Chapter 1: Introduction to Computer Science

1. Definitions

1.1. Computer science

Computer science defines all the sciences and techniques related to the automatic processing of information (create, delete, store, modify, process, and present data).

1.2. A computer

Is a machine composed of a collection of entities (hardware, software), designed for the automatic processing of information. It can process various types of information (texts, images, videos, sounds …) but internally all this information is converted into binary digital form (0 and 1).

2. A brief history about the evolution of Computer Science

Pascaline (1642), mechanical calculator, invented by Blaise Pascal and considered the first (purely mechanical) calculating machine.

Fig. Pascaline calculator.

The Jacquard loom (1801) is a loom developed by the Frenchman Joseph Marie Jacquard, the first programmable mechanical system with punched cards.

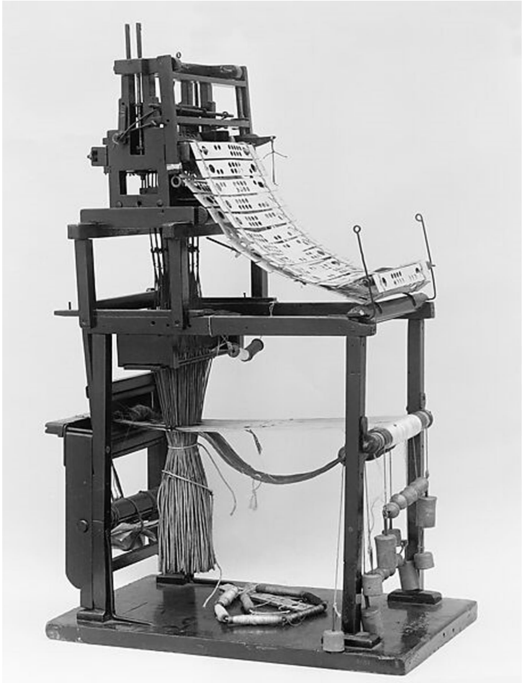


Fig. The Jacquard loom

The analytical machine (1834) is a programmable calculating machine designed by the English mathematician Charles Babbage and which is considered the first true precursor of computing. His "analytical machine", which uses punched cards (The Jacquard loom) indicating the data and operations to be carried out (similar to the program), was theoretically innovative but technically so complex that it never worked.

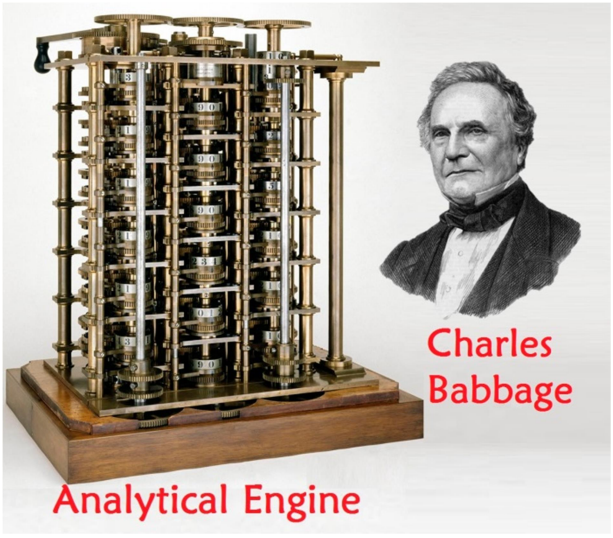


Fig. The analytical machine

It was during the development of Chargle Babbage's machine that **Ada Lovelace** developed the first programming algorithm in history, becoming humanity's first computer scientist.

