



Repetition and Loop Statements

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Comp 230

Loops

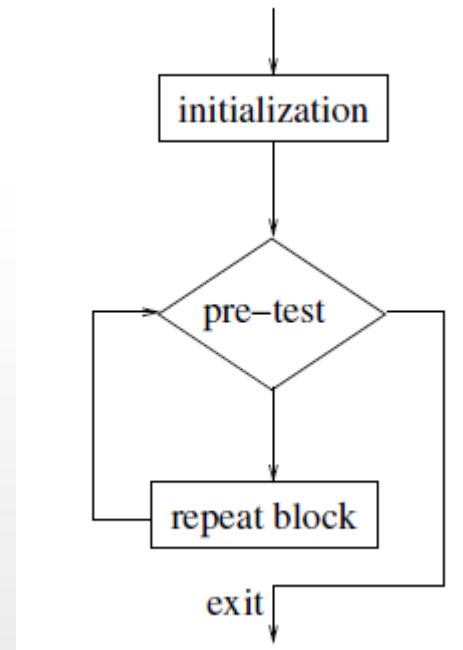
- The repetition of steps in a program is called loop.
- Three C loop control statement:
 - while
 - for
 - do-while

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

```
#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;
}
```

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

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;
```

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 $28 = 1 + 2 + 4 + 7 + 14$

Code

Examples

Write a program to find x^y ?

Example: $2^3 = 8$

```
#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: $2^3 = 8$

```
#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: $4! = 24$

```
#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?

```
#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
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 :

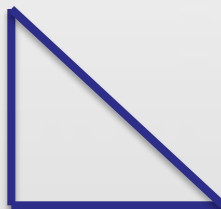
```
  *
 *
 ***
 *
 *****
 *
 *****
```

1



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

2



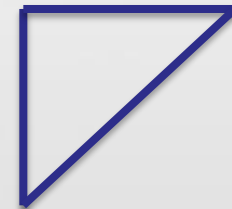
```
*****
 *
 *****
 *
 *****
 *
 *****
 *
 *****
```

3



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

4



do-while loop

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

- Statement is executed first, and then expression is 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

```
#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

```
#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 ?

```
#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 ?

```
#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.

Answer

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 $1^3 + 5^3 + 3^3 = 1 + 125 + 27 = 153$. $1634 = 1^4 + 6^4 + 3^4 + 4^4$

Answer

Extra Exercises

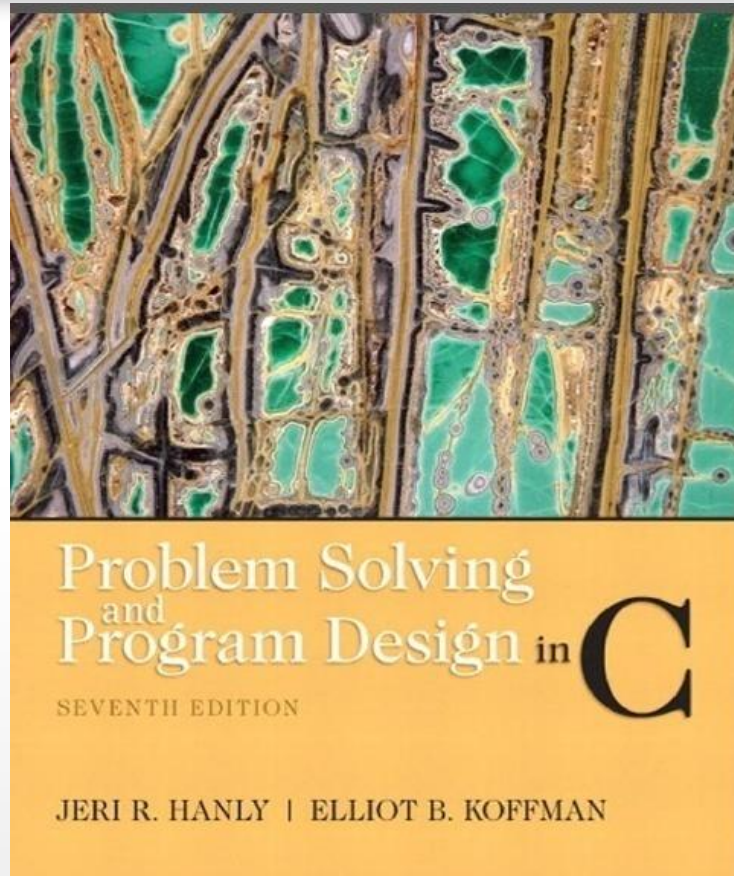
Write a program that will read an unspecified numbers of integers from keyboard, determine how many even and how many odd numbers have been read. The program should also compute the average of the integers read. The program should display the number of odd integers, the number of even integers; and the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

[Answer](#)

Question?



“Success is the sum of small efforts, repeated day in and day out.”
Robert Collier



References:

Problem Solving & Program Design in C (main reference)
<http://www.programmingsimplified.com/c-program-print-stars-pyramid>