FAST

National University of Computer and Emerging Sciences Peshawar

OOP Lab # 8.2

C++ (Classes and Objects)

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Programming

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Contents

Object Oriented Programming (OOP)

OOP is methodology or paradigm (نمونه) to design a program using class and object.

OOP is paradigm that provides many concepts such as:

- Classes and objects
- Encapsulation (binding code and its data) etc.
- Inheritance
- Polymorphism
- Abstraction
- Overloading

Class

- A Class is a collection of data and functions. The data items and functions are defined within the class. Functions are written to work upon the data items and each function has a unique relationship with data items of the class.
- Classes are defined to create user defined data types. These are similar to built in data types available in all programming languages.
- Definition of data type does not create any space in the computer memory. When a variable of that data type is declared, a memory space is reserved for that variable.
- Similarly, when a class is defined, it does not occupy any space in the computer memory. It only defines the data items and the member function that can be used to work upon its data items. Thus defining a class only specifies its data members and the relationship between the data items through it functions.

Defining a class

A class is defined in a similar way as structure is defined. The keyword "**class**" is used to define the class. The general syntax to define a class is:

```
class class_name
{
body of the class;
} ;
```

class is a keyword that is used to define a class.

class_name It represents the name of the class.

body of classs The body of the class consist of the data items and the functions. These are called members of the class. These are written between braces.

Semicolon (;) The body of a class ends with semicolon.

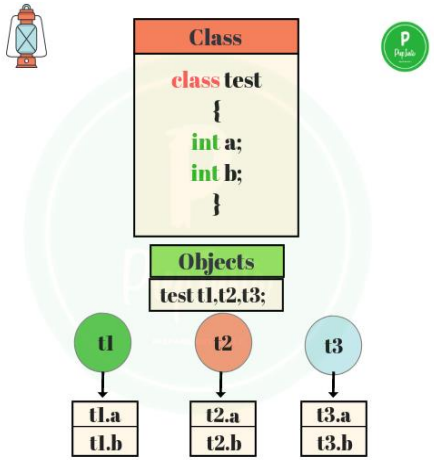
Members of a class

- A class contains data items and functions. These are called members of the class.
- The data items are called **data members** and the functions are called **member functions**.

Data Members

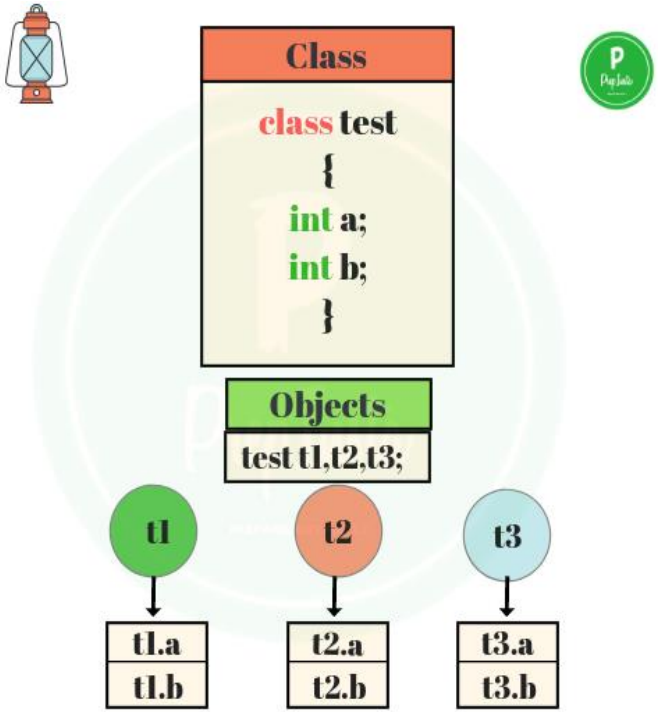
- The data items of a class are called data members of the class. For example a class that has four integer type and two float type data items is declared as:

```
class abc
{
        int w , x , y , z;
        float a , b;
}
```



In the above class **a, b, w, x, y** and **z** are data members of the class "**abc**".

Data Members



Member Functions

- The functions of a class that are defined to work on its data members are called member functions of the class.
- The member functions may be defined within the class or outside it.

