Object-Oriented Programming using C++

C++ Notes Day-5 Date: 13-12-2024

Polymorphism in C++

- Default Argument in C++
- Example:

```
#include<iostream>
using namespace std;
void sum( int num1, int num2 ){
int result = num1 + num2;
cout << "Result : " << result << endl;
}
void sum( int num1, int num2, int num3 ){
int result = num1 + num2 + num3;
cout << "Result : " << result << endl;
}
void sum( int num1, int num2, int num3, int num4 ){
int result = num1 + num2 + num3 + num4;
cout << "Result : " << result << endl;
}
void sum( int num1, int num2, int num3, int num4, int num5 ){
int result = num1 + num2 + num3 + num4 + num5;
cout << "Result : " << result << endl;
}
int main( void ){
sum( 10, 20 );
sum( 10, 20, 30 );
sum( 10, 20, 30, 40 );
sum( 10, 20, 30, 40, 50);
return 0;
}
```

- In C++, we can assign default value to the parameter of function. It is called as default argument.
- Using default argument, we can reduce developers effort.
- Default value can be:
  - constant
  - variable
  - macro
- Example-1:

```
void sum( int num1, int num2, int num3 = 0, int num4 = 0, int num5 = 0){
 int result = num1 + num2 + num3 + num4 + num5;
 cout << "Result : " << result << endl;
}
int main( void ){
 sum( 10, 20 );
 sum( 10, 20, 30 );
 sum( 10, 20, 30, 40 );
 sum( 10, 20, 30, 40, 50);
 return 0;
}
```

- Example-2:

```
int defaultArgument = 0;
void sum( int num1, int num2, int num3 = defaultArgument, int num4 =
defaultArgument, int num5 = defaultArgument ){
 int result = num1 + num2 + num3 + num4 + num5;
 cout << "Result : " << result << endl;
}
int main( void ){
 sum( 10, 20 );
 sum( 10, 20, 30 );
 sum( 10, 20, 30, 40 );
 sum( 10, 20, 30, 40, 50);
 return 0;
}
```

- Example-3:

```
 #define DEFAULT_VALUE 0
 void sum( int num1, int num2, int num3 = DEFAULT_VALUE, int num4 =
DEFAULT_VALUE, int num5 = DEFAULT_VALUE ){
 int result = num1 + num2 + num3 + num4 + num5;
 cout << "Result : " << result << endl;
 }
 int main( void ){
 sum( 10, 20 );
 sum( 10, 20, 30 );
 sum( 10, 20, 30, 40 );
 sum( 10, 20, 30, 40, 50);
 return 0;
```

- Default arguments are always given from right to left direction.
- We can assign, default argument to the parameters of member function as well as global function.
- When we separate , function declaration and definition then default argument must appear in declaration part:

```
 #include<iostream>
 using namespace std;
 #define DEFAULT_VALUE 0
 void sum( int num1, int num2, int num3 = DEFAULT_VALUE, int num4 = DEFAULT_VALUE,
int num5 = DEFAULT_VALUE );
 int main(){
 sum( 10, 20 );
 sum( 10, 20, 30 );
 sum( 10, 20, 30, 40 );
 sum( 10, 20, 30, 40, 50);
 return 0;
 }
 void sum( int num1, int num2, int num3, int num4, int num5 ){
 int result = num1 + num2 + num3 + num4 + num5;
 cout << "Result : " << result << endl;
 }
```

'extern' keyword in C++

- Using extern "C", we can invoke, C language function into C++ source code.
- If we declared any function using exten "C" then compiler do not generate mangled name for it.
- Consider the following MyFunctions.h Header file:

```
#ifndef MYFUNCTIONS_H_
#define MYFUNCTIONS_H_
extern "C"
{
int Method1();
int Method2();
int Method3();
int Method4();
}
#endif /* MYFUNCTIONS_H_ */
```

- Consider the MyFunctions.c file:

```
int Method1()
{
    return 100;
}
int Method2()
{
    return 200;
}
int Method3()
{
    return 300;
}
int Method4()
{
    return 400;
}
```

- Consider the Demo.cpp file:

```
#include <iostream>
#include "../MyHeaderFiles/MyFunctions.h"
using namespace std;
int main()
{
    cout<<"Value return by Method1: "<<Method1()<<endl;
    cout<<"Value return by Method2: "<<Method2()<<endl;
    cout<<"Value return by Method3: "<<Method3()<<endl;
    cout<<"Value return by Method4: "<<Method4()<<endl;
    return 0;
}
```

