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.

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**

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.**

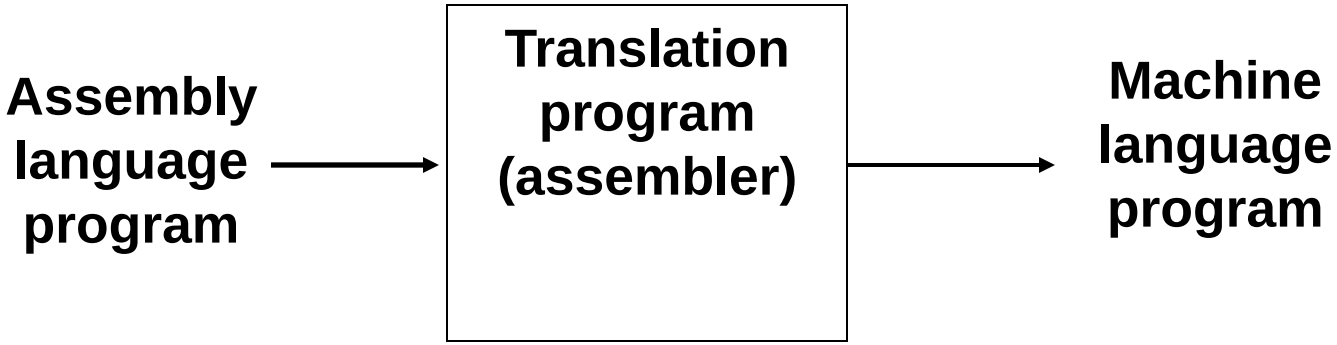
Assembly languages

- **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
```

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

Assembler


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 flatforms, 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.**
  - *Chapter 5* discusses the principles of structured programming.
- **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. *Analyse the problem*

Analyse 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:**

  - 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.**

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.**

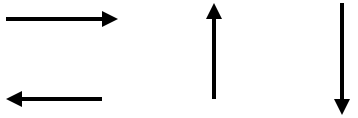
Flowchart symbols

Terminal

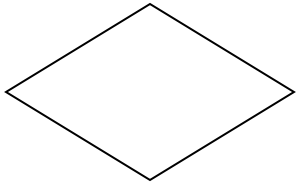
Input/output

Process

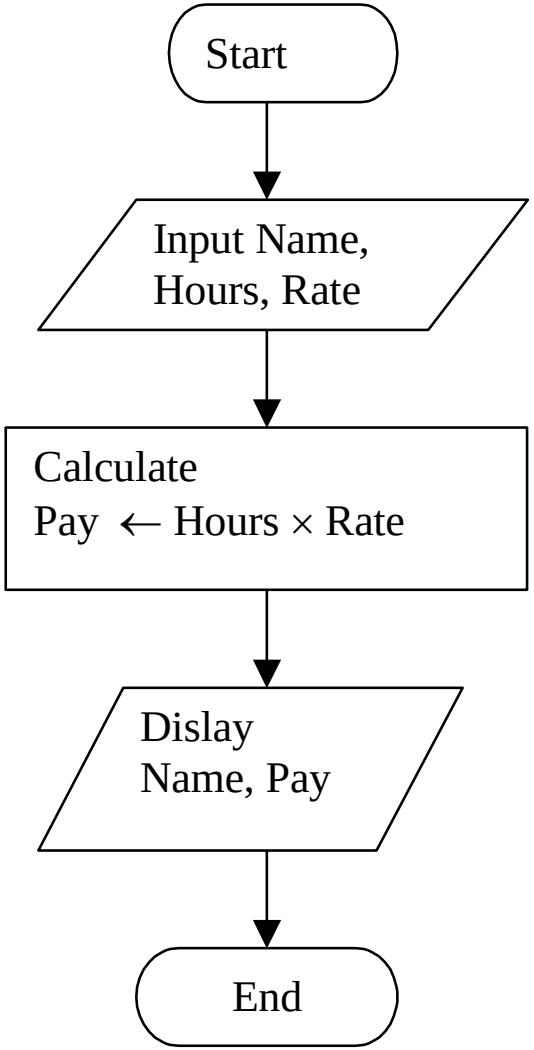
Flowlines



Decision



Example



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

Algorithms in pseudo-code

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

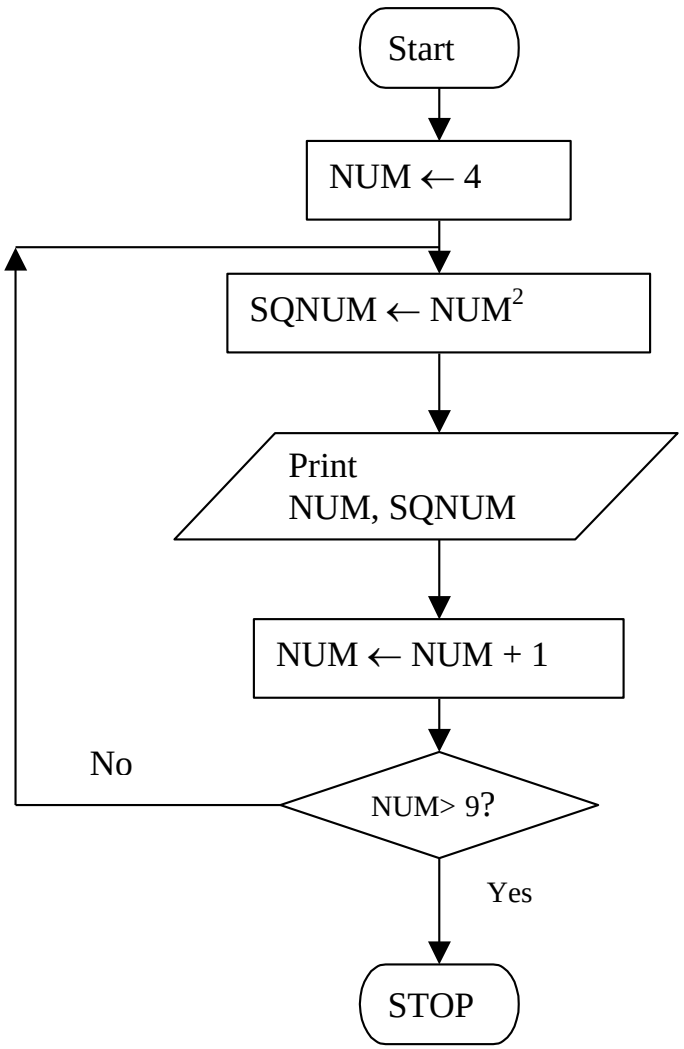
- **<u>Example</u>:**

  Input the three values into the variables Name, Hours, Rate.

  Calculate Pay = Hours × 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← NUM²

Print NUM, SQNUM

NUM ← NUM + 1

while (NUM <= 9)