Algorithms and Data Structure 01

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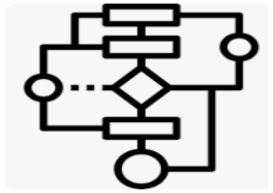
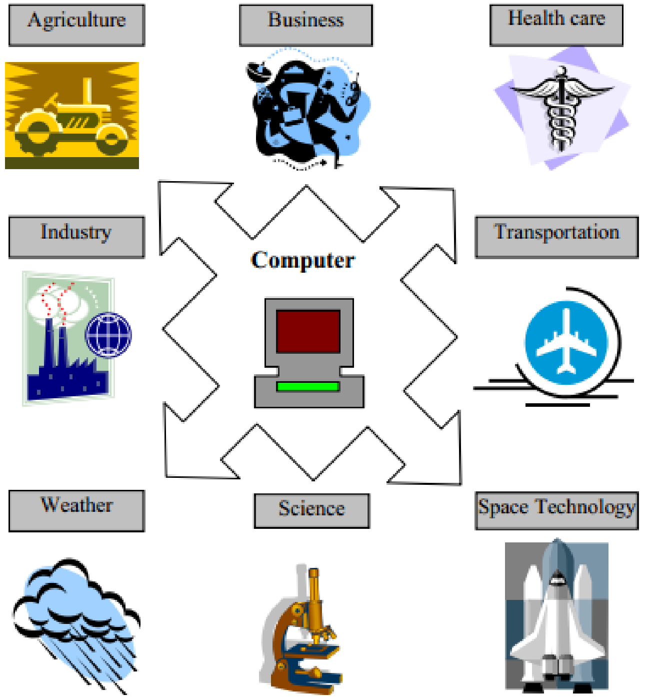
Chapter #01 Introduction



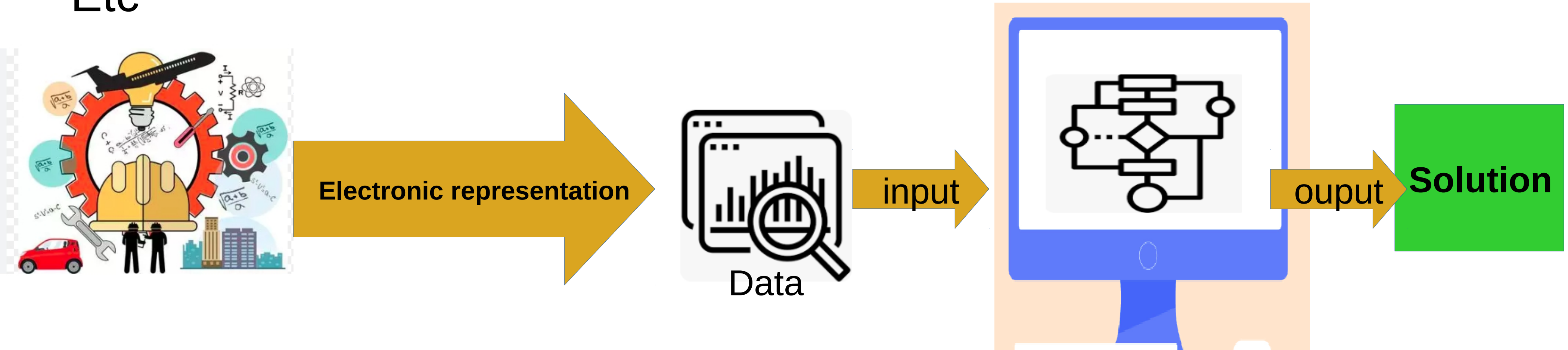
- Historical fact about algorithms and computing
  - Computer are omnipresent.
  - Any discipline that calls for ***problem solving using computers*** looks up to the discipline of computer science.
  - They seek efficient and effective methods of solving the problems in their respective fields.



