C Language

- **introduction**

The C Language is developed for creating system applications that directly interact with the hardware devices such as drivers, kernels, etc. C programming is considered as the base for other programming languages, that is why it is known as mother language.

It can be defined by the following ways:

1. Mother language
2. System programming language
3. Procedure-oriented programming language
4. Structured programming language
5. Mid-level programming language

C as a mother language

C language is considered as the mother language of all the modern programming languages because **most of the compilers, JVMs, Kernels, etc. are written in C language**, and most of the programming languages follow C syntax, for example, C++, Java, C#, etc.

It provides the core concepts like the array, strings, functions, file handling, etc. that are being used in many languages like C++, Java, C#, etc.

C as a system programming language

A system programming language is used to create system software. C language is a system programming language because it **can be used to do low-level programming (for example driver and kernel)**. It is generally used to create hardware devices, OS, drivers, kernels, etc. For example, Linux kernel is written in C.It can't be used for internet programming like Java, .Net, PHP, etc.

C as a procedural language

A procedure is known as a function, method, routine, subroutine, etc. A procedural language **specifies a series of steps for the program to solve the problem**. A procedural language breaks the program into functions, data structures, etc.C is a

procedural language. In C, variables and function prototypes must be declared before being used.

C as a structured programming language

A structured programming language is a subset of the procedural language. **Structure means to break a program into parts or blocks** so that it may be easy to understand.

In the C language, we break the program into parts using functions. It makes the program easier to understand and modify.

C as a mid-level programming language

C is considered as a middle-level language because it **supports the feature of both low-level and high-level languages**. C language program is converted into assembly code, it supports pointer arithmetic (low-level), but it is machine independent (a feature of high-level).

A **Low-level language** is specific to one machine, i.e., machine dependent. It is machine dependent, fast to run. But it is not easy to understand.

A **High-Level language** is not specific to one machine, i.e., machine independent. It is easy to understand.

C Program

```
#include <stdio.h>
int main ()
{
printf ("Hello C Programming\n");
return 0;
}
```

Output:

Hello C Programming

History of C Language

History of C language is interesting to know. Here we are going to discuss a brief history of the c language.

C programming language was developed in 1972 by Dennis Ritchie at bell laboratories of AT&T (American Telephone & Telegraph), located in the U.S.A.

Dennis Ritchie is known as the **founder of the c language**.

It was developed to overcome the problems of previous languages such as B, BCPL, etc.

Initially, C language was developed to be used in **UNIX operating system**. It inherits many features of previous languages such as B and BCPL.

Let's see the programming languages that were developed before C language.

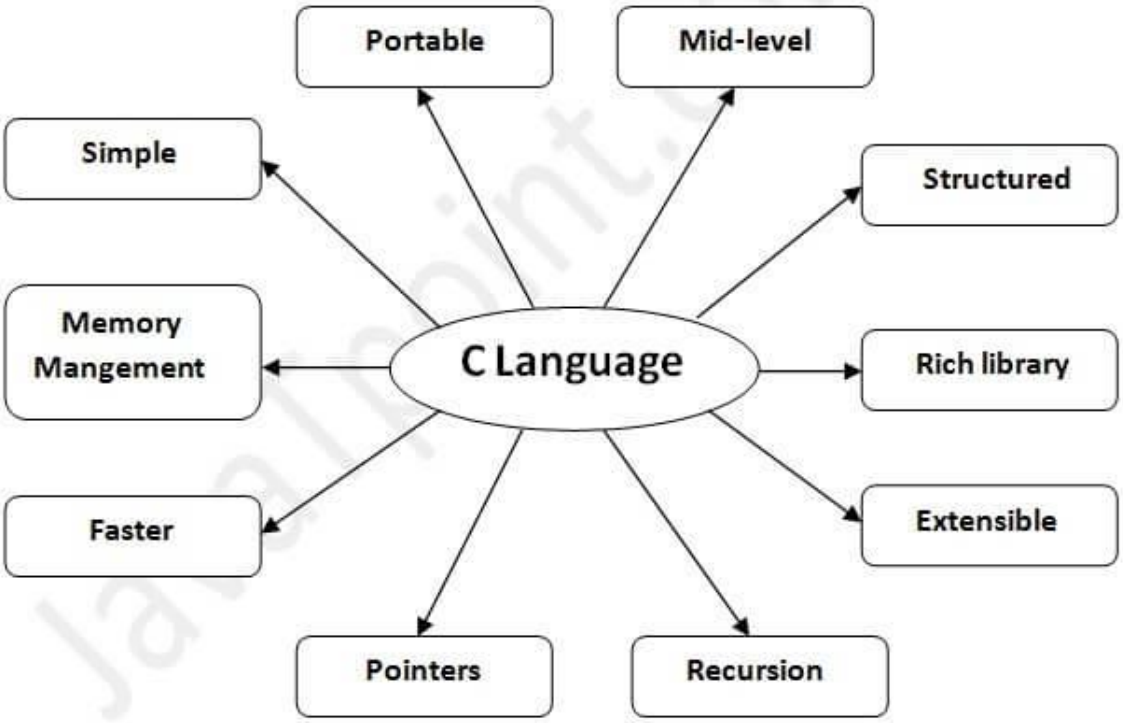
Language	Year	Developed By
Algol	1960	International Group
BCPL	1967	Martin Richard
B	1970	Ken Thompson
Traditional C	1972	Dennis Ritchie
K & R C	1978	Kernighan & Dennis Ritchie
ANSI C	1989	ANSI Committee
ANSI/ISO C	1990	ISO Committee
C99	1999	Standardization Committee