For example:

Member Functions …

```
class xyz
{
        private:
        int a , b , c;
        public:
        void getData(void)
        {
                cout<<Enter value of a, b and c” ;
                cin>>a>>b>>c;
        }
        void printData(void)
        {
                cout<<“a= ”<<a<<endl;
                cout<<“b= ”<<b<<endl;
                cout<<“c= ”<<c<<endl;

        }
};
```

In this class, there are three data members and two member functions. The member functions are “**getData**” and “**printData**”. The “**getData**” function is used to input values into data members **a, b** and **c**. The “**printData**” function is used to print values of the data members on the computer screen.

Member Functions ...

```
#include<iostream>
using namespace std;
class student
{
    private :
        int id;
        char name[20];
    public :
        Void Getdata(void);
        Void display (void)
        {
            cout << id <<'\t' << name << endl;
        }
};
int main( )
{
```

Data Members

Member Functions

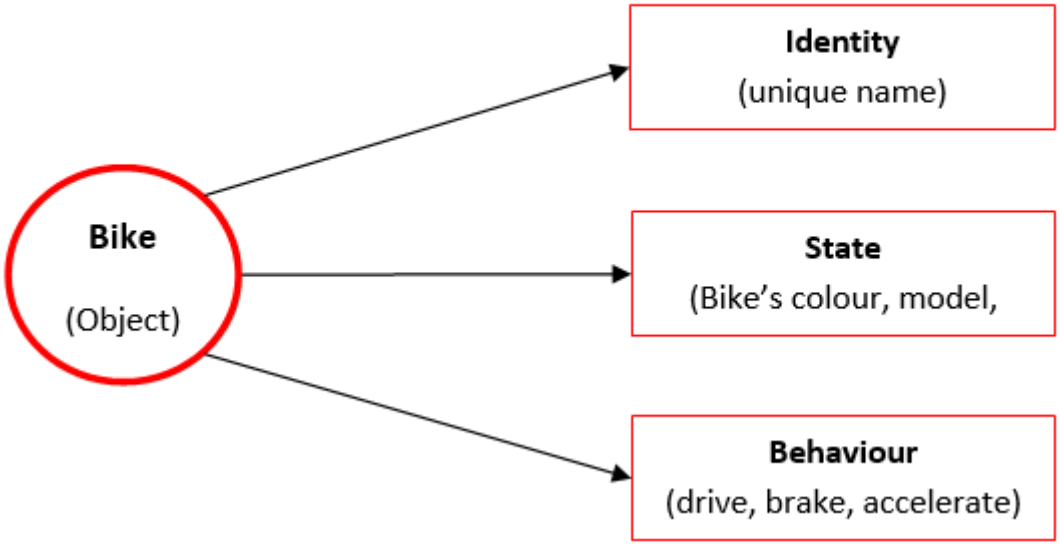
Objects

- A data type is used to declare a variable. A variable of a data type is also known as the instance or case of that data type.
- Each variable has unique name but each variable follows the rules of its data type. When a variable of a data type is declared, some space is reserved for it in the memory.
- A class is also like a data type. It is therefore used to declare variables or instances. The variables or instances of a class are called **objects**.
- A class may contain several data items and functions. Thus the object of a class consists of both the **data members** and **member functions** of the class.
- The combining of both the data and the functions into one unit is called data **encapsulation**.

