
# Repetition and Loop Statements

Refat Othman

Computer Science Department

Comp 133

# Loops

- **The repetition of steps in a program is called loop.**

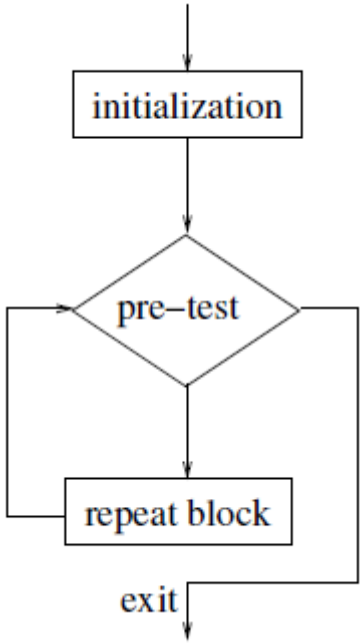
- **Three C loop control statement:**
  - **while**
  - **for**
  - **do-while**

# Loops: Controlling Loop

- **Counter controlled loops: control variable counting up/down (normal loops).**
- **Event controlled loops: until special value is encountered. (E.g., terminate loop when input is 'q' , or terminate loop when input is 0 ).**
- **Result controlled loops: continues until a test determines that the desired result is reached (e.g., numerical approximations)**

# Loop : While Loop

```
while ( condition )
{
      body
}
```



# Loop : Counter Controlled While

**Write a program to find and print the average of n values, where n is entered by the user.**

```
# include  <stdio. h>
int main ( )
{ int i=0, n;
  double sum=0.0, x;
  printf ("Please, enter number of values to read: ");
  scanf ("%d", &n);
  // don't forget to initialize i before entering loop
  while ( i < n)
  {
      printf (" Please, enter value: ");
      scanf ("%lf", &x); // Reading a double
      sum + = x;
      i++; // don't forget to increment i (update statement to stop the condition)
  }
  if (n)
  printf (" Average of %d values = %0.3f \n ", n, sum/n);
  else
  printf ("No values were entered !");
  return 0;
}
```

# **Loop :** Event controlled While

```
# include  <stdio. h>
int main ( )
{
  int  sum=0, x;
  printf (" Please, enter value or zero to stop ");
  scanf ("%d", &x); // Reading integer
  while ( x != 0) // Exit the on reading a zero
  {
       sum + = x;  // add the value to sum
       printf (" Please, enter next value or zero to stop ");
       scanf ("%d", &x); // Reading integer
 }
  if (sum)
  printf (" Sum = %d ", sum);
  else
  printf ("The first input is zero");
  return 0;
}
```

**Write a program to calculate the sum of a set of values (we don't know their count). When 0 is entered this means that program should stop receiving data, and print the sum.**

# Loop : Result controlled while

**Write a program to calculate the sum of a set of values (we don't know their count). When the sum exceeds 1000 this means that program should stop receiving data, and print the number of values were entered.**

```
# include  <stdio. h>
int main ( )
{
  int  sum=0, count=0,x;

 while ( sum <= 1000) // Exit when the sum more than 1000
  {
       printf (" Please, enter next value ");
       scanf ("%d", &x); // Reading integer
       sum + = x;  // add the value to sum
       count++;// increment count

  }
 printf ("Number of value %d ", count);
 return 0;
}
```

# Compound Assignment Operators (Assignment Shorthands)

| Simple Assignment Operators | Compound Assignment Operators |
|---|---|
| x = x + 1; | x += 1; |
| x= x -1; | x -= 1; |
| x = x * y; | x *= y; |
| x= x / y; | x /= y; |
| n = n % (x+1); | n %= x+1; |

