Object Oriented Programming Using C++

Day 1

Quick Review of C programming language

History

- Inventor: Dennis Ritchie
- Location: At&T Bell Lab
- Development Year: 1969-1972
- Operating System: Unix
- Hardware: PDP-11
- C is statically type checked as well as strongly type checked language.
- C is a general purpose programming language.
- Extension: .c
- Standardization: ANSI
  - C89
  - C95
  - C99
  - C11
  - C17
  - C23

Data Type

- Data Type Describe following things:

  - Size: How much memory is required to store the data.
  - Nature: Which type of data is allowed to stored inside memory
  - Operation: Which operations are allowed to perform on the data stored inside memory
  - Range: How much data is allowed to store inside memory

- Types:

  - Fundamental Data Types(5)
    - void
    - char
    - int
    - float
    - double
  - Derived Data Types
    - Array
    - Function
    - Pointer
  - User Defined Data Types
    - Structure

        - Union

- Type Modifiers
    - short
    - long
    - signed
    - unsigned
- Type Qualifiers
    - const
    - volatile

Entry Point Function

- According to ANSI specification, entry point function should be "main".
- Syntax: 1

```
int main( int argc, char *argv[ ], char *envp[ ] ){
  return 0;
}
```

- Syntax: 2

```
void main( int argc, char *argv[ ], char *envp[ ] ){

}
```

- Syntax: 3

```
int main( int argc, char *argv[ ] ){
  return 0;
}
```

- Syntax: 4

```
void main( int argc, char *argv[ ] ){

}
```

- Syntax: 5

```
int main( void ){
  return 0;
}
```

- Syntax: 6

```
void main( void ){

}
```

- Syntax: 7

```
void main(  ){

}
```

- main is user defined function.
- Calling main function is a responsibility of operating system. Hence it is called as callback function.
- main function must be global function.
- We can define only one main function per project. If we do not define main function then linker generates error.

