PROGRAMMING IN C

INTRODUCTION-1

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Introduction to C

C is a general-purpose, high-level ,procedural, all important computer programming language developed in 1972 by Dennis M. Ritchie at bell laboratories of AT&T (American Telephone & Telegraph), located in the U.S.A. to develop the UNIX operating system. C is the most widely used computer language. C was originally first implemented on the DEC PDP-11 computer in 1972.

The main features of C language include low-level access to memory, simple set of keywords, and clean style, these features make C language suitable for system programming like operating system or compiler development.
Many later languages have borrowed syntax/features directly or indirectly from C language. Like syntax of Java, PHP, JavaScript and many other languages is mainly based on C language. C++ is nearly a superset of C language . 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:

- ✓ Mother language
- ✓ System programming language
- ✓ Procedure-oriented programming language
- ✓ Structured programming language
- ✓ 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 has now become a widely used professional language for various reasons −

- ✓ Easy to learn
- ✓ Structured language
- ✓ It produces efficient programs
- ✓ It can handle low-level activities
- ✓ It can be compiled on a variety of computer platforms

Facts about C

- ✓ C was invented to write an operating system called UNIX.
- ✓ C is a successor of B language which was introduced around the early 1970s.
- ✓ The language was formalized in 1988 by the American National Standard Institute (ANSI).
- ✓ In 1978, Brian Kernighan and Dennis Ritchie produced the first publicly available description of C, now known as the K&R standard.
- ✓ The UNIX operating system, the C compiler, and essentially all UNIX application programs have been written in C.
- ✓ The UNIX OS was totally written in C.
- ✓ Today C is the most widely used and popular System Programming Language.
- ✓ Most of the state-of-the-art software have been implemented using C.
- ✓ Today's most popular Linux OS and RDBMS MySQL have been written in C.

Why use C?

C was initially used for system development work, particularly the programs that make-up the operating system. C was adopted as a system development language because it produces code that runs nearly as fast as the code written in assembly language. Some examples of the use of C might be –

- Operating Systems
- Language Compilers
- Assemblers
- Text Editors
- Print Spoolers
- Network Drivers
- Modern Programs
- Databases
- Language Interpreters
- Utilities

History of 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.

Development of Unix System

The PDP-11 version of Unix system was written in assembly language. Assembly languages are low-level programming languages that are specific to a particular computer architecture. They are hard to write and understand.

The developers of Unix Operating system (including Dennis Ritchie and Stephen C. Johnson) decided to rewrite the system in B language. However, B couldn't suffice some of the features of PDP-11, which led to the development of C.

In 1972, the development of C started on the PDP-11 Unix system. A large part of Unix was then rewritten in C. By 1973, C was powerful enough to be used in Unix Kernel. Dennis Ritchie and Stephen C. Johnson made further changes to the language for several years to make it portable in Unix Operating system.

ANSI C

With the rapid growth of C language for several years, it was time for language to get it standardized.

C89. The first standard of C was published by American National Standards Institute (ANSI) in 1989. This version is commonly popular as C89.

C99. In late 1990's, several new features like inline functions, several new data types and flexible array-members were added to the C standard. This is commonly known as C99.

C11. The C11 standard has new features like type generic macros, atomic operations, anonymous structures that doesn't exist in C99.

