CHAPTER I

Introduction

CHAPTER 1 : INTRODUCTION

1. A brief history of computer science
   - What is computer science ?
   - history of computer science.
2. Introduction to algorithms
   - Some examples
   - Algorithm definition
   - Program Development Phases
   - Characteristics of an algorithm

WHAT IS COMPUTER SCIENCE ?

- According to the Larousse dictionary, l'informatique :
  - « Science du traitement automatique et rationnel de l'information considérée comme le support des connaissances et des communications ».
  - Science of the automatic and rational processing of information considered as the support of knowledge and communication.
- Computer science is the study of how computers work and how to use them to solve problems

MAIN AREAS OF STUDY IN COMPUTER SCIENCE

- **Artificial intelligence:** The development of intelligent machines that can learn and perform tasks without being explicitly programmed.
- **Computer systems and networks:** The design and implementation of computer hardware and software systems, as well as the networks that connect them.
- **Security:** The development of systems and techniques to protect computer systems and networks from attack.
- **Database systems:** The design and implementation of systems for storing and managing large amounts of data.

MAIN AREAS OF STUDY IN COMPUTER SCIENCE

- **Human-computer interaction:** The study of how people interact with computers and the design of user interfaces that are easy to use and efficient.
- **Vision and graphics:** The development of algorithms and systems for processing and displaying images and videos.
- **Numerical analysis:** The development of algorithms and software for solving mathematical problems.

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MAIN AREAS OF STUDY IN COMPUTER SCIENCE

- **Programming languages:** The design and implementation of languages that programmers use to write software.
- **Software engineering:** The development of processes and tools for designing, developing, testing, and maintaining software systems.
- **Bioinformatics:** The use of computer science to solve problems in biology and medicine.
- **Theory of computing:** The study of the fundamental principles of computation, such as algorithms and complexity theory.

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WHAT IS INFORMATION

- According to the Larousse dictionary
  - Information is an element of knowledge that can be represented using conventions to be stored, processed or communicated.
- It can also be defined as:
  - An entity that has meaning. It can be
    - abstract or concrete,
    - represented in a variety of formats, such as text, numbers, images, and videos.
- Examples of information : the name of a person, temperature, a date, a note.....

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WHAT IS INFORMATION

- Information is a vital part of computer science, and it plays a key role in the development and use of computer technology.
- To be used, information must be written in a medium (sheet of paper, memory, etc.).
- In computer science, information is any data that has been processed or organized in a way that is meaningful to a computer.
  - This includes data that has been formatted, encoded, or encrypted.
  - Information can be stored on a computer's hard drive, in memory, or in a database.

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INFORMATION PROCESSING

- collect, exploit and manipulate information provided by any medium to obtain results.
- Processing can be
  - manual (carried out by a person)
  - automatic (using a machine or computer).
- Information processed automatically is called data.
  - It can be digital or not.

COMPUTER SCIENCE IN A FEW DATES

- 1642 first mechanical calculator (Blaise Pascal);
- 1936 Alan Turing publishes his description of the "Turing machine";
- 1936 first computer: Konrad Zuse's Z1;
- 1956 first hard disk drive (IBM);
- 1958 first (radar) network;
- 1967 invention of the mouse;
- 1969 creation of ARPAnet, precursor of the Internet, and the C language;
- 1981 first version of Windows; first laptop;
- 1983 creation of C++;
- 1990 creation of the World Wide Web;
- 1991 creation of Linux;
- 1996 beginning of Google;
- 1997 Garry Kasparov lost to Deep Blue;

COMPUTER SCIENCE IN A FEW DATES

- 2001 Wikipedia, BitTorrent;
- 2004 creation of Facebook;
- 2007 launch of the iPhone by Apple
- 2010 Development of cloud computing
- 2013 Tablet sales outpace PC sales
- 2014 The number of websites in the world exceeds one billion
- 2016 The alphaGo program beats the world champion of the game of Go
- 2017 Launch of blockchain technology
- 2018 Beginning of the deployment of 5G technology in the United States.
- 2019 Record number of cores for an Intel processor: 56 cores
- 2020 AMD releases a 64-core processor
- ...

