Chapter 1

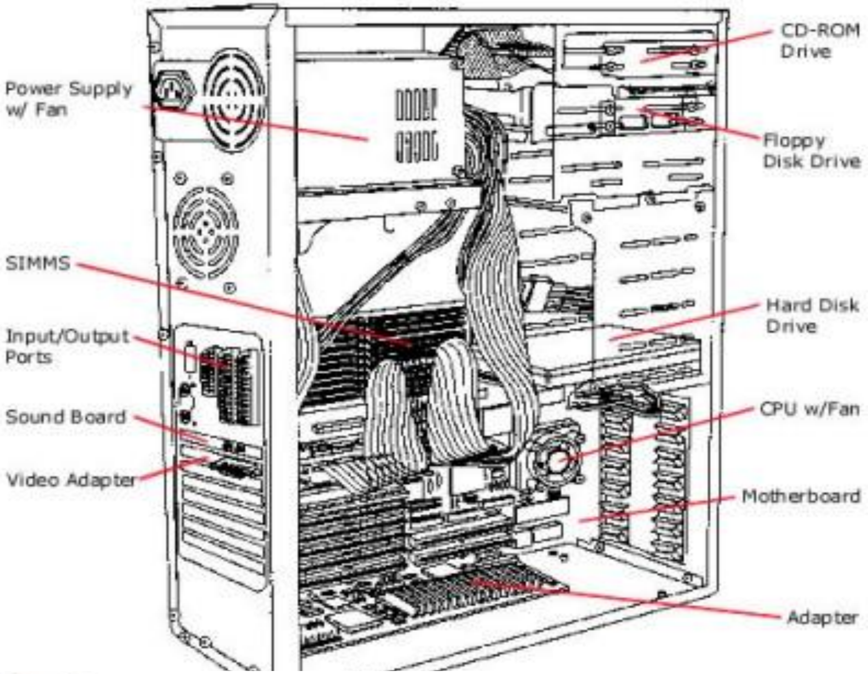
INTRODUCTION TO COMPUTER AND PROGRAMMING

Chapter 1

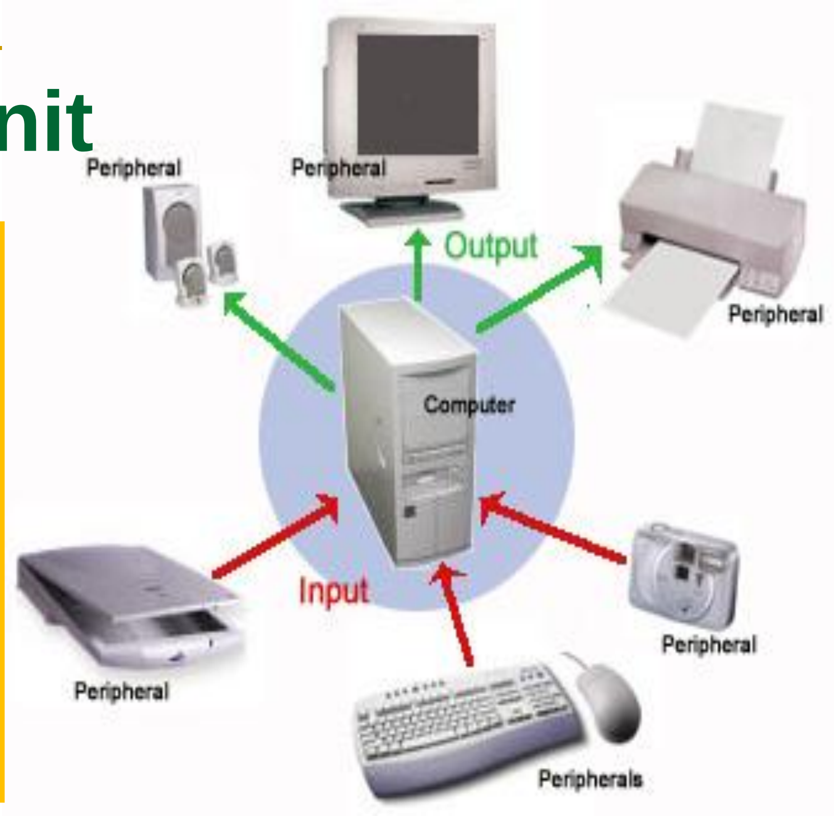
- Hardware and software
- Programming Languages
- Problem solution and software development
- Algorithms

Computer Hardware

- Input unit
- Output unit
- Memory unit
- ALU
- CPU
- Secondary storage



Input Unit and Output Unit



- **Input Unit**

  - It obtains information from various ***input devices*** and places this information at the disposal of the other units.

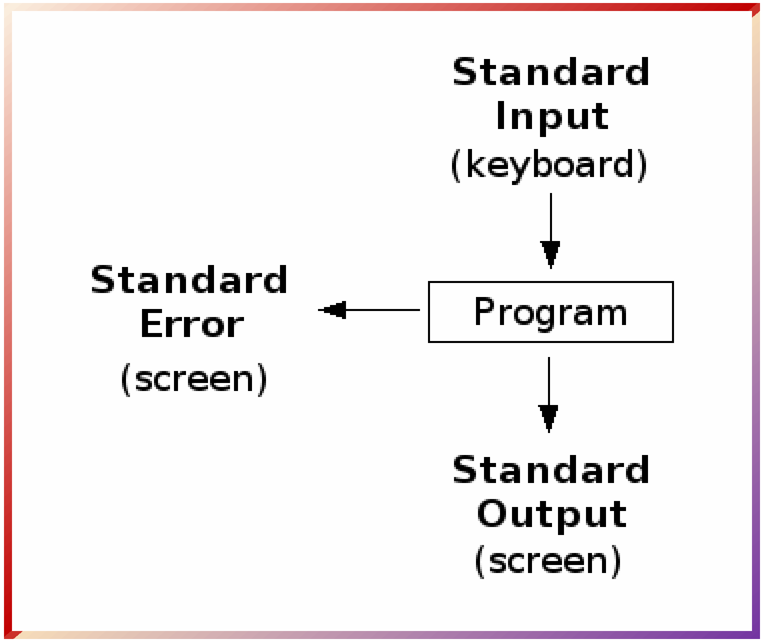
  - Examples of input devices: keyboards, mouse devices**.**