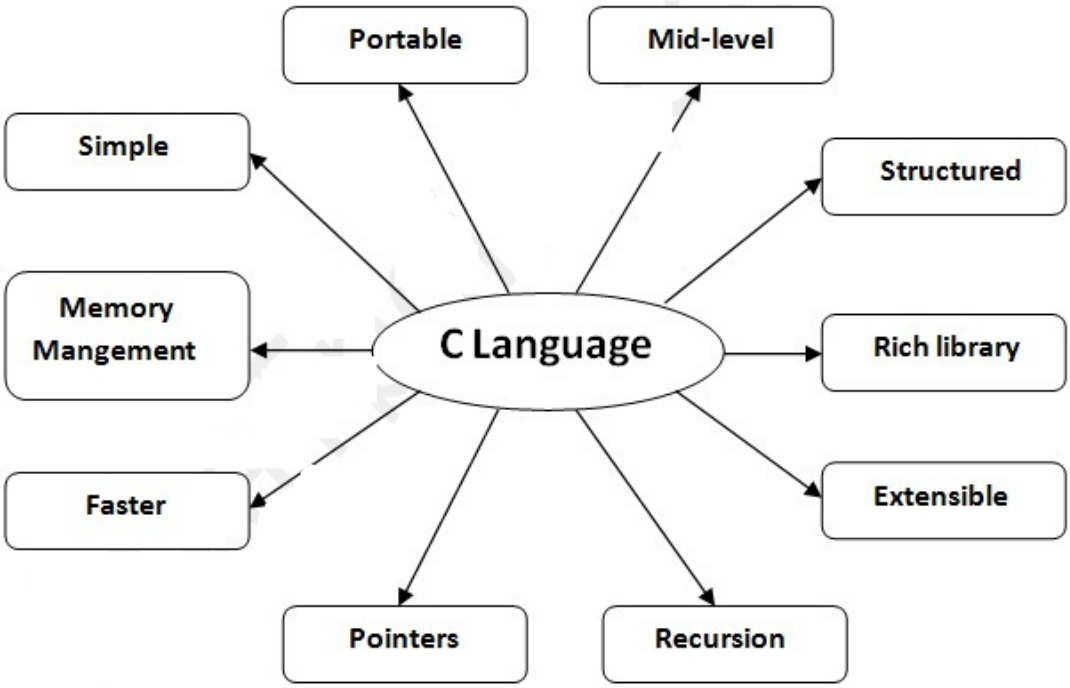
All these three standards are also known by the name of ANSI C.

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

Language	Year	Developed By

Algol Algorithmic Language	1960	International Group
BCPL Basic Combined Programming Language	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 Programming Language



1) **Procedural Language**
2) **Mid-level programming language**
3) **Structured programming language**
4) **Rich Library**
5) **Memory Management**
6) **Pointers**
7) **Recursion**
8) **Extensible**
9) **Faster**
10) **Portable**
11) **Modularity**
12) **Typed Language**
13) **General Purpose**
14) **Simple and Easy**
15) **Lingua franca (common language)**
16) **Provides opportunity to work on open source projects**

1) **Procedural Language**: In procedural languages like C, a list of predefined instructions are carried out step by step. A typical C program may contain one or more procedures (functions) to perform a task.

2) **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.

3) **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.

4) **Rich Library :** C provides a lot of inbuilt functions that make the development fast.

5) **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.

6) **Pointers**: 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.

7) **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.

8) **Extensible**: C language is extensible because it can easily adopt new features.

9) **Faster:** The compilation and execution time of C language is fast since there are lesser inbuilt functions and hence the lesser overhead. C language trusts programmers and allows direct manipulation of the computer hardware. This is not possible in most high-level programming languages.

10) **Portable**: Unlike assembly language, c programs can be executed on different machines with some machine specific changes. Therefore, C is a machine independent language. "Write once, compile everywhere". Well-written standard C programs are portable, meaning, programs written in one system (e.g. Windows 7) can be compiled in another system(e.g. Mac OS) without any change.

11) **Modularity**: You can store sections of C code in the form of libraries for future use. This concept is known as modularity.

12) **Typed Language**: C is a statically typed language. This means that the type of a variable is checked during the compile time but not in the run-time. This helps in detection of errors during the software development cycle. Also, the statically typed languages are faster than dynamically typed language in general.

13) **General Purpose:** Despite being old, C is used in variety of applications from system programming to photo editing softwares. Some of the applications where C programming is used are as follows:

- **Embedded Systems**
- **Operating System** - Windows, Linux, OSX, Android, iOS
- **Databases** - PostgreSQL, Oracle, MySQL, MS SQL Server
- **Other Uses** - Network drivers, Compilers, Print spoolers

14) **Simple and Easy:** 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.

15) **Lingua franca (common language)**: Almost all high-level programming languages like Java, Python, JavaScript etc. can interface with C programming. Also, it's a good language to

express common ideas in programming. Doesn't matter if the person you are talking with doesn't know C, you can still convey your idea in a way they can understand.

16) **Provides opportunity to work on open source projects**: Some of the larger open source projects where C programming is used are Linux Kernel, Python Interpreter, SQLite Database. ++. If you know C and C++, you can contribute to large open source projects that impacts hundreds of millions of people. For example - If we want to contribute to Python, you need to know C programming to work on Python interpreter that impacts millions of Python programmers. C is used for making Python. This is just one example. A large number of softwares that we use today is powered by C.