C PROGRAMING

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Computer and Program

- What is Computer?
  - It is a machine/hardware/digital device which does various tasks for the user efficiently and effectively.
- • What is Program?
  - Set of instructions given to the machine to do specific task.

Classification of Languages

- **The low-level language** is a programming language that provides no abstraction from the hardware, and it is represented in 0 or 1 forms, which are the machine instructions.
- **The high-level language** is a programming language that allows a programmer to write the programs which are independent of a particular type of computer. The high-level languages are considered as high-level because they are closer to human languages than machine-level languages.

Low level Languages

- Machine-level language
  - **The machine-level language** is a language that consists of a set of instructions that are in the binary form 0 or 1. As we know that computers can understand only machine instructions, which are in binary digits, i.e., 0 and 1, so the instructions given to the computer can be only in binary codes.
  - **Advantages:**
    - Performance is good as we are directly writing the program on machine
  - **Disdvantages:**
    - Machine dependent
    - Difficult to program
    - Error prone

- Assembly Language
  - The assembly language contains some human-readable commands Alphanumeric(Alphabet+numbers) codes, The language was introduced in 1952.
  - As we know that computers can only understand the machine-level instructions, so we require a translator that converts the assembly code into machine code. The translator used for translating the code is known as an assembler.
  - **Advantages**
    - Easier to understand and use and to locate errors
    - Easier to modify
  - **Disadvantages**
    - Machine dependent
    - Knowledge of hardware required
    - Machine level coding required

High Level Languages

- The high-level language is a programming language that allows a programmer to write the programs which are independent of a particular type of computer. The high-level languages are considered as high-level because they are closer to human languages than machine-level languages.
- A compiler is required to translate a high-level language into a low-level language.
- **Advantages:**
  - They are machine independent
  - They do not require programmer to know anything about hardware
  - They do not deal with machine level coding

- **Disadvantages:**
  - It takes additional translation times to translate the source to machine code.
  - High level programs are comparatively slower than low level programs.

C programming Language

- C programming Language is an High level Language
- C is a general-purpose programming language that is extremely popular, simple, and flexible to use.
- Machine Independent or Portable
- C language include low-level access to memory has simple set of keywords.
- C language is the most widely used language in operating systems and embedded system development today.

History

- C language was developed by Dennis Ritchie in 1972 at AT & T Bell Labs on PDP-11 machine.
- It was developed while porting UNIX from PDP-7 to PDP-11.
- Many features of C are inspired from B (Ken Thompson) and BCPL (Martin Richards).
- Initial release of C is referred as K & R C.

Standardization

- C was standardized by ANSI in 1989. This is referred as C89.

- Standardization ensures C code to remain portable.

- C standard is revised multiple times to add new features in the language.
  - C89 – First ANSI standard
  - C90 – ANSI standard adopted by ISO
  - C99 – Added few C++ features like bool, inline, etc.
  - C11 – Added multi-threading feature.
  - C17 – Few technical corrections.

Introduction

- High-level
- Compiled
- Procedural
- Block-Structured (control structures).
- Typed
- Library Functions

Features

- Data types
- Operators
- Control structures
- Functions
- Storage classes
- Pointers
- Arrays
- Strings
- Dynamic memory allocation
- Structures
- Unions
- Enums
- File IO
- Preprocessor directives

Strengths

- Low level memory access (pointers, data structures)
- Effective memory access (bitwise operators, bit-fields, unions)
- Can access OS features (functions/commands)
- Extensive library functions (math, strings, file IO, …)
- Compilers for different platforms & architectures
- Highly Readable (macros, enum, functions, …)

Applications

- System programming
  - OS development
  - Device drivers
  - System utilities
- Language development
  - Compiler development
- Achievements (tiobe.com)
  - In top-2 languages in last 40 years.
  - Language of year: 2019, 2017, 2008.

Toolchain & IDE

- Toolchain is set of tools to convert high level language program to machine level code.
  - Preprocessor
  - Compiler
  - Assembler
  - Linker
  - Debugger
  - Utilities
- Popular compiler (toolchains)
  - GCC
  - Visual Studio
- IDE – Integrated development environment
  - Visual Studio
  - Eclipse
  - VS Code (+ gcc)
  - Turbo C
  - Anjuta, KDevelop, Codeblocks, Dev C++, etc.

Software installation

- Installations
  - GCC (MinGW)
  - VS Code

Hello World

- Source Code

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

- Commands
  - cmd> gcc hello.c
  - cmd> ./a.exe

Thank you!

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