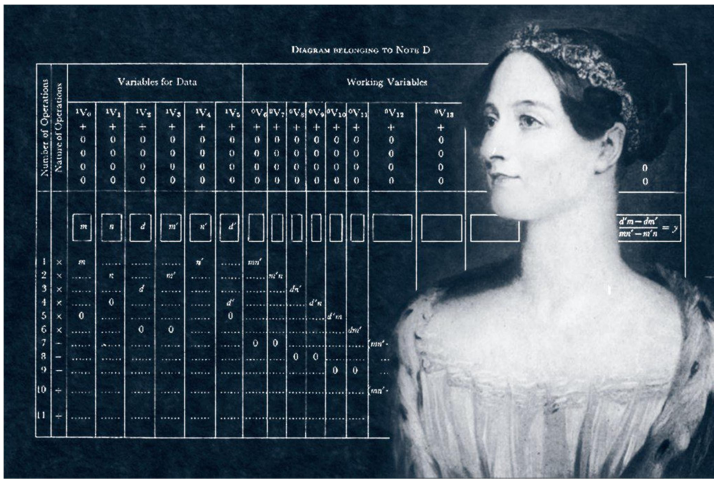


Fig. Ada Lovelace the first computer programmer

The Turing machine (1936), which is one of the basic concepts of computer science, founded by Alan Turing (British mathematician), is a pure abstract mathematical object, which formalizes the operation of mechanical calculation devices.

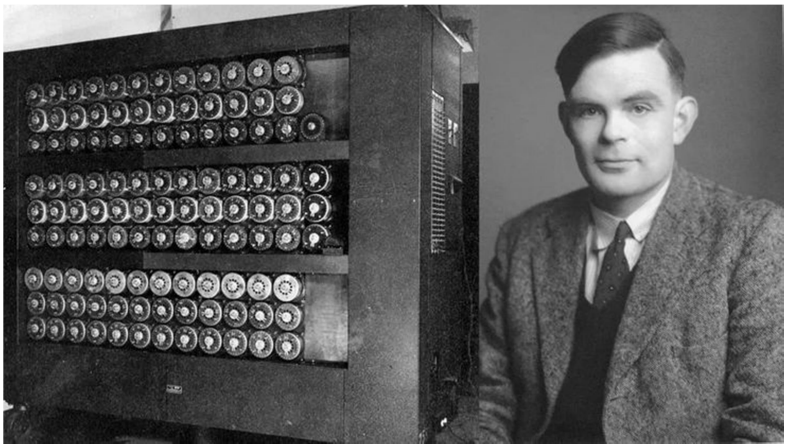


Fig. The analytical machine

Von Neumann (1944), designed the Eniac (Electronic Numerical Integrator And Computer), the first large entirely electronic calculator. Von Neumann is the designer of the architecture of classical computers.

It was in Great Britain, in 1948, at the University of Manchester, that the first computer was finally built. Alan Turing participated in its technical development and it was he who wrote the first "language" to communicate information to the machine. This very simple language is made up of around fifty instructions and it is the machine which translates them into binary language.

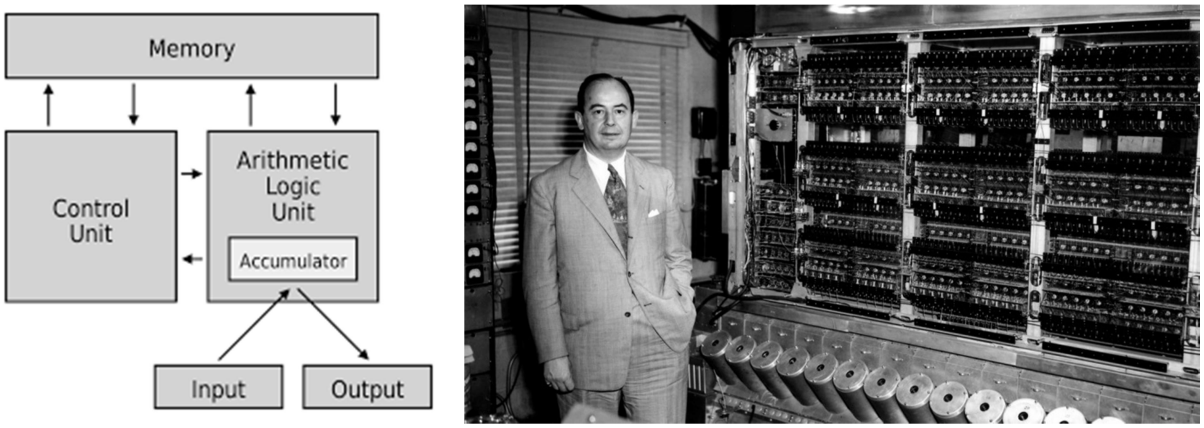


Fig. ENIAC (based on Von Neumann architecture)

