CENG 230

Introduction to C Programming

Week 6 – Repetition

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Some slides/content are borrowed from Tansel Dokeroglu, Nihan Kesim Cicekli.

TABLE 4.3 The && Operator (and)

operand1	operand2	operand1 && operand2
nonzero (true)	nonzero (true)	1 (true)
nonzero (true)	0 (false)	0 (false)
0 (false)	nonzero (true)	0 (false)
0 (false)	0 (false)	0 (false)

TABLE 4.4 The || Operator (or)

operand1	operand2	operand1 || operand2
nonzero (true)	nonzero (true)	1 (true)
nonzero (true)	0 (false)	1 (true)
0 (false)	nonzero (true)	1 (true)
0 (false)	0 (false)	0 (false)

TABLE 4.5 The ! Operator (not)

operand1	!operand1
nonzero (true)	0 (false)
0 (false)	1 (true)

C accepts *any nonzero value as a representation of true*.

short-circuit evaluation

Previously on CEng 230:

An expression of the form (a || b)
must be true if a is true. Consequently, C stops evaluating the expression when it determines that the value of !flag is 1 (true).

Similarly, an expression of the form (a && b)
must be false if a is false, so C would stop evaluating such an expression if its first operand evaluates to 0.

Writing English Conditions in C

Previously on CEng 230!

x is 3.0
y is 4.0
z is 2.0

English Condition	Logical Expression	Evaluation
x and y are greater than z	`x > z && y > z`	`1 && 1` is 1 (true)
x is equal to 1.0 or 3.0	`x == 1.0 || x == 3.0`	`0 || 1` is 1 (true)
x is in the range z to y, inclusive	`z <= x && x <= y`	`1 && 1` is 1 (true)
x is outside the range z to y	`!(z <= x && x <= y)` `z > x || x > y`	`!(1 && 1)` is 0 (false) `0 || 0` is 0 (false)

Comparing Characters

Previously on CEng 230!

Expression	Value
`'9' >= '0'`	1 (true)
`'a' < 'e'`	1 (true)
`'B' <= 'A'`	0 (false)
`'Z' == 'z'`	0 (false)
`'a' <= ch && ch <= 'z'`	1 (true) if **ch** is a lowercase letter

Examples

Previously on CEng 230!

int a = 6 , b = 9 , c = 14 , flag = 1 .

```
c == a + b  ||  !flag
a != 7  &&  flag  ||  c >= 6
!(b <= 12)  &&  a % 2 == 0
!(a > 5  ||  c < a + b)
```

int ans;
int p = 100, q = 50.

ans = (p > 95) + (q < 95);
What is the value of ans?

Complement the expression below

a != 7 && flag || c >= 6

a == 7 || flag && c < 6

!(1 || 0) 0

!(1 || 1 && 0) 0

!((1 || 0) && 0) 1 (Parenthesis are useful)

Previously on CEng 230:

```
if (x > 0.0)
pos_prod = pos_prod * x;
```

```
if (crsr_or_frgt == 'C')
  printf("Cruiser\n");
else
  printf("Frigate\n");
```

It displays either Cruiser or Frigate , depending on the character stored in the type char variable crsr_or_frgt .

```
if crsr_or_frgt == 'C'          /* error - missing parentheses */
     printf("Cruiser\n");
printf("Combat ship\n");
```

```
if (crsr_or_frgt == 'C');  /* error - improper placement of ;*/
      printf("Cruiser\n");
printf("Combat ship\n");
```

nested if statements and alternative decisions

Previously on CEng 230!

if statement inside another

```
if (x > 0)
        num_pos = num_pos + 1;
else
        if (x < 0)
                num_neg = num_neg + 1;
        else /* x equals 0 */
                num_zero = num_zero + 1;
```

Multiple-Alternative Decision Form of Nested if

Previously on CEng 230!

SYNTAX:

```
if (condition1)
     statement1
else if (condition2)
     statement2
        .
        .
        .
else if (conditionn)
     statementn
else
     statemente
```

EXAMPLE:

```
/* increment num_pos, num_neg, or num_zero depending
    on x */
if (x > 0)
      num_pos = num_pos + 1;
else if (x < 0)
      num_neg = num_neg + 1;
else /* x equals 0 */
      num_zero = num_zero + 1;
```

Previously on CEng 230!