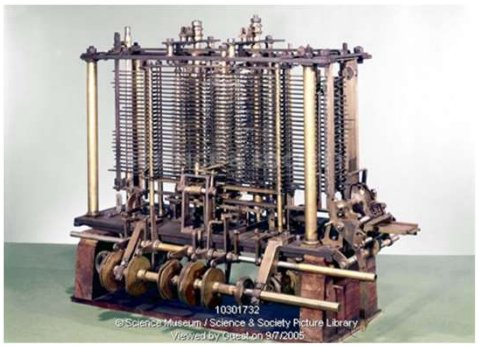
- The first mechanical calculating machine, Machine Arithmétique, was built by Blaise Pascal in 1642.
- He produced 50 machines in the next 10 years.
- In fact, Pascal's machine can add directly and subtract by addition the complementary number (like modern computers).
  - Multiplication and division were made by addition and subtraction.
  - Pascal had predecessors.

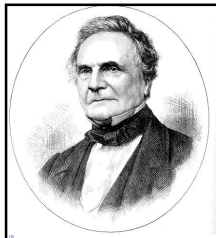
PASCALINE

Gottfried Wilhelm Leibniz (Leipzig 1646 - Hanover 1716) developed Pascal's ideas and in 1671 built the Step Reckoner

This machine could calculate additions, subtractions, and also multiplications, Divisions and square roots.

Charles Babbage (Teignmouth, Devon, 1792 - London 1871) was a British mathematician. He imagined, a calculating machine controlled by a program recorded on punched cards, which can be considered as the ancestor of computers.





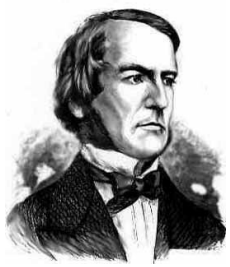
In 1822, Babbage designed a Difference Engine to automatically calculate tables of mathematical functions.
He had not finished making this machine when he came up with the idea of a more sophisticated machine that he called Analytical Engine.

- This last machine must have had features of modern computers:
  - Sequential control
  - Branch instruction
  - Loops.
- The use of punched cards was planned to introduce programs and data.

Augusta Ada Lovelace (1815-1852)
British mathematician. Daughter of poet George Gordon Byron

Brilliant mathematician, **Ada Lovelace** was among the few people who truly understood Babbage's vision.
She programmed for the Analytical Engine. Her contribution to the development of computing was honored by naming the programming language **Ada** after her.

George Boole
Lincoln 1815 - Ballintemple, near Cork, 1864



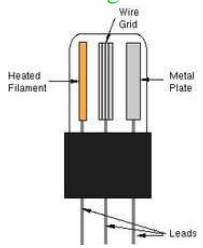
While Babbage was trying to build his analytical machine, George Boole, a British mathematician and logician, was laying the foundations of a major part of modern mathematical logic.(Boolean algebra).

1895: Guglielmo Marconi transmits a radio signal.
1896: Patent for the first wireless telegraph.

Guglielmo Marconi
Bologne 1874 - Rome 1937

1904: Sir John Ambrose Fleming (1849–1945)
British engineer, invents the vacuum lamp (diode)
1906: Lee de Forest makes a triode

Control grid



cathode

anode

triode

The current passes or does not pass from the cathode to the anode depending on the voltage on the grid. This phenomenon can model a switch of 2 states.

1927: The first TV demonstration in the United States.
The sound is transmitted via telephone wires.

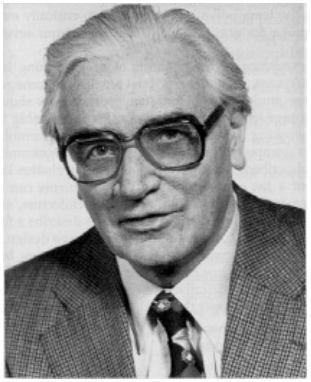
1928: Vladimir Zworykin invents the Cathode Ray Tube (CRT) to be used
as the first piece of computer memory
Vladimir Zworykin (Murom 1889, Russia - Princeton 1982, USA) American engineer of Russian origin. Best known for his invention of the iconoscope (1934),
The first in a long line of electronic tubes used in television.