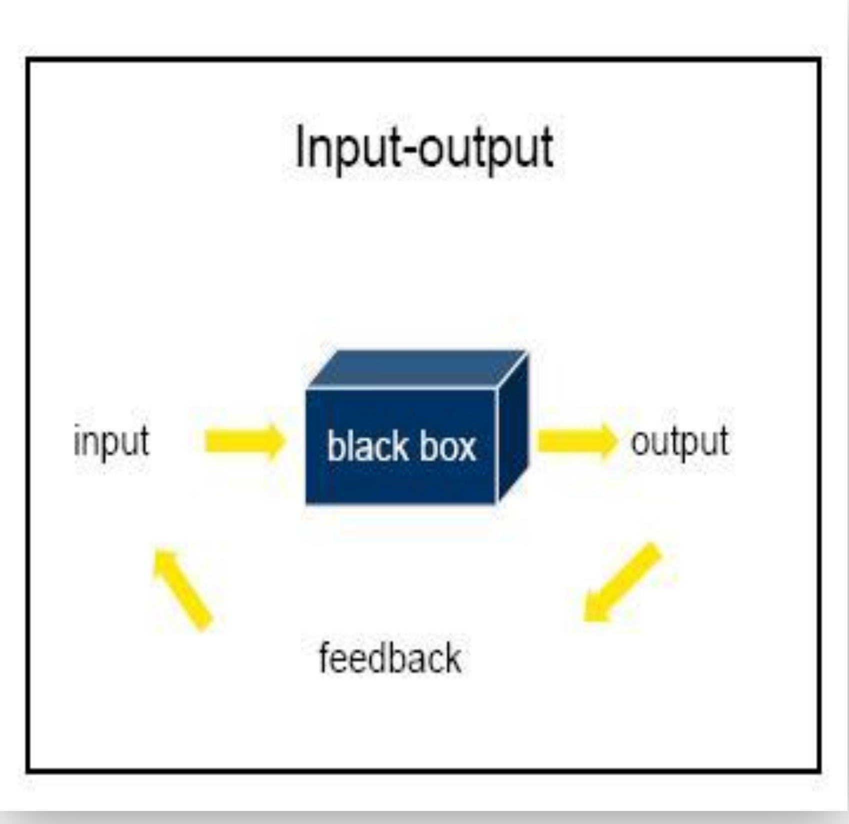
- **Output Unit**

  - It takes information that has been processed by the computer and places it on various ***output devices***.

  - Most output from computer is displayed on screens, printed on paper, or used to control other devices.

Input Unit and Output Unit



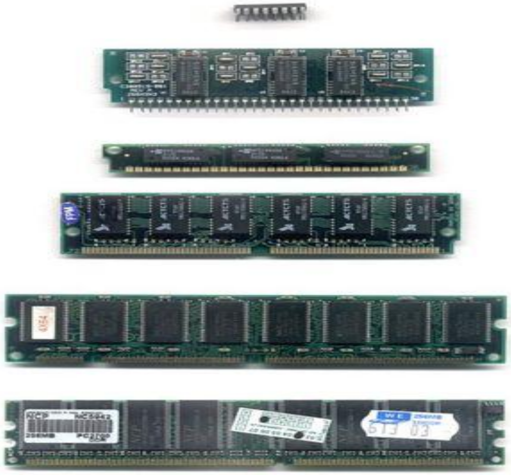


Memory Unit

- **The memory unit stores information. Each computer contains memory of two main types: RAM and ROM.**

- **RAM (*random access memory*)** is volatile. Your program and data are stored in RAM when you are using the computer.

- **ROM (*read only memory*)** contains fundamental instructions that cannot be lost or changed by the user. ROM is non-volatile.



ALU and CPU

- **Arithmetic and Logic Unit (ALU)**

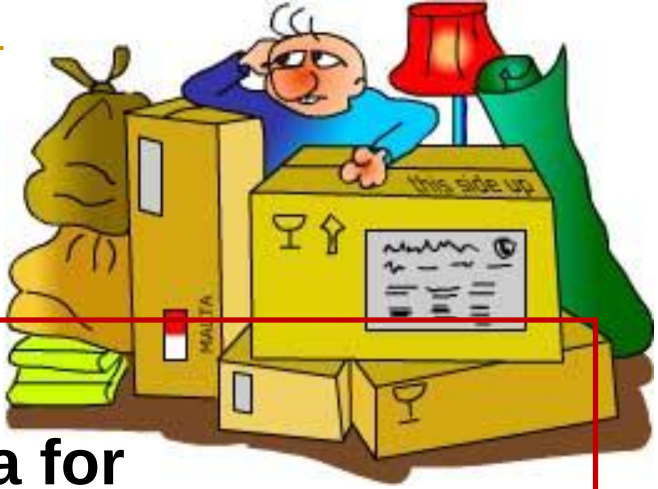
  ALU performs all the arithmetic and logic operations.

  Ex: addition, subtraction, comparison, etc..

- **CPU**

  The unit supervises the overall operation of the computer.

Secondary Storage



- Secondary storage devices are used to be permanent storage area for programs and data.

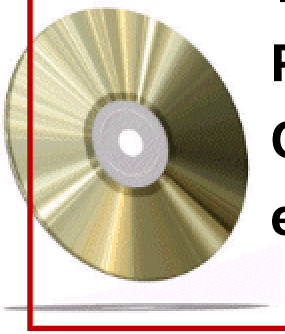
- Examples: magnetic tapes, magnetic disks and optical storage CD.

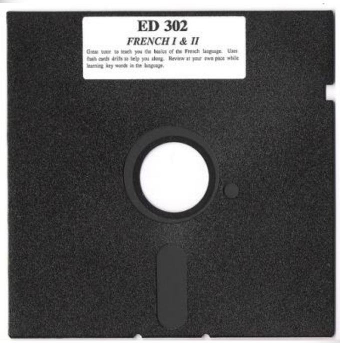
Magnetic hard disk

Floppy disk

CD ROM

etc..