Features of C Language

C is the widely used language. It provides many **features** that are given below.

1. Simple

2. Machine Independent or Portable
3. Mid-level programming language
4. structured programming language
5. Rich Library
6. Memory Management
7. Fast Speed
8. Pointers
9. Recursion
10. Extensible



Simple

C is a simple language in the sense that it provides a **structured approach** (to break the problem into parts), **the rich set of library functions**, **data types**, etc.

Machine Independent or Portable

Unlike assembly language, c programs **can be executed on different machines** with some machine specific changes. Therefore, C is a machine independent language.

Mid-level programming language

Although, C is **intended to do low-level programming**. It is used to develop system applications such as kernel, driver, etc. It **also supports the features of a high-level language**. That is why it is known as mid-level language.

Structured programming language

C is a structured programming language in the sense that **we can break the program into parts using functions**. So, it is easy to understand and modify. Functions also provide code reusability.

Rich Library

C **provides a lot of inbuilt functions** that make the development fast.

Memory Management

It supports the feature of **dynamic memory allocation**. In C language, we can free the allocated memory at any time by calling the **free()** function.

Speed

The compilation and execution time of C language is fast since there are lesser inbuilt functions and hence the lesser overhead.

Pointer

C provides the feature of pointers. We can directly interact with the memory by using the pointers. We **can use pointers for memory, structures, functions, array**, etc.

Recursion

In C, we **can call the function within the function**. It provides code reusability for every function. Recursion enables us to use the approach of backtracking.

Extensible

C language is extensible because it **can easily adopt new features**.

How to install C

There are many compilers available for c and c++. You need to download any one. Here, we are going to use **Turbo C++**. It will work for both C and C++. To install the Turbo C software, you need to follow following steps.

1. Download Turbo C++
2. Create turboc directory inside c drive and extract the tc3.zip inside c:\turboc
3. Double click on install.exe file
4. Click on the tc application file located inside c:\TC\BIN to write the c program
5.

Download Turbo C++ software

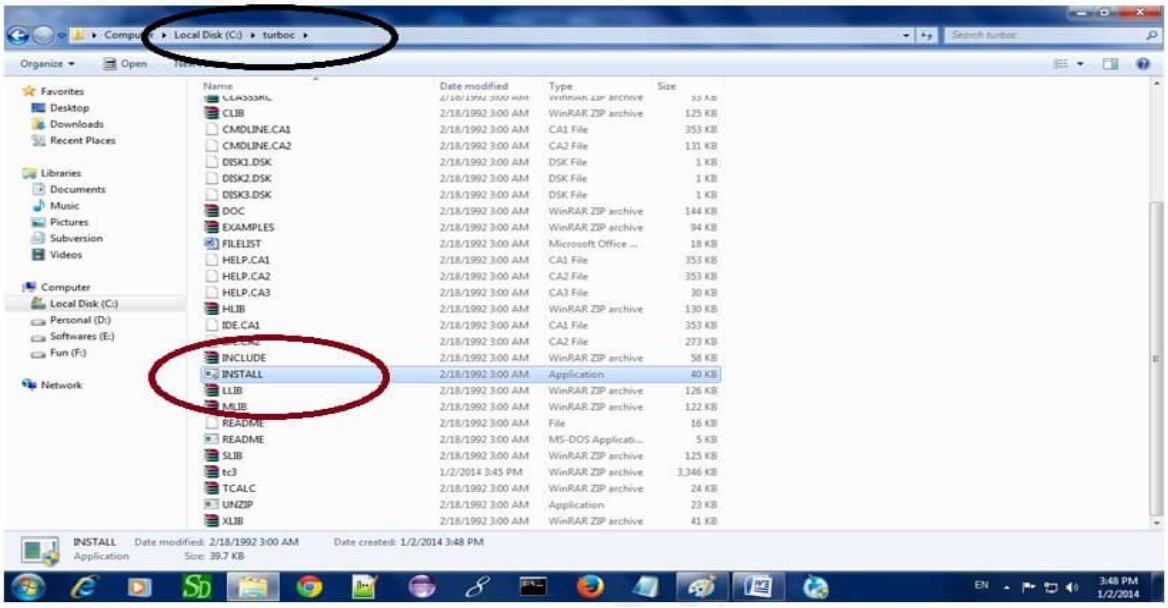
You can download turbo c++ from many sites. download Turbo c++