'this' Pointer

- As we know to process/manupulate state of the object we should call and define member function.
- If we call member function on object then compiler implicitly pass, address of current/ calling object as a argument to the member function. To catch/accpet address, compiler implicitly declare/create one paramater inside member function. Such parameter is called as this pointer.
- this is a keyword in C++.
- Parameter do not get space inside object. Since this pointer is a function parameter, it doesnt get space inside object.
- this pointer get space once per function call on stack section / segment.
- this pointer is a constant pointer. General type of this pointer is:

```
    ClassName *const this;
```

- To access members of the class, use of this keyword is optional. If we do not use this then compiler implicitly use this keyword.
- Using this pointer, data member and member function can communicate with each other.
- Hence this pointer is considered as a link / connection between them.
- Following functions do not get this pointer:
  - Global function
  - Static member function
  - Friend function
- this pointer is considered as first parameter of the member function.
- Example:

```
class Test{
private:
 int Num1;
 int Num2;
public:
 void SetData( /* Test *const this, */ int n1, int n1 ){
 cout << "Enter Num1 : ";
 cin >> this->Num1;
 cout << "Enter Num2 : ";
 cin >> this->Num2;
 }
};
int main( void ){
 Test t1;
 t1.SetData( 10, 20 ); //t1.SetData( &t1, 10, 20 );
 return 0;
}
```

- Definition:
  - this pointer is implicit pointer, which is available in every non static member function of the class and which is used to store address of current / calling object.
  - If name of data member and local variable / function parameter is same then preference will be given to local variable. In this case we should use this pointer before data members.
- Example:

```
class Test{
private:
 int Num1;
 int Num2;
public:
 void SetData( /* Test *const this, */ int Num1, int Num2 ){
 this->Num1=Num1;
 this->Num2=Num2;
 }
};
int main( void ){
 Test t1;
 t1.SetData( 10, 20 ); //t1.SetData( &t1, 10, 20 );
 return 0;
}
```

Getter and Setter methods in C++

- A member function of class, which is used to read state of the object is called as inspector / selector / getter function.
- A member function of class, which is used to modify state of the object is called as mutator / modifier / setter function.
- Example:

```
#include <iostream>
using namespace std;
class Test
{
```

```
private:
    int Num1;
    int Num2;
public:
    int getNum1() const {
        return Num1;
    }

    void setNum1(int num1) {
        Num1 = num1;
    }

    int getNum2() const {
        return Num2;
    }

    void setNum2(int num2) {
        Num2 = num2;
    }
};
int main()
{
    Test t1;
    //t1.Num1=100;  //NOT OK, Num1 is not visible
    //t1.Num2=100;  //NOT OK, Num2 is not visible

    t1.setNum1(10); //OK
    t1.setNum2(20); //OK

    cout<<"value of Num1:   "<<t1.getNum1();
    cout<<"value of Num2:   "<<t1.getNum2();
}
```

Constructor and its type in C++

- Member function of a class which is used to initialize the object is called as constructor.
- Note: Constructor do not create object rather it initializes object.
- Due to below reasons constructor is considered as special function of the class:
  - Its name is always same as class name.
  - It does not have any return type
  - It is designed to call implicitly
  - It gets called once per instance.
- We can not call constructor on object, pointer or reference explicitly.
- Example 1:

```
Test t1;
t1.Test( ); //Not OK
```

- Example 2:

```
Test t1;
Test *ptr = &t1; //ptr is pointer
ptr->Test( ); //Not OK
```

- Example 3:

```
Test t1;
Test &t2 = t1; //t2 is reference
t2.Test( ); //Not OK
```

- We can use any access specifier on constrctor:
- If constructor is public then we can create object inside member function of the class as non member function of the class.

public -- > member function as non member function

- If constructor is private then we can create object inside member function of the class only.
- We can not declare constructor static, constant, volatile or virtual but we can declare constructor inline.
- Types of constructor:

private --> member function of the class

  - Parameterless constructor
  - Parameterized constructor
  - Default constructor.
- Parameterless constructor:
  - It is also called as zero argument constructor or user defined default constructor.
  - Constructor of the class which do not take any parameter is called as parameterless constructor.
- Example:

```
Test( void ){
this->Num1 = 0;
this->Num2 = 0;
}
```