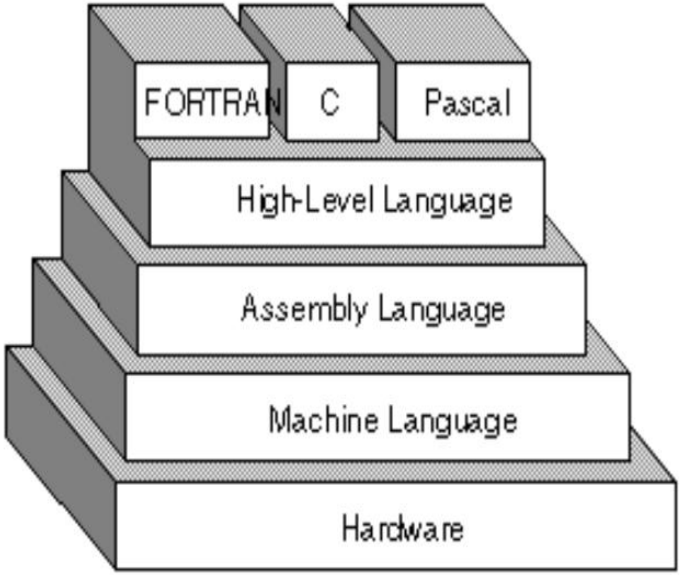


Some terminology

- A ***computer program*** is a set of instructions used to operate a computer to produce a specific result.
- Writing computer programs is called ***computer programming***.
- The languages used to create computer programs are called ***programming languages***.
- ***Software*** means a program or a set of programs

What we say to dogs
Okay, Ginger! I've had it! You stay out of the garbage! Understand, Ginger? Stay out of the garbage, or else!
What they hear
blah blah GINGER blah blah blah blah blah blah blah blah GINGER blah blah blah blah blah blah... blah blah

Machine languages



- **Machine languages are the lowest level of computer languages.** Programs written in machine language consist of 1s and 0s.
- **Programs in machine language can control directly to the computer's hardware.**
- **Example:**

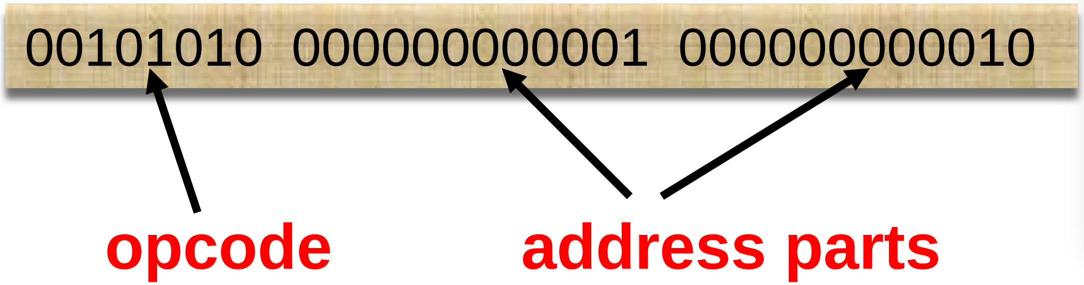
00101010 000000000001 000000000010

10011001 000000000010 000000000011

opcode **address parts**

Machine languages (cont.)

- A machine language instruction consists of two parts: an instruction part and an address part.
- The instruction part (*opcode*) tells the computer the operation to be performed.
- The ***address part*** specifies the memory address of the data to be used in the instruction.



00101010 000000000001 000000000010

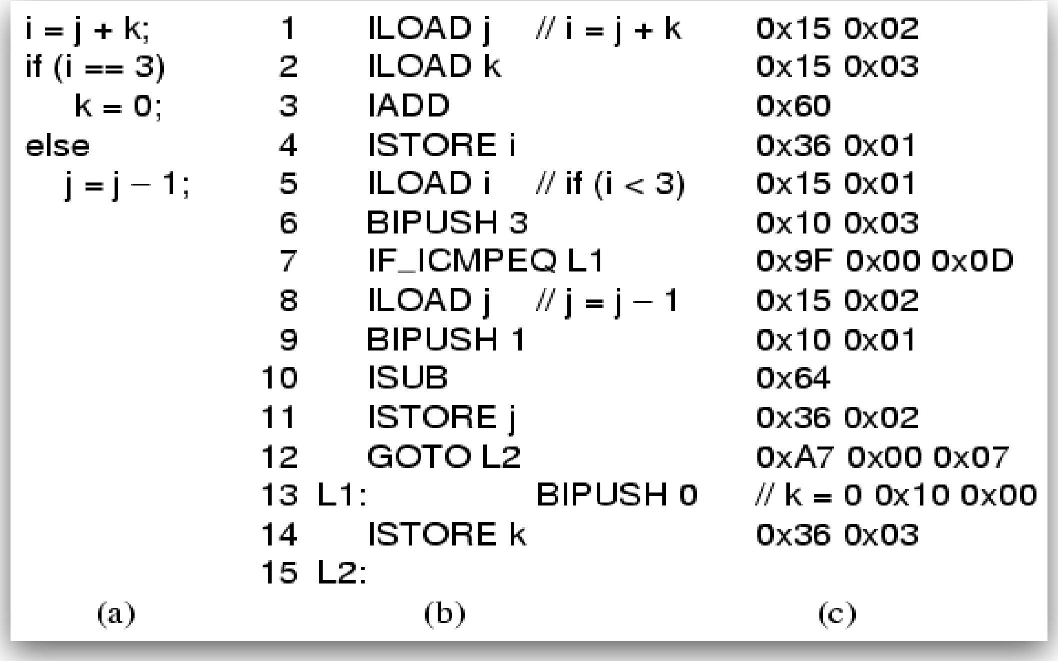
opcode

address parts

Assembly languages

- Assembly languages perform the same tasks as machine languages, but use symbolic names for opcodes and operands instead of 1s and 0s.