Create turboc directory in c drive and extract the tc3.zip

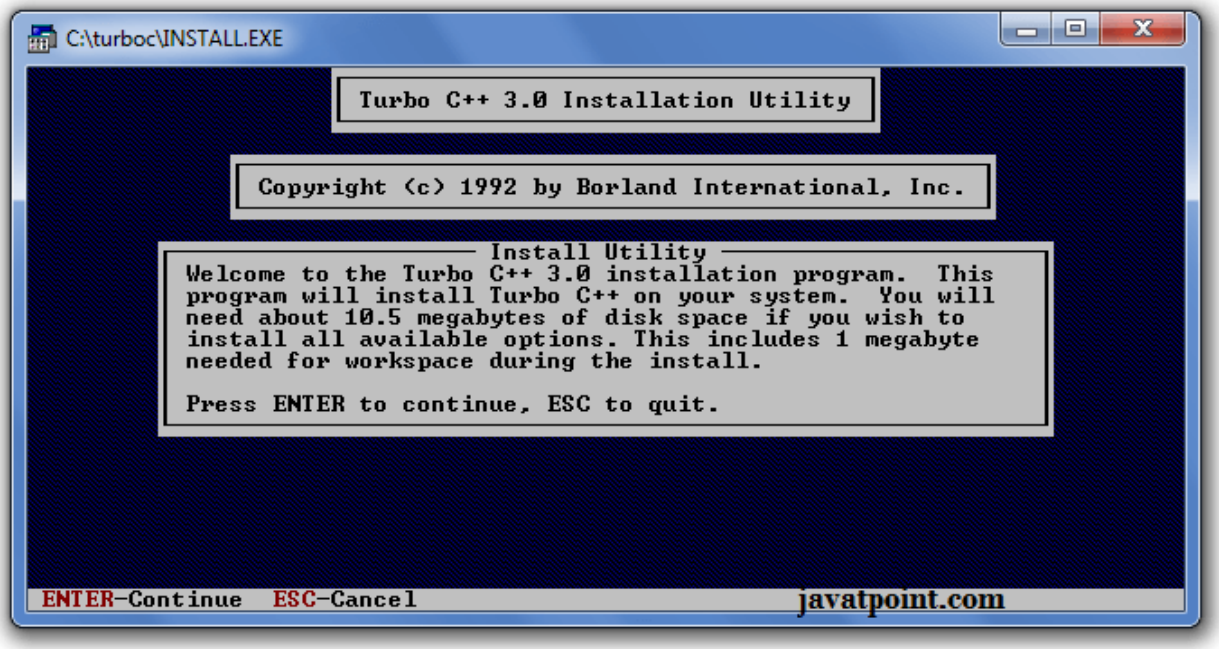
Now, you need to create a new directory turboc inside the c: drive. Now extract the tc3.zip file in c:\truboc directory.