Chapter #01 Introduction

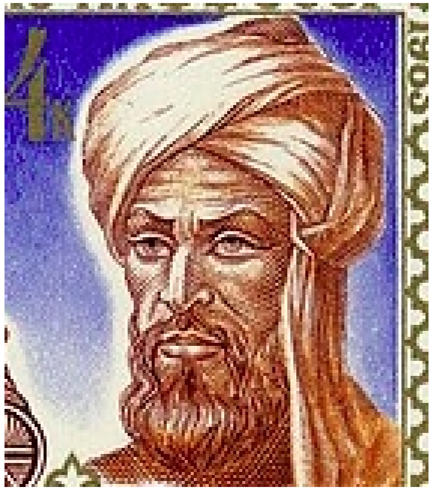
Computer science seeks to process data to solve real world problem :

- Patient data in order to detect disease
- Car data in order to detect faults
- Processing finance data in order to make prediction about trading
- Processing data about production in order to optimize production chain.
- Etc



History of Algorithm

- The word **algorithm** originates from the Arabic word algorism**,** which is linked to the name of the Arabic mathematician Abu Jafar Mohammed Ibn Musa Al Khwarizmi (825 CE).



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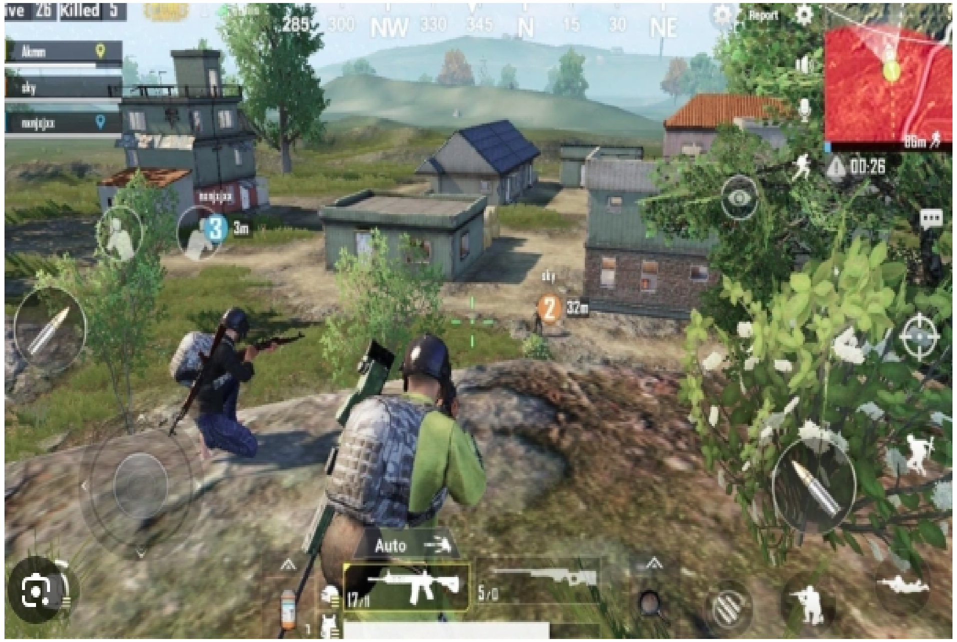
Example of Algorithms

Let us take for exmaple Pubg mobile game,
As you can see , we can find many Algorithms :
-The data in this situation are
Players health, The scene, the guns, communication etc.