# Pre and Post-Increment

- ++x  // Pre-increment x
- x++  // Post-increment x

Example (Pre-increment ):

a = ++x * b;  →

```
x = x + 1;
a = x * b;
```

# Pre and Post-Increment

- ++x  // Pre-increment x
- x++  // Post-increment x

Example (Post-increment ):

a = x++ * b;→

```
a = x * b;
x = x + 1;
```

# Pre and Post-Decrement

- --x // Pre-decrement x
- x-- // Post-decrement x

Example (Pre-decrement ):

a = --x * b; →

```
x = x - 1;
a = x * b;
```

# Pre and Post-Decrement

- --x // Pre-decrement x
- x-- // Post-decrement x

Example (Post-decrement ):

a = x-- * b; →

```
a = x * b;
x = x - 1;
```

# Examples

```
int a=2, b=3, c;
c = ++a * b++;

Find a,b,c ?
```

| | | |
|---|---|---|
| a=2 | b=3 | c= |
| a=3 | b=3 | c= |
| a=3 | b=3 | c=9 |
| a=3 | b=4 | c=9 |

a=3 , b=4, and c = 9

# Examples

```
int a=2,b=3,c=0;
c += --a * b++;
```

Find a,b,c ?

a=1 , b=4, and c = 3

# Examples

```
int a=4,b=3,c=20;
c /= ++a;
Find a, b, c ?
```

a=5 , b=3, and c = 4

# Examples

```
int a=2,b=3,c=4;
c *= ++a * b++;
Find a, b, c ?
```

a=3 , b=4, and c = 36

# Examples

```
int i = 1;
while (i < 5)
 printf ("%d " , i++);
```

- What is the output?
- What is the final value of i?

Output
1 2 3 4

Final value of i
i=5

# Examples

**Write a program to find if an entered number is perfect or not?**

**Hint:** perfect number is a positive integer that is equal to the sum of its proper positive divisors, that is, the sum of its positive divisors excluding the number itself.

**Example (1) :** The first perfect number is 6, because 1, 2, and 3 are its proper positive divisors, and 1 + 2 + 3 = 6

**Example (2)** : The next perfect number is 28 = 1 + 2 + 4 + 7 + 14

# Examples

**Write a program to find $x^y$ ?**

**Example: $2^3 = 8$**

```c
#include <stdio.h>
int main()
{
    int x,y;
    int result=1;
    printf("please enter x and y: ");
    scanf ("%d%d",&x,&y);
    while (y>=1)
    {
        result*=x;
        y--;

    }
    printf ("result is %d",result);

    return 0;
}
```

# Examples

**Write a program to find $x^{y}$ ?**

**Example: $2^{3} = 8$**

```c
#include <stdio.h>
int main()
{
    int x,y;
    int result=1;
    printf("please enter x and y: ");
    scanf ("%d%d",&x,&y);
    while (y-->=1)
    {
        result*=x;

    }
    printf ("result is %d",result);

    return 0;
}
```

# Examples

**Write a program to find n! ?**

**Example: 4! = 24**

```c
#include <stdio.h>
int main()
{
    int n;
    int result=1;
    printf("please enter a number: ");
    scanf ("%d",&n);
    while (n>=1)
    {
        result*=n;
        n--;

    }
    printf ("result is %d",result);

    return 0;
}
```

# Break and Continue

## break statement

- A break statement takes the control out of the loop.
- When break is encountered inside any loop, control automatically passes to the first statement after the loop.
- A break is usually associated with an if.

## continue statement

- continue statement take the control to the beginning of the loop, bypassing the statements inside the loop, which have not yet been executed.

# Break and Continue: Examples

## break statement

**What would be displayed by the following program?**

```
#include<stdio.h>
int main()
{
    int i;

    i = 0;
    while ( i++ < 10 )
    {

        printf("%d\n",i);
        if ( i == 5)
            break;
    }
    return 0;
}
```

**Output**

```
1
2
3
4
5
```

# Break and Continue: Examples

## continue statement

**What would be displayed by the following program?**

```
#include<stdio.h>
int main()
{
      int i;

      i = 0;
      while ( i++ < 10 )
      {

            printf("%d\n",i);
            if ( i == 5)
                  continue;
      }
      return 0;
}
```