Double click on the install.exe file and follow steps

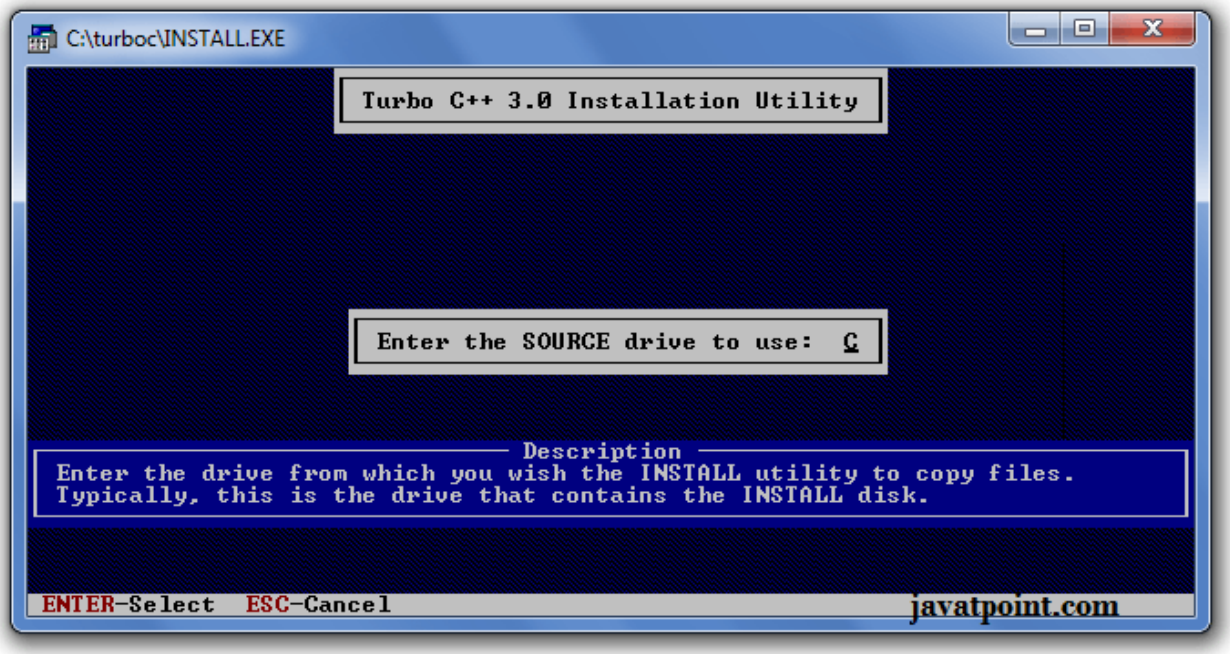
Now, click on the install icon located inside the c:\turboc



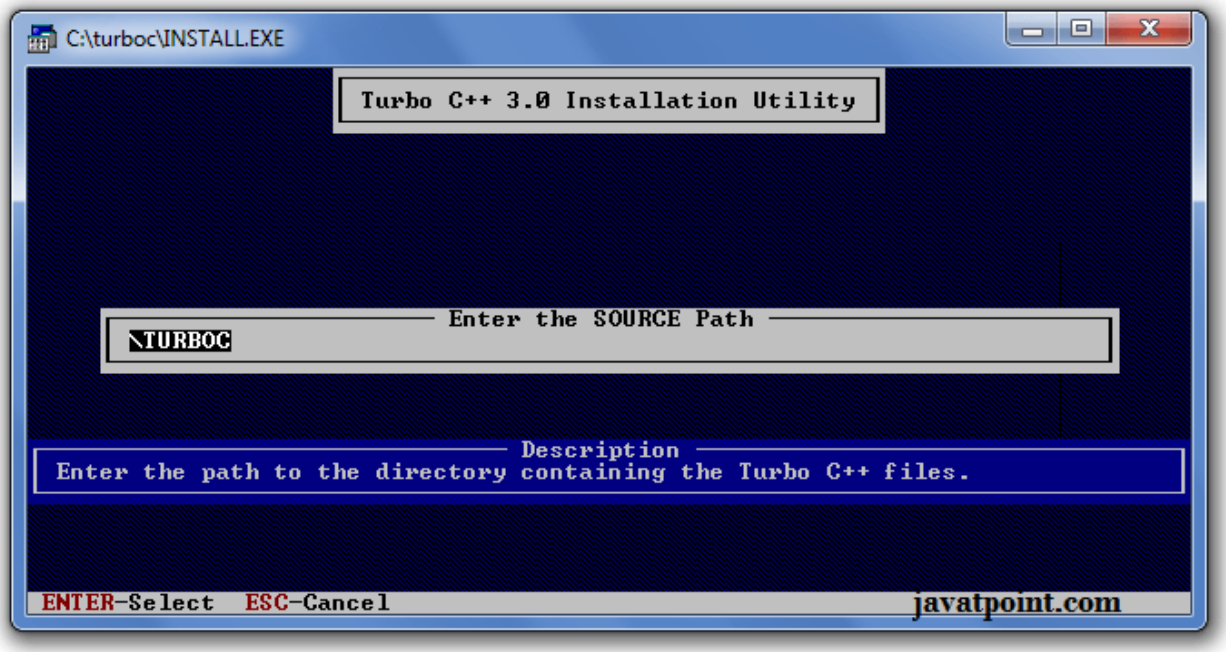
It will ask you to install c or not, press enter to install.



