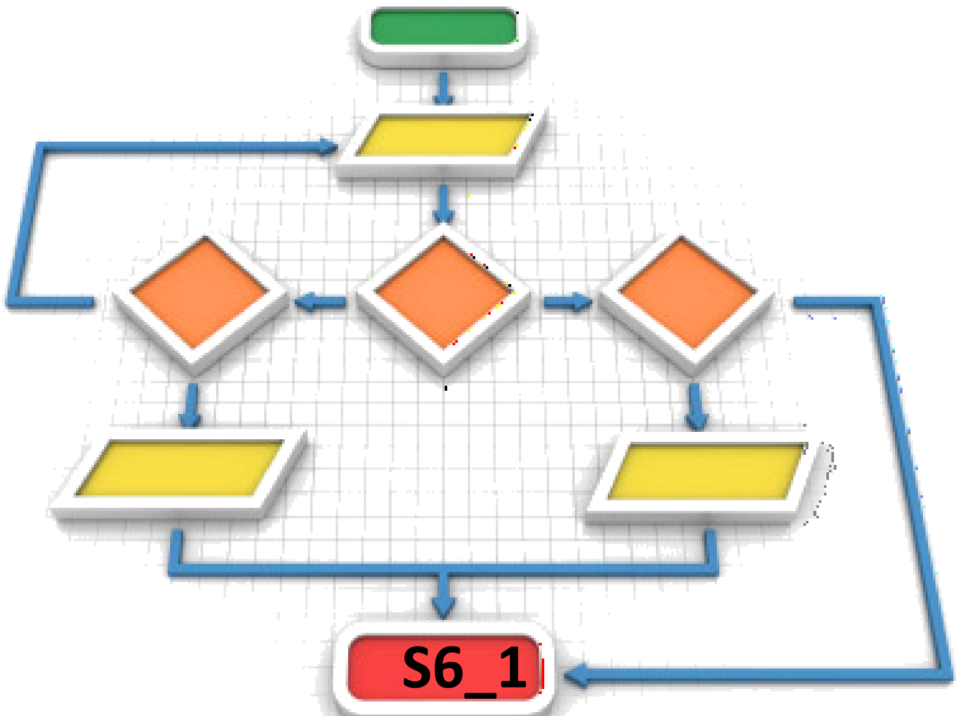
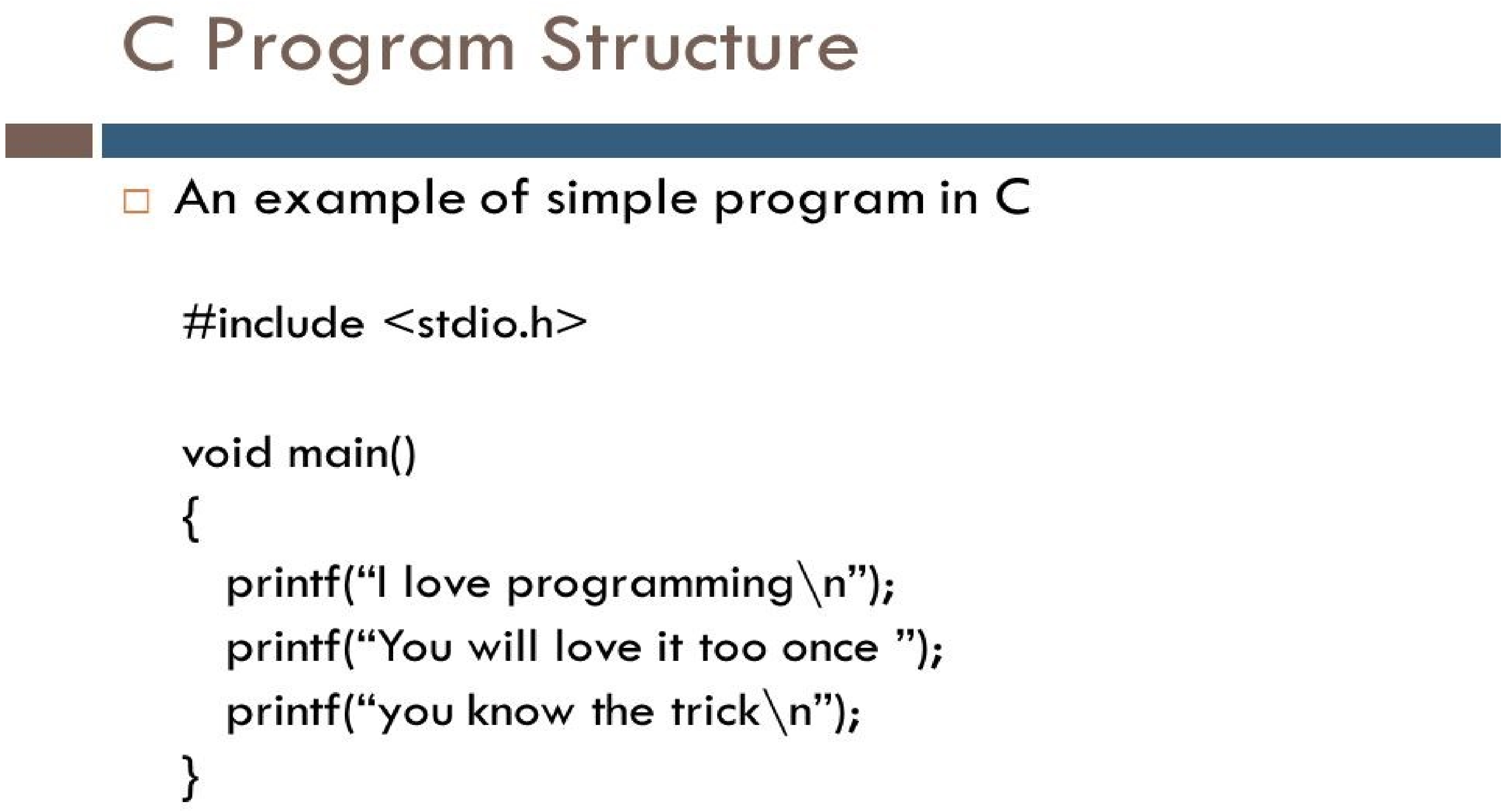