Loudness in Decibels (db)	Perception
50 or lower	quiet
51 – 70	intrusive
71 – 90	annoying
91 – 110	very annoying
above 110	uncomfortable

```
/* Display perception of noise loudness */

if (noise_db <= 50)
      printf("%d-decibel noise is quiet.\n", noise_db);
else if (noise_db <= 70)
      printf("%d-decibel noise is intrusive.\n", noise_db);
else if (noise_db <= 90)
      printf("%d-decibel noise is annoying.\n", noise_db);
else if (noise_db <= 110)
      printf("%d-decibel noise is very annoying.\n", noise_db);
else
      printf("%d-decibel noise is uncomfortable.\n", noise_db);
```

Previously on CEng 230!

Logic error

```
/* incorrect perception of noise loudness */

if (noise_db <= 110)
      printf("%d-decibel noise is very annoying.\n", noise_db);
else if (noise_db <= 90)

      printf("%d-decibel noise is annoying.\n",
             noise_db);
else if (noise_db <= 70)
      printf("%d-decibel noise is intrusive.\n",
             noise_db);
else if (noise_db <= 50)
      printf("%d-decibel noise is quiet.\n",
             noise_db);
else
      printf("%d-decibel noise is uncomfortable.\n", noise_db);
```

Switching values of two variables

Previously on CEng 230:

```
if (x > y) {
      temp = x;
      x = y;
      y = temp;
}
```

```
/* Switch x and y */
/* Store old x in temp */
/* Store old y in x */
/* Store old x in y */
```

Statement Part	x	y	temp	Effect
	12.5	5.0	?	
`if (x > y) {`				`12.5 > 5.0` is true.
`temp = x;`			12.5	Store old **x** in **temp**.
`x = y;`	5.0			Store old **y** in **x**.
`y = temp;`		12.5		Store old **x** in **y**.

Previously on CEng 230!

17- What is the output of the following program segment?

```
int x = -1;
if (x++==0)  printf("%d\n",x);
else if(++x>1) printf("%d",x);
else printf("%d",x);
```

a) -1 b) 0 c) 1 d) 2 e) 3

---

18. For what exact range of values of variables a and b, does the following code segment display the value 0?

```
m= -1;
if (a>20)
    if (b<10)
        if (a>=30)
            m =4;
        else
            m=0;
    else
        m=1;
else
    m=2;
printf("%d",m);
```

a) a > 20
b ≥ 10

b) 20 ≤ a ≤ 30
b ≤ 10

c) 20 < a < 30
b < 10

d) a ≥ 30
b < 10

e) 20 < a < 30
b ≥ 10

Previously on CEng 230!

19- Assuming that x,y and flag are integers, what is the value printed by the following if statements?

```
if(x>y)
  if(x>z) printf("%d", x);
  else
    if(z>y) printf("%d",z);
    else printf("%d", y);
else
  if(y>z) printf("%d",y);
  else printf("%d",z);
```

a) minimum b) maximum c) median
d) last e) indeterminate

20- What is the output of the following program segment?

```
int x=6, y=3, A=3, B=5, C=7;
if (x <A && y >B)
  if (y >0)
     printf("A");
  else printf("B");
else if (y>C || x >0)
     printf("C");
```

a) A b) B c) C d) AC e) no output

Previously on CEng 230!

Scope of else without {}

27) What will be the output of the program?

```
#include<stdio.h>
void main( ){
   int a = 4;
   if(a == 4)
      printf("a1");
   else
      printf("a2");
         printf("a3");
   printf("a4"); }
```

a) a4 **b)** a1a4 **c)** a2a3a4 **d)** a1a3a4 **e)** a2a3

Scope of if without {}

28) What will be the output of the program?

```
#include<stdio.h>
void main()
{
   int a = 9, b = 3;
   if( !a <= 4 )
      b = 5;
      a = 1;
   printf("a=%d b=%d\n", a, b); }
```

a) a = 9, b = 3

b) a = 4, b = 3

c) a = 1, b = 5

d) a = 9, b = 5

e) a = 1, b = 3

Previously on CEng 230!