1929: Color TV signals are transmitted.

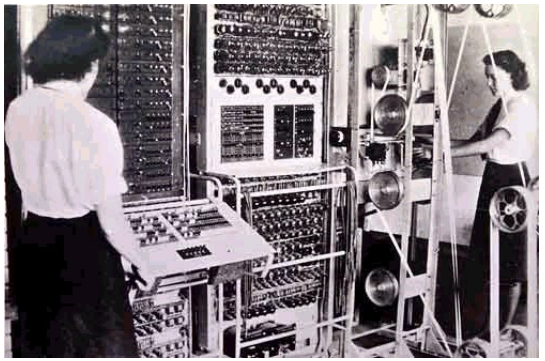
Alan Mathison Turing
Londron 1912 - Wilmslow, Cheshire, 1954

1937 : The publication of the paper "On Computable Numbers", which introduced the concepts of Turing machines and universal machines. The concept of universal machines allowed for the clarification of the structure of computers with stored programs. This was done by **John von Neumann**, who was familiar with this concept.

Konrad Zuse (1910-1995), German engineer, built the **Z3** electromechanical computer in 1941. The **Z3** used binary arithmetic and floating-point calculations, and is considered to be the first computer.



Zuse developed one of the first Programming languages

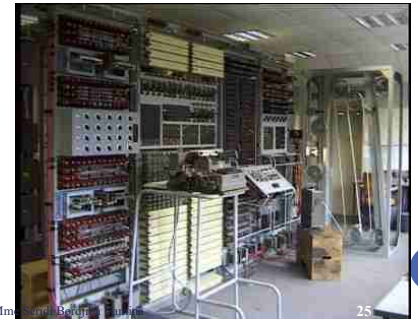


COLOSSUS

The first really functional electronic computer.

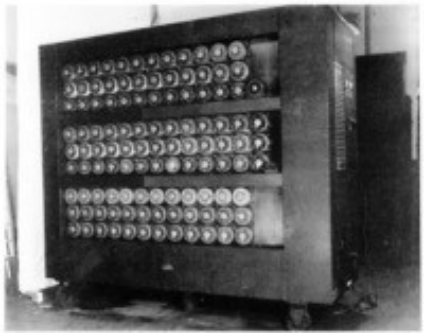
1943 [December]: Colossus, a British electronic computer (vacuum tube computer), is operational at Bletchley Park thanks to Alan Turing, Tommy Flowers et M.H.A. Newman.
He played a crucial role in decrypting German ciphers.

Bletchley Park. The British Centre for Interception and Decryption during the 1939-1945 war. Today it is a museum.



COLOSSUS 2

Bletchley Park



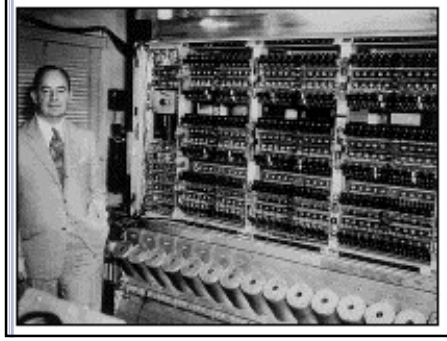
Bombe (named after Polish bomb)

An electromechanical machine used by A. Turing at Bletchley Park for decryption

- 1944: ENIAC (Electronical Numerical Integrator And Calculator)
- The fully electronic computer developed and built under the direction of John Eckert (1919 – 1995, USA) and John William Mauchly (1907 – -1980, USA)
- First prototype of an electronic computer
- 5000 additions per second,
- multiplication in 3 milliseconds,
- something like 18000 electronic tubes, consuming as much as several subway trains,
- 30 tons on 42 boxes 180x60x30 cm,
- clock frequency of 100kHz, ...
  - Data: punched cards
  - Program: Hand Connections

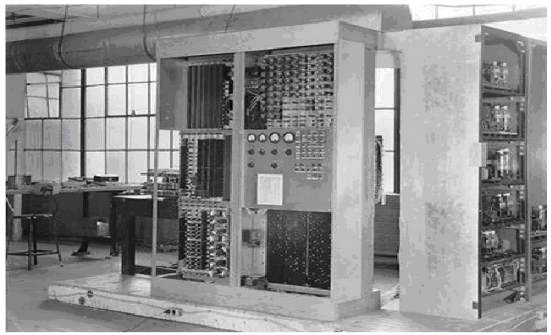
1945: J. Presper Eckert and John Mauchly sign a contract to build EDVAC (Electronic Discrete Variable Automatic Computer).