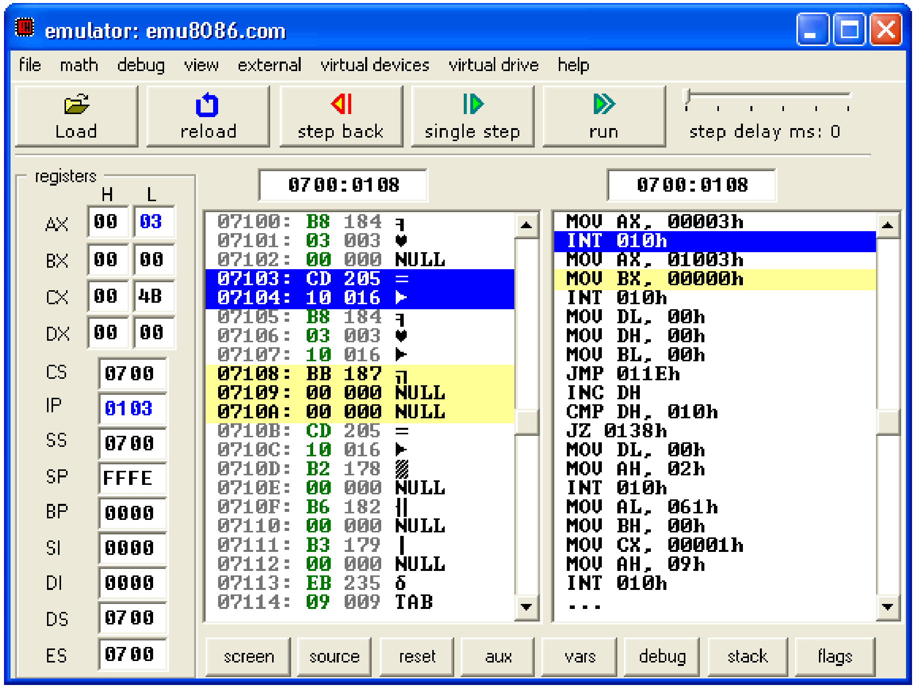
```
LOAD BASEPAY
ADD OVERPAY
STORE GROSSPAY
```



```
i = j + k;          1      ILOAD j    // i = j + k      0x15 0x02
if (i == 3)         2      ILOAD k                      0x15 0x03
   k = 0;           3      IADD                         0x60
else                4      ISTORE i                     0x36 0x01
   j = j − 1;       5      ILOAD i    // if (i < 3)     0x15 0x01
                    6      BIPUSH 3                     0x10 0x03
                    7      IF_ICMPEQ L1                 0x9F 0x00 0x0D
                    8      ILOAD j    // j = j − 1      0x15 0x02
                    9      BIPUSH 1                     0x10 0x01
                   10      ISUB                         0x64
                   11      ISTORE j                     0x36 0x02
                   12      GOTO L2                      0xA7 0x00 0x07
                   13  L1:              BIPUSH 0        // k = 0 0x10 0x00
                   14      ISTORE k                     0x36 0x03
                   15  L2:
       (a)                      (b)                          (c)
```

- An assembly language program must be translated into a machine language program before it can be executed on a computer.

Assembler



	H	L
AX	00	03
BX	00	00
CX	00	4B
DX	00	00

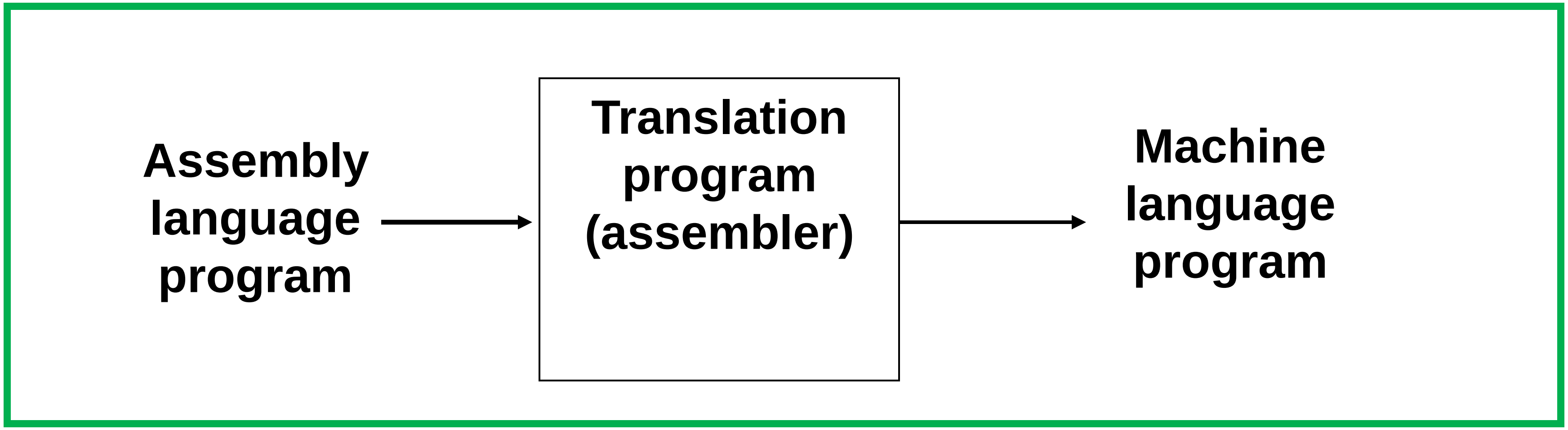
CS	0700
IP	0103
SS	0700
SP	FFFE
BP	0000
SI	0000
DI	0000
DS	0700
ES	0700

```
0700:0108

07100: B8 184 ╕
07101: 03 003 ♥
07102: 00 000 NULL
07103: CD 205 ═
07104: 10 016 ►
07105: B8 184 ╕
07106: 03 003 ♥
07107: 10 016 ►
07108: BB 187 ╗
07109: 00 000 NULL
0710A: 00 000 NULL
0710B: CD 205 ═
0710C: 10 016 ►
0710D: B2 178 ▓
0710E: 00 000 NULL
0710F: B6 182 ╢
07110: 00 000 NULL
07111: B3 179 │
07112: 00 000 NULL
07113: EB 235 δ
07114: 09 009 TAB
```

```
0700:0108

MOV AX, 00003h
INT 010h
MOV AX, 01003h
MOV BX, 00000h
INT 010h
MOV DL, 00h
MOV DH, 00h
MOV BL, 00h
JMP 011Eh
INC DH
CMP DH, 010h
JZ 0138h
MOV DL, 00h
MOV AH, 02h
INT 010h
MOV AL, 061h
MOV BH, 00h
MOV CX, 00001h
MOV AH, 09h
INT 010h
...
```