  - If we create object without passing argument, then compile invoke parameterless constrctor.
- Example:

```
Test t1; //Here on t1 parameterless constructor will call.
```

- Parameterized constructor
  - Constructor of the class which is having parameter(s) is called as parameterized constructor.
- Example:

```
Test( int value ){ //Single parameter constructor
this->Num1 = value;
this->Num2 = value;
}
Test( int Num1, int Num2 ){ // 2 parameter constructor
this->Num1 = Num1;
this->Num2 = Num2;
}
```

  - If we create object by passing arguments then parameterized constructor gets called.
  - Example:

```
Test t1( 10, 20 );
Test t2( 30 );
```

- We can overload constructor. Consider below code:

```
class Test{
private:
 int Num1;
 int Num2;
public:
 Test( ){ //Parameterless constructor
 this->Num1 = 0;
 this->Num2 = 0;
 }
 Test( int Num1, int Num2 ){ //Parameterized constructor
 this->Num2 = Num1;
 this->Num2 = Num2;
 }
};
```

- Constructor calling sequence depends on order of object declaration:
- Example:

```
Test t1(10,20), t2;
//First, parameterized constructor on t1 will call
//Then parameterless constructor on t2 will call
```

- Default constructor
  - If we do not define constructor inside class then compiler generate constructor for the class. Such constructor is called as default constructor.
  - Compiler never generate parameterized constructor. In other words, compiler generated constructor is zero argument / parameterless constructor.
  - Example:

```
class Test{
};
int main( void ){
Test t1; //On t1 Default constructor will call
Test t2( 10, 20 ); //Compiler error
return 0;
}
```

Aggregate Type and Aggregate initialization

- In C, below types are aggregate types whose object can be initialize using initializer list.
  - Array
  - Structure
  - Union
- Example:

```
int arr[ 2 ] = { 100,200};
struct Student s1 = { 101, "Malkeet", 446.89f };
```

- Aggregate class class following properties:
  - It does not contain private or protected non static data member.
  - It does not contain any user defined constructor.
  - It does not have base class
  - It does not contain virtual function
- Aggregate initialization:
- Example-1:

```
class Test{
public:
 int Num1;
 int Num2;
public:
 void printRecord( void ){
 cout << "Num1 Number : " << this->Num1 << endl;
 cout << "Num2 Number : " << this->Num2 << endl;
 }
};
int main( void ){
 Test t1{ 10, 20 }; //Aggregate initialization
 return 0;
}
```

- Example-2:

```
struct Employee
{
    int EmpId;
    string Name;
    void PrintRecord()
    {
        cout<<"EmpId:   "<<this->EmpId<<" Name: "<<this->Name<<endl;
    }
};
int main()
{
    //Aggregate Type (Array, Structure, Union), Aggregate Initialization,
Initializer List
    int Num1=90;
    int Num2=100;
    int Arr[10]={10,20,30,40};      //Valid, OK :Aggregate Initialization
    Employee emp={101,"Malkeet"};
    emp.PrintRecord();      //emp.PrintRecord(&emp);
    return 0;
}
```

- More example of Constructors of the class:

```
class Test{
private:
 int Num1;
 int Num2;
public:
 Test( void ){
 this->Num1 = 0;
 this->Num2 = 0;
 }
 Test( int value ){
 this->Num1 = value;
 this->Num2 = value;
 }
 Test( int Num1, int Num2 ){
 this->Num1 = Num1;
 this->Num2 = Num2;
 }
 void printRecord( void ){
 cout << "Num1 Number : " << this->Num1 << endl;
 cout << "Num2 Number : " << this->Num2 << endl;
 }
};
```

