Unit-5
Control Statements

Introduction

The statements which alter the flow of execution of the program are known as **control statements.**

Sometimes we have to do certain calculations/tasks depending on whether a condition or test is true or false. Similarly, it is necessary to perform repeated actions or skip some statements. For these operations, control statements are needed.

Types of Control Statements

There are two types of control statements:

- Decision Making(or branching) Statements
  - If statement
  - If…else statement
  - Nested if...else statement
  - Else if statement
  - Switch statement
- Loop statement or Iteration
  - For loop
  - While loop
  - Do…while loop

Decision making statements

- Used to making decisions based upon certain condition.
- Conditions are decide whether or not a statement should be executed.
- If the condition is determined to be true, a statement is executed and optionally other statements to be executed if the condition is determined to be false.

Types of decision making statements:

If statement

If a single statement or block of statements has to be executed only when the given condition is true, if- statement is used.

Syntax:

```
if (condition)
{
   //Statement(s);
}
```

The if statement first checks a condition and then, it executes the statements within its block if the condition is true.

E.g.

Program to test whether the given number is negative:

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

```
main()
{
   int n;
   printf("Enter a number to be tested:");
   scanf("%d",&n);
   if(n<0)
      printf("The number is negative");
   getch();
   return 0;
}
```

If…else statement

The if-else statement is used when there are only two possible actions-one happens when a test condition is true, and other when it is false.

Syntax:

```
if(condition)
{
   //Statement block
}
else
{
   //Statement block
}
```

E.g.

Program to find whether a number is odd or even:

```
#include<stdio.h>
#include<conio.h>
void main()
{
   int a;
   printf("Enter a number :");
   scanf("%d",&a);
   if (a%2==0)
   {
      printf("%d is even",a);
   }
   else
   {
      printf("%d is odd",a);
   }
   getch();
}
```

Nested if...else statement

The nested if-else statement includes if-else statement inside if-else statement itself.

Syntax:

```
if(condition1)
{
  if(condition2)
  {
    statement/statements;
  }
  else
  {
    statement/statements;
  }
}
else
{
  if(condition3)
  {
    statement/statements;
  }
  else
  {
    statement/statements;
  }
}
```

E.g.

```
#include<stdio.h>
main()
{
  int num,rem;
  printf("Enter an integer Number:");
  scanf("%d",&num);
  if(num>=0)
  {
    rem=num%2;
    if(rem==0)
    {
        printf("%d is positive even number",num);
    }
    else
    {
        printf("%d is positive odd number",num);
    }
  }
  else
  {
    rem=num%2;
    if(rem==0)
    {
      printf("%d is negative even number",num);
    }
    else
    {
      printf("%d is negative odd number",num);
    }
  }
  return 0;
}
```

Else if statement (if-else-if ladder)

Else if is used when multipath decisions are required.

Syntax:

```
if (condition)
    statement;
else if (condition)
    statement;
else if (condition)
    statement;
.
.
else
    statement;
```

As soon as one of the conditions controlling the if is true, the statement associated with that if is executed, and the rest of the else-if ladder is bypassed. If none of the conditions are true, then the final else statement will be executed.

E.g.

```
#include <stdio.h>
void main( )
{
    int a;
    printf("Enter a number...");
    scanf("%d", &a);
    if(a%5 == 0 && a%8 == 0)
    {
        printf("Divisible by both 5 and 8");
    }
    else if(a%8 == 0)
    {
        printf("Divisible by 8");
    }
    else if(a%5 == 0)
    {
        printf("Divisible by 5");
    }
    else
    {
        printf("Divisible by none");
    }
}
```

Q. Write a program to find whether given an integer is divisible by 3 and 5 but not by 10.

```
#include <stdio.h>
#include<conio.h>
main( )
{
    int n;
    printf("Enter an integer:");
    scanf("%d", &n);
    if(n%3 == 0 && n%5 == 0)
    {
        if(n%10!=0)
        {
          printf("%d is divisible by 3 & 5 and not by 10", n);
        }
        else
        {
            printf("%d is divisible by 3, 5 & 10", n);
        }
    }
}
```

Q. Write a program to read three numbers from user and determine the largest number among them.

```
#include <stdio.h>
#include<conio.h>
int main( )
{
    int n1, n2, n3;
    printf("Enter 3 numbers:");
    scanf("%d%d%d",&n1,&n2,&n3);
    if(n1>n2)
    {
        if(n1>n3)
            printf("largest=%d", n1);
        else
            printf("largest=%d", n3);
    }
    else
    {
        if(n2>n3)
            printf("largest=%d", n2);
        else
            printf("largest=%d", n3);
    }
    getch();
    return 0;
}
```

Switch case statement

When there are a number of options available and one of them is to be selected on the basis of some criteria, switch statement is used. Thus, a switch statement allows user to choose a statement among several alternatives. The switch statements compares a variable or expression with different constants (i.e. cases). If it is equal to case constant, a set of statements following the constants are executed. If there is no match, the default statements are executed.