Control Structures
Decision Making &
Branching

Structure of C program



C Program Structure

- An example of simple program in C

```
#include <stdio.h>

void main()
{
   printf("I love programming\n");
   printf("You will love it too once ");
   printf("you know the trick\n");
}
```

Adding two integers

```
#include <stdio.h>
int main( void )
{/* start of function main */
        int sum; /* declaration: variable to store addition result */
        int integer1; /* declaration: first number to be input by user */
        int integer2; /* second number to be input by user */
        printf( "Enter first integer\n" );
        scanf( "%d", &integer1 ); /* read the first integer */
        printf( "Enter second integer\n" );
        scanf( "%d", &integer2 ); /* read the second integer */
        sum = integer1 + integer2; /* ADD the integers and assign total to sum */
        printf( "Sum is %d\n", sum ); /* print sum */
        return 0; /* indicate that program ended successfully */
} /* end function main */
```

scanf()

scanf() is used to obtain the value from the user

- It is included in stdio.h
  - E.g. scanf("%d", &integer1);

Format Specifiers

The format specifiers are used in C for input and output purposes. Using this concept the compiler can understand that what type of data is in a variable during taking input using the **scanf()** function and printing using **printf()** function.

Format Specifiers

Format Specifier	Type	Format Specifier	Type
%c	**Character**	**%Lf**	Long double
%d	**Signed integer**	**%lu**	Unsigned int or unsigned long
%e or %E	Scientific notation of floats	**%lli or %lld**	Long long
%f	**Float values**	**%llu**	Unsigned long long
%g or %G	Similar as %e or %E	**%o**	Octal representation
%hi	Signed integer (short)	**%p**	Pointer
%hu	Unsigned Integer (short)	**%s**	String
%i	Unsigned integer	**%u**	Unsigned int
%l or %ld or %li	Long	**%x or %X**	Hexadecimal representation
%lf	**Double**		

printf()

C provides the printf() to display the data on the monitor.