1945 [June]: John von Neumann clarifies the concept of program stored in the June 30, 1945 report on the design of the EDVAC. This gives the term "von Neumann architecture"



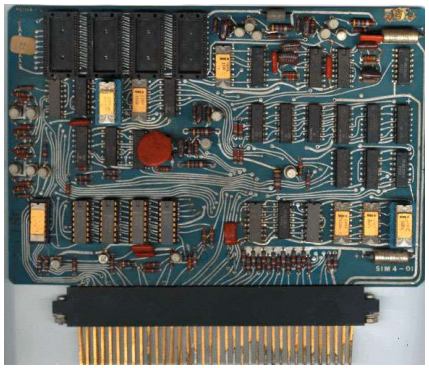
Johann ou John von Neumann (Budapest 1903 - Washington 1957)

- 1947: successor to the ENIAC, the EDVAC (Mark I) integrates an entire program (written in binary on a keyboard) into the machine's memory (Von Neuman architecture)



- 1958: 1st transistor computer [MIT] and first integrated circuit at Texas Instrument
- 1963: invention of the mouse (D. Engelbart)

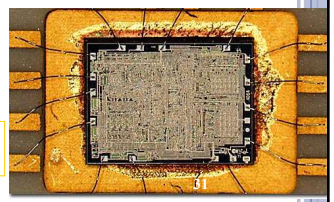
1971: The first microprocessor, Intel 4004



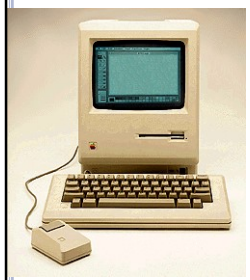
Intel 4040: 740 KHz, 24-pin – the same speed as Intel 4004, larger memory

Intel 4004

This microprocessor integrates logic, arithmetic etc., memory and other services



1981 : l'Osborne 1, the first laptop (almost 10 kg), was placed on the market.
1984 : Apple Commercialized the Macintosh who gave a "standard" ofPC (personal computer), in particular GUI with icons.



Apple Macintosh

Steve Jobs

Steve Wozniak

[13]

Apple II, Late 70s

COMPUTER SYSTEM

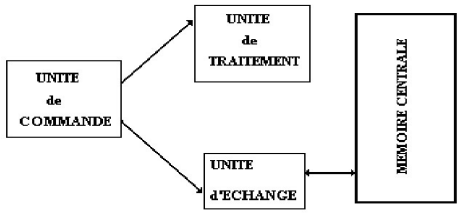
- A computer system is a set of components that work together to process information automatically.
- It is designed to receive inputs, process them according to a set of predetermined rules (programs), and produce outputs.
- An computer system can be divided into two main components:
  - Hardware tools (machine)
  - Software (program)

HARDWARE

- These are all the physical elements of the system.
- A computer is an electronic machine specially designed to allow the automatic processing of information.
- It is composed of
  - a central unit and
  - a set of peripherals devices.

THE CENTRAL UNIT

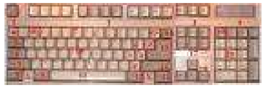
- Processing unit
- Control or command unit
- Input/Output Unit
- Central memory

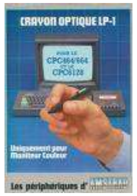


PERIPHERALS DEVICES

- They are responsible for performing information input and/or output tasks.
- *They can be:*
  - *Input devices*
  - *Output devices*
  - *I/O devices*

INPUT DEVICES





OUTPUT DEVICES



INPUT/OUTPUT DEVICES

- Sound card,
- Auxiliary memory (used to store data and programs):
  - Mass storage on hard disk or floppy disk.
  - Magnetic tape, CD-Rom, DVD, etc.