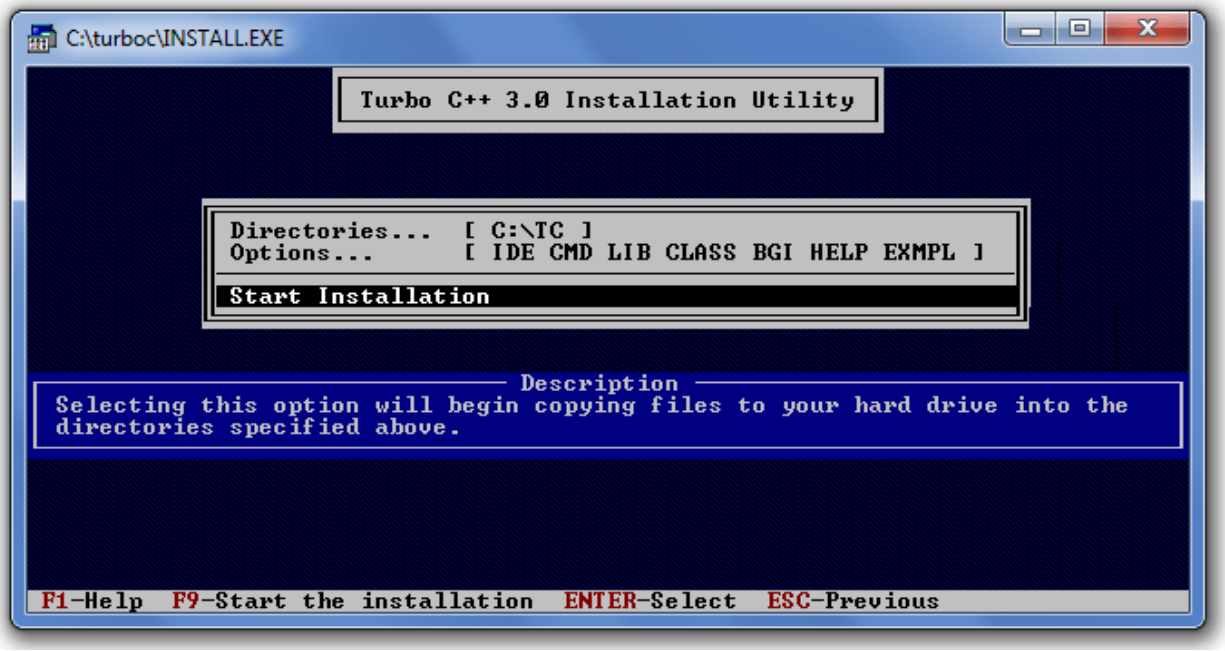
Change your drive to c, press c.



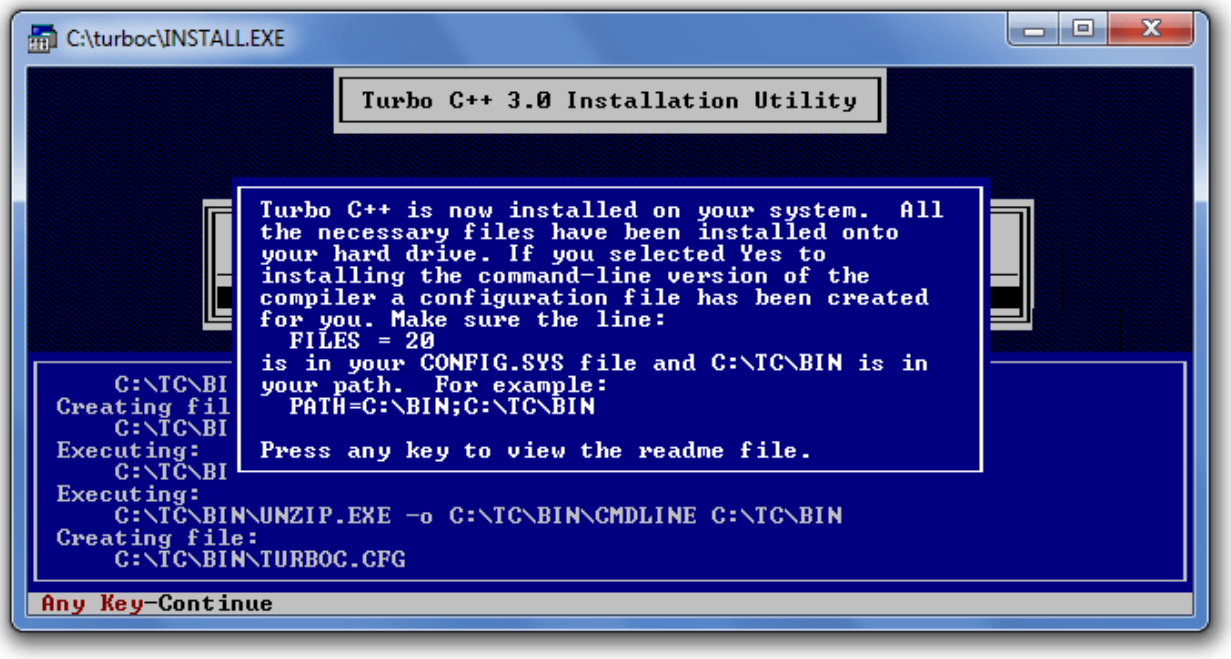
Press enter, it will look inside the c:\turboc directory for the required files.



