Lecture 3

CLASSES AND OBJECTS

3.1 CLASS

A class is a way to bind the data and its associated functions together its similar syntactically to a structure. Generally, a class specification has two parts:

1. Class declaration
2. Class function definitions

Class declaration: - describes the type and scope of its members.

Class function definitions: - describe how the class functions are implemented.

The general form of a class declaration is:

```
class class_name
{
   private:
     variable declarations;
     function declarations;
   public:
     variable declarations;
   function declarations ;
 };
```

However, the public members (both functions and data) can be accessed from outside the class. This is illustrated in fig. 3.1.

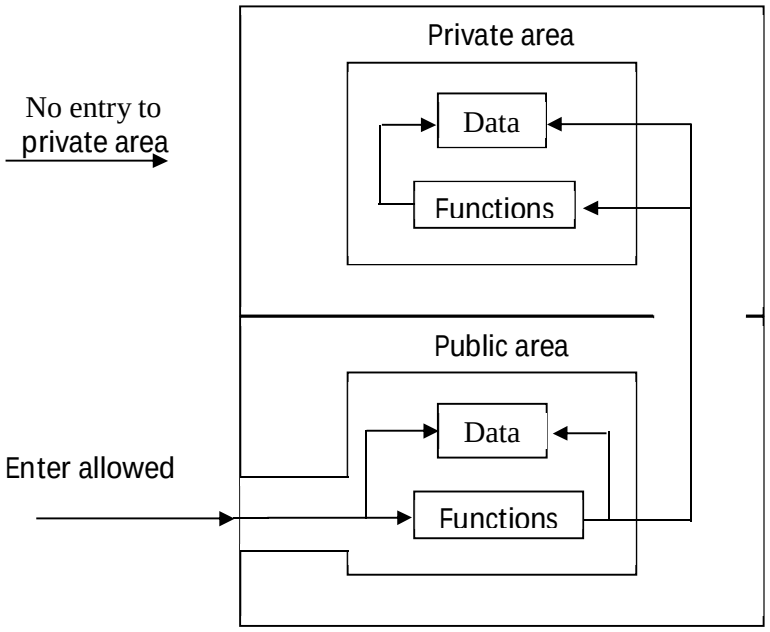


Fig. 3.1 Data hiding in classes

3.1.1 A Simple Class

EX(1):-The program contains a class and two objects of that class. Although it's simple, the program demonstrates the syntax and general features of classes in C++. Here's the listing for the SMALLOBJ program:

Class Example 1: // smallobj

```
#include <iostream>

using namespace std;

class smallobj                //define a class

{

 private:

int somedata;                 //class data

public:
```

```
void setdata(int d)          //member function to set data
{ somedata = d; }
void showdata()              //member function to display data
{ cout << "Data is " << somedata << endl; }
};
int main()
{
 smallobj s1, s2;             //define two objects of class smallobj
s1.setdata (1066);           //call member function to set data
s2.setdata (1776);
s1.showdata ();              //call member function to display data
s2.showdata ();
return 0;
}
```

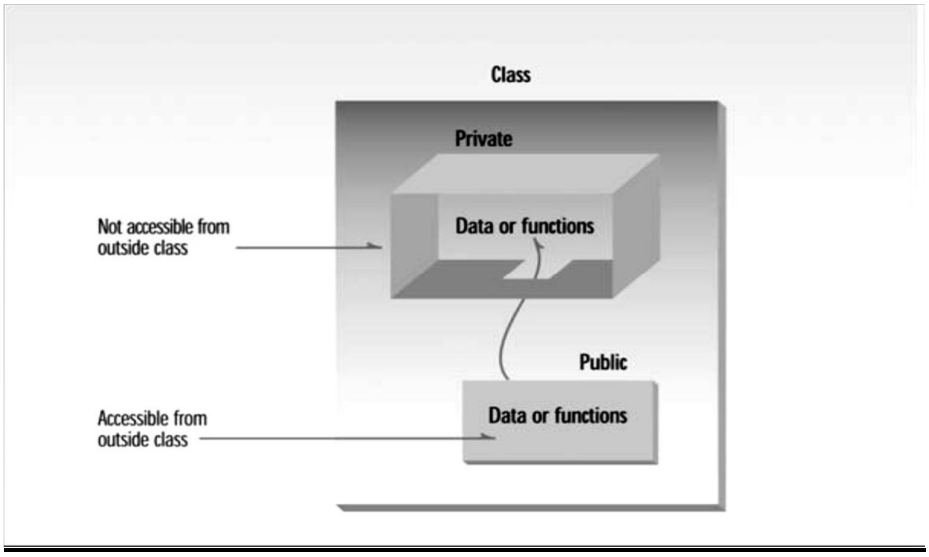
1- The class **smallobj** defined in this program contains one data item and two member functions.
2- The first member function sets the data item to a value, and the second displays the value.
3- Each of the two objects is given a value, and each displays its value.

