7.1 Control statemets (Loops)

- There may be a situation, when you need to execute a block of code several number of times. In general, statements are executed sequentially: The first statement in a function is executed first, followed by the second, and so on.
- Programming languages provide various control structures that allow for more complicated execution paths.
- A loop statement allows us to execute a statement or group of statements multiple times and following is the general from of a loop statement in most of the programming languages

Loop Types:

C++ programming language provides the following type of loops to handle looping requirements.

Loop Type	Descryption
for loop	The initialization, condition and increment/decrement all put together. Initialization will be done once at the beginning of loop. Then, the condition is checked by the compiler. If the condition is false, for loop is terminated. But, if condition is true then, the statements are executed until condition is false.
while Loop	Repeats a statement or group of statements while given condition is true. It tests the condition before executing the loop body.
do...while loop	Like a 'while' statement, except that it tests the condition at the end of the loop body.
nested loops	You can use one or more loop inside any another 'while', 'for' or 'do..while' loop.

For Loop: A **for** loop is a repetition control structure that allows you to efficiently write a loop that needs to execute a specific number of times.

Syntax of For Loop

```
for ( initialization ;  condition; increment )
{
    Statements ;
}
```

Int i;

for (i=1; i<=5; i ++)
cout <<i;

i	i<=5	cout	Output
1		Cout<<1	1 2 3 4 5
2		Cout<<2	
3		Cout<<3	
4		Cout<<4	
5		cout<<5	
6			

EX:
y=1
z=2

   1- X= y++ + z;   x=   ,y=   ,z=
       3   1 + 2

   2- X=++y + z;   x= ,y=   ,z=
       4   2   + 2

 مثال اخر عن تتبع تنفيذجملة التكرار
Int i ,x;
for (i=1;i<=5;i++)
  {
  cin>>x;
 cout<<"\n x="<<x;
 }

int i=1;
i<=5;
i++;
++i;

i	i<=5	x	screen
1		3	X=3
2		-10	X=-10
3		70	X=70
4		0	X=0
5		-4	X=-4
6			

Here is the flow of control in a for loop:

- The (initialization step is executed first, and only once. This step allows you to declare and initialize any loop control variables. You are not required to put a statement here, as long as a semicolon appears.
- Next, the **condition** is evaluated. If it is true, the body of the loop is executed. If it is false, the body of the loop does not execute and flow of control jumps to the next statement just after the for loop.
- After the body of the for loop executes, the flow of control jumps back up to the **increment** statement. This statement allows you to update any loop control variables. This statement can be left blank, as long as a semicolon appears after the condition.
- After the condition becomes false, the for loop terminates.

Example:

```
#include<iostream>
```

```
using namespace std;
```

```cpp
void main()
{
    int a, num;
    cout << "Enter any number : ";
    cin >> num;
  for (a=1;a<=num;a++)
    cout << "\nHello...!!";     }
```

The output:

```
Enter any number : 5
        Hello...!!
        Hello...!!
        Hello...!!
        Hello...!!
        Hello...!!
```

-For Statement:

     for(exp1 ; exp2 ; exp3)

When:

exp1: First counter

exp2: End counter

exp3: Increment or Decrement Counter

Example:

for(i=1;i<=10;i++) cout<<i; // = 123…910

for(i=10;i>=1;i--) cout<<i; // = 1098…321

for(i=2;i<=10;i+=2) cout<<i; // = 246810

<div dir="rtl">

ماهو الفرق بين السؤالين التاليين:

حساب مجموع الاعداد بين (1-10)؟

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الفرق سيكون بين المعلوم والمجهول
حساب مجموع الاعداد بين (1-10)؟ (معلوم)
for(i=1;i<=10;i++) **s+=i;**
حساب مجموع 10 اعداد؟ (مجهول)
for(i=1;i<=10;i++) **{ cin>>x;** **s+=x; }**