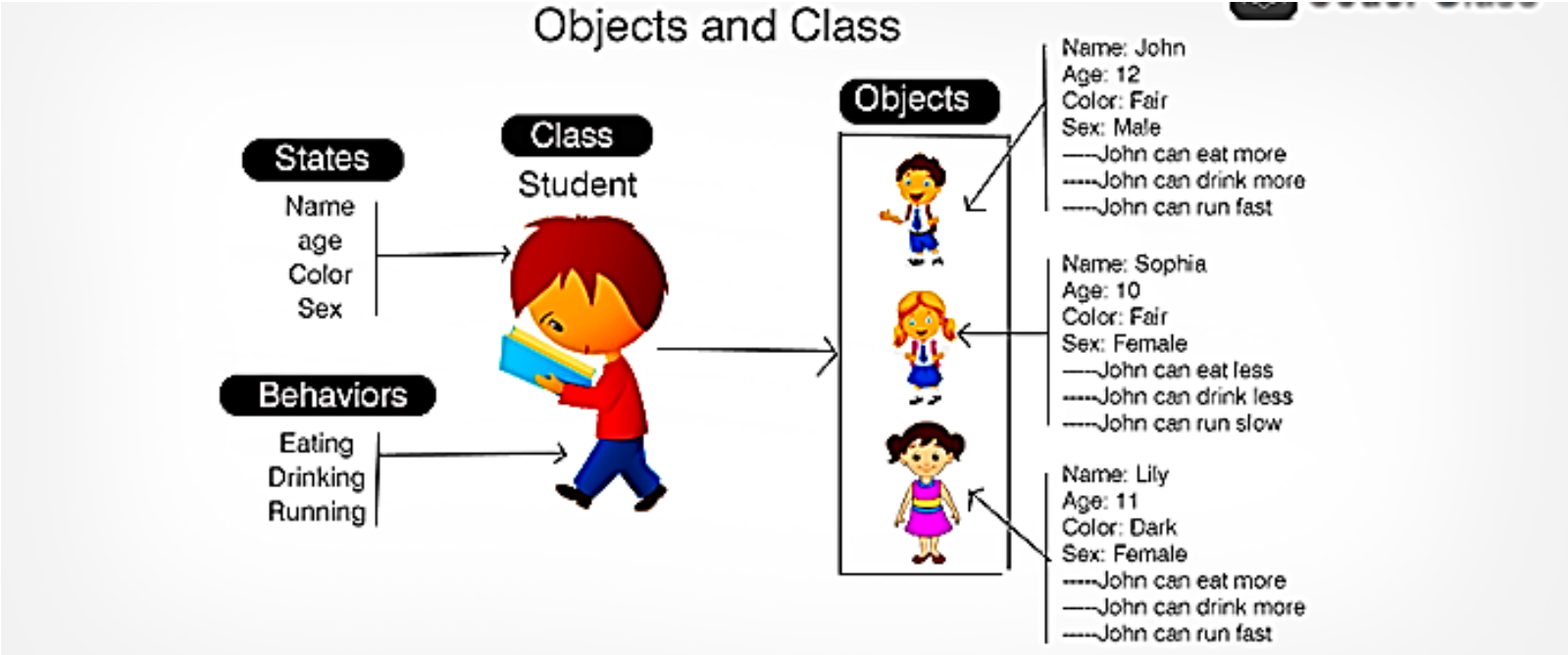
Objects…

- An object represents data members of a class in the memory. Each object of class has unique name. The name of an object differentiates it from other objects of the same class.
- The values of data members of different objects may be different or same. The values of data members in an object are known as the **state** of the object.
- The functions in an object are called the member functions. They are also known as the them **methods**.
- The member functions are used to process and access data of the objects.

Characteristics of Object (Identity, State & Behavior)



Characteristics Object (Identity, State & Behavior)



Declaring object of a class

- The objects of a class are declared in the similar way as the variables of any data or structure type are declared.
- When a class is defined, no space is reserved for it in the memory. It only provides information how its object will look like.
- When an object of a class is declared, a memory space is reserved for that object.
- The syntax to create objects of a class type is:

  class_name object_name separated by commas;

- For example, to define an objects of Student class, the statement is written as:

  Student s1;

Declaring object of a class

- In the above statement one object namely **s1** is declared of Students class. It is the declaration of an object that actually creates an object in the memory.

A Class is a Full-Fledged Type

- A class is a type just like **int** and double. You can have variables of a class type, you can have parameter of class type, a function can return a value of a class type, and more generally, you can use a class type like any other type.

- **For example:** Student s1,s2,s3;

Accessing data members and member functions

- The data members and member functions of class can be accessed using the dot('.') operator with the object.
- For example if the name of object is *obj* and you want to access the member function with the name *printName()* then you will have to write *obj.printName()* .

Accessing Data Members

- The public data members are also accessed in the same way given however the private data members are not allowed to be accessed directly by the object.
- Accessing a data member depends solely on the access control of that data member. This access control is given by Access modifiers in C++.
- There are three access modifiers : **public, private and protected**.