Here's the output of the program:

```
Data is 1066 ← object s1 displayed this
Data is 1776 ← object s2 displayed this
```

3.1.2 Private and Public

The body of the class contains two keywords: private and public. What is their purpose? The primary mechanism for hiding data is to put it in a class and make it private. Private data or functions can only be accessed from within the class the use of the keyword **private** is optional. By default, the members of a class are **private**. Public data or functions, on the other hand, are accessible from outside the class. This is shown in Figure 3.2.



Fig(3.2) a two objects of class smallobj

3.1.3 Class Data

The smallobj class contains one data item: some data, which is of type int. The data items within a class are called data members. The data member **some data** follows the keyword private, so it can be accessed from within the class, but not from outside.

3.1.4 Member Functions

Member functions are functions that are included within a class. There are two member functions in **smallobj: setdata()** and **showdata().**Because setdata() and showdata() follow the keyword public, they can be accessed from outside the class. Figure 3.3 shows the syntax of a class definition.

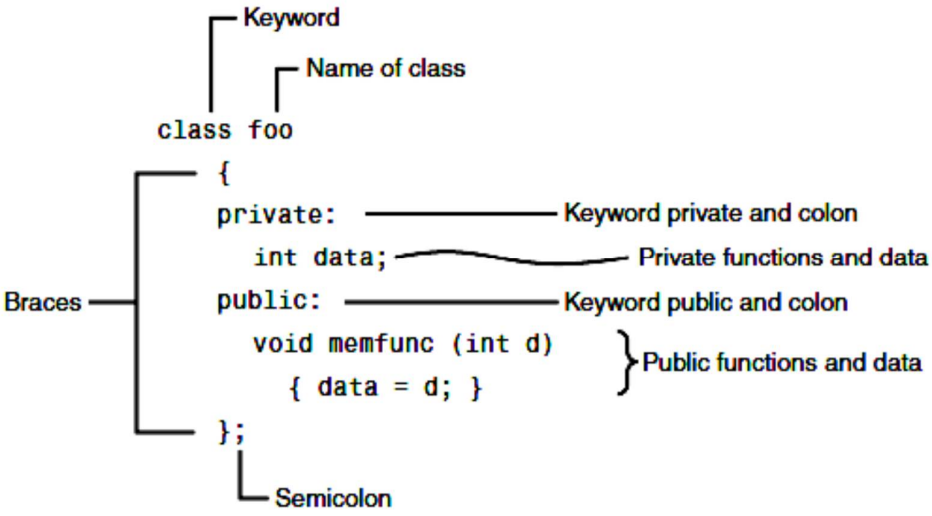


Fig (3.3) Syntax of a class definition.

3.2 Defining Objects (Creating Objects)

The first statement in main() smallobj s1, s2; defines two objects, s1 and s2, of class **smallobj.** The definition of the class **smallobj** does not create any objects. Defining an object is similar to defining a variable of any data type: Space is set aside for it in memory. Defining objects in this way means creating them.

3.3 Accessing Class members (Calling members functions)

The private data of a class can be accessed only through the member functions of that class. The **main( )** cannot contain statements that access to **somedata** directly . The following is the format for calling a member function:

The next two statements in main() call the member function setdata():

s1.setdata(1066);

s2.setdata(1776);

```
cobject-name . function-name (actual-arguments);
```

The first call to setdata() s1.setdata(1066); executes the setdata() member function of the s1 object. This function sets the variable somedata in object s1 to the value 1066. The second call s2.setdata(1776); causes the variable somedata in s2 to be set to 1776. Now we have two objects whose somedata variables have different values, as shown in Figure 3.4.