IBM-360

In 1964, the American firm IBM marketed the IBM-360 computer. This computer was equipped with printed circuits and was a real commercial success. Computing was no longer just a tool mainly used for military applications or scientific research; it was penetrating massively into businesses.

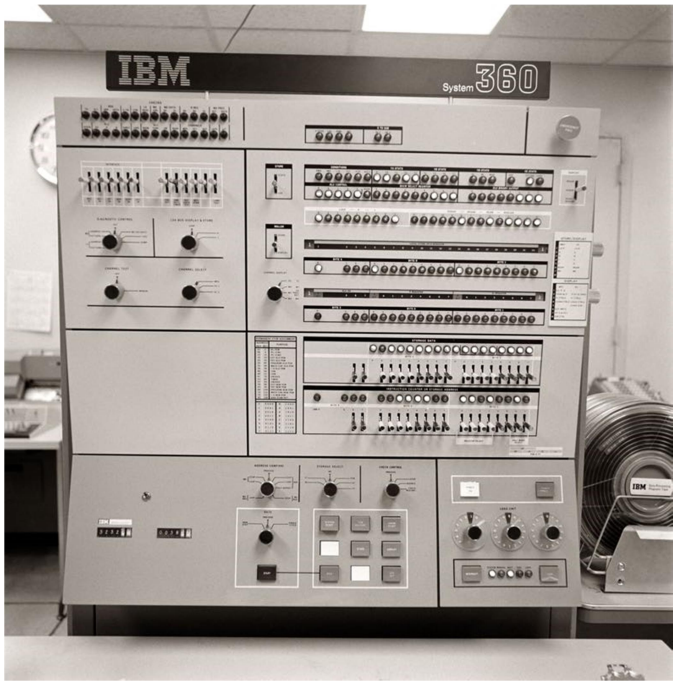


Fig. IBM-360

The microcomputer

Developed from 1975. The immense progress in the miniaturization of circuits led to the invention of the microprocessor, which is the basic organ of the microcomputer.

The first microcomputers were developed and marketed by students. Apple founders (in a garage!).

In 1983 The Lisa machine (Lisa OS) (very slow and expensive)

In 1984, Apple developed the Macintosh (using a mouse inspired by Xerox laboratories)

The success is worldwide and will inspire Bill Gates for his Windows system (Microsoft).

Bill Gates' Microsoft company was successful from 1981, when its system was chosen by IBM to equip its computers known as PCs (Personal computers).

From 2007, new revolution → smartphones era (Apple iPhone)…etc

3. An algorithm

1.1. Definition 1

An algorithm is a series of instructions ordered in a logical and sequential manner indicating the procedure to follow to solve a problem.

Examples :

- The Euclid algorithm which calculate the p.g.c.d. of two integers.
- Sorting algorithms, which allow, for example, ordering values.

Algorithms that do not necessarily only applied to computing:

- Indication of a path to reach a destination.
- Cooking recipe

1.2. Definition 2

An algorithm can be considered as a machine operating in three stages:

1- Enter the necessary data: The entries (or inputs).

2- Sequentially execute instructions on this data: Processing.