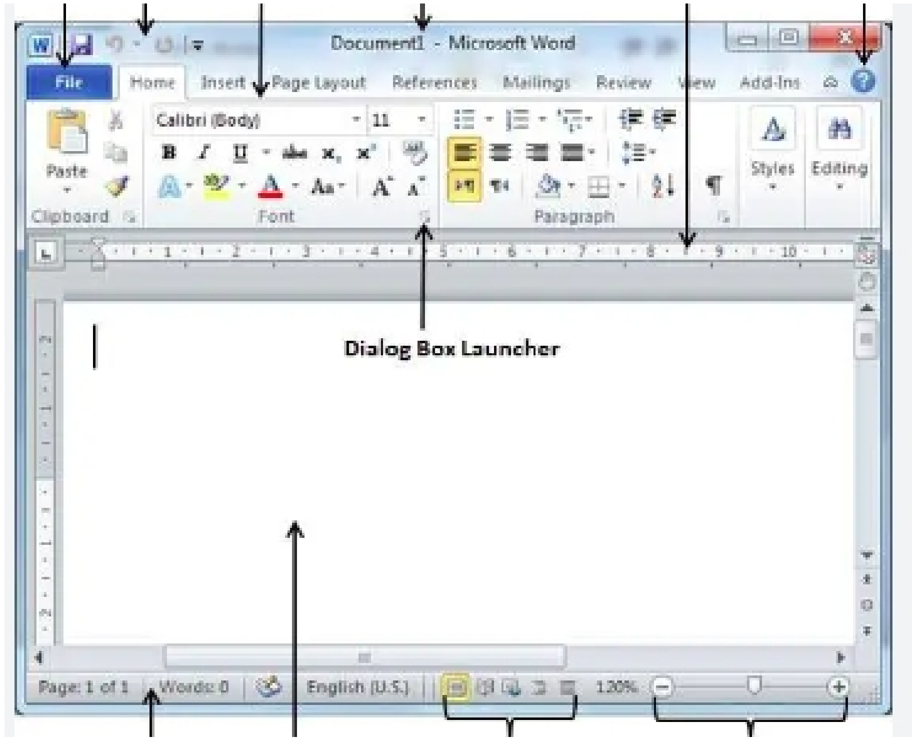


1) When the player move, all the scene should
2)be updated accordignlly
3)When the player get shout or shout another
4)the score of health level should be updated
5)The communication between the players
6)The loaded gun
7)The other objects should be deformed
8)when an explosion is fired

Example of Algorithms

Let us take for exmaple Microsoft Word
-The data in this situation are
Text, Images, shapes, colors etc
communication etc.

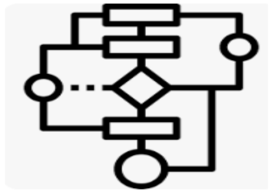
1) count character number,
2) copy/past text
3)Find text
4)Replace Text
5)Print the document
6)etc



Banking software
-The data in this situation are
Account, costumers name
Company names, etc

1) Keeping account balance
2) Online payment
3) Tracking frauds
4)etc

We can find Algorithm in any software

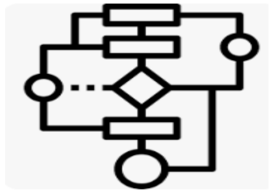


Social networks
 Recommending **content**
1) Keeping contact/ messaging
2) Keeping track of the interaction
3)Updating the network.
4)etc

Car boarding Software

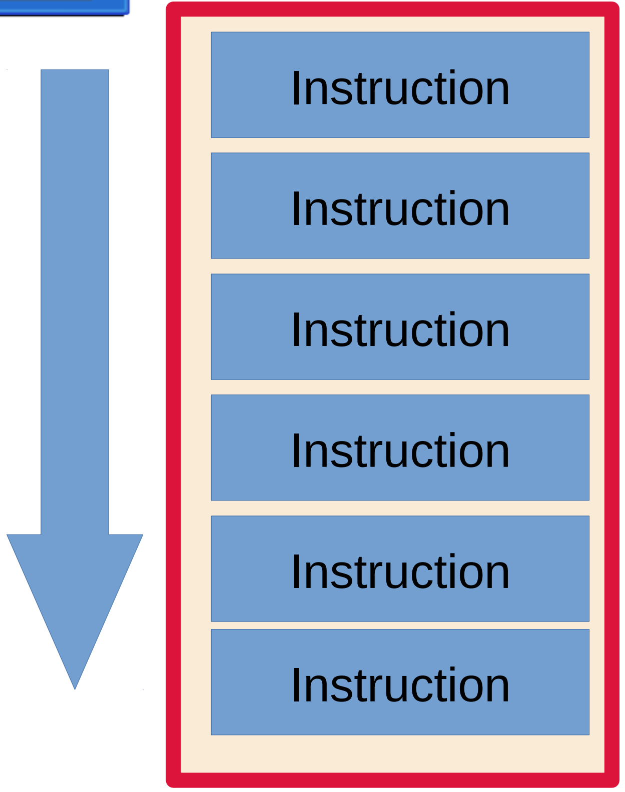
1)Controlling the engine
2)Tracking the Faults
3) Navigation etc.