Accessing Data Members...

```
// C++ program to demonstrate accessing
 of data members
#include <iostream>
using namespace std;

class Student
{
   // Access specifier
    public:

   //Data members
   int id;
   string name;
   double salary;
}; // end of class body
```

Accessing Data Members...

```
int main () {

// Declare an object of class Student
    Student s1;
// accessing data members
    s1.id=144;
    s1.name="Aisha";
    s1.salary=60000;

    cout<<"Student Id is:"<<s1.id<<endl;
    cout<<"Student Name is:"<<s1.name<<endl;
    cout<<"Student Salary is:"<<s1.salary<<endl;
   return 0;
}
```

Output:

Student Id is:144
Student Name is:Aisha
Student Salary is:60000

Accessing Member Functions

- The member functions of a class is called or accessed in similar way as member or data item of a structure is called.
- The member function is called/accessed through an object of the class.
- The dot operator is used. The dot operator connects the **object name** and **member function**.
- For example, if "**add**" is the name of the object and "**pdate()**" is the member function then the member function is called as shown below:

```
add.pdate();
```

Accessing Member Functions…

- The **dot operator** is also called the class member **access operator**.
- Only those member functions can be accessed from outside the class with dot operator that have been declared as public.

```
class Student
{
   // Access specifier
    public:
   //Data members
   int id;
   string name;
   double salary;
```

Accessing Member Functions...

```
// Member Functions
   void setData(int i, string n, double s)
    {
       id=i;
       name=n;
       salary=s;
    }

    void printData()
    {
        cout<<"Student Id is:"<<id<<endl;
        cout<<"Student Name is:"<<name<<endl;
        cout<<"Student Salary is:"<<salary<<endl;
    }
}; // end of class body
```

Accessing Member Functions...

```
int main () {

    // Declare an object of class Student
    Student s1;

    // accessing member function
    s1.setData(144, "Aisha", 60000);

    s1.printData();

   return 0;
}
```

Output:

Student Id is:144
Student Name is:Aisha
Student Salary is:60000

Accessing Member Functions...

Program 01 : Write a program to input a date and print on the screen using class.

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

class Date
{
   // Access specifier
    private:
   //Data members
   int y,m,d;
```

Accessing Member Functions...

```
  public:
   void getDate()
    {
       cout<<"Enter Year: "; cin>>y;
       cout<<"Enter Month: "; cin>>m;
       cout<<"Enter Day: "; cin>>d;
    }

    void printDate()
    {
        cout<<"Date is :";
        cout<<d<<"/" <<m<<"/"<<y;
    }
}; // end of class body
```

Accessing Member Functions...

```
int main () {

    // Declare an object of class Date
    Date date;

    // accessing member function
    date.getDate();
    date.printDate();
   return 0;
}
```

Output:

Enter Year: 1995
Enter Month: 12
Enter Day: 12
Date is :12/12/1995

Accessing Member Functions...

Program 02: Write a program by using class to input values using a member functions of a class. Display the sum of two values by using another member function of the class.

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

class Sum
{
   // Access specifier
    private:
   //Data members
   int n , m;
```

Accessing Member Functions...

```
    public:
    void getDate(int x, int y)
     {
        n=x;
        m=y;
     }

     void displayData()
     {
         cout<<"Sum is: "<<(n+m);
     }
}; // end of class body
```

Accessing Member Functions...

```
int main () {

    // Declare an object of class
    Sum sum;

    int x, y;
    cout<<"Enter first No. :"; cin>>x;
    cout<<"Enter second No. :"; cin>>y;

    // accessing member function
    sum.getDate(x,y);
    sum.displayData();
   return 0;
}
```

Output:

Enter first No. :4
Enter second No. :4
Sum is: 8

Accessing Member Functions...

Program 03: Write a program to input the name of student and marks of three subjects, calculate the total marks and average marks. Each subjects has maximum of 100 marks.

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

class StudentRecord
{
   private:
    char name[15];
    float s1,s2,s3, total, avg;
```

Accessing Member Functions...

```
public:
    void getRecord()
    {
       cout<<"Enter Name of the student: "; cin>>name;
       cout<<"Enter marks of 1st subject: "; cin>>s1;
       cout<<"Enter marks of 2nd subject: "; cin>>s2;
       cout<<"Enter marks of 3rd subject: "; cin>>s3;
       total= s1+s2+s3;
       avg= total/3.0;
    }
```

Accessing Member Functions...

```
 void displayRecord()
    {
       cout<<"Name of the student : "<<name<<endl;
       cout<<"Marks of 1st subject : "<<s1<<endl;
       cout<<"Marks of 2nd subject : "<<s2<<endl;
       cout<<"Marks of 3rd subject : "<<s3<<endl;
       cout<<"Total Marks : "<<total<<endl;
       cout<<"Average Marks : "<<avg<<endl;
    }
}; // end of class body
```

Accessing Member Functions...