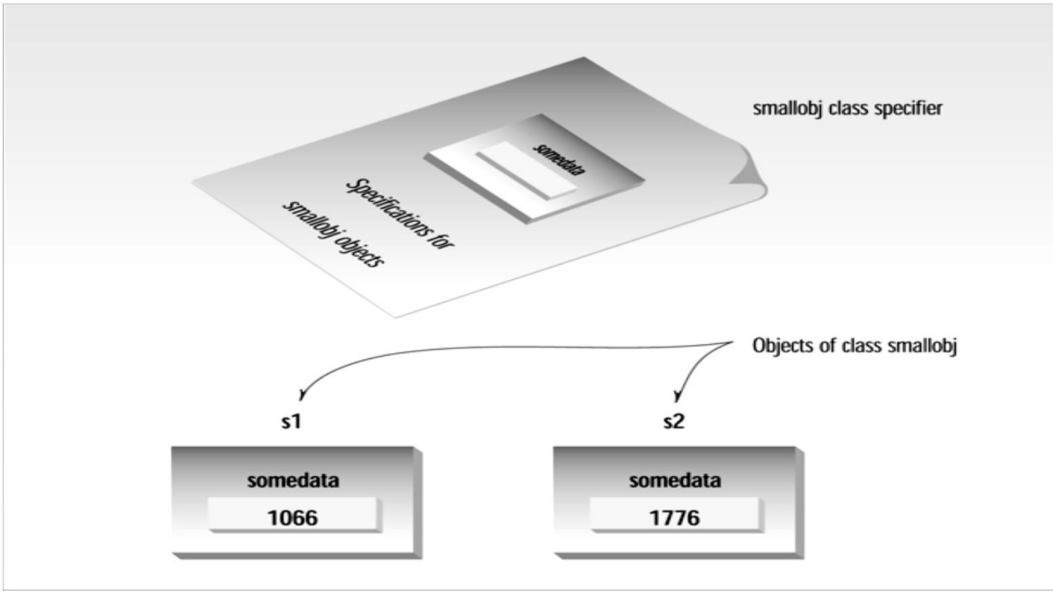


FIGURE 3.4 Two objects of class smallobj.

Similarly, the following two calls to the showdata() function will cause the two objects to display their values:

s1.showdata();

s 2.showdata();

Messages

Some object-oriented languages refer to calls to member functions as messages. Thus the call s1.showdata(); can be thought of as sending a message to s1 telling it to show its data. Talking about messages emphasizes that objects are discrete entities and that we communicate with them by calling their member functions**.**

3.4 Defining Member Functions

Member functions can be defined in two places:

1- Outside the class definition.

2- Inside the class definition

1- Outside The Class Definition

They should have a function header and a function body. The general form of a member function definition is:

```
return-type class-name : : function-name (argument declaration)
{
    Function body
}
```

The class-name:: tells the compiler that the function function-name belongs to the class class-name. That is, the scope of the function is restricted to the *class-name* specified in the header line.

The symbol:: is called the *scope resolution* operator.

For instance, consider the member functions **getdata ( )** and **putdata ( )** member functions. They may be coded as follows:

```
Class item
    {
        int number;
        float cost;
       public:
       void getdata (int a, float b );    // declaration
        void putdata (void);              // declaration
        };
  void item :: getdata (int a , float b )
         {
              number = a;
              cost = b;
         }
         void item :: putdata(void)
         {
              cout << "number : " << number << "\n";
              cout << "cost       : " << cost       << "\n";
          }
```

Since these functions do not return any value, their *return-type* is **void**.

- Member function can access the private data of the class. A non-member function cannot do so.
- A member function can call another member function directly, without using the dot operator.

2- **Inside the class Definition:-**

Another method of defining a member function is to replace the function declaration by the actual function definition inside the class. For example, we could define the **item** class as follows:

```
Class item
{
     int number;
     float cost;
   public:
   void getdata (int a, float b );    // definition
    {
          number = a;
          cost = b;
     }
    void putdata (void)              // definition
    {
         cout << number << "\n";
         cout << cost      << "\n";
    }
};
```

When a function is defined inside a class, it is treated as an **inline** function.