Definition



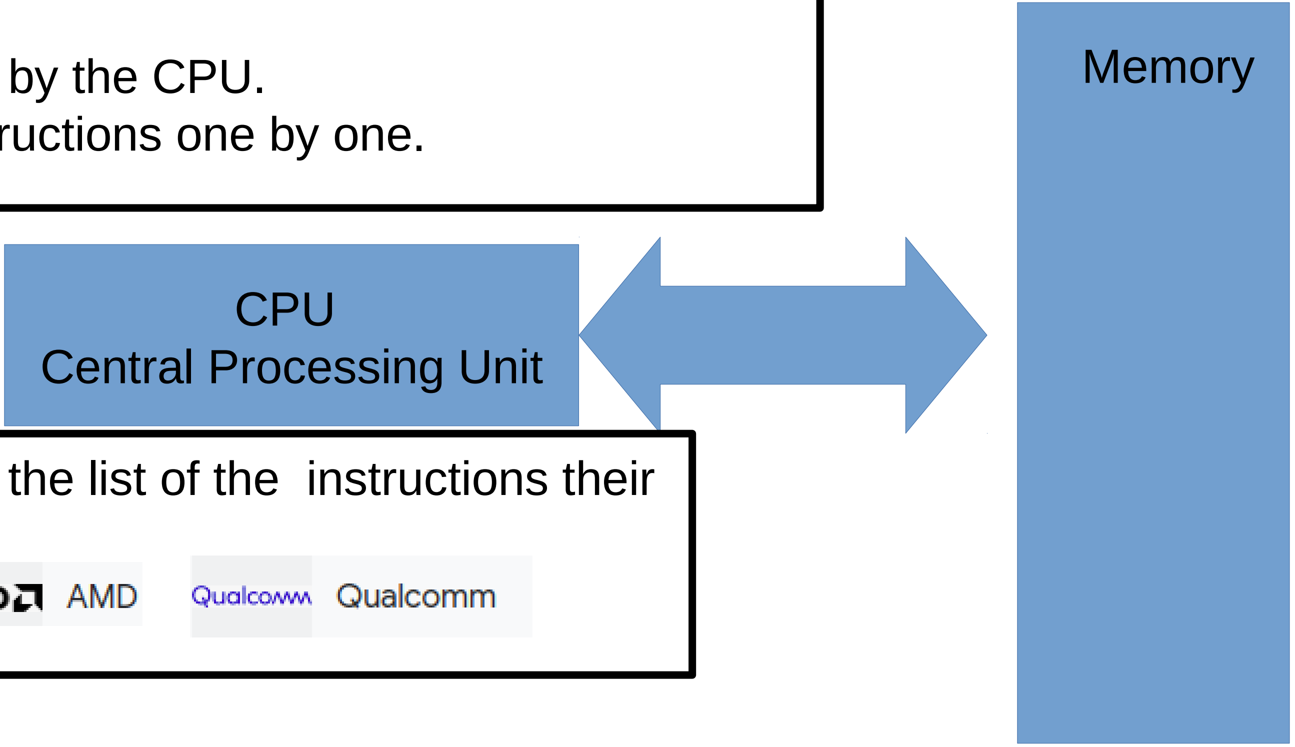
An **algorithm** is a **finite sequence** of **instructions**, each of which
has a **clear meaning** and can be performed with a **finite amount** of **effort** in a **finite**
length of **time**.