```
int main () {

    // Declare an object of class
    StudentRecord stdRecord;

    // accessing member function
    stdRecord.getRecord();
    stdRecord.displayRecord();
    return 0;
}
```

Output:

Enter Name of the student: Aousaf
Enter marks of 1st subject: 55
Enter marks of 2nd subject: 77
Enter marks of 3rd subject: 88

Name of the student : Aousaf
Marks of 1st subject : 55
Marks of 2nd subject : 77
Marks of 3rd subject : 88
Total Marks : 220
Average Marks : 73.3333

Accessing Member Functions…

Program 04: Write a program by using class Employee to input the record of employees.

Define the following data members:

- name, bpay, h_rent, ma, gpay

Define the following member functions:

- to input data in name and bpay
- to calculate h_rent, ma, gpay
- to print complete record on the computer Screen.

Where

h-rent = house rent= 60 %

ma = medical allowance = 20 %

Gpay = bpay + h_rent + ma

Accessing Member Functions...

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

class EmployeeRecord
{
   private:
    char name[15];
    float bpay, h_rent, ma, gpay;

    public:
    void getRecord()
    {
       cout<<"Enter Name of the employee: "; cin>>name;
       cout<<"Enter basic pay of employee: "; cin>>bpay;
    }
```

Accessing Member Functions...

```
void allow()
    {
       h_rent =bpay*60/100;
       ma= bpay*20/100;
       gpay=bpay+h_rent+ma;
    }
    void displayRecord()
    {
       cout<<"Name of the Employee : "<<name<<endl;
       cout<<"Basic Pay            : "<<bpay<<endl;
       cout<<"House Rent           : "<<h_rent<<endl;
       cout<<"Medical Allowance    : "<<ma<<endl;
       cout<<“Net Pay              : "<<gpay<<endl;
    }
```

}; // end of class body

Accessing Member Functions...

```
int main () {

    // Declare an object of class
    EmployeeRecord empRecord;

    // accessing member function
    empRecord.getRecord();
    empRecord.allow();
    empRecord.displayRecord();
    return 0;
}
```

Output:

Enter Name of the employee: Aisha
Enter basic pay of employee: 30000

Name of the Employee : Aisha
Basic Pay : 30000
House Rent : 18000
Medical Allowance : 6000
Net Pay : 54000

Defining Member Functions outside class

- Members functions of a class can also be defined outside the class. In this case, only the prototype of the member function is declared inside the class.
- The member functions are defined outside the class in the similar way as user defined functions are defined. However, the scope resolution operator (**::**) is used in the member function declarator to define the function of the class outside the class.
- The general syntax of member function definition outside the class is:

```
type class_name :: function_name (arguments)
{
        body of function
}
```

Defining Member Functions outside class…

- Note: The member function is defined outside its class if the body of the function definition is large. Otherwise the function definition should be defined inside the class.
- To define a member function outside the class definition we have to use the scope resolution :: operator along with class name and function name.

Defining Member Functions outside class…

- **Program 05:** Write a program by using class Employee to input the record of employee by defining the function member outside the class.

```
#include <iostream>
using namespace std;
class EmployeeRecord
{
   private:
    char name[15];
    float bpay, h_rent, ma, gpay;

    public:
     void getRecord(void);
     void allow(void);
     void displayRecord(void);
}; // end of class
```

Defining Member Functions outside class…

```
int main () {

    // Declare an object of class
    EmployeeRecord empRecord;

    // accessing member function
    empRecord.getRecord();
    empRecord.allow();
    empRecord.displayRecord();
    return 0;
}
```

Defining Member Functions outside class…

```
// Definition of getRecord using scope resolution operator ::

   void EmployeeRecord::getRecord()
    {
       cout<<"Enter Name of the employee: "; cin>>name;
       cout<<"Enter basic pay of employee: "; cin>>bpay;
    }
```

Defining Member Functions outside class…

```
// Definition of allow using scope resolution operator ::

  void EmployeeRecord::allow()
   {
      h_rent =bpay*60/100;
      ma= bpay*20/100;
      gpay=bpay+h_rent+ma;
   }
```

