comp20005 Intro. to Numerical Computation in C

Semester One 2023

Chapter 1: Computers and Programs

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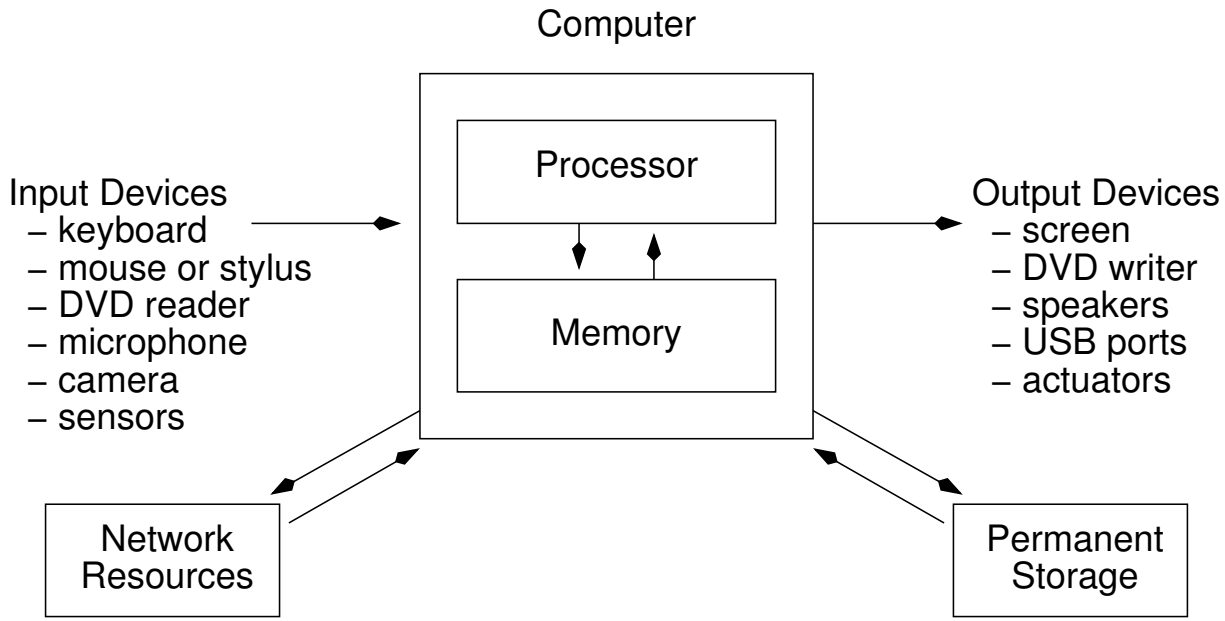
Chapter 1 – Concepts

- Computer Science is the study of information – how it is represented, manipulated, and transformed.
- Software Engineers design and implement large-scale software systems, and do so in a manner that is both socially responsible, and maximizes the likelihood of a successful outcome.
- Other technology disciplines require a level of knowledge of both of these areas.
- Programming is fun!

1.1 Computers and computation

Computers manipulate information symbolically.



1.1 Computers and computation

Computers have a limited repertoire of operations, but carry them out extremely quickly and with astounding reliability.

As a rule of thumb, a standard laptop computer can perform around a billion operations per second; and a desktop computer today has more power than a multi-million-dollar computer of thirty years ago.

1.2 Programs and programming

The computer hardware is controlled and directed by the computer software, with each program written in one or more programming languages.

Natural language cannot be used for programming because it is too imprecise.

1.2 Programs and programming

There are many different programming languages, loosely categorized into four broad classes.

C is a procedural programming language, developed in the 1970s at Bell Laboratories in the United States by Brian Kernighan and Dennis Ritchie.

It is a robust, standardized, portable, and widely available language suitable for a broad range of computing, engineering, and scientific calculations.

1.3 A first C program

- `helloworld.c`

To actually run a program, it needs to be converted to simple machine instructions using a compiler:

```
mac: ls
helloworld.c
mac: gcc -Wall -o helloworld helloworld.c
mac: ls
helloworld helloworld.c
mac: ./helloworld
Hello world!
mac:
```

1.3 A first C program

The command `gcc` is a C compiler, and the option `-Wall` requests all warning messages be shown. (The additional `-ansi` option shown in the book relates to the original C ANSI standard and will not be applied in comp20005.)

You might use different shell commands in your computing environment for compiling and executing C programs.

The C program itself is portable from one machine to another. But it needs to be compiled for each such system.

1.3 A second C program

- `addnumbers.c`

The principal features in most programs are comments, declarations, assignment statements, control structures, and I/O statements.

What changes would be necessary so that `addnumbers.c` reports the number of input values and their mean, as well as their sum?

1.4 The task of programming

Programming is a construction exercise.

- Think about the problem
- Write down a proposed solution
- Break each step into smaller steps
- Convert the basic steps into instructions in the program
- Use an editor to create a file that contains the program
- Use the compiler to check the syntax of the program
- Test the program on a range of data.

Remember an important message: keep it simple, stupid.

1.5 Be careful

Computers always eventually fail. Be prepared for that day.

If you have used your computer for work or a business, the value of the data might easily be 10 or 100 times greater than the value of the hardware.

Maintain a regular routine for backing up your work.

Keep some of your backups in a different location.

1.5 Be careful

Time spent working on a computer is a resource far more precious than the hardware itself. To minimize the impact of hardware failure, you should adopt a regular backup routine.

Reflect back on the dumbest way that you have ever lost data off a computer or phone.

Chapter 1 – Summary

- Computers manipulate information according to the instructions specified by programs; programs are written in a programming language.
- C is a standardized and portable language in widespread use.
- A compiler translates the program statements into the detailed machine instructions executed by a particular computer.
- Data is more valuable than hardware, and needs to be carefully safeguarded aganist both accidental loss and against theft.