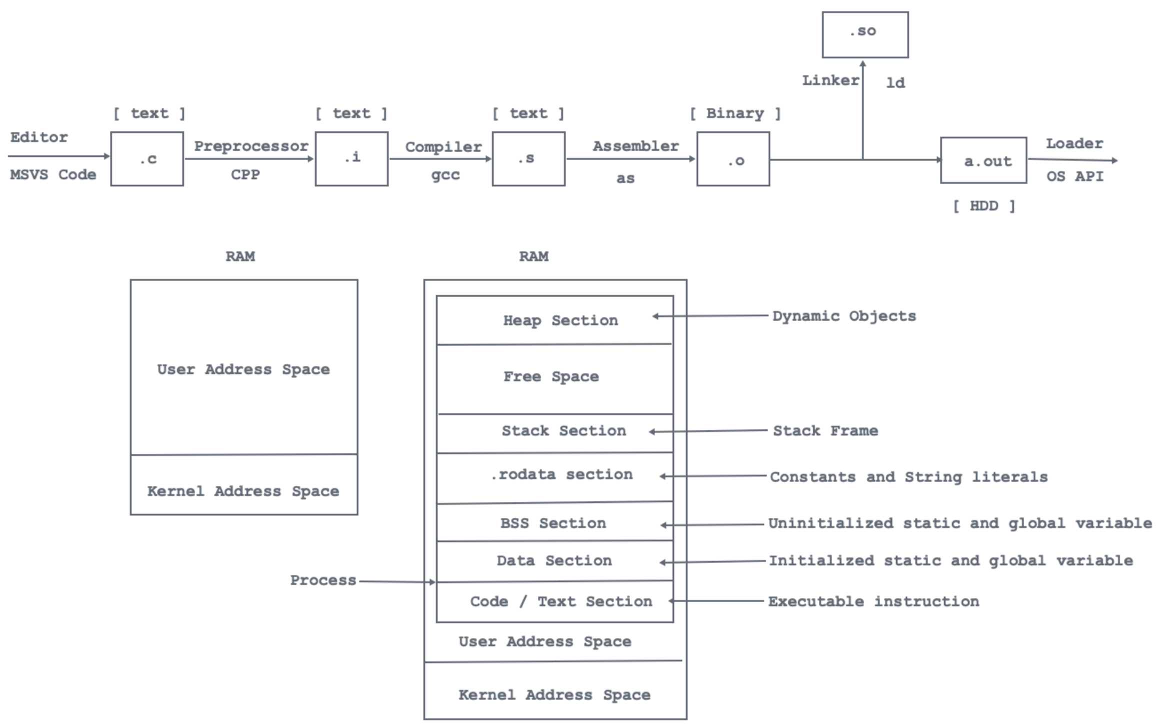
Software Development Kit

- SDK = Development tools + Documentation + Runtime Environment + Supporting Libraries
- Development tools
    - Editor
        - It is used to create/edit source file(.c/.cpp)
        - Example:
            - MS Windows: Notepad, Notepad++, Edit Plus, MS Visual Studio Code, Wordpad etc.
            - Linux: vi, vim, TextEdit, MS Visual Studio Code etc.
            - Mac OS: vi, vim, TextEdit, MS Visual Studio Code etc.
    - Preprocessor
        - It is a system program whose job is:
            - To remove the comments
            - To exapand macros
        - Example: CPP(C/C++ Pre Processor)
        - Preprocessor generates intermediate file(.i /.ii)
    - Compiler
        - It is a system program whose job is:
            - To check syntax

            - To convert high level code into low level(Assembly code)
        - Example:
            - Turbo C: tcc.exe
            - MS Visual Studio: cl.exe
            - Linux: gcc
        - Compiler generates .asm / .s file.
    - Assembler:
        - It is a system program which is used to convert low level code into machine level code.
        - Example:
            - Turbo C: Tasm
            - MS Visual Studio: Masm
            - Linux: as
        - It generates .obj / .o file.
    - Linker
        - It is a program whose job is to link machine code to library files.
        - It is responsible for generating executable file.
        - Example:
            - Turbo C: Tlink.exe
            - MS Visual Studio: link.exe
            - Linux: ld
    - Loader:
        - It is an OS API.
        - It is used to load executable file from HDD into primary memory(RAM).
    - Debugger:
        - Logical error is also called as bug.
        - To find the bug we should use debugger
        - Example
            - Linux: gdb, ddd
- Documentation
    - It can be in the form of html / pdf / text format.
    - Example: https://en.cppreference.com/w/c/language
- Runtime Environment
    - It is responsible for managing execution of application
    - Example: C Runtime

Flow Of Execution

- Reference: https://www.tenouk.com/ModuleW.html



Comments

- If we want to maintain documentation of the source code then we should use comments.
- Comments in C/C++
    - Single Line Comment

    ```
    //This is single line comment
    ```

    - Multiline / Block Comment

    ```
    /*
      This is multiline comment
    */
    ```

- "-save-temps" Save intermediate compilation results

Local Function Declaration

```
int main( void ){//Calling Function
  int sum( int num1, int num2 );  //Local Function Declaration: OK
  int result = sum( 10, 20 ); //Function Call
  return 0;
}
int sum( int num1, int num2 ){  //Called Function
```

```
  int result = num1 + num2;
  return result;
}
```

Global Function Declaration

```
int sum( int num1, int num2 );  //Local Function Declaration: OK
int main( void ){//Calling Function
  int result = sum( 10, 20 ); //Function Call
  return 0;
}
int sum( int num1, int num2 ){  //Called Function
  int result = num1 + num2;
  return result;
}
```

Function Definition as a Declaration

```
//Treated as declaration as well as definition
int sum( int num1, int num2 ){  //Called Function
  int result = num1 + num2;
  return result;
}
int main( void ){//Calling Function
  int result = sum( 10, 20 ); //Function Call
  return 0;
}
```

Linker Error

- Without definition, If we try to use function then linker generates error.

```
int sum( int num1, int num2 );  //Function Declaration
int main( void ){//Calling Function
  int result = sum( 10, 20 ); //Function Call
  return 0;
}
//Output: Linking Error
```

Argument versus Parameter

- During function call, if we use variable or constant value then it is called as argument.
- Example 1

```
int main( void ){
  int result = sum( 10, 20 );   //Here 10 and 20 are arguments
  return 0;
}
```

- Example 2

```
int main( void ){
  int num1 = 50;
  int num2 = 60;
  int result = sum( num1, num2 );   //Here num1 and num2 are arguments
  return 0;
}
```

- Example 3

```
int main( void ){
  int num1 = 110;
  int result = sum( num1, 120 );   //Here num1 and 120 are arguments
  return 0;
}
```