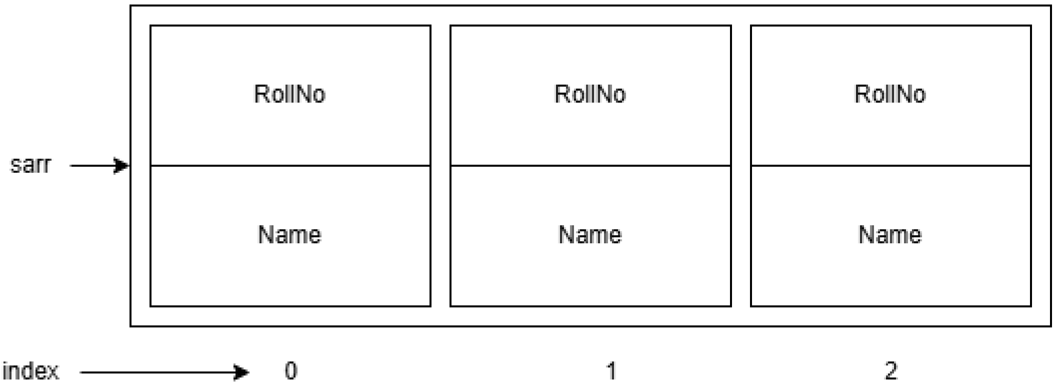
- Test t1;
  - Here on t1 object, parameterless constructor will call.
- Test t2(10);

    - Here on t2 object, single parameter constructor will call.
- Test t3(10, 20);
    - Here on t3 object, 2 parameter constructor will call.
- Test t4( );
    - It is declaration of t4 function which do not take any parameter and return object or Test type.
    - Constructor will not call here.
- Test t5 = 30;
    - It is same as Test t5(30).
    - Hence on t5, single parameter constructor will call.
- Test(40, 50);
    - It is anonymous object.
    - On object, 2 parameter constructor will call.
- Test t6 = 60, 70;
    - Compiler error.

Array of objects

- In C++ we can create array of objects aparts from creating the objects of the class one by one.
- We can process the objects as we process the elements of an array.
- Example:

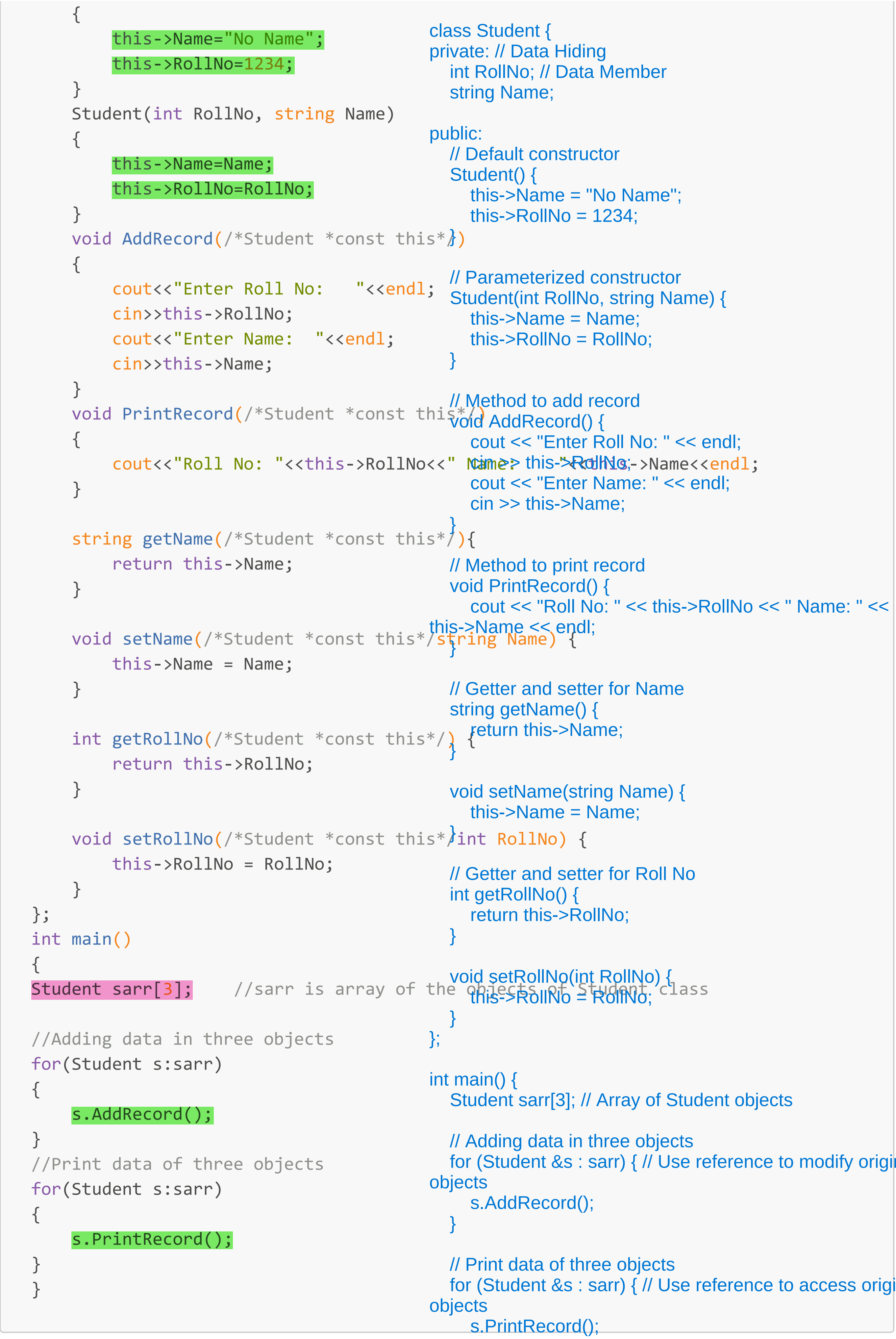
```
Student sarr[3];    //Here, sarr is an array of the obects of class Student
```