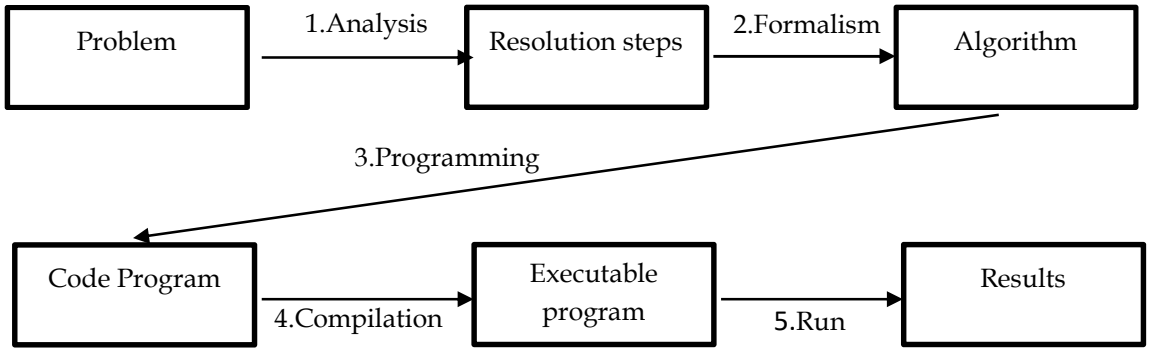
3- Display the obtained results: The outputs.

4. A program

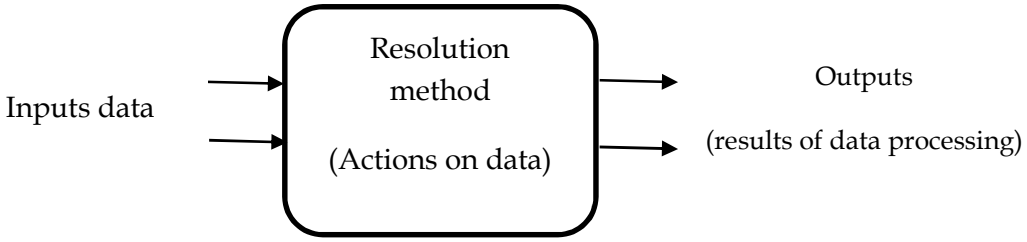
1.1. Definition

A computer program is a logical sequence of instructions (algorithm) written in a well-defined programming language (understandable by machine). Example: C, Pascal, Python, Java, etc.

1.2. Program Construction



- ***The first step:*** consists of analyzing the problem to determine the expected inputs and outputs as well as the elementary operations which describe the resolution method.



- ***The second step:*** is the establishment of an algorithm which is a formalism to represent the steps for solving the problem analyzed.
- ***The third step:*** is the translation of the algorithm into a program using a chosen programming language (C language, for example).
- ***The fourth step:*** Once the program is written, you will have to check it and correct it using the compilation method. The compiler is software that detects program syntax errors, but does not detect semantic errors.
- ***The last step:*** consists of executing the compiled program. This step leads to the exploitation of the program and the verification of the results.

Note:

When writing a program, you may encounter two types of errors:

Syntactic errors: they are noticed during compilation and are the result of poor writing in the programming language.

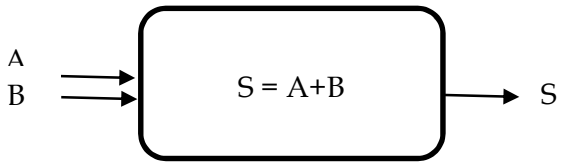
Semantic errors: they are noticed at execution, they are the result of poor analysis. These errors are much more serious because they can appear while the program is running.

Example:

Problem

Write an algorithm that calculate the addition of two real numbers A and B.

Analysis



- Determine the inputs and outputs:
  Inputs A, B: real values
  S = A + B // A and B are real, so, S is also real.

- Determine the methods:

  Read the values of A and B from the keyboard (input).
  Evaluate: S = A + B
  Write into the screen the value of S (result)

Algorithm (formalism)

```
Algorithm Add ;
 Var
   A, B, S : Real ;
 Begin
       read ( A ) ;
       read ( B ) ;
       S ← A + B ;
       write ( S ) ;
 end.
```

Program (code in C language)

```
#include <stdio.h>
int main( )
{
        float A, B, S ;
        scanf("%f", &A) ;
        scanf("%f", &B) ;
        S = A + B ;
        printf("The sum = %f \n", S) ;
        return 0 ;
}
```