- During function definition, if we use variables then it is called as function parameter or simply parameter.
- Example 1:

```
//Here num1 and num2 are parameters
int sum( int num1, int num2 ){
  int result = num1 + num2;
  return result;
}
```

Declaration and Definition

- Declaration refers to the term where only nature of the variable is stated but no storage is allocted.
- Definition refers to the place where memory is assigned / allocated.
- Example 1

```
int main( void ){
  //Uninitialized non static local variable
  int num1; //Declaration as well as definition
  return 0;
}
```

- Example 2

```
int main( void ){
  //Initialized non static local variable
  int num1 = 10; //Declaration as well as definition
  return 0;
}
```

- Example 3

```
  //Initialized non static global variable
int num1 = 10; //Declaration as well as definition
int main( void ){
  printf("Num1  : %d\n", num1);
  return 0;
}
```

- Example 4

```
int main( void ){
  extern int num1;  //Declaration
  printf("Num1  : %d\n", num1);
  return 0;
}
//Initialized non static global variable
int num1 = 10; //Declaration as well as definition
```

- Example 5

```
int main( void ){
  extern int num1;  //Declaration
  printf("Num1  : %d\n", num1); //Linker Error
  return 0;
}
```

Initialization and Assignment

- During declaration, process of storing value inside variable is called as initialization.
- Consider example:

```
int number = 10;  //Initialization
```

- We can do initialization of variable only once.

```
int number = 10;  //Initialization: OK
int number = 20;  //Not OK
```

- After declaration, process of storing value inside variable is called as assignment.
- Example 1:

```
int number;
number = 10;  //Assignment
```

- Example 2:

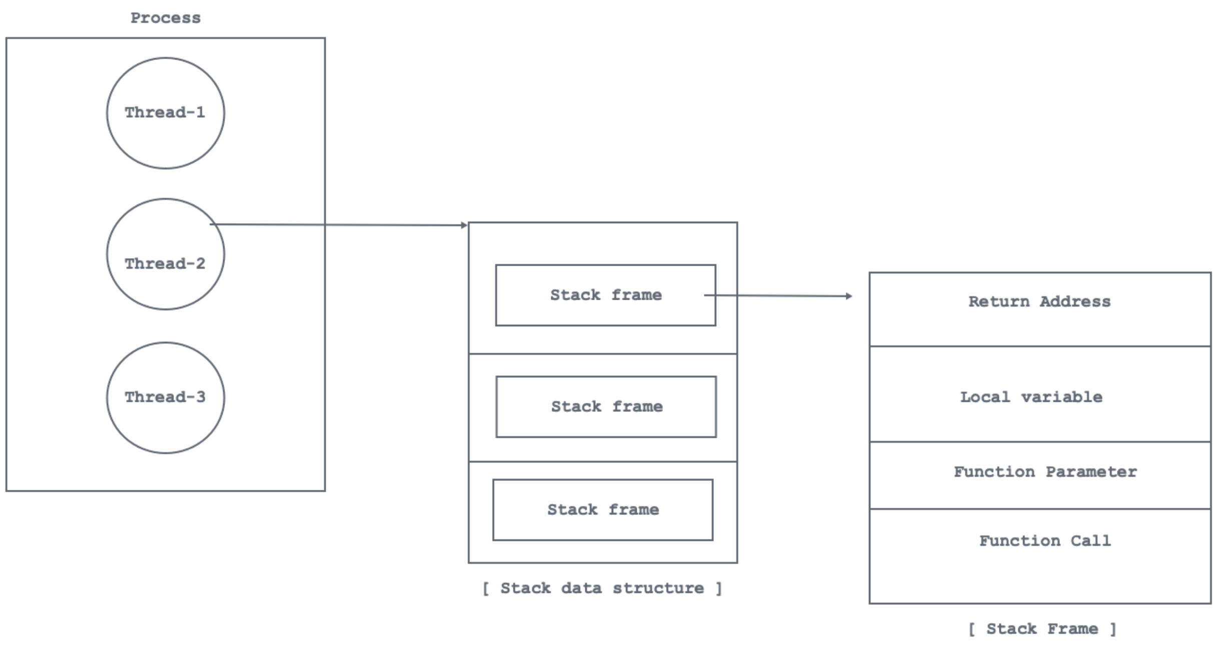
```
int number = 10;  //Initialization
number = 20;  //Assignment
```