BUSES

- They represent in the computer the communication system between its various constituents.
- Buses are a subsystem that is used to connect computer components and transfer data between them.

BUSES

- These are:
  - Address Bus: it allows the control unit to transmit the addresses to be searched and stored.
  - the Data Bus: on which instructions or data to be processed or already processed for storage circulate.
  - The Control Bus: transports orders and synchronization signals from the control unit to the various parts of the machine. It also conveys the various response signals of the components.

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SOFTWARE

- These are the programs and data that make the hardware operate usefully.
- Software is a digital component that manages the processing of data by the machine.
- Software can be subdivided into:
  - operating systems and
  - applications.

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OPERATING SYSTEM

- An operating system manages hardware and software resources on a machine.
- It is the main software that manages the hardware and provides services to application software.
- The most well-known operating systems are :
  - Windows for PC,
  - MacOS for Macintosh and
  - Unix for minicomputers.
  - Linux is an operating system created from Unix for PC-type machines.

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APPLICATIONS SOFTWARE

- These are programs designed to perform specific tasks for the user.
- There are thousands of application software designed to run on different computers.

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APPLICATIONS SOFTWARE

- They are often grouped as follows: :
  - Office software (word processing, spreadsheets),
  - Image processing software (image retouching or creation),
  - Database software (e.g. Excel, Paradox, Oracle),
  - business software (managing a practice, a pharmacy, etc.).

CHAPITER 1 : INTRODUCTION

1. A brief history of computer science
   - What is computer science ?
   - history of computer science.
2. Introduction to algorithms
   - Some examples
   - Algorithm definition
   - Program development phases
   - Characteristics of an algorithm

SOME EXAMPLES
EXAMPLE 1 : COOKING RECIPE

Ingrédients :
- 250 g de farine
- 50 cl de lait
- 2 œufs
- 1 pincée de sel

La pâte à crêpes

Ustensiles :
- Un fouet
- Un saladier
- Un verre doseur

1 Verse la farine dans le saladier. Ajoute une pincée de sel.	
2 Casse les œufs dans le saladier, puis mélange avec le fouet.	
3 Ajoute progressivement le lait sans cesser de tourner.	

La pâte est prête ! Demande à un adulte de te cuire les crêpes, sur une poêle ou une machine à crêpes.
Puis tu peux les garnir avec du sucre ou de la confiture par exemple.

SOME EXAMPLES
EXAMPLE 2 : INSTRUCTIONS FOR USE

- An extract from a fax machine's instructions for sending a document.
  1. **Insert** the document in the automatic feeder.
  2. **Dial** the recipient's fax number using the keypad.
  3. **Press** the send button pour **start transmission**.
- This instruction manual specifies how to send a fax. It is composed
  - Of an ordered sequence of instructions (Insert …, dial…, Press..)
  - that manipulate data (document, autofeeder, fax number, numeric keypad, send button)
  - to perform the desired task (sending a document).

SOME EXAMPLES
EXAMPLE 3 : WAY INDICATION

- Extract from a dialogue between a lost tourist and a local resident.
  - Could you please show me the way to the station?
  - Yes of course: you go straight to the next crossroads, you turn left at the crossroads and then the third right, and you will see the station right in front of you..
  - Thank you.
- In this dialogue, the local resident's response
  - is the description of an ordered sequence of instructions (go straight, turn left, take the third right) that manipulate data (crossroads, streets)
  - to perform the desired task (go to the station).

SOME EXAMPLES
EXAMPLE 4 : SEARCHING FOR AN OBJECT

- Hi, Mom !
- Hello, why are you calling now? Have you done your registrations ?
- In fact, I forgot my insurance card at home. Please, I need you to give me my insurance number.
- Okay, now, where is it?
- Go to my bedroom, in my office, you'll find it in the first drawer on the right, and send me the number by text message.

- You've already opened a cookbook?
- Have you ever used a fax machine manual?
- If yes
  - You have already executed algorithms without knowing it..
- Have you shown a way to a lost tourist?
- Have you asked someone to find something for you over the phone?
- If yes
  - You've already designed - and had executed - algorithms

Conclusion:
algorithms are not specific to computer science

WHAT IS AN ALGORITHM?