Syntax:

```
switch (expression)
{
    case constant1:
      // statements
      break;

    case constant2:
      // statements
      break;
    .
    .
    .
    default:
      // default statements
}
```

The break is used to break out of the case statements. break is a keyword that breaks out of the code block. The break prevents the program from testing the next case statement also.

E.g.

```
#include <stdio.h>
int main() {
    int num = 8;
    switch (num) {
        case 7:
            printf("Value is 7");
            break;
        case 8:
            printf("Value is 8");
            break;
        case 9:
            printf("Value is 9");
            break;
        default:
            printf("Out of range");
            break;
    }
    return 0;
}
```

Q. Write a program to find whether a input char is vowel or constant or other characters using switch statement.

```
#include <stdio.h>
int main() {
  char c;
  printf("Enter a character:");
  scanf("%c", &c);
  if(c>='A'&&c<='Z'||c>='a'&&c<='z')
  {
    switch (c) {
        case'a':
        case'e':
        case'i':
        case'o':
        case'u':
        case'A':
        case'E':
        case'I':
        case'O':
        case'U':
            printf("It is vowel");
            break;
        default:
            printf("It is consonant");
    }
  }
  else
    printf("It is other character");
    return 0;
}
```

Loop Statements or Iteration

Loops are used when we want to execute a part of program or block of statement several times. So, a loop may be defined as a block of statements which are repeatedly executed for a certain number of times or until a particular condition is satisfied. There are three types of loop statements in C:
1. For
2. While
3. Do...while

For loop

The for loop is the most commonly used looping in C. When the number of repetitions is known in advance, the use of this loop will be more efficient.

For loop contains 3 parts Initialization, Condition and Increment or Decrements.
1. Initialization part: Where value is assigned to the variable.
2. Conditional or Logical Part: where the condition is checked until the expression is true.
3. Increment or decrement part: Which change index value of the for loop.

Syntax:

```
for(initilization; condition expression; increment/decrement)
{
    //Body of loop
}
```

E.g.

```
#include<stdio.h>
void main( )
{
    int i;
    for(i = 1; i <= 10; i++)
    {
        printf("%d\t", i);
    }
}
```

Q. Write a program to calculate sum of first n natural number.

```
#include<stdio.h>
#include<conio.h>
int main()
{
    int n, i, sum=0;
    printf("\n Enter a number n:");
    scanf("%d", &n);
    for(i=1; i<=n; i++)
    {
        sum=sum+i;
    }
    printf("\nThe sum is %d", sum);
    getch();
    return 0;
}
```

While Loop

Syntax:

```
initialization;
while(condition_expression)
{
    //Body of loop
    //update statement(increment/decrement)
}
```

First the condition is evaluated; if it is true then the statements in the body of loop are executed. After the execution, again the condition is checked and if it is found to be true then again the statements in the body of loop are executed. This means that these statements are executed continuously till the condition is true and when it becomes false, the loop terminates and the control comes out of the loop.

E.g.

```
#include<stdio.h>
void main( )
{
   int i;
   i = 1;
   while(i <= 10)
   {
      printf("%d\t", i);
      i++;
   }
}
```

Q. Write a program to calculate factorial of a number using while loop.

```
#include<stdio.h>
#include<conio.h>
int main( )
{
  int n, i;
  long int fact;
  printf("Enter the integer:");
  scanf("%d", &n);
  fact=1, i=1;
  while(i<=n)
  {
     fact=fact*i;
     i++;
  }
  printf("Factorial of %d is %ld", n, fact);
  getch();
  return 0;
}
```

Do-while Loop

Syntax:

```
initialization;
do{
   //Body of loop
   //update statement
}while(condition_expression);
```

Here firstly the segments inside the loop body are executed and then the condition is evaluated. If the condition is true, then again the loop body is executed and this process continues until the condition becomes false.

E.g.

