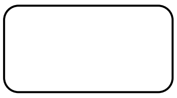
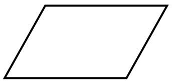
Chapter 3: Conditional Structures

1. Introduction :

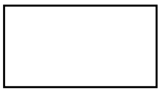
- Control structures also called structured instructions (actions).
  They make it possible to express the way of the sequence of execution of the instructions of an algorithm.
- There are three fundamental structures:
  1) Sequential actions,
  2) Conditional actions,
  3) Repeat actions.
- To describe these structures we use a textual notation (algorithm) and a graphic notation (flowchart).
- In a flowchart, the following symbols are used:



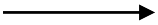
Represents the start and the end of the flowchart



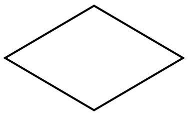
Inputs / Outputs: Reading of data and writing of results.



Represents Actions (processing)



Represents the order of execution of operations (Sequence)



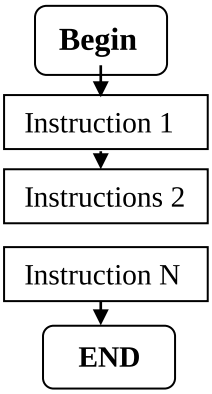
Represent conditions (Testing and decision)

2. Sequential actions:

- Sequential Actions come in the form of an ordered sequence of instructions grouped together in a block.

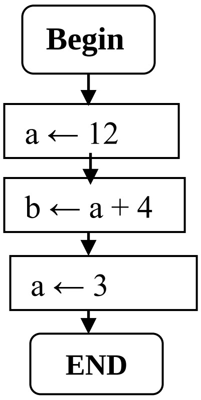
<u>Syntax:</u>

```
    Begin
            Instruction 1;
            Instruction 2;
            …… ……
            Instruction N;
    END.
```



Example :

```
 Algorithm exp_sequ
        a, b: integer;
Begin
a← 12; (Instruction 1)
b←a+4; (Instruction 2)
a ← 3; (Instruction 3)
END.
```



Execution trace:

	a	b
begin	**?**	**?**
a← 12;	**12**	**?**
b←a+4;	**12**	**16**
a ← 3;	**3**	**16**
END.	**3**	**16**

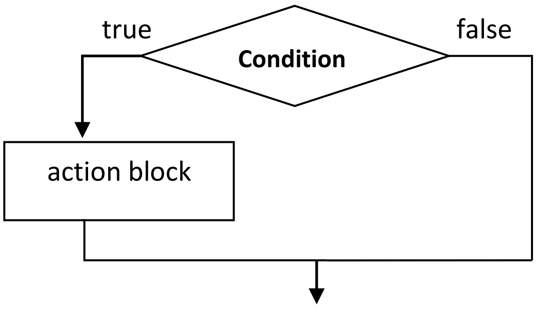
3. Conditional action:

3.1. Simple conditional action:

- ➢ It consists of two parts: condition and action.
  - ✓ The (condition) part describes a state which can be true or false (Boolean type expression).
  - ✓ The <Action Block> part represents a piece of an algorithm (one or more instructions).

Syntax:

```
……….
If (condition) then
        < Block of actions (instructions)>
End if
………
```

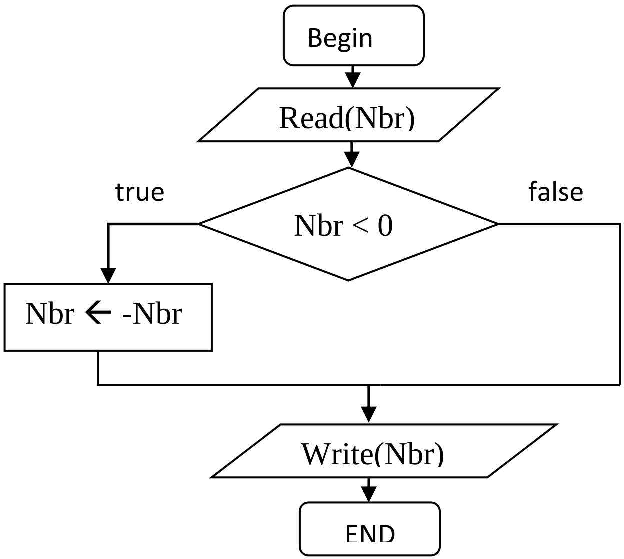


Execution of the conditional action:

- ➢ If the condition is checked (**true**), the instructions of the < Block of actions > are executed then we continue the execution of the actions (instructions) located after the **End if**.
- ➢ If the condition is not verified (**false**), the part < Block of actions > inside the **If** is not executed and the execution of the algorithm is continued directly from the instruction which follows the **End if**.

Example: Write an algorithm that reads a real number identified by 'Nbr', then gives its absolute value.

```
Algorithm val_abs
        Nbr: real;
Begin
        Read (Nbr);
        If (Nbr < 0) then
                Nbr ← - Nbr ;
        End if
        Write (Nbr);
END.
```



Syntax in C++ language:

```
……….
If (condition) then
        < Actions block (instructions)>
End if
```

```
…………..
if (condition) {
< Actions block (instructions)>
}
```

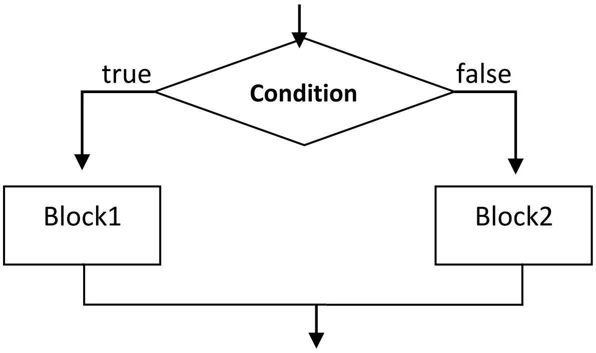
Noticed :

- The condition is a Boolean type expression so it must include at least one comparison operator (<, >, =, ≠, etc.) or a Boolean variable.