- It is included in stdio.h

Examples are:

- Printf("programming is an art");
- Printf("%d", number);
- Printf("%f%f", p, q);

Syntax and Logical errors

Syntax errors: violation of programming language rules (grammar)

- Detected by the compiler
- E.g. **printf ("hello world")** // semicolon missing

Logical errors: errors in meaning

- Programs are syntactically correct but don't produce the expected output
- User observes output of running program

Course Objectives

To learn and appreciate the following concepts

- The if Statement
- The if-else Statement

Course Outcome

At the end of session student will be able to learn and understand

- The if Statement
- The if-else Statement

Control Structures

➢ **A control structure refers to the order of executing the program statements.**

➢ The following three approaches can be chosen depending on the problem statement:

✓ **Sequential (Serial)**

- In a **Sequential approach**, all the statements are executed in the same order as it is written.

✓ **Selectional (Decision Making and Branching)**

- In a **Selectional approach**, based on some conditions, different set of statements are executed.

✓ **Iterational (Repetition)**

- In an **Iterational approach** certain statements are executed repeatedly.

Decision making and branching

C decision making and branching statements are:

1. `if` statement

2. `switch` statement

Different forms of `if` statement

1. Simple **`if`** statement.
2. **`if…else`** statement.
3. Nested **if…else** statement.
4. **else if** ladder.

Simple `if` Statement

General form of the simplest if statement:

```
if (test Expression)
    {
     statement-block;
    }
next_statement;
```

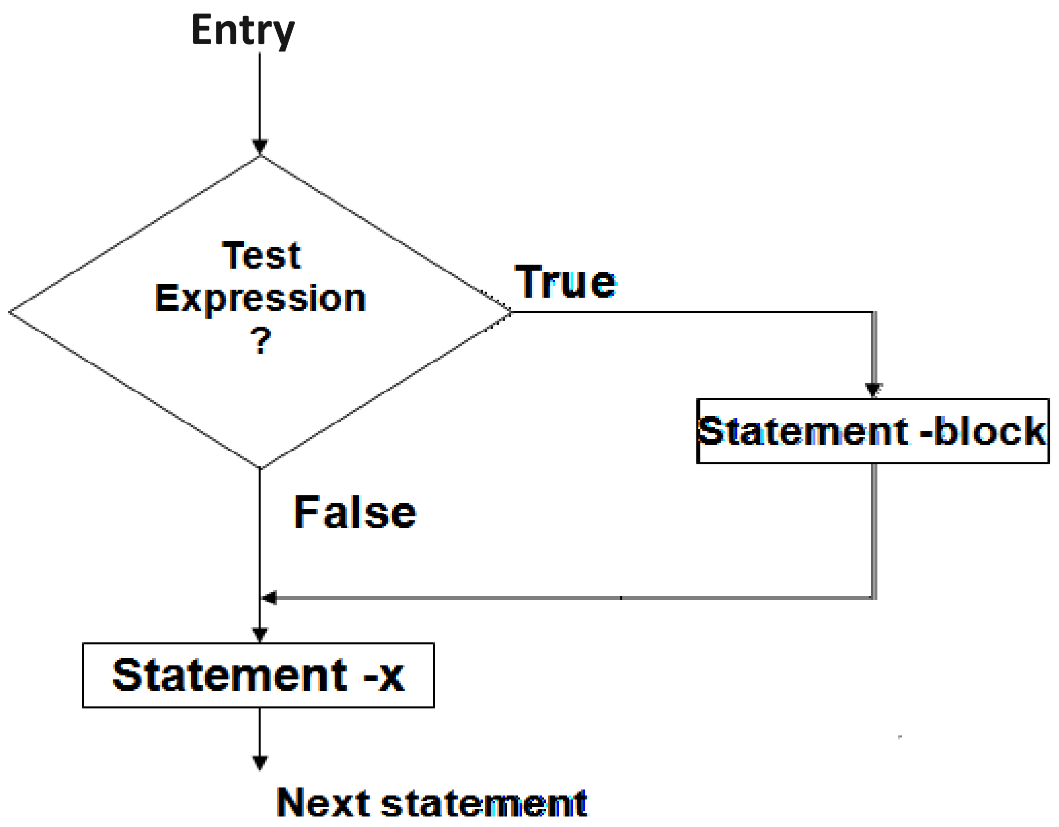
If expression is true (non-zero), executes statement.
It gives you the choice of executing statement or skipping it.

if Statement- explanation

- (*test Expression*) is first evaluated.
- If TRUE (non-zero), the 'if' statement block is executed.
- If FALSE (zero) the next statement following the if statement block is executed.
- So, during the execution, based on some condition, some code will not be executed (skipped).