EX:- A C++ program with class

```
// Class implementation
# include <iostream>
using namespace std;
class  item                                    // class declaration
{      private:
 int number;                                   // private by default
float cost  ;                                  // private by default
public:
void getdata (int a , float b ) ;              // prototype declaration
void putdata (void )                           // function defined her
{
 cout <<"number :'' << number << "\n" ;
 cout <<"cost      :"  << cost       << "\n" ;
 }
  }
//Member Function Definition
void item :: getdata ( int a , float b )       // use membership label
{
     number = a ;          // private variables
     cost   = b;           // directly used
}
// Main Program
main( )
{
    item  x;                                   // create object x
    cout << "\n object  x " << " \n" ;
    x. getdata ( 100,299.95 );                 // call member function
    x.putdata ( );                             // call member function
```

```
    item y;                                  // create object y
    cout << "\no bject y " << "\n" ;
    y.getdata (200, 175.50);
    y. putdata ( );
}
```

Here is the output of above program:

object x
number : 100
cost : 299.950012
object y
number : 200
cost :175.5

Ex3:-Write program to create class to compute value of Y from equation

$Y=\frac{X^2-z}{2X}$ if X>0

Solution:-

```
#include <iostream>
using namespace std;
class equation
{
float X,Y,Z;
public:
void getdata (float a, float b);
void compute_disp();
};
void equation :: getdata(float a ,float b)
{ X=a;
```

```
   Z=b;}
void equation ::compute_disp( )
{
 if (X>0)
{   Y=(X*X -Z)/2*X;  cout <<"\n Y= "<<Y;}
else   cout<< "\n value of X less than zero";
  }
 void main()
 {
 equation XE;   float a,b;
 cin>> a>>b;
 XE.getdata (a,b);
  XE.compute_disp();
  }
```

EX4:- Write program to create class to compute area of rectangle.

Solution:-

```
#include <iostream>
using namespace std;
class rectangle
{
float length,width ,Ar;
public:
void readdata (float a, float b);
void AREA(void);
void display(void);
}
void rectangle :: readdata(float a, float b )
{ length=a;      width=b;}
```

```
void rectangle ::AREA( )
{   Ar= length * width;}
void rectangle :: display( )
{ cout <<"\n area of rectangle =  "<< Ar; }
 void main()
 {
 rectangle R; float L,W;
cout <<"enter length and width of rectangle :"<<endl;
cin>> L>>W;
 R.readdata (L,W);
 R.AREA ();
 R.display ();
  }
```

// widget part as an object

```
#include <iostream>

using namespace std;
class part //define class

{

private:

int modelnumber;                                    //ID number of widget

int partnumber;                                     //ID number of widget part

float cost;                                         //cost of part

public:

void setpart(int mn, int pn, float c)               //set data
```

```
{
modelnumber = mn;
partnumber = pn;
cost = c;
}
void showpart()                    //display data
{
cout << "Model " << modelnumber;
cout << ", part " << partnumber;
cout << ", costs $" << cost << endl;
}
};
main()
{ part part1; //define object of class part
part1.setpart(6244, 373, 217.55);          //call member function
part1.showpart();                          //call member function
}
```

3.5 Nesting of member functions

A member function can be called by using its name inside another member function of the same class. This is known as **nesting of member functions.**

//Nesting of Member Functions

```
# include <iostream>
using namespace std;
class set
{
        int m , n;
   public:
        void input (void);
        void display (void);
        int largest (void );
};
int set :: largest (void )
{
   if ( m >=n )
      return (m);
else
      return (n);
}
void set :: input (void )
{
   cout << " input values of m and n " << "\n" ;
   cin >> m >> n ;
}
void set :: display (void )
{
    cout <<"largest value = "
          << largest ( ) << "\n";              // calling member function
}
main ( )
```

```
{
set A ;
A. input ( );
A. display ( );
}                                   // end program
```

The output of program would be:

```
Input values of m and n
30 17
largest value = 30
```

EX5:-Write program to create class to find summation of any two integer numbers.

Solution:-

```
#include <iostream>
using namespace std;
class SUM1
{
int X,Z;
public:
void readdata (float a, float b)
{  X=a; Z=b; }
int sum(void)
{  return (X+Z) ;  }
void putdata ()
{  cout <<" \n summation of "<<X <<"+"<<Z <<" =   "<<sum()<<endl; }
};
void main()
 {
 SUM1 S; int a,b;
  cout<<" \n enter two integer number :"<<endl;
```

```
 cin>> a>>b;
 S.readdata (a,b);
 S.putdata ();
S.readdata (30,15);
S.putdata();
}
```

3.6 Private member functions

Although it is normal practice to place all the data item in a private section and all the functions in public, some situations may require certain functions to be hidden (like private data) from the outside calls. Tasks such as deleting an account in a customer file, or providing increment to an employee are events of serious consequences and therefore the functions handling such tasks should have restricted access. We can place these functions in the private section.