وحساب مجموع 10 اعداد؟

EX// W.P. to read 10 integer number and find biggest?
```cpp
#include<iostream>
using namespace std;
int main()
{
int i,x,larg=0;
cin>>x;
larg=x;
for(i=1;i<=9;i++)
{
cin>>x;
if(x>larg) larg=x;
}
cout<<"larg="<<larg;
 return 0;
}
```

EX// W.P. to find factorial x! ?

```cpp
#include<iostream>
using namespace std;
int main()
{
int i,x,f=1;
cin>>x;
for(i=1;i<=x;i++)
f*=i;
cout<<"factorial x="<<f;
return 0;
}
```

EX// W.P. to find power x^y ?
(without using pow function)

```cpp
#include<iostream>
using namespace std;
int main()
{
int i,x,y,p=1;
cin>>x>>y;
for(i=1;i<=y;i++)
p*=x;
cout<<"power="<<p;
return 0;
}
```

While Loop

While loop is also called entry control loop because, in while loop, compiler will 1st check the condition, whether it is true or false, if condition is true then execute the statements.

Syntax of While Loop

while (condition)

{

    Statmentes;

    --- - -- - -- -- - -

}

- Here, **statement(s)** may be a single statement or a block of statements.

- The **condition** may be any expression, and true is any non-zero value. The loop iterates while the condition is true. When the condition becomes false, program control passes to the line immediately following the loop.

EX/ print even numbers between (4-100)?

using (For, while, do—while) statement

for (i=4;i<=100;i+=2)

cout<<i;   // 4 6 8 ... 98 100 by for

----

i=4;
while (i<=100)
{ cout<<i;
i+=2; }   // 4 6 8 ... 98 100 by while
----

i=4;
do
{ cout<<i;

```
  i+=2;
 } // 4 6 8 … 98 100 by do-while
while (i<=100);
```

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Q// Write a program to calculate the sum of a list of numbers ending the number zero?

```
#include<iostream>
using namespace std;
int main()
{
int x,s=0;
Cin>>x;
While(x!=0)
{s+=x;  cin>>x; }
cout<<s;
return 0;}
```

```
#include<iostream>
using namespace std;
int main()
{
int x,s=0;
do
{cin>>x;
s+=x;} while(x!=0);
cout<<s;
return 0;
}
```

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Q / Write a program to check X value if the number prime or not?

```
#include<iostream>
using namespace std;
int main()
{
int x, flag;
flag=0;     cin>>x;
for (int i=2; i<x ;i++)
if(x %i ==0)     flag=1;
 if (flag==0)
      cout<<"x is prime";
 else
      cout<<"x is NOT prime";
return 0;  }
```

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Q1//write a program to compute the sum of the integers that divisible by 4 and 5 from 10 different integers?

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Q2// Write a program to calculate the sum of the positive numbers to the list of numbers ending the number zero?

Loops OR Iterations : الحلقات او التكرارات-

Removing all the expressions gives us an infinite loop. This loop's condition is assumed to be always true:

```
for ( ; ; ) // infinity loop
something;
&&&&&&&&&&&&&&&&&&&&&&&&&
int i,j,n=6;
for (i = 0, j = 0; i + j < n; ++i, ++j)
cout << '(' << i << ',' << j << ")\n";
```

Output :
/----------
(0,0)
(1,1)
(2,2)

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Loops OR Iterations : الحلقات او التكرارات-

Because loops are statements, they can appear inside other loops. In other words, loops can be nested. For example,

```
for (int i = 1; i <= 3; ++i)
for (int j = 1; j <= 3; ++j)
cout << "(" << i << "," << j << ")\n";
```

Output :

(1,1)

(1,2)

(1,3)

(2,1)

(2,2)

(2,3)

(3,1)

(3,2)

(3,3)

Loops OR Iterations : الحلقات او التكرارات-

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Q//write a program used nested loop to calculate "X" ,where:- X= 1!+ 3!+ 5!+ 7!+9!

```cpp
#include<iostream>
using namespace std;
 int main()
 { int i,j,f=1,x=0;
 for(i=1;i<=9;i+=2)
 { f=1;
 for(j=1;j<=i;j++)
 f*=j;
 cout<<"factorial " <<i<<"= "<<f<<endl;
 x+=f; }
  cout<<"Sum ="<<x<<endl;
return 0;   }
```