- We can do assignment multiple times.
- Example 3:

```
int number = 10;  //Initialization
number = 20;  //Assignment
number = 30;  //Assignment
```

Day 2

Function Activation Record



Pointer

- Variable Definition:
    - An entity whose value can be change is called as variable.
    - Named memory location / name given to memory location is called as variable.
    - Variable is also called as identifier.
- Assignement:
    - Identify the rules for variable/identifier name.
- Pointer is a variable which is designed to store address of another variable.
- Size of pointer:
    - 16-bit : 2 bytes
    - 32-bit : 4 bytes
    - 64-bit : 8 bytes
- Pointer Declaration:
    - Example 1

    ```
    int* ptrNumber; //OK
    ```

    - Example 2

    ```
    int * ptrNumber; //OK
    ```

    - Example 3

```c
int *ptrNumber; //OK: Recommended
```

  - Example 4

```c
int main( void ){
  //Uninitialied non static local pointer variable
  int *ptrNumber; //Wild Pointer
  return 0;
}
```

  - Uninitialied pointer is called as wild pointer.
  - NULL is a macro whose value is 0.

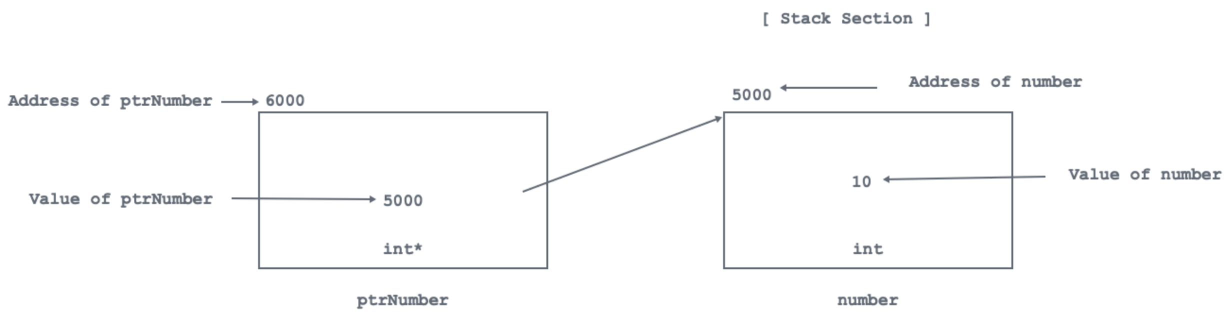
```c
#define NULL 0
```

  - To initializer pointer or to avoid dangling pointer we should use NULL;
    - Example 4

```c
int main( void ){
  //NULL is a macro
  int *ptrNumber = NULL;
  //ptrNumber is a NULL pointer
  return 0;
}
```

  - If pointer contains NULL value then it is called as Null pointer
- Pointer Initialization

```c
int number = 10;  //Initialzation
int *ptrNumber = &number; //Initialization
//How will you print value 10
printf("Value : %d\n", number);
printf("Value : %d\n", *ptrNumber); //10
```

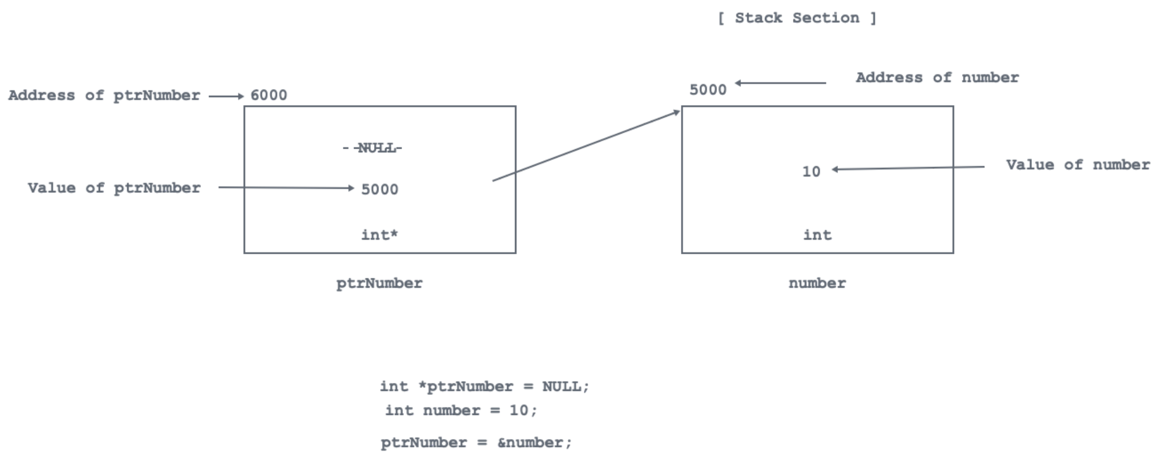


```
&ptrNumber ==> 6000
ptrNumber  ==> 5000
&number    ==> 5000
number     ==> 10
*ptrNumber ==> 10  //Dereferencing
```