32) What will be the output of the program?

```
#include<stdio.h>
void main( ){
   int m=8;
   float n=8.6;
   if (m > n)
      { }
   else {
      m = n * 2;
      n = n / 2; }
     printf(" %d %f ", m, n);
  }
```

a) 17 4.300000
b) 17 4.000000
c) 16 4.300000
d) 16 4.000000
e) Compile error

---

31) What will be the output of the program?

```
#include<stdio.h>
void main( ){
   int z=9;
   z=z-4;
   if( z<9 || ++z>4 ) z=z+2;
   printf(" %d ", z);
   }
```

a) 5 **b)** 6 **c)** 7 **d)** 8 **e)** 9

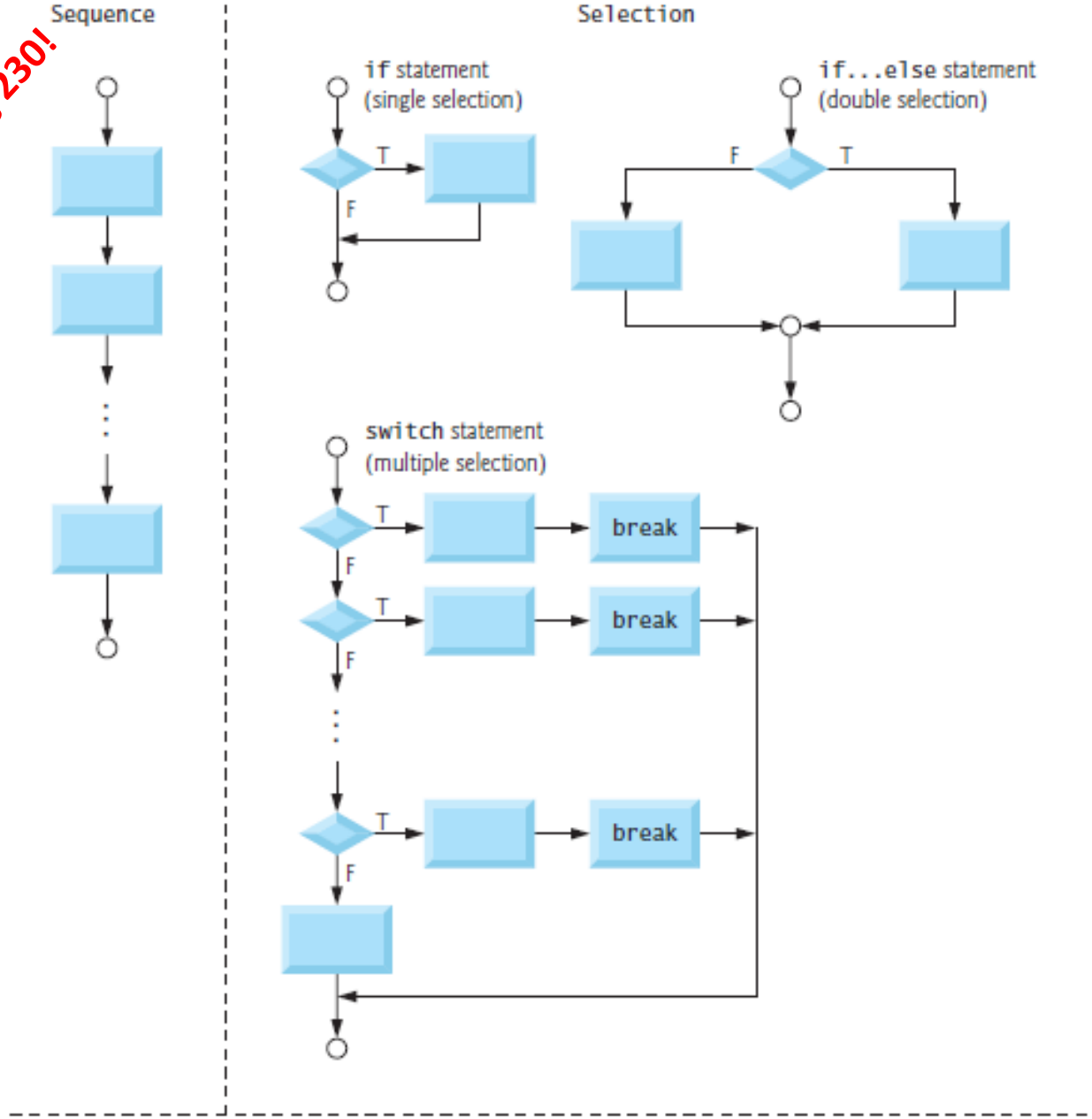
Changing the flow of the program

Previously on CEng 230!

- Multi-way conditionals: switch statements

```
switch(expr)
{
   case  value-1:
         ….
         break;
   case  value-2:
         ….
         break;
   default:
         ….
         break;
}
```

Previously on CEng 230!



Example

Previously on CENG 230!

- ```
  main()
  {
  int i=3;
  switch(i)
  {
  default: printf("zero");
  case 1: printf("one");
  break;
  case 2: printf("two");
  break;
  case 3: printf("three");
  break;
  }
  }
  ```

- ```
  main()
  {
  int i=1;
  switch(i)
  {
  default: printf("zero");
  case 1: printf("one");
  case 2: printf("two");
  break;
  case 3: printf("three");
  break;
  }
  }
  ```

Simple Macros

Previously on CENG 230!

- For long and/or frequent constants:
  - **#define** PI 3.14159265

- For long and/or frequent calculations:
  - **#define** Area(Radius) (4*PI*Radius*Radius)
  - … a = 10.0 + Area(2.0);

Remember Types of Errors?

Previously on CEng 230

Compile time → Syntax errors

- When the code violated the grammer rules of C.
- Compiler detecs these errors

Run-time errors

- happen when the program directs the computer to an illegal operation.
- Such as Division by zero

Logic errors

- A faulty algorithm
- It gives no error message.

Run-time error (division by zero)

Previously on CEng 230!

```
/*
