Problem Solving Through programming in C
Course Code:ONL1001

Topic-Introduction to C language and Compilation process

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INTRODUCTION TO C

C Programming:

- Was developed by Dennis Ritchie at AT&T Bell Labs, USA in 1972.

- Is a middle-level language programming language used to develop applications for high-level business programs and low-level system programs.

- Became popular because of its power, simplicity and ease of use.

- Enables system program writing, using pointers.

- It is reliable, simple and easy to use.

Advantage

▶ **Building block for many other programming languages**

C is considered to be the most fundamental language that needs to be studied if you are beginning with any programming language. Many programming languages such as Python, C++, Java, etc are built with the base of the C language.

▶ **Powerful and efficient language**

C is a robust language as it contains many data types and operators to give you a vast platform to perform all kinds of operations.

▶ **Portable language**

C is very flexible, or we can say machine independent that helps you to run your code on any machine without making any change or just a few changes in the code.

▶ **Built-in functions**

There are only 32 keywords in ANSI C, having many built-in functions. These functions are helpful when building a program in C.

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▶ Quality to extend itself

Another crucial ability of C is to extend itself. We have already studied that the C language has its own set of functions in the C library. So, it becomes easy to use these functions. We can add our own functions to the C Standard Library and make code simpler.

▶ Structured programming language

C is structure-based. It means that the issues or complex problems are divided into smaller blocks or functions. This modular structure helps in easier and simpler testing and maintenance.

▶ Middle-level language

C is a middle-level programming language that means it supports high-level programming as well as low-level programming. It supports the use of kernels and drivers in low-level programming and also supports system software applications in the high-level programming language.

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- System-programming

C follows a system based programming system. It means the programming is done for the hardware devices.

- Procedural programming language

C follows a proper procedure for its functions and subroutines. As it uses procedural programming, it becomes easier for C to identify code structure and to solve any problem in a specific series of code. In procedural programming C variables and functions are declared before use.

- Dynamic memory allocation

C provides dynamic memory allocation that means you are free to allocate memory at run time. For example, if you don't know how much memory is required by objects in your program, you can still run a program in C and assign the memory at the same time.

Disadvantage

▶ Concept of OOPs

C is a very vast language, but it does not support the concept of OOPs (Inheritance, Polymorphism, Encapsulation, Abstraction, Data Hiding). C simply follows the procedural programming approach.

▶ Run-time checking

In the C programming language, the errors or the bugs aren't detected after each line of code. Instead, the compiler shows all the errors after writing the program. It makes the checking of code very complex in large programs.

▶ Concept of namespace

C does not implement the concept of namespaces. A namespace is structured as a chain of commands to allow the reuse of names in different contexts. Without namespaces, we cannot declare two variables of the same name.

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▶ Lack of Exception Handling

Exception Handling is one of the most important features of programming languages. While compiling the code, various anomalies and bugs can occur. Exception Handling allows you to catch the error and take appropriate responses. However, C does not exhibit this important feature.

▶ Constructor or destructor

C does not have any constructor or destructor. Constructors & Destructors support basic functionality of Object Oriented Programming. Both are member functions that are created as soon as an object of the class is created.

▶ Low level of abstraction

C is a small and core machine language that has minimum data hiding and exclusive visibility that affects the security of this language.

Applications

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1. Operating Systems

The first operating system to be developed using a high-level programming language was UNIX, which was designed in the C programming language. Later on, Microsoft Windows and various Android applications were scripted in C.

2. Embedded Systems

The C programming language is considered an optimum choice when it comes to scripting applications and drivers of embedded systems, as it is closely related to machine hardware.

3. GUI

GUI stands for Graphical User Interface. Adobe Photoshop, one of the most popularly used photo editors since olden times, was created with the help of C. Later on, Adobe Premiere and Illustrator were also created using C.

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4. New Programming Platforms

Not only has C given birth to C++, a programming language including all the **features of C** in addition to the concept of object-oriented programming but, various other programming languages that are extensively used in today's world like MATLAB and Mathematica. It facilitates the faster computation of programs.

5. Google

Google file system and Google chromium browser were developed using C/C++. Not only this, the Google Open Source community has a large number of projects being handled using C/C++.

6. Mozilla Firefox

Since Mozilla Firefox was open-source email client projects, they were written in C/C++.

7. MySQL

MySQL, again being an open-source project, used in Database Management Systems was written in C/C++.

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8. Compiler Design

One of the most popular uses of the C language was the creation of compilers. Compilers for several other programming languages were designed keeping in mind the association of C with low-level languages, making it easier to be comprehensible by the machine. Several popular compilers were designed using C such as Bloodshed Dev-C, Clang C, MINGW, and Apple C.

9. Gaming and Animation

Since the C programming language is relatively faster than Java or Python, as it is compiler-based, it finds several applications in the gaming sector. Some of the most simple games are coded in C such as Tic-Tac-Toe, The Dino game, The Snake game and many more. Increasing advanced versions of graphics and functions, Doom3 a first-person horror shooter game was designed by id Software for Microsoft Windows using C in 2004.