- Example:

```
#include <iostream>
#include <string.h>
using namespace std;
class Student
{
private:                //Data Hiding    Encapsulation
    int RollNo;         //Data Member
    string Name;

public:
    Student()
```



```
    {
        this->Name="No Name";
        this->RollNo=1234;
    }
    Student(int RollNo, string Name)
    {
        this->Name=Name;
        this->RollNo=RollNo;
    }
    void AddRecord(/*Student *const this*/)
    {
        cout<<"Enter Roll No:   "<<endl;
        cin>>this->RollNo;
        cout<<"Enter Name:  "<<endl;
        cin>>this->Name;
    }
    void PrintRecord(/*Student *const this*/)
    {
        cout<<"Roll No: "<<this->RollNo<<" Name: "<<this->Name<<endl;
    }

    string getName(/*Student *const this*/){
        return this->Name;
    }

    void setName(/*Student *const this*/string Name) {
        this->Name = Name;
    }

    int getRollNo(/*Student *const this*/) {
        return this->RollNo;
    }

    void setRollNo(/*Student *const this*/int RollNo) {
        this->RollNo = RollNo;
    }
};
int main()
{
Student sarr[3];    //sarr is array of the objects of Student class

//Adding data in three objects
for(Student s:sarr)
{
    s.AddRecord();
}
//Print data of three objects
for(Student s:sarr)
{
    s.PrintRecord();
}
}
```

```
#include <iostream>
#include <string>
using namespace std;

class Student {
private: // Data Hiding
    int RollNo; // Data Member
    string Name;

public:
    // Default constructor
    Student() {
        this->Name = "No Name";
        this->RollNo = 1234;
    }

    // Parameterized constructor
    Student(int RollNo, string Name) {
        this->Name = Name;
        this->RollNo = RollNo;
    }

    // Method to add record
    void AddRecord() {
        cout << "Enter Roll No: " << endl;
        cin >> this->RollNo;
        cout << "Enter Name: " << endl;
        cin >> this->Name;
    }

    // Method to print record
    void PrintRecord() {
        cout << "Roll No: " << this->RollNo << " Name: " <<
this->Name << endl;
    }

    // Getter and setter for Name
    string getName() {
        return this->Name;
    }

    void setName(string Name) {
        this->Name = Name;
    }

    // Getter and setter for Roll No
    int getRollNo() {
        return this->RollNo;
    }

    void setRollNo(int RollNo) {
        this->RollNo = RollNo;
    }
};

int main() {
    Student sarr[3]; // Array of Student objects

    // Adding data in three objects
    for (Student &s : sarr) { // Use reference to modify original
objects
        s.AddRecord();
    }

    // Print data of three objects
    for (Student &s : sarr) { // Use reference to access original
objects
        s.PrintRecord();
    }

    return 0;
```

To be discussed tomorrow (14-12-2024)

- Constant variable, data member, member function and object
- mutable data member.
- Reference
- Call by value vs call by address vs call by reference
- Difference between pointer and reference
- Exception handling in C++