Figure 2.16  A Program with a Run-time Error
*/
 #include <stdio.h>

 int
 main(void)
 {
        int    first, second;
        double temp, ans;

        printf("Enter two integers> ");
        scanf("%d%d", &first, &second);

        ans = first / second;
        printf("The result is %.3f\n", ans);

        system("pause");
        return (0);
 }
/*
Enter two integers> 14 3
Arithmetic fault, divide by zero at line 272 of routine main
*/
```

If the value of variable “second” is given as zero

Logic error

Previously on CEng 230!

```c
#include <stdio.h>

int
main(void)
{
	int	first, second, ans;

	printf("Enter two integers> ");
	scanf("%d%d", &first, &second);

	ans = first * second;
	printf("The sum of the number is : % d\n", ans);

	system("pause");
	return (0);
}
```

Sample questions

Previously on CEng 230!

Evaluate the following expressions with 7 and 22 as operands. (be careful that the values are integers)

```
22 / 7    7 / 22    22 % 7    7 % 22
```

Evaluate the following, assuming that letters have consecutive character codes.

a. `(int)'D' - (int)'A'`
b. `(char)((int)'C' + 2)`
c. `(int)'6' - (int)'7'`

4) What will be the output of the following C program?

```
#include <stdio.h>
#define X 5+3
int main() {
int a = X / 2;
printf("%d", a);
return 0; }
```

a) 3 **b)** 4 **c)** 6 **d)** 8 **e)** 6.5

5) What will be the output of the following C program?

```
#include <stdio.h>
int main() {
  double x, y;
  x = 7;
  x = x / 2;
  y = x + x / 2;
  printf("%.2f %.2f", x, y);
  return 0; }
```

a) 3.00 3.00 **b)** 3.0 4.50 **c)** 3.50 3.50
d) 3.50 5.25 **e)** 4.50 5.25

6) What will be the output of the following C program?

```
  #include <stdio.h>
int
              main
       (void) {
    int a; double b; printf("%d %.2f", a=5+3/2,
b=5+3/2);
    return 0; }
```

a) 6 6.00 **b)** 6 6.50
c) 7 7.00 **d)** 7 7.50
e) This program will not compile successfully because of bad indentation.