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

```
void main()
{
  int i;
  i=1;
  do
  {
    printf("\n%d",i);
    i++;
  }while(i<5);
  getch();
}
```

Difference between while and do-while loop

1. The while loop is **pre-test loop**, where firstly the condition is checked and if the condition is true then only the statements of the while loop execute. The do-while loop is a **post-test loop**. In the do-while loop, the statements of the do-while loop are executed after that, the condition is evaluated, and if the condition is true then again the statements of the do-while loop are executed.

2. The condition of the while loop is at the top of the loop but the condition of the do-while loop is at the bottom of the loop.

3. While loop can't be terminated with a semicolon but the do-while loop should be terminated with a semicolon.

4. The statements of the do-while loop execute at least 1 time in every condition. In the while loop, the test expression evaluates false in first checking then the statements of the while loop is not executed. But the condition of the do-while loop is checked at the end of the loop, so it is guaranteed that the statements of the do-while loop execute at least once.

Q. Write a program to print the even number upto n using do-while loop.

```
#include<stdio.h>
#include<conio.h>
void main()
{
  int n, i;
  printf("Enter a value of n:");
  scanf("%d",&n);
  i=1;
  do
  {
    if(i%2==0)
        printf("%d\t",i);
    i++;
  }while(i<=n);
  getch();
}
```

Q. Write a program to compute and print the sum of given numbers of squares.
[$1^2+2^2+3^2+….+n^2$]

```
#include<stdio.h>
#include<conio.h>
void main()
{
  int n, i, sum=0;
  printf("Enter a value of n:");
  scanf("%d",&n);
  for(i=1;i<=n;i++)
  {
     sum=sum+i*i;
  }
  printf("\nThe sum is:%d", sum);
  getch();
}
```

Q. Write a program using loop to compute a^b (a raised to power b) with a, b as input.

```
#include<stdio.h>
#include<conio.h>
void main()
{
  int a, b;
  int result, i;
  printf("Enter the base:");
  scanf("%d", &a);
  printf("Enter the exponent:");
  scanf("%d", &b);
  if(b==0)
    result=1;
  else
  {
     result=1;
     for(i=1; i<=b;i++)
     {
        result=result*a;
     }
  }
  printf("%d raised to power %d=%d", a, b, result);
  getch();
}
```

Nesting of Loops

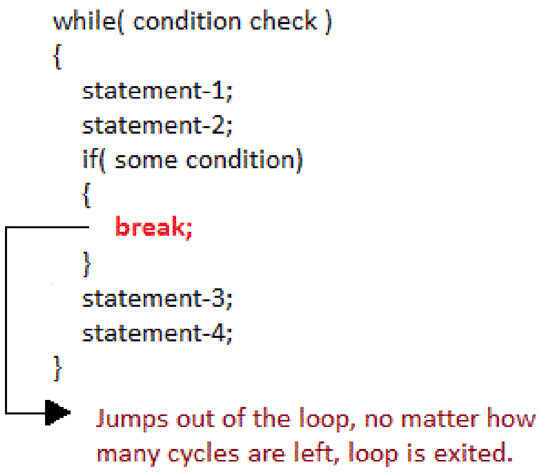
When a loop is written inside the body of another loop, then it is known as nesting of loops. Any type of loop can be nested inside any other type of loop. For example, a for loop may be nested inside another for loop or inside a while or do...while loop. Similarly, while and do while loops can be nested.

E.g.

```
#include<stdio.h>
void main( )
{
   int i, j;
   /* first for loop */
   for(i = 1; i < 5; i++)
   {
      printf("\n");
      /* second for loop inside the first */
      for(j = i; j > 0; j--)
      {
         printf("%d", j);
      }
   }
}
```

Break Statement

The break statement is used to terminate loops or exit from a switch. It can be used within a for, while, do –while, or switch statement. If a break statement is included in a while, do – while or for loop, then control will immediately be transferred out of the loop when the break statement is encountered.



```
while( condition check )
{
   statement-1;
   statement-2;
   if( some condition)
   {
      break;
   }
   statement-3;
   statement-4;
}
```