For example:
```
bonus = 0;
if (hours > 70)
bonus = 10000;
salary= salary + bonus;
```

Flow chart of simple `if`



Find out whether a number is even or odd.

```
#include <stdio.h>
int main() {
  int  x;
  printf(“input an integer\n”);
  scanf(“%d”, &x);
  if ((x % 2) == 0) {
        printf(“It is an even number\n”);
    }
  if ((x%2) == 1) {
        printf(“It is an odd number\n”);
    }
   return 0;
}
```

Example - `if`

```
// Program to calculate the absolute value of an integer

int main ()
{
        int number;
        printf(“Type in your number: “);
        scanf(“%d”, &number);
        if ( number < 0 )
                number = -number;
        printf(“The absolute value is”);
        printf(“%d”, number);
        return 0;
}
```

The `if-else` statement

```
if (test expression )
      {
            statement _block1
      }
    else
      {
            statement _block2
      }
Next_statement
```

if-else statement: enables you to choose between two statements

`if-else` statement

Explanation:

1.First ,the (test expression) is evaluated.

2.If it evaluates to non-zero (TRUE), statement_1 is executed, otherwise, if it evaluates to zero (FALSE), statement_2 is executed.

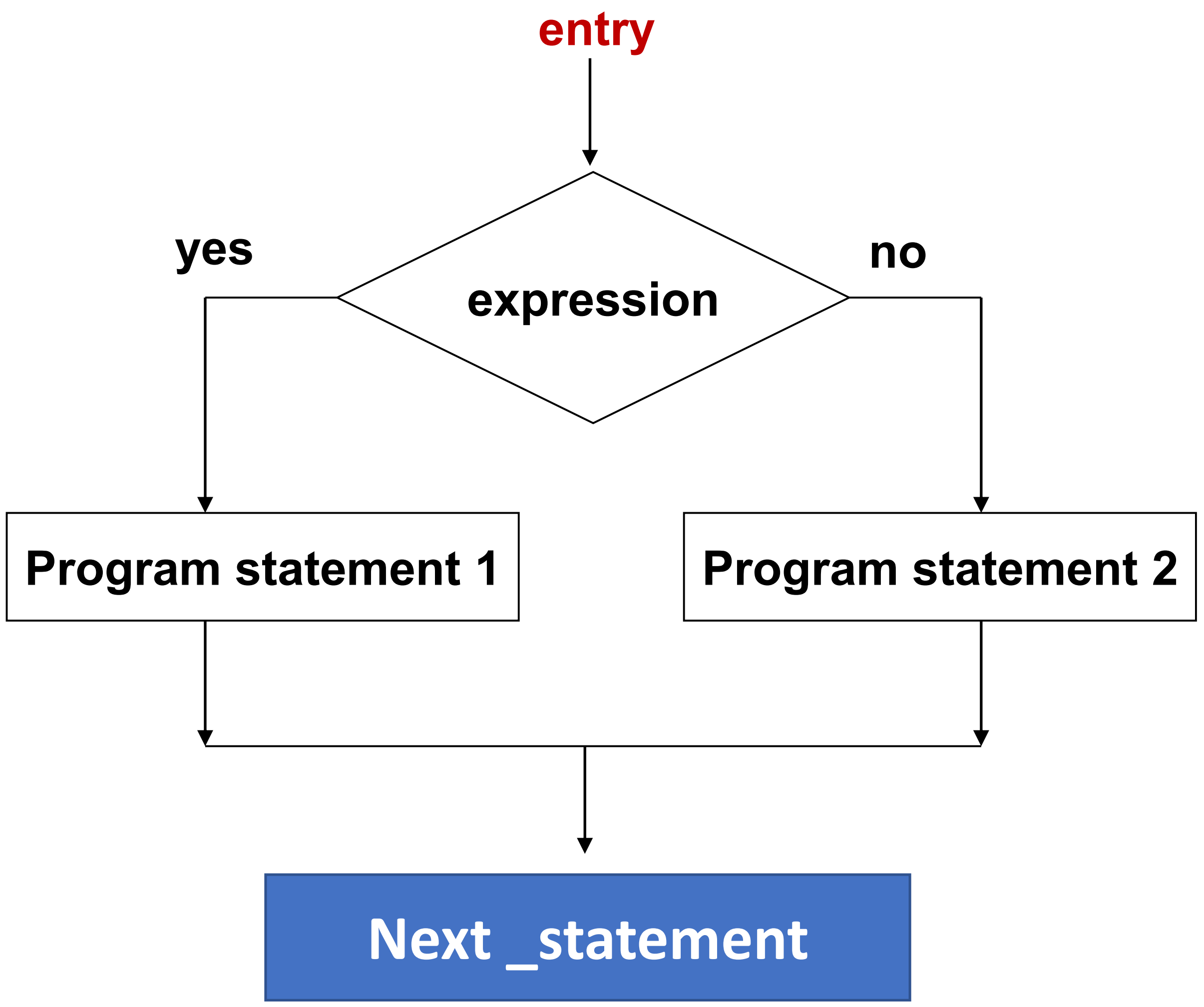
3.They are mutually exclusive, meaning, either statement_1 is executed or statement_2, but not both.