3.2. Alternative action:

Syntax:

```
………
If (condition) then
        < Block of actions1(instructions) >
else
        < Block of actions2(instructions) >
End if
………
```



Example: Write an algorithm that reads two real numbers and then determines the biggest of them?

```
Algorithm biggestNbr
        x, y,Max: real;
Begin
read(x);
read(y);
If (x > y) then
        Max←x;
else
        Max←y;
End if
Write ('The biggest number is:', Max);
END.
```

Syntax in C++ language

```
………                                            ………………….
If(condition) then                               if(condition) {
        < Actions block1 (instructions) >         < Actions block1 (instructions) >
                                                 }
else                                             else
                                                 {
        < Actions block2 (instructions) >        < Actions block2 (instructions) >
End if                                           }
………                                            …………….
```

Noticed:

- We can see an entire control structure as a single action (< Action block >) so there can be several **nested** control structures.

```
If (condition1) then
        If (condition2) then
        < Block of actions1 (instructions) >
        Else
        < Block of actions3(instructions) >
        End if
Else
        < Block of actions2(instructions) >

    End if
```

Example : Write an algorithm that reads two real numbers and then determines the biggest of them?

```
Algorithm biggest
        x, y, Max: real;
Begin
Read (x, y);
If (x = y) then
Write (' Both are equal');
Else  //x ≠ y
        If (x > y) then
        Max← x;
        Write ('The biggest number is:', Max);
        Else  //x < y
        Max←y;
        Write ('The biggest number is:', Max);
        End if
End if
END.
```

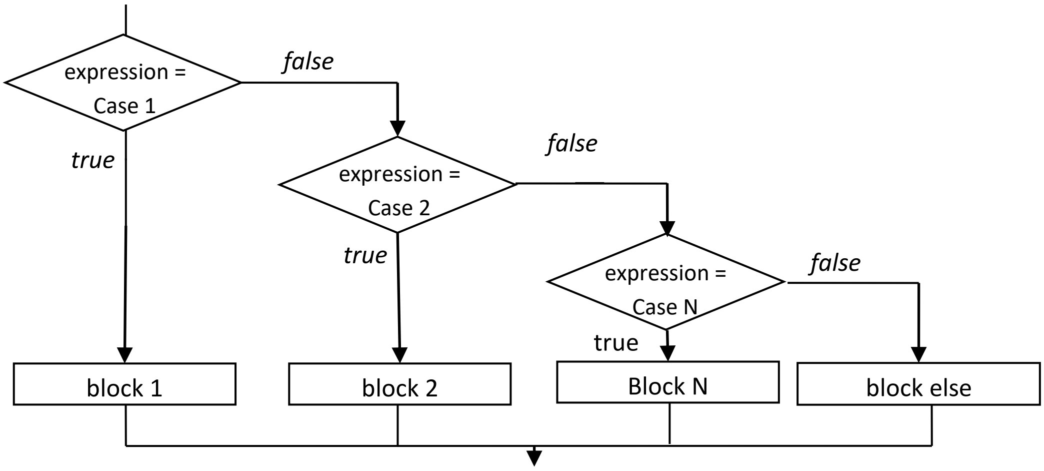
3.3. Multiple choice action:

- It makes it possible to distinguish several cases according to the values of an expression.
- The “ **if** ” allows to distinguish just two cases whereas the « **switch**» allows to distinguish a large number of cases.

Syntax:

```
Switch (expression)
Case 1: <action block 1>
Case 2: <action block 2>
……………..
Case N: <action block N>
Else // else is optional
< else action block>
end switch
```

The organization chart of the " **switch** " structure is as follows:



Syntax in C++ language

```
Switch (expression)          Switch (expression) {
Case 1:<action block 1>            Case val1: { <action block 1> break; }
Case 2:<action block 2>            Case val2: { <action block 2> break;}
……………..                    ……………..
Case N:<action block N>            Case valN: { <action block N> break;}
Else // else is optional           default
<else action block>                {<default action block> break; }
end case                           }
```

Noticed :the " break; " is necessary to exit the structure depending on the case once the corresponding action block has been executed; so as not to test the other cases, but it is not an obligatory.

Example : Write the algorithm that reads a number (0, 1, 2, 3, 4) then gives its name (zero, one, two, three, four)?

Nested Alternate Action	**Multiple choice action**

Algorithm Number_name
n: integer;
Begin
write ('enter a number between 0 and 4:');
Read (n);
If (n=0) Then
write ('Zero');
else
  If (n=1) Then
   write ('A');
  else
    If (n=2) Then
      write ('Two');
    else
       If (n=3) Then
         write ('Three');
       else
         If (n=4) Then
          write ('Four');
         else
          write ('error');
         End if
       End if
     End if
  End if
 End if
END.
	Algorithm Number_name
	n: integer;
	Begin
	write ('enter a number between 0 and 4:');
	Read (n);
	 switch (n)
	  0: Write ('Zero');
	  1: Write ('One');
	  2: Write ('Two');
	  3: Write ('Three');
	  4: Write ('Four');
	 else
	  Write ('error');
	  end switch
	END.