Structure :
Genneraly an algorithm has the following structure :
- Input Step
- assignment step
- decision step
- repetitive step
- output step



What are instructions ?

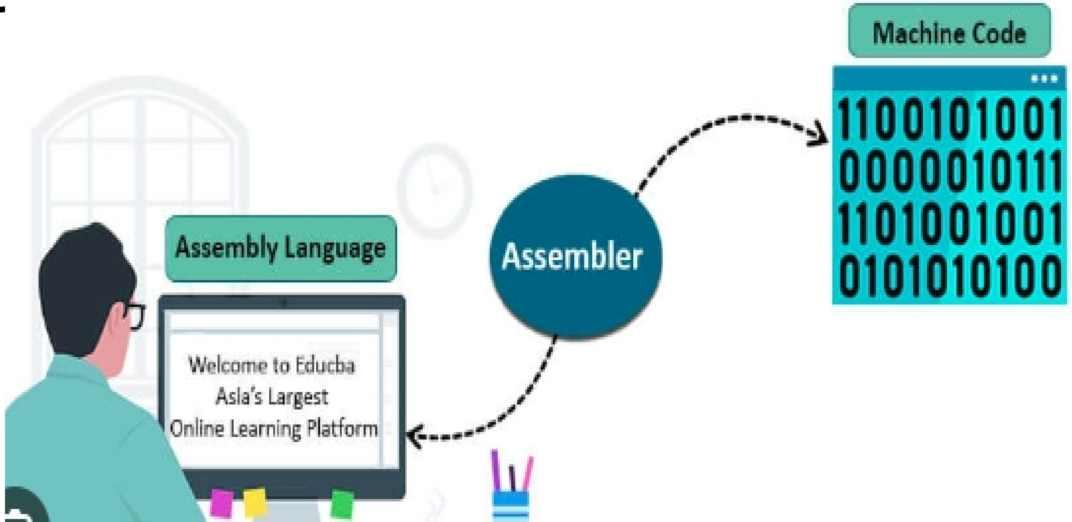
Let us first see how computer are internally designed !
Every data is stored in the memory of the computer before it is processed
- then it is retreved by the CPU
- and every Instructions is executed by the CPU.
- CPU execute the sequence of instructions one by one.



The manufacture of the CPU define the list of the instructions their CPU can execute.
For example : Intel AMD Qualcomm

What are instructions ?

- An algorithm one designed , can then be implemented using a programming language, and then translated (**compiled**) to machine language (Instructions

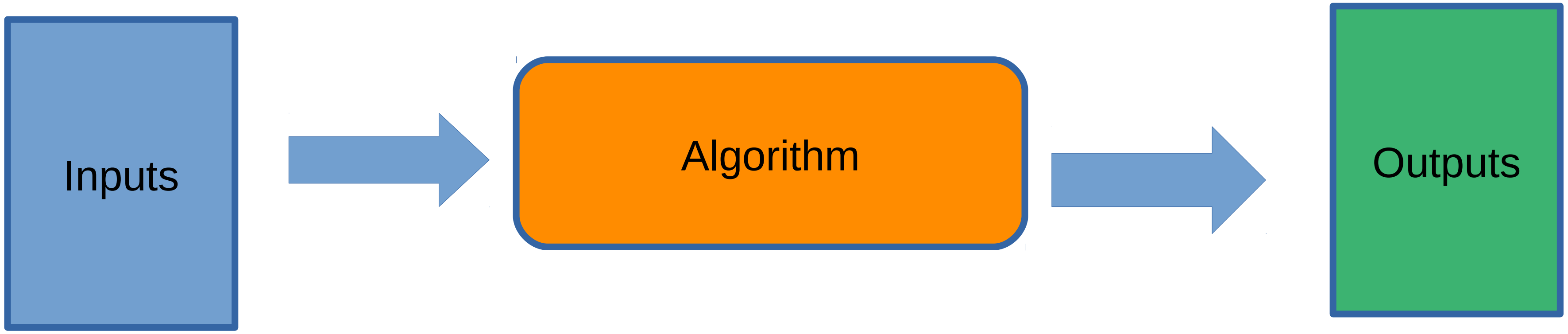


Properties of an Algorithm

Finiteness

– **Finiteness**: an algorithm must **terminate** after a **finite number of steps**.