4.If the statements_ 1 and statements_ 2 take the form of block , they must be put in curly braces.

Example:

```
 if(job_code ==  1)
        rate = 7.00;
else
         rate = 10.00;
prinf(“%d”,rate);
```

The `if-else` statement



Find out whether a number is even or odd

```
#include <stdio.h>
int main() {
  int  x;
  printf(“Input an integer\n”);
  scanf(“%d”,&x);
  if ((x % 2) == 0)     {
        printf(“It is an even number\n”);
  }
  else
  {
        printf(“It is an odd number\n”);
  }
   return 0;
  }
```

WAP to find largest of 2 numbers

```
#include<stdio.h>
int main()
{
        int a, b;
        printf(“Enter 2 numbers\n”);
        scanf(“%d %d”, &a, &b);
          if(a > b)
                  printf(“Large is %d\t“,a);
          else
                  printf(“Large is %d\t“,b);
        return 0;
}
```

Attention on `if-else` syntax !

```
if ( expression )
        program statement 1
else
        program statement 2
```

In C, the ; is part (end) of a statement !

```
if ( remainder == 0 )
        printf("The number is even.\n“);
else
        printf(“The number is odd.\n“);
```

Syntactically OK [void (null) statements in `if`]
But a semantic error! !

```
if ( x == 0 );
        printf(“The number is zero.\n“);
```

Problem: determine if a year is a leap year

```
#include<stdio.h>
int main() {
    int year;
    printf("Enter the year");
    scanf("%d", &year);
    if(year % 4 == 0) {
        if( year % 100 == 0) {
            if ( year % 400 == 0)
                printf("%d is a leap year", year);
              else
                printf("%d is not a leap year", year);
        } else
            printf("%d is a leap year", year);
    }
     else
          printf("%d is not a leap year", year);
    return 0;
}
```

A leap year is exactly divisible by 4 except for century years (years ending with 00). The century year which is evenly divisible by 100 is a leap year only if it is also divisible by 400.

e.g. 2000, 2004, 2020 are leap years
But 1900, 1400 is NOT

Testing for range

?

```
if (x >= 5 && x <= 10)
          printf("in range");
```

?

```
if (5 <= x <= 10)
          printf("in range");
```

Testing for range

YES

```
if (x >= 5 && x <= 10)
                printf("in range");
```

NO !

```
if (5 <= x <= 10)
      printf("in range");
```

Syntactically correct, but semantically an error !!!

Because the order of evaluation for the <= operator is left-to-right, the test expression is interpreted as follows:

`(5<= x) <= 10`

The sub expression `5 <= x` either has the value 1 (for true) or 0 (for false). Either value is less than 10, so the whole expression is always true, regardless of `x` !

Poll Question

Go to chat box/posts for the link to the Poll question

Submit your solution in next 2 minutes

Click the result button to view your score

Summary

- The if Statement
- The if-else Statement