Select Start installation by the down arrow key then press enter.

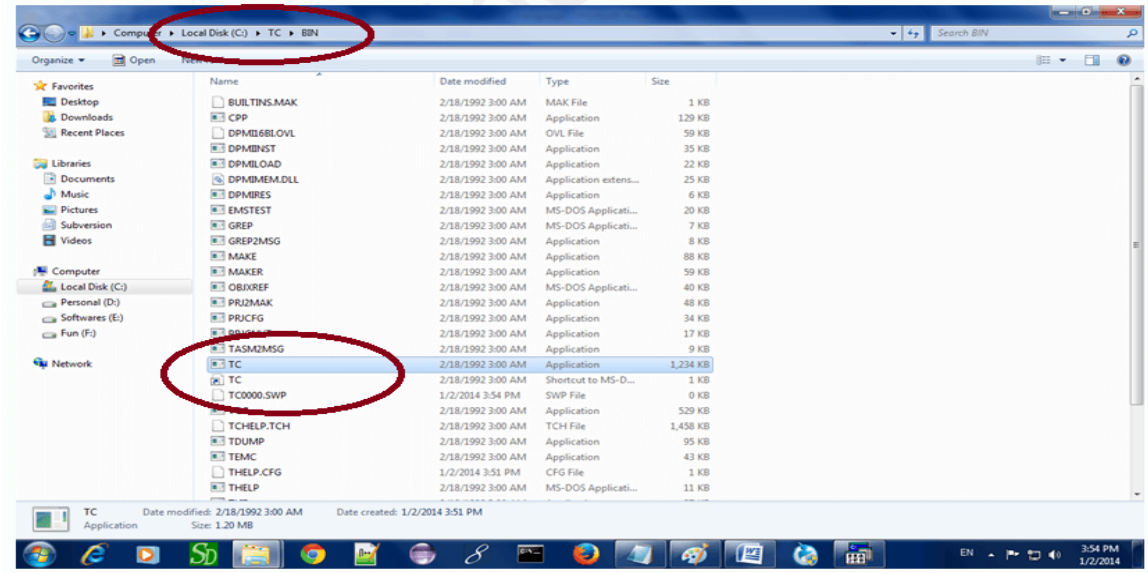


Now C is installed, press enter to read documentation or close the software.



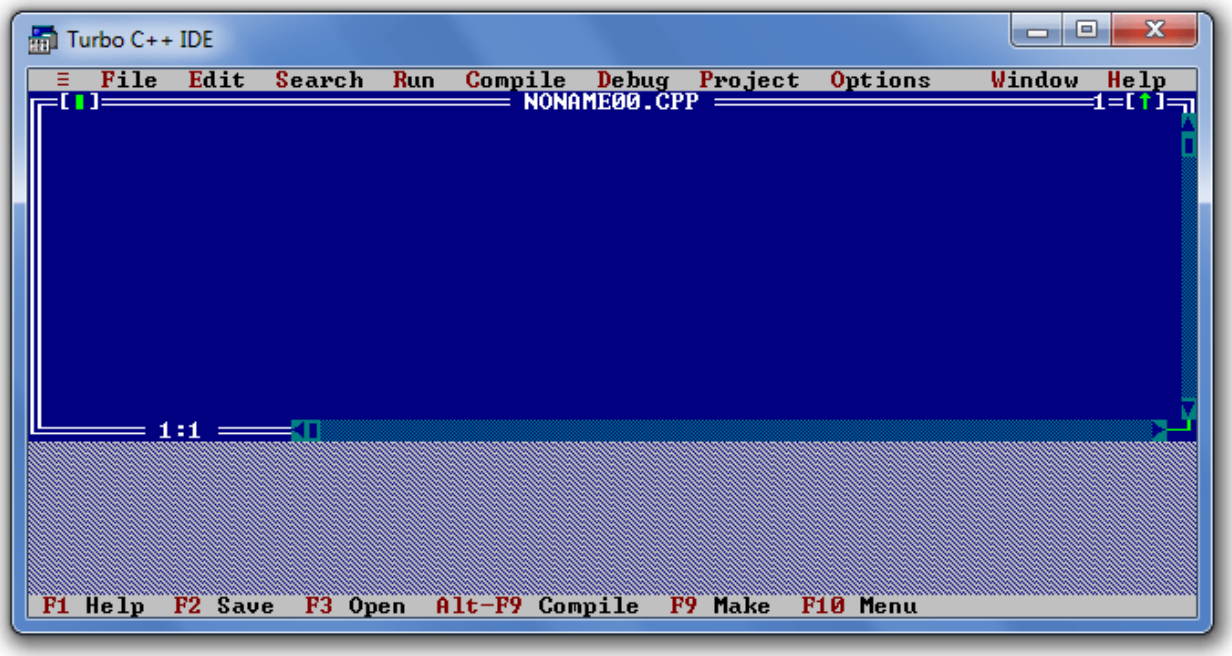
Click on the tc application located inside c:\TC\BIN