- Pointer Assignment

```
int *ptrNumber = NULL; //Initialzation
int number = 10;  //Initialzation
ptrNumber = &number;  //Assignment
//How will you print value 10
printf("Value : %d\n", number);
printf("Value : %d\n", *ptrNumber); //10
```

- We should not derefer Null pointer. Behaviour will be unpredictable.



Constant Qualifier

- const is a keyword in C/C++ and it is consider as type qualifier.
- Example 1

```
#include<cstdio>
int main( void ){
  int number = 10;  //Initialization
  printf("Number    :   %d\n", number); //10
  number = number + 5;
  printf("Number    :   %d\n", number); //15
  return 0;
}
```

- If we dont want to modify value of the variable then we should use const qualifier.
- Example

```
#include<cstdio>
int main( void ){
  const int number = 10;    //Initialization
  printf("Number    :   %d\n", number); //10
  //number = number + 5;    //Not OK
  return 0;
}
```

- We can not modiy value of constant variable but we can read its value. Hence it is called as read-only variable.

Constant and Pointer combinations

int *ptrNumber

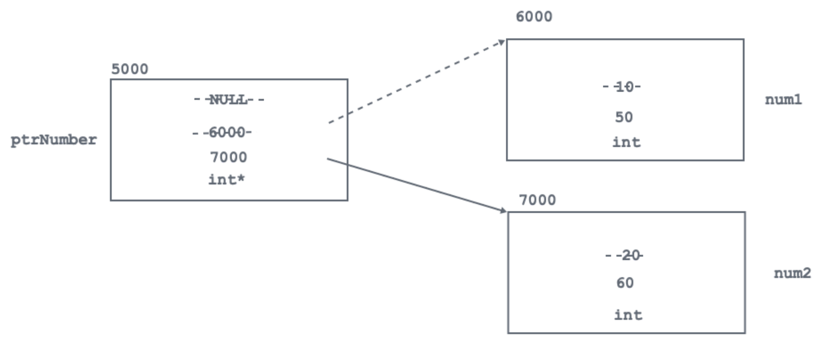
- Here ptrNumber is non constant pointer variable which can store address of non constant integer variable.
- Example:

```
int main( void ){
  int *ptrNumber = NULL;

  int num1 = 10;
  ptrNumber = &num1;
  //num1 = 50;  //OK
  *ptrNumber = 50;  //Dereferencing

  printf("Num1  :   %d\n", num1);   //50
  printf("Num1  :   %d\n", *ptrNumber); //50: Dereferencing


  int num2 = 20;
  ptrNumber = &num2;
  //num2 = 60;  //OK
  *ptrNumber = 60;  //Dereferencing
  printf("Num2  :   %d\n", num2);   //60
  printf("Num2  :   %d\n", *ptrNumber); //60:Dereferencing
  return 0;
}
```