Computer
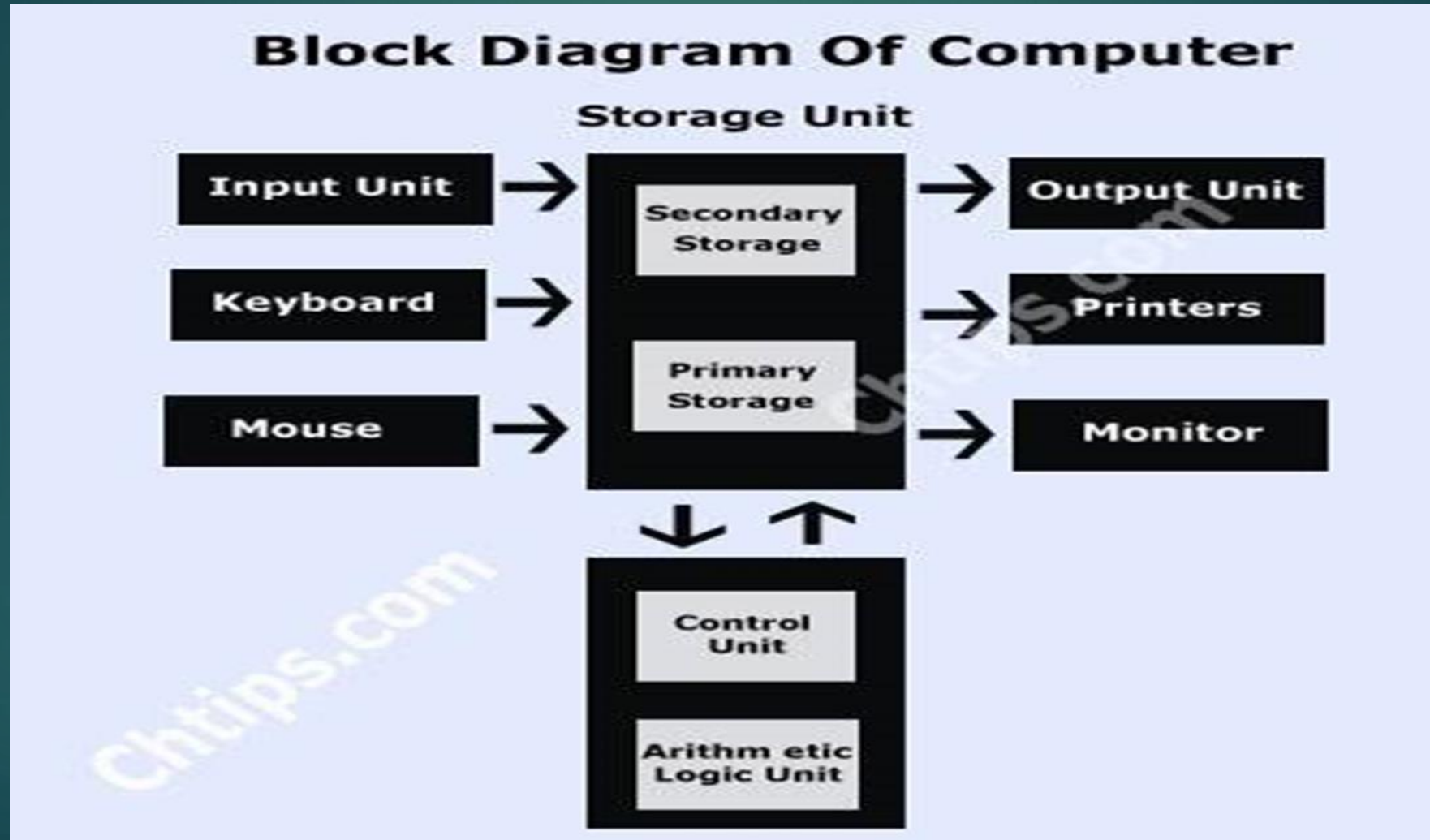
Compilation Process

▶ Like most high-level languages, C also uses compiler to convert its source code (files with the extension .c) to object code (files with the extension .obj).

▶ Four Steps of Compilation:

▶ preprocessing

▶ compiling

▶ assembly

▶ linking

Steps

► Preprocessing:

Preprocessing is the first step. The preprocessor obeys commands that begin with # (known as directives) by:

- removing comments

- expanding included files

➢ If you included a header file such as #include <stdio.h>, it will look for the stdio.h file and copy the header file into the source code file.

► Compiling:

Compiling is the second step. It takes the output of the preprocessor and generates assembly language, an intermediate human readable language, specific to the target processor.

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▶ Assembly:

Assembly is the third step of compilation. The assembler will convert the assembly code into pure binary code or machine code (zeros and ones). This code is also known as object code.

▶ Linking:

Linking is the final step of compilation. The linker merges all the object code from multiple modules into a single one. If we are using a function from libraries, linker will link our code with that library function code.

In static linking, the linker makes a copy of all used library functions to the executable file. In dynamic linking, the code is not copied, it is done by just placing the name of the library in the binary file.

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