Now double click on the tc icon located in c:\TC\BIN directory to write the c program.



In windows 7 or window 8, it will show a dialog block to ignore and close the application because full screen mode is not supported. Click on Ignore button.

Now it will showing following console.



First C Program

```
1. #include <stdio.h>
2. int main(){
3. printf("Hello C Language");
4. return 0;
5. }
```

is a preprocessor

Include is directory

<> is angular brackets

<stdio.h> is the **standard input output** library functions. The printf() function is defined in stdio.h .

int main() The **main() function is the entry point of every program** in c language.

printf() The printf() function is **used to print data** on the console.

return 0 The return 0 statement, returns execution status to the OS. The 0 value is used for successful execution and 1 for unsuccessful execution.

How to compile and run the c program

There are 2 ways to compile and run the c program, by menu and by shortcut.

By menu

Now **click on the compile menu then compile sub menu** to compile the c program.

Then **click on the run menu then run sub menu** to run the c program.

By shortcut

Or, press ctrl+f9 keys compile and run the program directly.

You will see the following output on user screen.

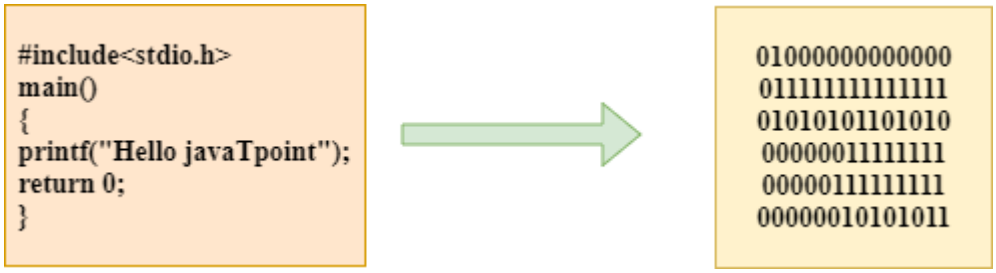
You can view the user screen any time by pressing the **alt+f5** keys.

Now **press Esc** to return to the turbo c++ console.

Compilation process in c

What is a compilation?

The compilation is a process of converting the source code into object code. It is done with the help of the compiler. The compiler checks the source code for the syntactical or structural errors, and if the source code is error-free, then it generates the object code.