Loops OR Iterations : ‑الحلقات او التكرارات

Q//what's output:

```cpp
#include<iostream>
using namespace std;
 int main()
 { int i,j;
 for(i=1;i<=4;i++)
 {
 for(j=1;j<=4;j++)
cout<<"*";
cout<<endl;
  }
return 0;
}
```

Output :

****

****

****

****

Loops OR Iterations : ‑الحلقات او التكرارات

Q//what's output:

```cpp
#include<iostream>
using namespace std;
 int main()
 { int i,j;
 for(i=1;i<=4;i++)
 {
 for(j=1;j<=i;j++)
```

Output :

----

*

**

***

****

```
cout<<"*";
cout<<endl;
 }
return 0;
}
```

Example

```cpp
#include <iostream>
using namespace std;
int main ()
{
// Local variable declaration:
int a = 10;
// while loop execution
while( a < 20 )
{
cout << "value of a: " << a << endl;
a++;
}return o;}
```

```
value of a: 10
value of a: 11
value of a: 12
value of a: 13
.
.
value of a: 19
```

يقوم هذا البرنامج بطباعة قيمة
المتغير a طالما الشرط (20>a)
متحقق او TRUE

Homework: trace the following c++ cods and Find the output for these cods :

```cpp
#include <iostream>

 using namespace std;
```

```cpp
int main()
{
    int n, sum = 0;
    cout << "Enter a positive integer: ";
    cin >> n;


    for (int i = 1; i <= n; ++i)
    {        sum += i;        }
    cout << "Sum = " << sum;
}
```

```cpp
#include <iostream>
using namespace std;
int main()
{
int n = 10 ;
  while (n > 0)
{
  cout << n  << "," ;
  --  n ;
  }  cout << "End of program \n";
 return 0;}
```

Exercises

1. Write C++ program to find the summation of the following series:
   Sum= 1+3+5+7+ . . . . +99

lin other words: find the summation of the odd numbers, between 0 and 100)

```
#include<iostream.h>
void main( )
{
        int count = 1;
        int sum = 0;
        while ( count <= 99 )
        {
           sum = sum + count;
           count = count + 2;
        }
         cout << "sum is: " << sum << endl;
}
```

EX: Write C++ program to read 10 integer numbers, and find the sum of the positive numbers only.

```
#include<iostream.h>
void main( )
{
        int num, sum = 0;
        for ( int i = 1; i <= 10; i ++ )
        {
           cout << "enter your number: ";
           cin >> num;
           if ( num > 0 )     sum = sum + num;
        }
         cout << "The sum is: " << sum;
}
```

EX: Write C++ program to find the summation of the following series :

$$\sum_{i=1}^{n} i^2 = 1^2 + 2^2 + 3^2 + \cdots + n^2$$

```cpp
#include<iostream.h>
void main( )
{
        int i = 1, n ,sum = 0;
        cout << "enter positive number";
        cin >> n;
        while ( i <= n )
        {
            sum +=  i * i ;
            i++;
        }
        cout << "sum is: " << sum << endl;
}
```

EX: Write C++ program to find the summation of students marks, and its average, assume the student have 8 marks.

```
#include<iostream.h>
void main( )
{
        int mark, i, sum = 0;
        float av = 0;
        i = 1;
        while ( i <= 8 )
        {
            cout << "enter mark: ";
            cin >> mark;
            sum = sum + mark;
            i++;
        }
        cout << "sum is: " << sum << endl;
        av = sum / 8;
        cout << "average is: " << av;
}
```

Loops OR Iterations : الحلقات او التكرارات-

The break Statement
A *break* statement may appear inside a loop (while, do, or for) or a switch statement. It causes a jump out of these constructs, and hence terminates them.
EX// read positive No. and terminate by zero?
for(; ;) //infinity loop
{   cin >> num;
if (num < 0) continue;
If (num==0) break;
 // process num here...
}

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