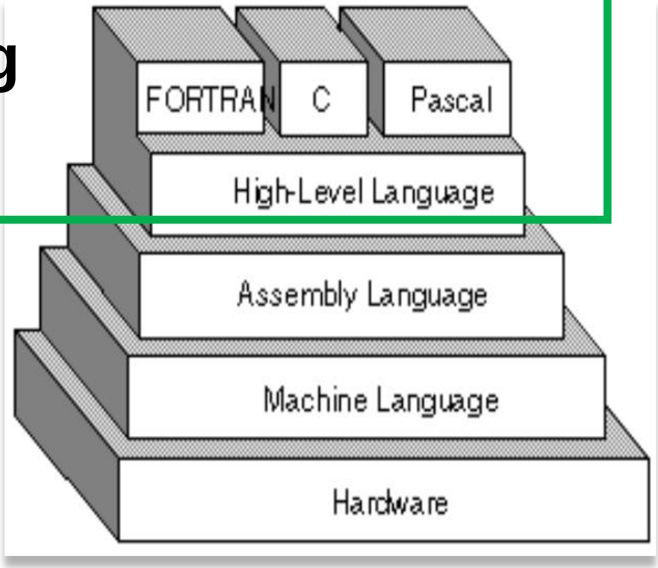

Assembly language program

Translation program (assembler)

Machine language program

High-level Programming Languages

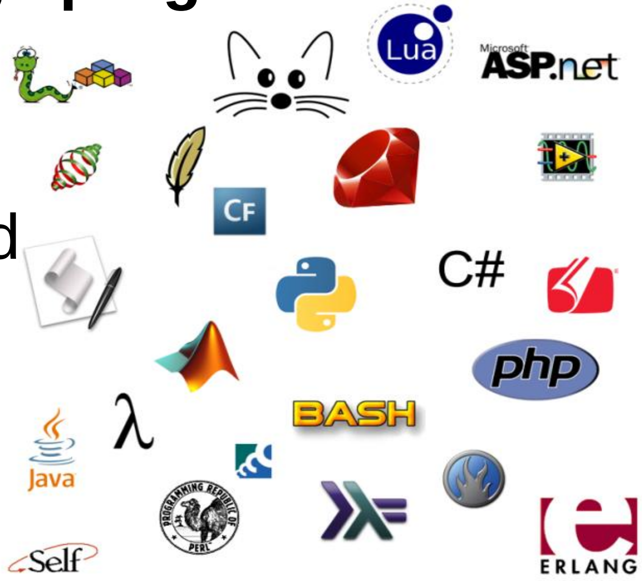
- **High level programming languages create computer programs using instructions that much easier to understand.**
- **Programs in a high-level languages must be translated into a low level language using a program called a *compiler*.**
- **A compiler translates programming code into a low-level format.**



High-level Programming Languages (cont.)

- **High-level languages allow programmers to write instructions that look like every English sentences and commonly-used mathematical notations.**
- **Each line in a high-level language program is called a *statement*.**
- **Example:**

  Result = (First + Second)*Third



Application and System Software

- Two types of computer programs are: application software and system software.
- *Application software* consists of those programs written to perform particular tasks required by the users.
- *System software* is the collection of programs that must be available to any computer system for it to operate.

Examples of system software

- The most important system software is the *operating system*.

  MS-DOS, UNIX, MS WINDOWS, MS WINDOWS NT

- Many operating systems allow user to run multiple programs. Such operating systems are called *multitasking systems*.

- Beside operating systems, *language translators* are system software.

PROGRAMMING LANGUAGES

- **Some well-known programming languages:**

FORTRAN	**1957**	
COBOL	**1960s**	
BASIC	**1960s**	
PASCAL	**1971**	**Structure programming**
C		
C++		**Object-oriented programming**
Java		

- **What is Syntax?**

A programming language's syntax is the set of rules for writing correct language statements.

The C Programming Language

- **In the 1970s, at Bell Laboratories, Dennis Ritchie and Brian Kernighan designed the C programming language.**
- **C was used exclusively on UNIX and on mini-computers. During the 1980s, C compilers were written for other platforms, including PCs.**
- **To provide a level of standardization for C language, in 1989, ANSI created a standard version of C, called ANSI C.**
- **One main benefit of C : it is much closer to assembly language other than other high-level programming languages.**
- **The programs written in C often run faster and more efficiently than programs written in other high-level programming language.**

The C++ Programming Language

- **In 1985, at Bell Laboratories, Bjarne Stroutrup created C++ based on the C language. C++ is an extension of C that adds object-oriented programming capabilities.**

- **C++ is now the most popular programming language for writing programs that run on Windows and Macintosh.**

- **The standardized version of C++ is referred to as ANSI C++.**

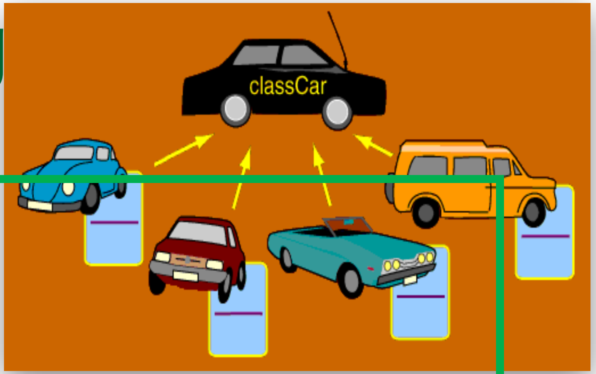
- **The ANSI standards also define *run-time libraries*, which contains useful functions, variables, constants, and other programming items that you can add to your programs.**

- **The ANSI C++ run-time library is called Standard Template Library or Standard C++ Library**

Structured Programming

- **During 1960s, many large softwares encountered severe difficulties. Software schedules were late, costs exceeded budgets and finished products were unreliable.**
- **People realized that software development was a far more complex activity than they had imagined.**
- **Research activity in the 1960s ⇒ *Structured Programming*.**
- **It is a discipline approach to writing programs that are clearer than unstructured programs, easier to test and debug and easier to modify.**
- **Pascal (Niklaus Wirth) in 1971.**
  - Pascal was designed for teaching structured programming in academic environments and rapidly became the preferred programming languages in most universities.

