Overview of Computer Science: Part I
What is a Computer ?

Computer Science

Wikipedia:[1] Computer Science is the study and the science of the theoretical foundations of information and computation and their implementation and application in computer systems.

- **Computer systems: (= hardware)**
  - Abacus.
  - Charles Babbidge's difference engine.
  - Calculator.
  - *Turing Machine.*
  - **Standalone computer**.
  - Game console.
  - Embedded system (cell phone, digital camera, cofeemaker, etc).
  - Distributed computer systems.
  - *Quantum computers* (riiight. . .).
- **Theoretical foundations of information and computation.**
  - Computation and algorithms.
    - Computability.
    - Complexity.
  - Information and information management/analysis.
  - Information transfer.
  - Information encoding and protection (cryptography etc.).

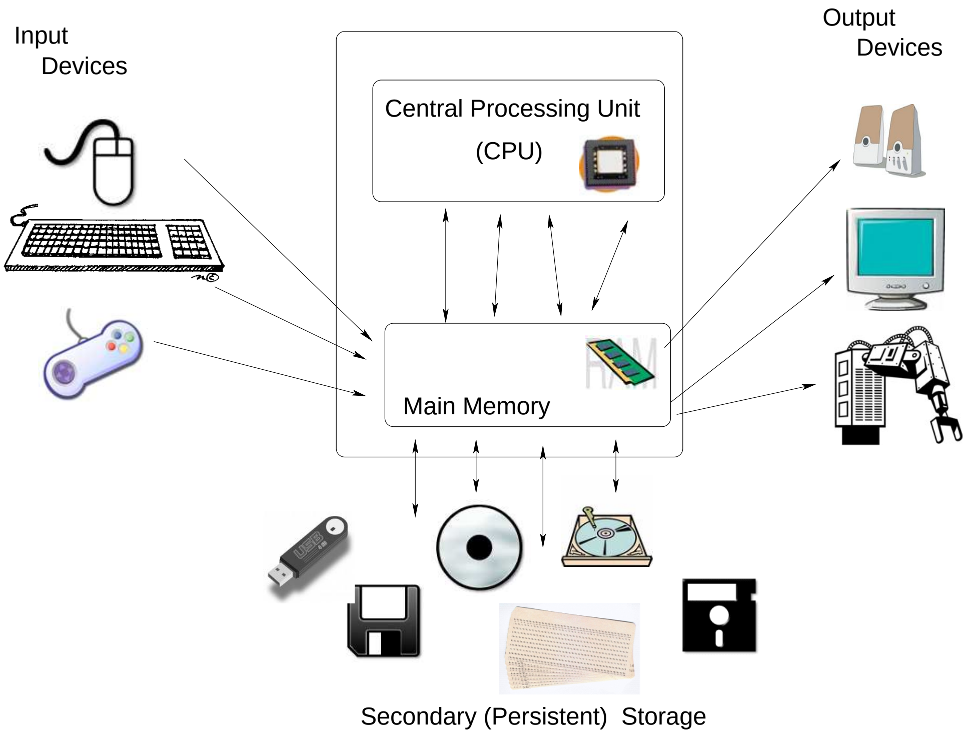
[1] http://en.wikipedia.org/wiki/Computer_science.

– Information visualization.

- **Implementation and application. (= software)**
  - Programs (= implementations of algorithms).
  - Programming languages and compilers.
  - Operating systems (make computers usable).
  - Software development and Software engineering.

Hardware in a Nutshell.

What we have to work with ...



Memory.

Memory is the component of the computer system, that is responsible for storage of all information and programs used by the system.

Main Memory. **Physically**, main memory of a computer consists of a collection of *integrated digital circuits*, each of which has the *capacity* to store a specific amount of information.

Logically, main memory is a **sequence** of *memory cells*. Each *memory cell* is capable of storing an *atomic unit of information* (i.e., the smallest non-divisible amount of information a computer can work with). Each memory cell has:

- **address**: essentially, the position of the cell in the *sequence* of all memory cells in main memory. Adresses must be unique.
- **contents**: the information, actually stored in the cell.

RAM (Random-Access memory) : the area of main memory that is used for storage of programs and data. Contents of RAM change over time.

Random-access means that it takes *the same amount of time* to access each memory cell.

RAM is **volatile**, which means, it requires electical current in order to maintain the contents of the memory cells. Turning the power off results in destruction of its contents.

ROM (Read-Only memory : the area of main memory with non-volatile, unchangeable contents. ROM typically contains startup instructions and data for the computer.

Secondary (Persistent) Storage. Any **non-volatile** (a.k.a. persistent) memory component of the computer system. **Physically** can come up in a number of different forms: from *punch cards* to hard drives to floppy disks, CD-Rs, DVD-Rs, magnetic tape and flash memory devices.

Logically, secondary storage is also a sequence of memory cells, with exactly the same properties as the cells of main memory.

Units of Memory

Bit. In a digital computing device, information is encoded by detecting the presence/absence of **electical current** running through a specific circuit. This information unit is called a **bit** (binary digit). Logically, *absence of current* is encoded as 0 and *presence of current* is encoded as 1.

Byte. A combination of 8 bits. Each *memory cell* has the size of *1 byte.*

Here is how a memory cell looks:

1	0	1	0	0	0	1	0

Beyond bytes. Here are some more units that measure memory sizes.

Unit	Abbreviation	Equals
Byte	B	8 bits
Kilobyte	KB	1,024 bytes (2^{10} B)
Megabyte	MB	1,024 kilobytes (2^{20} B)
Gigabyte	GB	1,024 megabytes (2^{30} B)
Terabyte	TB	1,024 gigabytes (2^{40} B)
Petabyte	PB	1,024 terabytes (2^{50} B)

CPU (Central Processing Unit)

Two roles:

- coordinates all computer operations;
- performs operations on data.

Physically a CPU is an integrated circuit (IC) or a collection of integrated circuits.

A **microprocessor** is an integrated circuit that is a full CPU.

Machine language: set of operations that a CPU can perform with data.

Register: a memory cell (or a collection of memory cells) residing inside a CPU. Registers are used to bring in the data from main memory right before it is used in CPU operations, and to store the immediate result(s) of the CPU operations before they are returned back to main memory.

Input and Output Devices

Input and output devices make up the hardware *interface* between a computer and the external world.

Input Devices

Input devices are components that provide data and control signals to an computer system.

- keyboard
- mouse
- joystick
- game controller
- camera (video)
- scanner (image, barcode, 3D, fingerprint)
- microphone
- sensors (of various kind)
- punch card/punch tape reader

Output Devices

Output devices are components used to communicate the results of the work of the computer system back to the user/external world.

- display/monitor
- speakers
- printer
- plotter
- projector