**Output**

```
1
2
3
4
5
6
7
8
9
10
```

# Break and Continue: Examples

## break statement

**What would be displayed by the following program?**

```
#include<stdio.h>
int main()
{
      int i;

      i = 1;
      while ( i++ < 7 )
      {

            printf("Hello\n");
            if ( i == 3)
                  break;
            printf("Hi\n");
      }
            printf("Bye\n");
      return 0;
}
```

**Output**

```
Hello
Hi
Hello
Bye
```

# Break and Continue: Examples

## continue statement

**What would be displayed by the following program?**

```c
#include<stdio.h>
int main()
{
    int i;

    i = 1;
    while ( i++ < 7 )
    {

        printf("Hello\n");
        if ( i == 3)
            continue;
        printf("Hi\n");
    }
        printf("Bye\n");
    return 0;
}
```

**Output**

```
Hello
Hi
Hello
Hello
Hi
Hello
Hi
Hello
Hi
Hello
Hi
Bye
```

# Break and Continue: Examples

## break statement

**What would be displayed by the following program?**

```
#include<stdio.h>
int main()
{
     int i;

     i = 1;
     while ( i++ < 5 )
     {

          printf("%d\n",++i);
          if ( i == 3)
               break;
          printf("%d\n",i);
     }
          printf("%d\n",++i);
     return 0;
}
```

| Output |
| --- |
| 3<br>4 |

# Break and Continue: Examples

## continue statement

**What would be displayed by the following program?**

```
#include<stdio.h>
int main()
{

 int x=0 ;

 while(x++<=10)  {

 if (x%2) continue;

 printf("%d\n" , x);

 }
    return 0;
}
```

**Output**

```
2
4
6
8
10
```

# Break and Continue: Examples

## break statement

**What would be displayed by the following program?**

```
#include<stdio.h>
int main()
{

 int x=0 ;

 while(x++<=10)  {

 if  (x%2) break;

 printf("%d\n" ,  x);

 }
     return 0;
}
```

**Output**

# The for Statement

```
for(expr1; expr2; expr3)
{
    body
}
```

**Normal forms are:**

```
for(i = 0; i < 10; i++) {...}
for(i = n-1; i >= 0; i--) {...}
```

**expr1 : initialization expression**

**expr2 : loop repetition condition**

**expr3 : update statement**

**When expr1 is omitted: loop index should be initialized before entry into loop.**

**When expr3 is omitted, loop index should be incremented inside the loop.**

**When expr2 is omitted, loop becomes infinite loop unless break occurs inside the loop.**

# The for Statement

```
1.  /*
2.  * Computes n!
3.  * Pre: n is greater than or equal to zero
4.  */
5.  int
6.  factorial(int n)
7.  {
8.        int i,          /* local variables */
9.            product;    /* accumulator for product computation */
10.
11.       product = 1;
12.       /* Computes the product n x (n-1) x (n-2) x ... x 2 x 1 */
13.       for (i = n;  i > 1;  --i) {
14.            product = product * i;
15.       }
16.
17.       /* Returns function result */
18.       return (product);
19. }
```

# The for Statement

**Print all numbers between 1 and 100 that are divisible by 7**

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
      int i;
      for (i=1;i<=100;i++)
        if (i%7==0)
          printf("%d\n",i);
      return 0;
}
```

Output
7
14
21
28
35
42
49
56
63
70
77
84
91
98

# The for Statement: **Nested Loop**

**What would be the output of the following code ?**

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
    int i,j;

    for (i=0;i<3;i++)
     for (j=0;j<2;j++)
       printf("i=%d   j=%d\n",i,j);
    return 0;
}
```

output

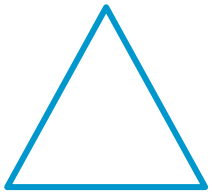
```
i=0   j=0
i=0   j=1
i=1   j=0
i=1   j=1
i=2   j=0
i=2   j=1
```