Object Oriented Programming

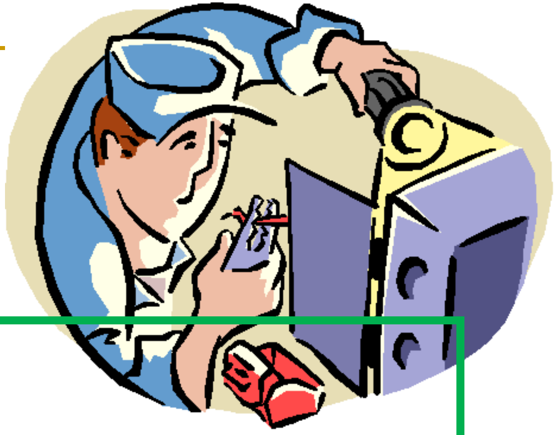


- **In the 1980s, there is another revolution in the software community: *object- oriented programming*.**
- **Objects are *reusable* software components that model items in the real world.**
- **Software developers are discovering that:** using a modular, object-oriented design and implementation approach can make software development much more productive.
- **OOP refers to the creation of reusable software objects that can be easily incorporated into another program.**

Object Oriented Programming (cont.)

- An *object* is programming code and data that can be treated as an individual unit or component.
- *Data* refers to information contained within variables, constants, or other types of storage structures. The procedures associated with an object are referred as *functions* or *methods*.
- Variables that are associated with an object are referred to as *properties* or *attributes*.
- OOP allows programmers to use programming objects that they have written themselves or that have been written by others.

PROBLEM SOLUTION AND SOFTWARE DEVELOPMENT



- **Software development consists of three overlapping phases**

  - Development and Design
  - Documentation
  - Maintenance

- **Software engineering is concerned with creating readable, efficient, reliable, and maintainable programs and systems.**

Phase I: Development and Design

The first phase consists of four steps:

1. ***Analyze the problem***

   Analyze the problem requirements to understand what the program must do, what outputs are required and what inputs are needed.

2. ***Develop a Solution***

   We develop an algorithm to solve the problem.

   Algorithm is a sequence of steps that describes how the data are to be processed to produce the desired outputs.

3. ***Code the solution***

   This step consists of translating the algorithm into a computer program using a programming language.

4. ***Test and correct the program***

Phase II: Documentation

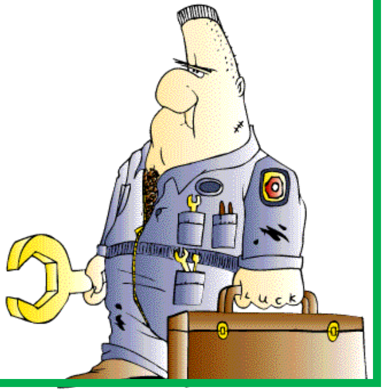
- **Documentation requires collecting critical documents during the analysis, design, coding, and testing.**
- **There are five documents for every program solution:**

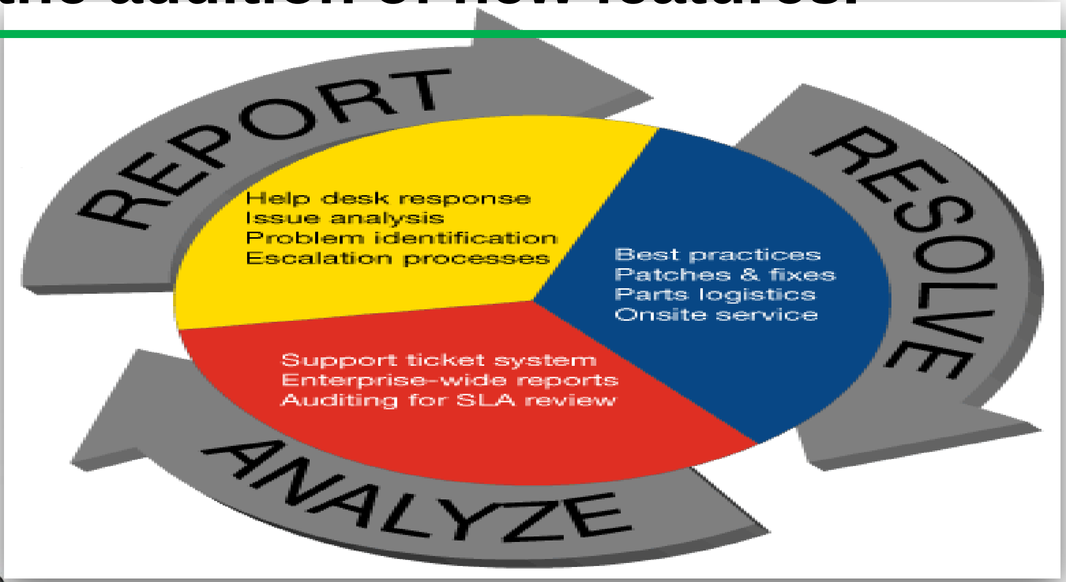
FRANCHEMENT, MAMAN, TU ME DÉÇOIS... EST-CE QUE JE LIS DES LIVRES SUR LE "TROISIÈME ÂGE" MOI ?!
N'EXISTE PAS
Anne-Catherine

- Program description
- Algorithm development and changes
- Well-commented program listing
- Sample test runs
- User's manual

Phase III: Maintenance

- This phase is concerned with
  - the ongoing correction of problems,
  - revisions to meet changing needs and
  - the addition of new features.





