C PROGRAMING

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About Trainer

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Computer System

What is Computer ?

- Computer System is electronic device is integrated using Hardware and Software.

- Hardware is tangible which helps to process data where as software is set of instructions which are executed with the help of hardware.

What is Program ?

Program is set of instructions collected together in specific logical flow to completer particular task.

A program can be constructed using various program constructs like

Sequence

Decision Control

Loop / Iteration

Classfication of Languages

A Program can be written using

Low Level Language

The low level language is a programming language where machine instructions can be given in 0 and 1 form.

High Level Language

- Make easy communication to computer system
- Independent to particular type of computer
- More close to human language than machine language.
- Compiler helps to convert instructions to machine understandable form.
- Takes additional time to translate the instructions to machine understandable instructions.

Classfication of 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.

- Performance is good as we are directly writing the program on machine
- Platform dependent
- Difficult to program
- Error prone

Assembly Language

- The assembly language contains some human-readable instructions (consists of numbers, symbols, abbreviations), 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.
  - Easier to understand and use and to locate errors
  - Platform dependent
  - Knowledge of hardware will help to program Machine level coding
  - Execution is slower compared to machine level language.

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).
- Free form
- Typed
- Library Functions

Features

- Data types
- Operators
- Control structures
- Functions
- Storage classes
- Pointers
- Arrays
- Strings
- Dynamic memory allocation
- Structure
- Union
- Enum
- 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
- Embedded programming
  - ARM, AVR, PIC, etc.
  - IoT development
- 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.

Compilation & Execution of C program

.c ---->PreProcessor ---->.I ---->Compiler ----> .obj / .o----> Assembler ----> .asm/ .s ----> .o / .obj ---->

linker ----> user .o + lib fun .o → .exe / .out executable code loaded by loader in RAM

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

Hello World

- printf() – library function
- stdio.h – header file
- main() – entry point function
  - void main() { … }
  - int main() { … }
  - int main(void) { … }
  - int main(int argc, char *argv[]) { … }
  - int main(int argc, char *argv[], char *envp[]) { … }
- return 0 – exit status

Thank you!

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