system** (Linux, Windows, etc.)
- **software** (games, utilities, etc.)
The Operating System

Operating system (OS) is a piece of complex software layer that manages a computer’s hardware. Allows you to program without knowing (independent) of hardware details.

- examples - Windows, OS X, Linux, IOS
- long history; many innovations come from Unix
- Unix first widely used multi-user and multi-tasking OS
- Linux, Android, OS X, FreeBSD - descendants of Unix
Linux

Linux is a multi-user operating system, you will have your own account on the CSE machines, with a unique username and password. Logging in to your CSE account, either from a lab machine or from home, will give your access to your files and settings. These are not to be shared with anyone else.

- logging into a Linux system gives you access to a terminal window
- a terminal window is for text commands which the OS executes
- common commands: ls, cd, mkdir, more, etc.
- many tasks can be performed through graphical user interfaces (GUI)
Programming Languages

Why don’t we program in English?

- it is too informal
- it is too big

What does ”Time flies like an arrow” mean?

So we invent a programming language that:

- is small
- is formal (syntax and grammar)
- is still reasonably intuitive for humans

Because programming language instructions are usually too complex to execute directly, they must be translated into an even simpler machine language.
The C Programming Language

Historical notes:

- created by Dennis Ritchie in the early 70’s at AT&T Bell Labs
- named so because it succeeded the B programming language
- designed as a high(er)-level language to replace assembler
- powerful enough to implement the Unix kernel
- in 1978 Dennis Ritchie and Brian Kernighan published “The C Programming Language”
- now considered low-level, widely used for system and application programming
Why C?

• classic example of an imperative language
• many libraries and learning resources
• widely used for writing operating systems and compilers as well as industrial and scientific applications
• provides low level access to machine
• language you must know if you want to work with hardware
Like most programming languages, C supports features such as:

- program comments
- declaring variables (data storage)
- assigning values to variables
- performing arithmetic operations
- performing comparison operations
- control structures, such as branching or looping
- performing input and output
Hello World

#include <stdio.h>

int main(void) {
    printf("Hello world!\n");

    return 0;
}

// Author: Kernighan and Ritchie
// Date created: 1978
// A very simple C program.
Hello World

The program is complete, it compiles and performs a task. Even in a few lines of code there are a lot of elements:

- a comment
- a `#include` directive
- the `main` function
- a call to a library function, `printf`
- a `return` statement
- semicolons, braces and string literals
A Closer Look

What does it all mean?

• //, a single line comment, use /* */ for block comments
• #include <stdio.h>, import the standard I/O library
• int main(...), the main function must appear in every C program and it is the start of execution point
• (void), indicating no arguments for main
• printf(...), the usual C output function, in stdio.h
• ("Hello world!\n"), argument supplied to printf, a string literal, i.e., a string constant
• \n, an escape sequence, special character combination that inserts a new line
• return 0, a code returned to the operating system, 0 means the program executed without error
A C program must be translated into machine code to be run. This process is known as compilation. It is performed by a compiler. We will use a compiler named dcc for COMP1511. dcc is actually a custom wrapper around a compiler named clang. Another widely used compiler is called gcc.
Compiling A Program

- Create a file named `hello.c` containing the program
  
  ```
  gedit hello.c
  ```

- Once the code is written and saved, compile it:
  
  ```
  dcc hello.c
  ```

- Run the program:
  
  ```
  ./a.out
  ```

$ gedit hello.c &
$ dcc hello.c
$ ./a.out
• Lists files in current directory (folder)
• Several useful switches can be applied to `ls`
  ▶ `ls -l` (provide a long listing)
  ▶ `ls -a` (list all file, i.e., show hidden files)
  ▶ `ls -t` (list files by modification time)
  ▶ Can combine options. For example, `ls -la`
mkdir

- `mkdir directoryName`
- Create (make) new directory called *directoryName* in the current working directory
- a directory is like a folder in windows
- To verify creation, type `ls`
- `cd directoryName`
- **Change directory**
  - Change current directory to `directoryName`
  - `directoryName` must be in the current working directory
  - We will see how to use more complex names (paths) later
- **Special directory names**
  - `cd ..`
    - move up one directory (to parent directory)
  - `cd ~`
    - move to your home directory