REPORT

Help desk response
Issue analysis
Problem identification
Escalation processes

RESOLVE

Best practices
Patches & fixes
Parts logistics
Onsite service

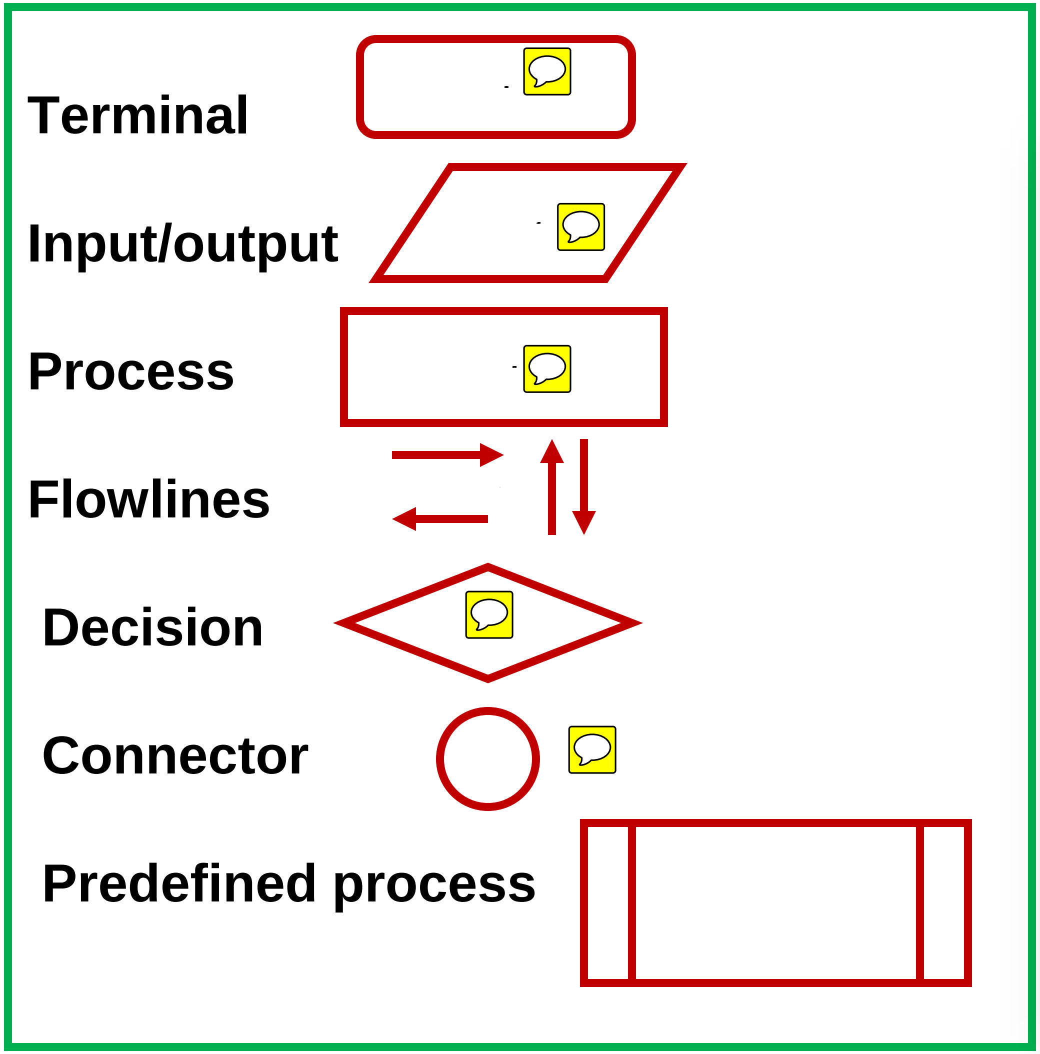
ANALYZE

Support ticket system
Enterprise-wide reports
Auditing for SLA review

ALGORITHMS

- You can describe an algorithm by using flowchart symbols. By that way, you obtain a flowchart.
- *Flow chart* is an outline of the basic structure or logic of the program.
- Another way to describe an algorithm is using *pseudocode*.
- Since flowcharts are not convenient to revise, they have fallen out of favor by programmers. Nowadays, the use of pseudocode has gained increasing acceptance.