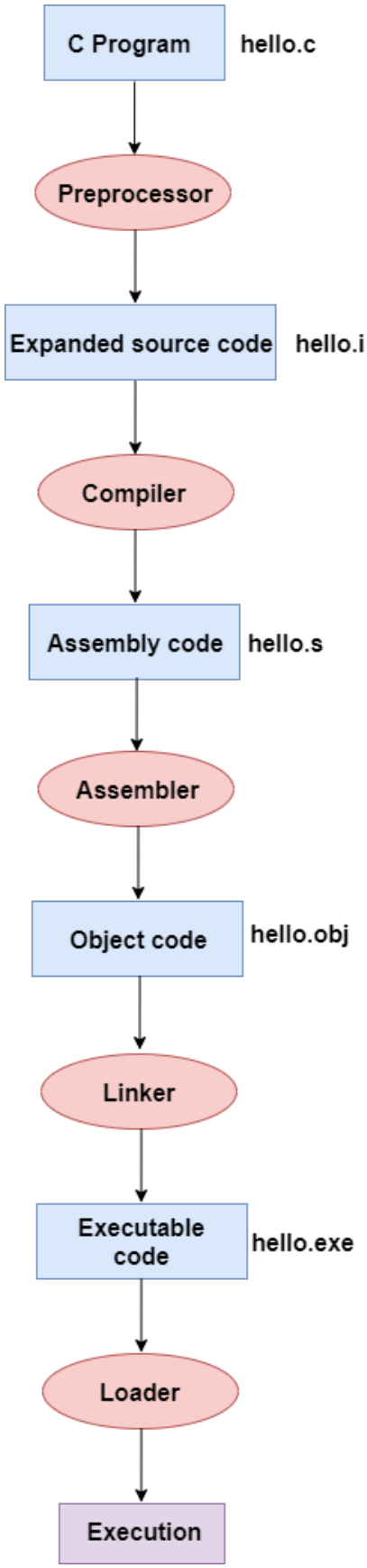


The c compilation process converts the source code taken as input into the object code or machine code. The compilation process can be divided into four steps, i.e., Pre-processing, Compiling, Assembling, and Linking.

The preprocessor takes the source code as an input, and it removes all the comments from the source code. The preprocessor takes the preprocessor directive and interprets it. For example, if **<stdio.h>,** the directive is available in the program, then the preprocessor interprets the directive and replace this directive with the content of the **'stdio.h'** file.

The following are the phases through which our program passes before being transformed into an executable form:

- **Preprocessor**
- **Compiler**
- **Assembler**
- **Linker**


C Program
hello.c
Preprocessor
Expanded source code
hello.i
Compiler
Assembly code
hello.s
Assembler
Object code
hello.obj
Linker
Executable code
hello.exe
Loader
Execution

Preprocessor

The source code is the code which is written in a text editor and the source code file is given an extension ".c". This source code is first passed to the preprocessor, and then the preprocessor expands this code. After expanding the code, the expanded code is passed to the compiler.

Compiler

The code which is expanded by the preprocessor is passed to the compiler. The compiler converts this code into assembly code. Or we can say that the C compiler converts the pre-processed code into assembly code.

Assembler

The assembly code is converted into object code by using an assembler. The name of the object file generated by the assembler is the same as the source file. The extension of the object file in DOS is '.obj,' and in UNIX, the extension is 'o'. If the name of the source file is **'hello.c',** then the name of the object file would be 'hello.obj'.

Linker

Mainly, all the programs written in C use library functions. These library functions are pre-compiled, and the object code of these library files is stored with '.lib' (or '.a') extension. The main working of the linker is to combine the object code of library files with the object code of our program. Sometimes the situation arises when our program refers to the functions defined in other files; then linker plays a very important role in this. It links the object code of these files to our program. Therefore, we conclude that the job of the linker is to link the object code of our program with the object code of the library files and other files. The output of the linker is the executable file. The name of the executable file is the same as the source file but differs only in their extensions. In DOS, the extension of the executable file is '.exe', and in UNIX, the executable file can be named as 'a.out'. For example, if we are using printf() function in a program, then the linker adds its associated code in an output file.

- Firstly, the input file, i.e., **hello.c,** is passed to the preprocessor, and the preprocessor converts the source code into expanded source code. The extension of the expanded source code would be **hello.i.**

- The expanded source code is passed to the compiler, and the compiler converts this expanded source code into assembly code. The extension of the assembly code would be **hello.s.**
- This assembly code is then sent to the assembler, which converts the assembly code into object code.
- After the creation of an object code, the linker creates the executable file. The loader will then load the executable file for the execution.

printf() and scanf() in C

The printf() and scanf() functions are used for input and output in C language. Both functions are inbuilt library functions, defined in stdio.h (header file).

printf() function

The **printf() function** is used for output. It prints the given statement to the console.

The syntax of printf() function is given below:

printf("format string",argument_list);

scanf() function

The **scanf() function** is used for input. It reads the input data from the console.

scanf("format string",argument_list);

Program to print cube of given number

```
1. #include<stdio.h>
2. int main(){
3. int number;
4. printf("enter a number:");
5. scanf("%d",&number);
6. printf("cube of number is:%d ",number*number*number);
7. return 0;
8. }
```

Output

```
enter a number:5
cube of number is:125
```

The **scanf("%d",&number)** statement reads integer number from the console and stores the given value in number variable.

The **printf("cube of number is:%d ",number*number*number)** statement prints the cube of number on the console.

Program to print sum of 2 numbers

```
1. #include<stdio.h>
2. int main(){
3. int x=0,y=0,result=0;
4.
5. printf("enter first number:");
6. scanf("%d",&x);
7. printf("enter second number:");
8. scanf("%d",&y);
9.
10.result=x+y;
11.printf("sum of 2 numbers:%d ",result);
12.
13.return 0;
14.}
```

Output

```
enter first number:9
enter second number:9
sum of 2 numbers:18
```