# The for Statement: **Nested Loop**

**Write a program to display the following outputs :**

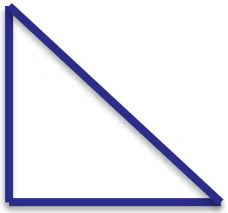
```
   *
  ***
 *****
*******
```

1



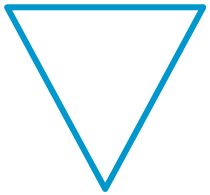
```
*
***
*****
*******
```

2



```
*********
 *******
  *****
   ***
    *
```

3



```
*********
 *******
  *****
   ***
    *
```

4

# do-while loop

```
do
statement;
while (expression);
```

- Statement is executed first, and then expression in evaluated
- If expression is TRUE, the statement is executed again
- If expression is FALSE, the loop terminates
- In general, do-while loops are less frequently used

# do-while loop

**Print all numbers between 1 and 100 that are divisible by 7**

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
    int x =1;
     do
     {
          if ((x % 7) == 0)

               printf("%d\n", x);
          x++;
     }
     while (x<=100);

}
```

# Example: while loop

**Write a c program to find out sum of digit of given number**

```c
#include <stdio.h>
#include <stdlib.h>

int main()
{
      int num;
      int sum=0;
      printf("Please enter a number: ");
      scanf ("%d",&num);
      while (num>0)
      {
            sum+=num%10;
            num=num/10;
      }
      printf ("the sum is %d",sum);
      return 0;
}
```

# Example: for loop

**Write a c program to find out sum of digit of given number**

```c
#include <stdio.h>
#include <stdlib.h>

int main()
{
    int num;
    int sum=0;
    printf("Please enter a number: ");
    scanf ("%d",&num);
    for (;num>0; num=num/10)
    {
        sum+=num%10;

    }
    printf ("the sum is %d",sum);
    return 0;
}
```

# Example

**Convert the following while loop to a for loop**

```
int x = 5;
    while ( x < 50 )
    {
      printf("%d",x);
      x++;
    }
```

```
for (x = 5; x < 50; x++)
  printf("%d",x);
```

# Example

**Convert a following for loop to a while loop**

```
for (x = 50; x > 5; x--)
  printf("%d",x);
```

```
x = 50;
while ( x > 5)
{
   printf("%d",x);
   x--;
}
```

# Example

**What would be the output of the following code ?**

```c
#include <stdio.h>
#include <stdlib.h>

int main()
{
    int balance = 29;
    while ( 5 )
    {
        if (balance < 9)
            break;
        balance = balance - 9;
    }
    printf("%d",balance);
    return 0;
}
```

Output
2

# Example

**What would be the output of the following code ?**

```c
#include <stdio.h>

int main()
{
    int i = 10;

    do
    {
        printf("Hello %d\n", i );
        i = i -1;
    }
    while ( i > 0 );
  return 0;
}
```

Output

Hello 10
Hello 9
Hello 8
Hello 7
Hello 6
Hello 5
Hello 4
Hello 3
Hello 2
Hello 1

# Extra Exercises

**Input a range from user and print all the magic numbers in that range. A number is magical if repeated adding of its digit gives 1. Example 19 is magical as 1 + 9 = 10, 1 + 0 = 1 hence magical.**
**So is 991 as 9 + 9 + 1 = 19, 1 + 9 = 10, 1 + 0 = 1.**
**However 224 is not.**

**Input a range from user and print all the narcissistic number in that range.**
**Hint: A number is called narcissistic if each of its digits raised to the power of the number of digits equals the number. Example : 153 is a narcissistic number since 1^3 + 5^3 + 3^3 = 1 + 125 + 27 = 153. 1634 = 1^4 + 6^4 + 3^4 + 4^4**

# Extra Exercises

**Write a program that will read an unspecified numbers of integers from keyboard, determine how many even and how many odd numbers have been read. The program should also compute the average of the integers read. The program should display the number of odd integers, the number of even integers; and the average. Your program should stop when user enters 0**