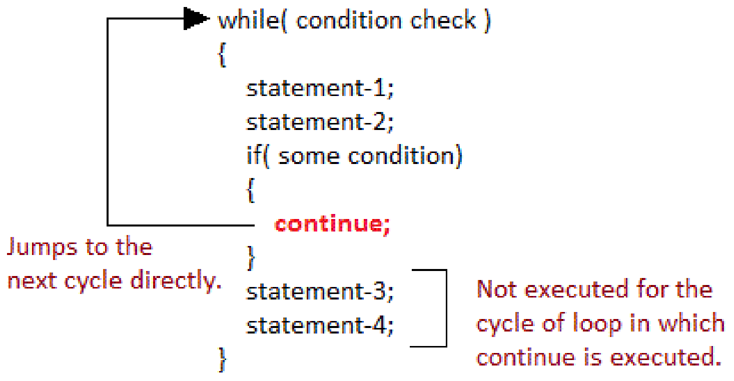
Jumps out of the loop, no matter how many cycles are left, loop is exited.

E.g.

```
#include <stdio.h>
int main()
{
  int i;
  double number, sum = 0.0;
  for (i = 1; i <= 10; ++i)
  {
    printf("Enter a n%d: ", i);
    scanf("%lf", &number);
    // if the user enters a negative number, break the loop
    if (number < 0.0)
    {
      break;
    }
    sum = sum + number;
  }
  printf("Sum = %lf", sum);
  return 0;
}
```

Continue statement

The continue statement is used to bypass the reminder of the current pass through a loop. The loop does not terminate when a continue statement is encountered. Rather, the remaining loop statements are skipped and the computation proceeds directly to the next pass through the loop.



```
while( condition check )
{
   statement-1;
   statement-2;
   if( some condition)
   {
      continue;
   }
   statement-3;
   statement-4;
}
```

Jumps to the next cycle directly.
Not executed for the cycle of loop in which continue is executed.

E.g

Program to print sum of odd numbers between 0 and 10

```
#include <stdio.h>
int main ()
{
 int a,sum = 0;
 for (a = 0; a < 10; a++)
 {
   if ( a % 2 == 0 )
     continue;
  sum = sum + a;
  }
 printf("sum = %d",sum);
 return 0;
}
```

Goto Statement

The goto statement is used to alter the normal sequence of program execution by transferring control to some other part of the program.

Syntax:

```
        goto label;
```

Where label is an identifier that is used to label the target statement to which control will be transferred. The target statement must be labeled, and the label must be followed by a colon. Thus, the target statement will appear as

```
        label: statement
```

E.g.

```
#include<stdio.h>
#include<conio.h>
int main( )
{
  int n ;
  printf("Enter the number :") ;
  scanf ("%d", &n) ;
  if (n%2 == 0)
    goto even ;
  else
    goto odd;
  even :
     printf ("Number is even") ;
     goto end ;
  odd :
     printf ("Number is odd") ;
  end :
     printf ("\n") ;
  getch( );
  return 0;
}
```

Q. Write a program to determine whether a number is prime or not.

```
#include <stdio.h>
#include<conio.h>
int main( )
{
    int i, n;
    printf("Enter a number:");
    scanf("%d", &n);
    for(i=2; i<n; i++)
    {
        if(n%i==0)
        {
            printf("\nNot Prime!!");
            break;
        }
    }
    if(i==n)
    {
        printf("\nPrime Number!!");
    }
    getch();
    return 0;
}
```

Q. Write a program to give the following output.

```
1
2     3
4     5     6
7     8     9     10
11    12    13    14    15 …….
```

```
#include <stdio.h>
#include<conio.h>
int main( )
{
    int n, i, j, a;
    printf("How many rows:");
    scanf("%d", &n);
    a=1;
    for(i=1; i<=n; i++)
    {
        for(j=1; j<=i;j++)
        {
            printf("%d\t", a++);
        }
        printf("\n");
    }
    getch();
    return 0;
}
```

Q. Write a program to give following output:

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

```
#include <stdio.h>
#include<conio.h>
#define n 5
int main( )
{
    int i, j;
    for(i=1; i<=n; i++)
    {
        for(j=1; j<=i;j++)
        {
            printf("\t*");
        }
        printf("\n");
    }
    getch();
    return 0;
}
```

Q. Write a program to give following output:

```
1
1    2
1    2    3
1    2    3    4 …….upto n rows.
```

```
#include <stdio.h>
#include<conio.h>
int main( )
{
    int n, i, j;
    printf("How many rows:");
    scanf("%d", &n);
    for(i=1; i<=n; i++)
    {
        for(j=1; j<=i;j++)
        {
            printf("%d\t", j);
        }
        printf("\n");
    }
    getch();
    return 0;
}
```