Flowchart symbols



Terminal

Input/output

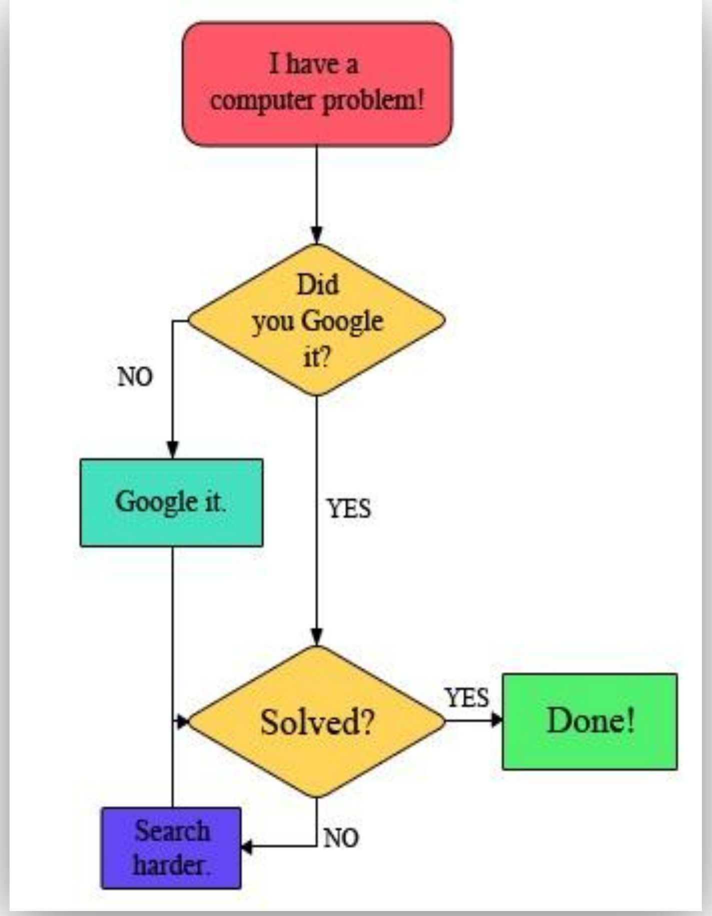
Process

Flowlines

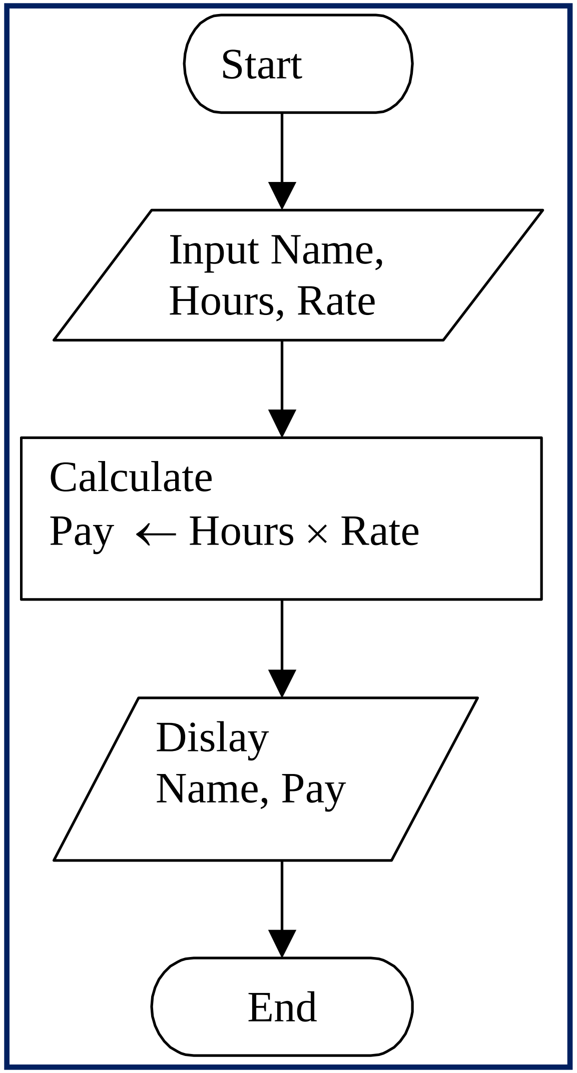
Decision

Connector

Predefined process



Example



Note:

Name, Hours and Pay are *variables* in the program.

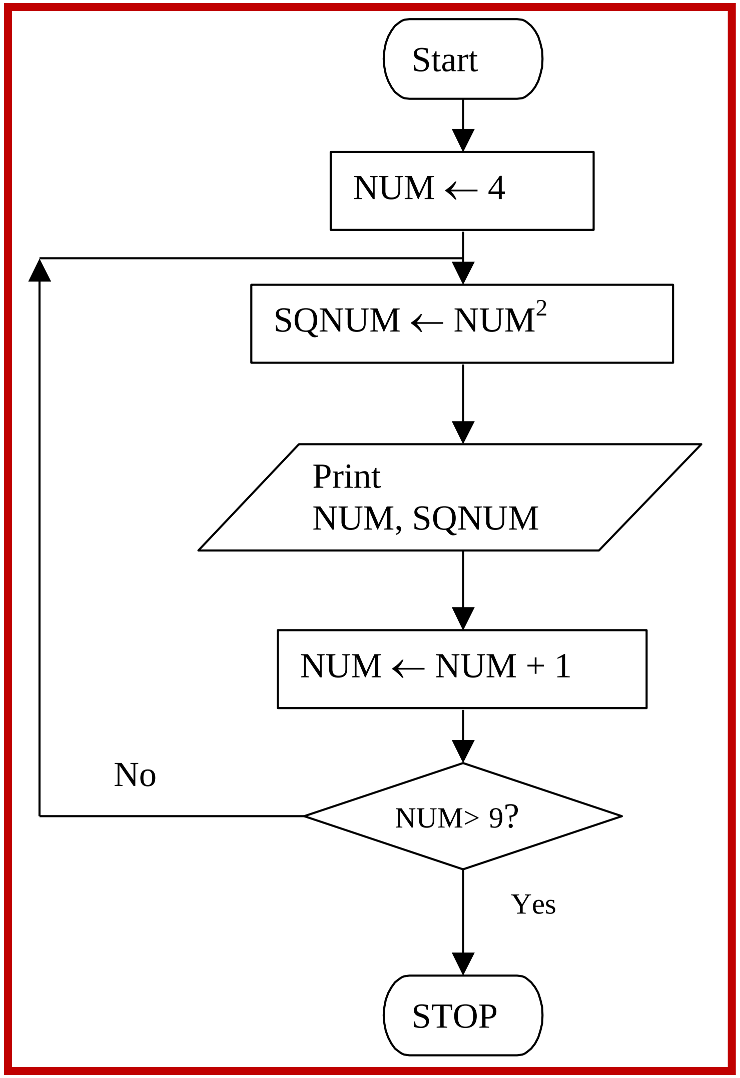
Algorithms in pseudo-code

- You also can use English-like phases to describe an algorithm. In this case, the description is called ***pseudocode***.

- **Example**:

```
Input the three values into the variables Name, Hours, Rate.
Calculate      $Pay = Hours \times Rate$.
Display Name and Pay.
```

Loops



Note:

1. **Loop is a very important concept in programming.**

2. **NUM ← NUM + 1 means**

old value of NUM + 1 becomes new value of NUM.

The algorithm can be described in pseudocode as follows:

```
NUM ← 4
do
    SQNUM ← $NUM^2$
    Print NUM, SQNUM
    NUM ← NUM + 1
while (NUM <= 9)
```

Exercise