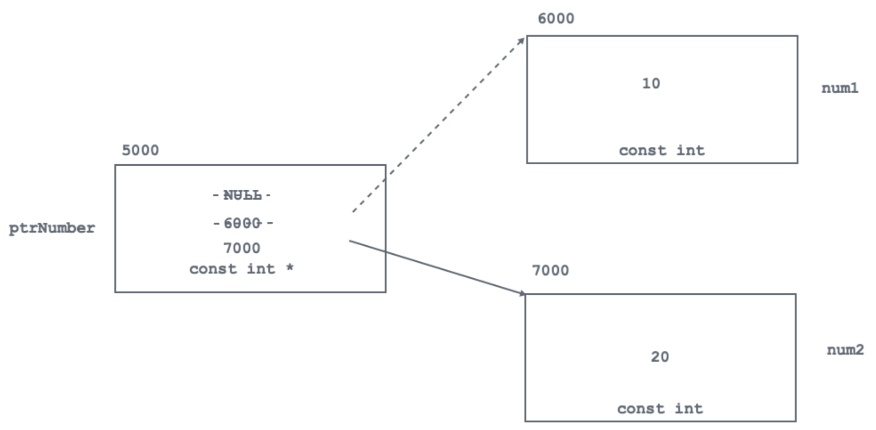
const int *ptrNumber

- Here ptrNumber is non constant pointer variable which can store address of constant integer variable.
- Example:

```c
int main( void ){
  const int *ptrNumber = NULL;  //OK

  const int num1 = 10;
  ptrNumber = &num1;     //OK
  //num1 = 50;  //Not OK
  //*ptrNumber = 50;    //Not OK
  printf("Num1  :   %d\n", num1);   //10
  printf("Num1  :   %d\n", *ptrNumber); //10: Dereferencing

  const int num2 = 20;
  ptrNumber = &num2;     //OK
  //num2 = 60;  //Not OK
  //*ptrNumber = 60;    //Not OK
  printf("Num2  :   %d\n", num2);   //20
  printf("Num2  :   %d\n", *ptrNumber); //20: Dereferencing
  return 0;
}
```



int const *ptrNumber

- const int *ptrNumber and int const *ptrNumber are same.

const int const *ptrNumber

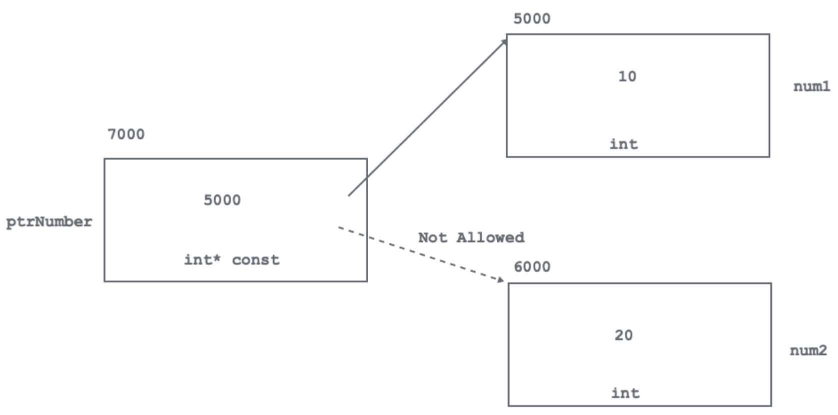
- const int *ptrNumber, int const *ptrNumber and const int const *ptrNumber are same.
- warning: duplicate 'const' declaration specifier

int *const ptrNumber

- Here, ptrNumber is constant pointer variable, which can store address of non constant integer variable.

```
int main( void ){
  int num1 = 10;
  int *const ptrNumber = &num1;
  //num1 = 50;  //OK
  *ptrNumber = 50;
  printf("Num1  :   %d\n", num1);   //50
  printf("Num1  :   %d\n", *ptrNumber); //50: Dereferencing

  int num2 = 20;
  //ptrNumber = &num2;  //Not OK
  return 0;
}
```



int *ptrNumber const

- It is invalid syntax.

const int *const ptrNumber

- Here ptrNumber is constant pointer variable which can store address of constant integer variable.
- Example:

```
int main( void ){
  const int num1 = 10;  //OK
  const int *const ptrNumber = &num1;

  //num1 = 50;  //Not OK
  //*ptrNumber = 50;    //Not OK:Dereferencing
  printf("Num1  :   %d\n", num1);   //10
  printf("Num1  :   %d\n", *ptrNumber); //10: Dereferencing

  const int num2 = 20;  //OK
  //ptrNumber = &num2;  //Not OK
  return 0;
}
```

int const *const ptrNumber

- const int *const ptrNumber and int const *const ptrNumber are same.

Lab Assignment

- Write a menu driven program to test accept/print employee record.
- Define structure:
    - Employee:
        - name: char[30]
        - empid: int
        - salary: float
- Create object and test the functionality
    - int main(void)
    - void accept_record(struct Employee *ptr);
    - void print_record(struct Employee *ptr);