- The word algorithm (from the Latin algorithmus) is derived from the name of a Persian author and scientist who lived in the ninth century :

  "Abu Ja'far Mohammed Ibn Mûsâ Al Khowârizmî"
- The word algorithm comes from Al Khowârizmî.
- Khowarizm is currently the small town of Khiva, in Uzbekistan.
- Although intuitive, the notion of algorithm is difficult to define formally. Several definitions are possible:

WHAT IS AN ALGORITHM?

The ***Encyclopaedia Universalis*** gives the following definition:

"An algorithm is a finite sequence of rules to be applied in a given order to a finite number of data in order to arrive, in a finite number of steps, at a certain result, independently of the data."

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OTHER DEFINITION

- *"An algorithm is a sequence of rules, reasoning or operations that transform given quantities (input data) into other quantities (output data). "*

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THE ALGORITHM IN THE DEVELOPMENT PHASES OF A PROGRAM

- To solve a problem by computer
  - prepare a plan
  - Translate the plan into a language that the computer can understand.
  - Submit the plan to the computer.
  - Save the plan in the computer's memory.
  - Execute the actions one after the other, saving the intermediate results in its memory.
  - The final result is given as output.

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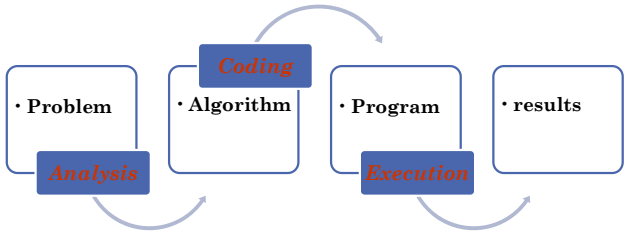
THE DEVELOPMENT CYCLE OF A "COMPUTER PROGRAM (OR APPLICATION)" CAN BE SUMMARIZED AS FOLLOWS:



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ANALYSIS

- A reflection phase which identifies the characteristics of the problem to be resolved and then divides the problem into a succession of simple, distinct tasks.
- It also involves defining what is given and what is required.
- The result of the analysis stage is the Algorithm.

which is a description of the operations to be implemented, explaining how to obtain a result from data

CODING

- It consists of translating the algorithm into a given programming language
- The result of this stage is what we call a "program ".
- This program, initially written in advanced language (PASCAL, JAVA, C, COBOL, BASIC, FORTRAN, ...) is transformed into a machine language

EXECUTION

- the computer executes the instructions of a program in "binary" language

EXAMPLE : THE PROBLEM

- Calculate the sum of the squares of two given integers.

EXAMPLE : ANALYSIS

- Determine the problem to be solved:
  - Inputs: two integers a, b
  - Outputs : an integer z= a^2+b^2
- Determine the method:
  - Modeling data a, b by integers
  - The sub-problems are
    - a^2
    - b^2

EXAMPLE: ANALYSIS, THE ALGORITHM

- Calculate x=a^2
- Calculate y=b^2
- Calculate z=x+y


```
Algorithm Somme_ squares ;
Var a, b, x, y, z : integer ;
begin
Read (a, b) ;
x←a*a ;
y←b*b ;
z←x+y ;
write (z) ;
End.
```


CODING IN C

```
#include<stdio.h>
int a, b, x, y, z;
main()
{
printf("donner a et b");
scanf("%d",&a);
scanf("%d",&b);
x=a*a;
y=b*b;
z=x+y;
printf("la somme des carrés est %d", z);
}
```

CHARACTERISTICS OF AN ALGORITHM

- It must be **clear** and **easy** to understand for everyone who reads it (**structure** and **documentation**)
- It must be as **general** as possible in order to respond to as many cases as possible.

CHARACTERISTICS OF AN ALGORITHM

- It must be **easy** to use, even for those who haven't written it, via on-screen messages that indicate:
  - what data needs to be provided
  - and in what form they should be introduced
  - as well as the different actions expected from the user
- It must be designed to **limit** the number of operations to be performed and the space occupied in memory.