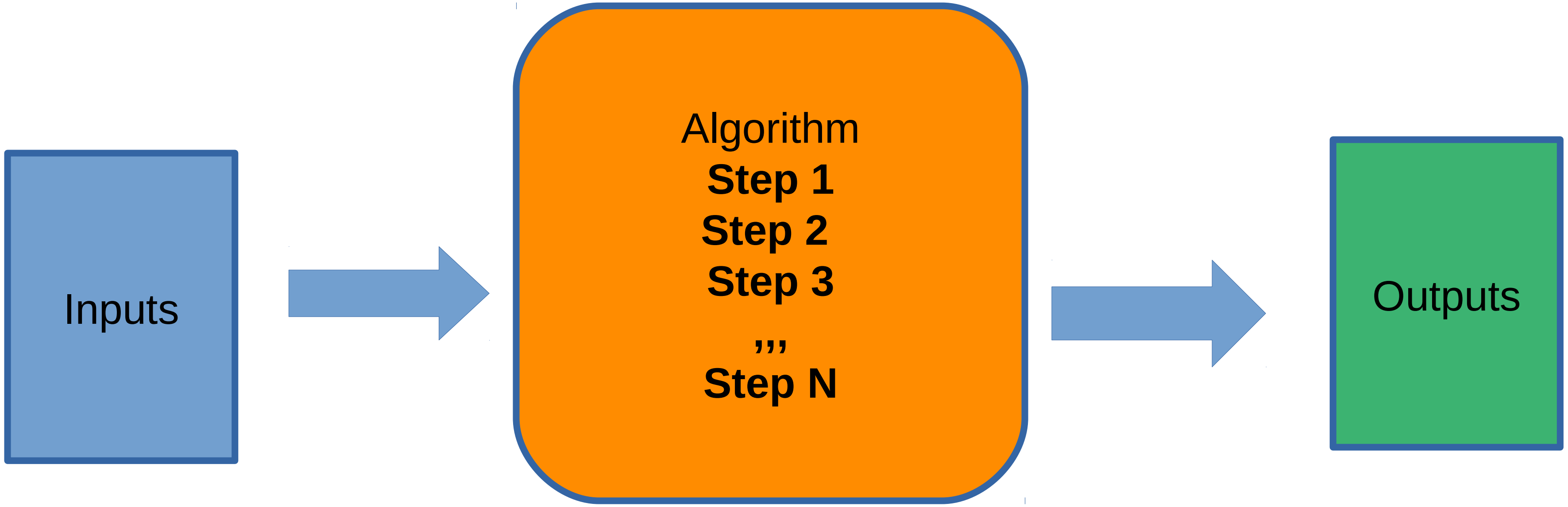
-Once it has all the inputs , an algorithm must in reasonable time give us an answer, in form of output, and don’t last forever !