Previously on CEng 230!

```
# include <stdio.h>
int main (void){
printf ("%c,%d,%c,%d",'a','a', 97, 97);
return 0;}
```

a) a,97,a,98 **b)** 97,a,97,a **c)** 97,97,a,a
d) a,97,a,97 **e)** a,97,97,a

9) What will be the output of the following code segment?

```
double pi= 22/7;
printf("%3.2f", pi);
```

a)3.142857 **b)**3.142 **c)**3.14 **d)**03.14 **e)**3.00

10) What would be the output after execution of the following code?

```
int x=5,y=3;
y+=5-y+x++;
x=y%x;
printf("%d", x);
```

a) 3 **b)** 5 **c)** 6 **d)** 4 **e)** 2

Previously on CEng 230!

12) What would be the output after execution of the following code?

```
int x=2;
double y=22/5*(double)x;
printf("%.2f", y);
```

a) 2.20 **b)** 2.00 **c)**8.00 **d)** 8.80 **e)** 2.80

10 is wrong!

16) What would be the output after execution of the following code?

```
int b,a=3,c=5;
b=12+a--/++c-(--a);
printf("%d",b);
```

a) 10 **b)** 12 **c)** 9 **d)** 11 **e)** 8

6) What could be the output of the following code segment?

```
printf("%07.4f", 22/7.0);
```

a) 03.143
b) 003.143
c) .314285
d) 03.1429
e) .003143

Previously on CEng 230!

15) What will be the output of the following code segment?

```
int a=4,b=3;
a= 4*3-2+b--/2*3%2*4-2;
printf("%d",a--);
```

a) 8 **b)** 7 **c)** 12 **d)** 10 **e)** 11

Hint: b--/2*3%2*4 : execute this part from left to right

2) What will be the output after the input of 13 ?

```
int s;
scanf("%d", &s);
printf ("%d", s%2+--s);
```

This one is first executed

a) 12 **b)** 6 **c)** 7 **d)** 8 **e)** None of them

4) What will be the output after the input of 7?

```
int x;
printf ("Enter a number");
scanf("%d",&x);
printf("%d %d %d", x - 1, x, x--);
```

a) 5 6 7 **b)** 4 6 6 **c)** 6 7 6 **d)** 6 7 7 **e)** 4 5 6

Previously on CEng 230!

4) If *a* is 5, *b* is 4 , *c* is 10 what is the output?

```
a=b=c+6%2;
printf("%d %d %d", a,b,c);
```

a) `5 10 10` **b)** `13 13 10` **c)** `10 10 10` **d)** `5 4 10` **e)** `13 10 10`

5) What is the output of the below code segment ?

```
int i=32;
char c;
c=i;
printf("%d", c);
```

a) 23 **b)** 'c' **c)** 69 **d)** 'E' **e)** 32

8) What is the C equivalent of the following expression?

$$x = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

a) x=(-b-sqrt(b*b-4*a*c))/(2*a)
b) x=(-b-sqrt(b*2-4*a*c)/2*a
c) x=(-b-sqrt(b*2-4ac)/2a
d) x=((-b)-sqrt(b*2-4ac)/2a
e) x=-b-sqrt(b*b-4*a*c)/2*a

Today

- Conditional Expressions
- Repetitions
  - Iterative statements
    - while
    - do-while
    - for

Conditional Expression Operator

y= x > 3 ? a+1 : a-1; means

```
İf (x > 3)
        y=a+1;
else
        y=a-1;
```

---

z=(a > b) ? a: b;   (finds maximum)

Printf(“%d%c”, k, (k%10==9) ? ‘A’ : ‘a’);