Defining Member Functions outside class…

```
// Definition of displayRecord using scope resolution operator ::
    void EmployeeRecord::displayRecord()
    {
       cout<<"Name of the Employee : "<<name<<endl;
       cout<<"Basic Pay            : "<<bpay<<endl;
       cout<<"House Rent           : "<<h_rent<<endl;
       cout<<"Medical Allowance    : "<<ma<<endl;
       cout<<“Net Pay              : "<<gpay<<endl;

    }
```

Defining Member Functions outside class…

Output:

Enter Name of the employee: Aisha
Enter basic pay of employee: 30000

Name of the Employee : Aisha
Basic Pay : 30000
House Rent : 18000
Medical Allowance : 6000
Net Pay : 54000

Storage of Object in Memory

- When an object of a class is created, a space is reserved in the computer memory to hold its data members. Similarly, separate memory spaces are reserved for each class object.
- The member functions of a class are, however, stored at only one place in the computer memory.
- All objects of the class use the same member functions to process data.
- Therefore while, each object has separate memory space for data members, the member functions of a class are stored in only one place and are shared by all objects of the class.

Storage of Object in Memory…

Program 06:

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

class Temp
{
   private:
    int x;
    float y;

    public:
     void getData(void)
     {
        cout<<"Enter value of x : "; cin>>x;
        cout<<"Enter value of y : "; cin>>y;
     }
```

Storage of Object in Memory…

```
 void print(void)
     {
        cout<<"Entered value of x = "<<x<<endl;
        cout<<"Entered value of y = "<<y<<endl;

     }

}; // end of class body
```

Storage of Object in Memory…

```
int main () {

    // Declare an object of class
    Temp a, b;

    cout<<"Get data data in object a"<<endl;
    a.getData();
    cout<<"Get data data in object b"<<endl;
    b.getData();

    cout<<"Data in object a is : "<<endl;
    a.print();
    cout<<"Data in object b is : "<<endl;
    b.print();

    return 0;
}
```

Storage of Object in Memory…

Output:

Get data in object a
Enter value of x : 44
Enter value of y : 5

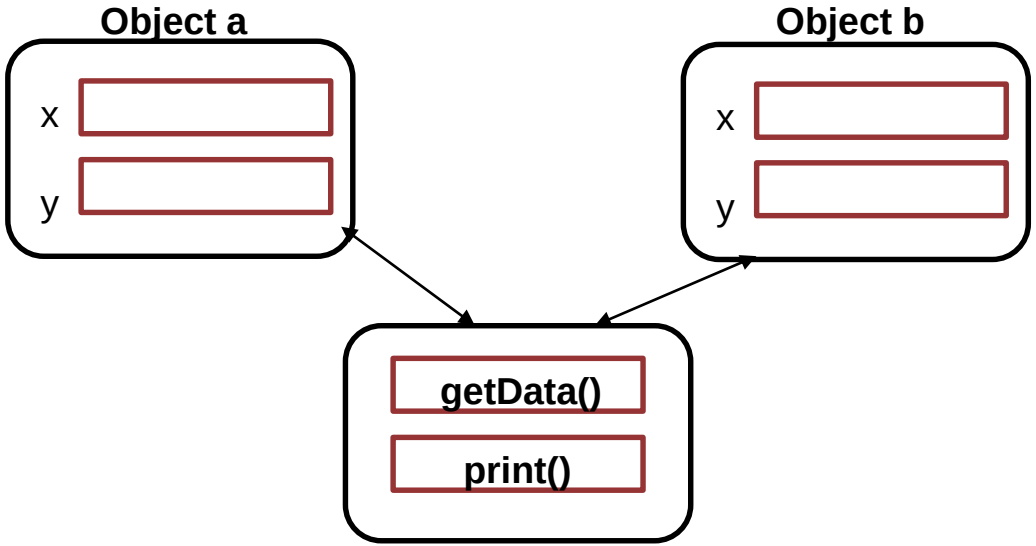
Get data in object b
Enter value of x : 66
Enter value of y : 66

Data in object a is :
Entered value of x = 44
Entered value of y = 5

Data in object b is :
Entered value of x = 66
Entered value of y = 66

Storage of Object in Memory…

- The storage of object **a** and **b** as mentioned in the above program example is shown below. These object use the same member functions.



Functions vs Methods

Function — a set of instructions that perform a task.

Method — a set of instructions that are associated with an object.

METHODS

A method, like a function, is a set of instructions that perform a task. The difference is that a method is associated with an object, while a function is not.

References

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THANK YOU