Properties of an Algorithm

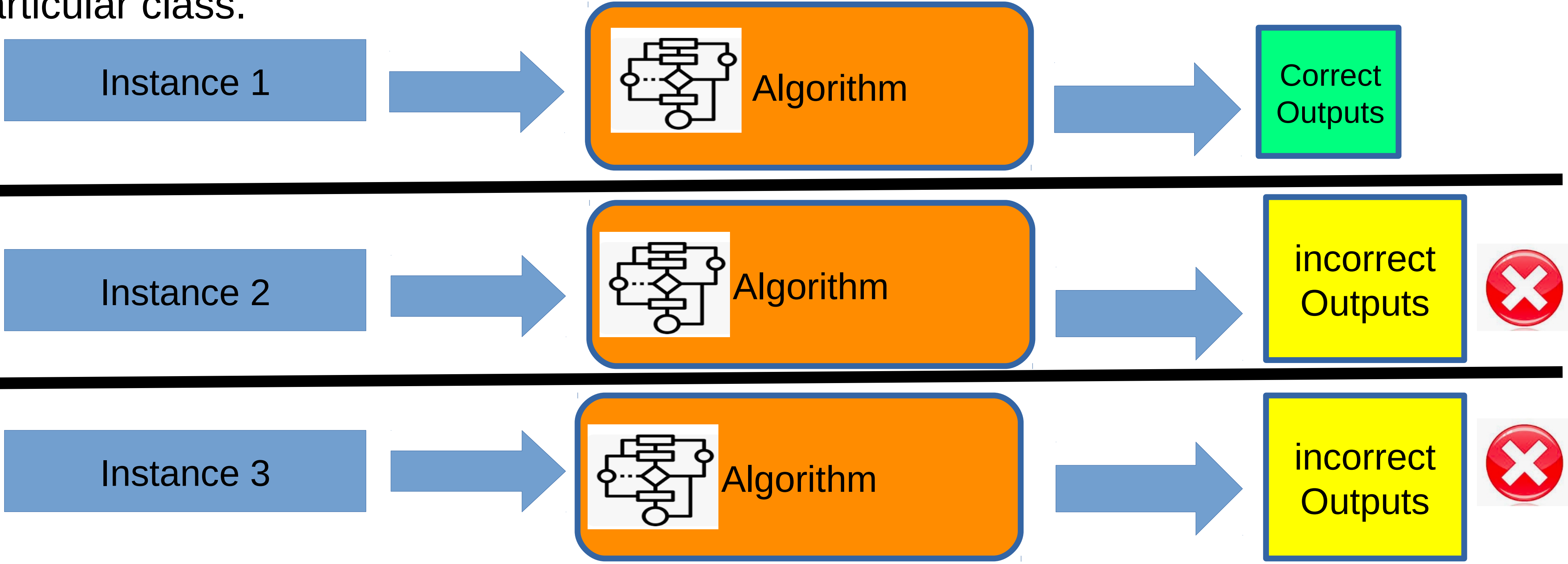
Definiteness

–**Definiteness**: the steps of the algorithm must be **precisely** defined or **unambiguously** specified.



Generality

– **Generality**: an algorithm must be **generic** enough to solve all problems of a particular class.



Generality

Example of non generic algorithm

```
Algorithm non Generic
Begin
 read X

 if X > 0 then

         print("X is positive")
 else
         print("X is negative")
end
```