Loops, iterations, repetitions

while, do-while and for statements

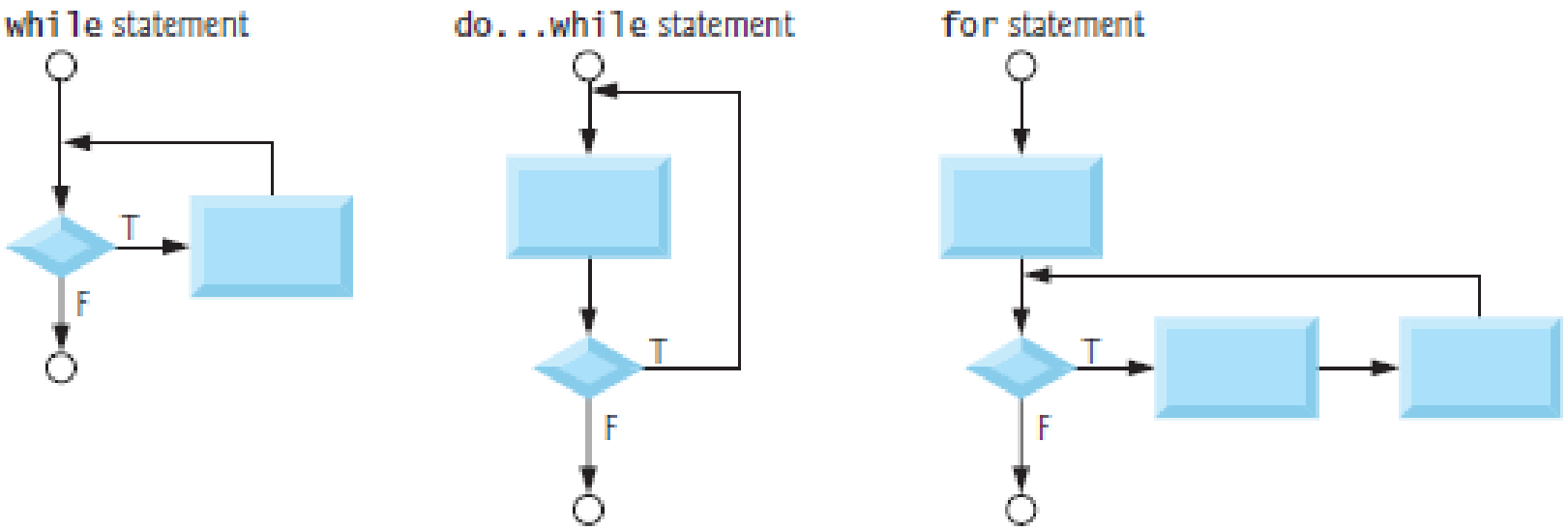
Most programs involve repetition or looping.

A **loop** is a group of instructions the computer executes repeatedly while some **loop-continuation condition remains true.**

```c
/* Fig. 4.1: fig04_01.c
   Counter-controlled repetition */
#include <stdio.h>

/* function main begins program execution */
int main( void )
{
   int counter = 1; /* initialization */

   while ( counter <= 10 ) { /* repetition condition */
      printf ( "%d\n", counter ); /* display counter */
      ++counter; /* increment */
   } /* end while */

   return 0; /* indicate program ended successfully */
} /* end function main */
```

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

Repetition



Repetitions

- while loop

Initialization;
while(expr)
    statement;

Initialization;
while(expr)
{
    statement;
    statement;
    statement;
}

- Bad examples:

```
while( x = 1)
{
        x = getchar();
}
```

```
x = 0.0;
while( x != 1.0 )
{
        x += 0.005;
}
```

Example

- Factorial

```
int N, fact = 1;
scanf(“%d”, &N);
while( N > 0 )
{   fact *= N--;  }
```

Repetitions

- do-while loop

Initialization;
do
    statement
while(expr);
    statement;

Initialization;
do
{
    statement;
    statement;
    statement;
} **while**(expr);

```
do
{
        x = getchar();
       putchar(x);
} while( x != EOF );
```

Example

- Factorial with do-while:

```
int N, fact = 1;
scanf(“%d”, &N);
do
{ fact *= N--;  }
while( N > 0 );
```

Finding power of a number

```c
/* C program to calculate the power of an integer*/
#include <stdio.h>
int main()
{
  int base, exp;
  long long int value=1;
  printf("Enter base number and exponent respectively: ");
  scanf("%d%d", &base, &exp);
  while (exp!=0)
  {
      value*=base;  /* value = value*base; */
      --exp;
  }
  printf("Answer = %d\n", value);
   system("pause");
}
```