Instance 1
Let x = 10
The output is correct

Instance 2
Let x = -10
The output is correct

What if we put
X=0 ???
The output is incorrect

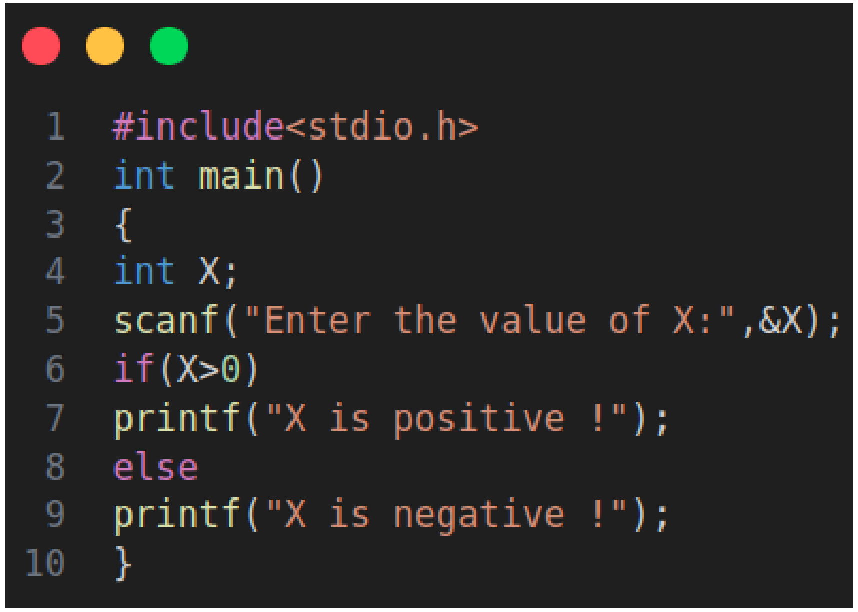
Generality

Example of non generic algorithm

```
Algorithm non Generic
Begin
 read X
 if X > 0 then

        write(“X is positive”)
 else
        write(“X is negative”)
end
```

The same algorithm written in C



```c
#include<stdio.h>
int main()
{
int X;
scanf("Enter the value of X:",&X);
if(X>0)
printf("X is positive !");
else
printf("X is negative !");
}
```

Effectiveness

– **Effectiveness**: the operations of the algorithm must be **basic**. They should not be too **complex** to warrant writing another **algorithm** for the **operation**!

– Input–output: the algorithm must have certain initial and precise inputs, and outputs that may be generated both at its intermediate or final steps.

Write simple sequential Algorithms
Working with **variables**

An Algorithm as described , is a sequence of finit instructions, executed by the computer in order to obtain the desired output.
It manipulates Data which are stored in the memory of the computer, and this is done through **Variables**

Variable: A variable is a named location in a the computer memory, it holds data. It can represent various **types** of **information**, such as **numbers**, **text**, or **objects**, and its **value** can **change** during **program execution**.

In this example, we have two memory locations, a variable nammed **X**, and another called **firstname**.
The first can contain a **number**, and the second can contain a **text**

variable	**adress**	**value**
X	0001	10
firstname	0002	“sabri”

Write simple sequential Algorithms
Working with **variables**

When we want to use a variable in our algorithm we need to **declare** it first.
This means that we give it :

- a **name** : any sequence of charactere, ofcourse except key words.
- a **type**: depending on what we want to store in that variables

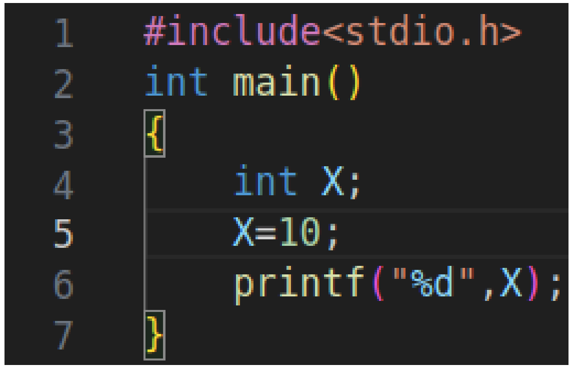
type	**range**	**examples**
int	Integer number - ∞ to +∞	10 , +5 , - 2500 , -50
float	A real number - ∞ to +∞	10.0055, - 3.14325, 2.5 e^12
char	Any alphanumeric symbole	‘a’, ‘b’, ‘Z’, ‘#’, ‘$’ … ec
char[]	A sequence of character	“annaba”, “Algerie”, “karim”

Write simple sequential Algorithms
Working with **variables**

Via variables we can manipulate the memory location, we can put data in it by using **assignement**, as described in the example, we use ← to indicate the assigement.

```
Algorithm Example
 X: Int;
begin
   X← 10 ;
   print( X);
end
```

in C



```c
#include<stdio.h>
int main()
{
    int X;
    X=10;
    printf("%d",X);
}
```

before

variable	adress	value
X	0001	

after

variable	adress	value
X	0001	10