A private member function can only be called by another function that is a member of its class.

Example:-

```
 class sample
 {
  int m ;
   void read (void);                  //private member function
   public:
   void update (void);
   void write (void);
     };
```

If **s1** is an object of **sample,** then

```
  s1.read( );          // won't work ; objects cannot access private
                                  // members
```

Is illegal. However, the function **read()** can be called by the function **update( )** to update the value of **m** .

```
void sample : : update ( void )
 {
  read ( );                    // simple call; no object used
   }
```

3.7 Arrays within a Class

The arrays can be used as member variables in a class. The following class definition is valid.

```
   const int size = 10 ;          // provides value for array size
    class array
    {
    int a[size];                 // 'a' is int type array
     public:
    void setval(void);
    void display(void);
    };
```

EX:-

```
#include <iostream>
#include <conio.h>
using namespace std;
const m=5;
class ITEMS
{
        int itemcode [m] ;
        float itemprice [m] ;
        int count ;
```

```
  public:
        void CNT(void)  { count=0 ;}                // initializes count to 0
        void getitem(void) ;
        void displaysum(void) ;
        void remove(void) ;
        void displayitems(void) ;
};
```

// Member functions

```
void ITEMS :: getitem(void)    //assign values to members
{
       cout <<"Enter item code :" ;
       cin >> itemcode [count] ;
       cout << "Enter item cost :" ;
       cin >> itemprice [count] ;
       count ++;
 }
void ITEMS :: displaysum(void)   // display total value
{     float sum = 0;
      for(int i= 0 ; i< count ; i++)
          sum = sum + itemprice[i] ;
      cout << "\n Total value :"<< sum << "\n" ;
 }
void ITEMS :: remove(void)                    // Delete a specified  item
{
     int a;
     cout << "Enter item code :" ;
     cin >> a;
     for(int i=0 ;  i < count ; i++)
          if (itemcode [i]==a)
```

```
 { itemcode[i] =0;itemprice [i]=0;}
 }
void ITEMS :: displayitems(void)                    // displaying items
{
       cout << "\n code price\n" ;
       for (int i=0 ; i< count ; i++)
       {
            cout <<"\n"<<  itemcode[i];
            cout <<"   "<<  itemprice[i];
        }
        cout <<"\n" ;
 }
// Main program
main( )
{
    ITEMS order;
    order. CNT();
    int x;
    do         //do . . . while loop
    {
          cout <<"\n You can do this following ;"
                 << "\n Enter appropriate number \n";
          cout << "\n1 : Add an item ";
          cout << "\n2 : Display total value ";
          cout << "\n3 : Deleting an item ";
          cout << "\n4 : Display all items ";
          cout << "\n5 :  Quit ";
          cout <<"\n\nwhat is your option?";
          cin >> x ;
```

```
        switch (x)
        {
            case  1 : order. getitem( ) ; break ;
            case  2 : order. displaysum( ) ; break ;
            case  3 : order. remove( ) ; break ;
            case  4 : order. displayitems( ) ; break ;
            case  5 : break ;
            default : cout << "Error in input ; try again\n" ;
        }
    } while (x !=5);          // do . . while en
getch();
  }
```

3.8 Arrays of Objects

We know that an array can be of any data type including **struct**. Similarly, we can also have arrays of variables that are of the type **class**. Such variables are called *arrays of objects.* Consider the following class definition:

```
class employee
{char name[30];
      float age;
   public:
       void
getdata(void);
       void
putdata(void);
};
```

The identifier **employee** is a user-defined data type and can be used to create objects that related to different categories of the employees.

EX:-

```
employee manager[3];        // array of manager
employee foreman[15];       // array of foreman
employee worker[75];        // array of  worker
```

The array **manager** contains three objects(managers), namely, **manager[0], manager[1] and manager[2],** of type **employee** class. Similarly, the **foreman** array contains 15 objects(foremen) and the **worker** array contains 75 objects(workers).

We can use the usual array-accessing methods to access individual elements and then the dot member operator to access the member functions. For example, the statement

Manager [I]. Putdata ();

Will display the data of the ith element of the array **manager.** That is, this statement

Arrays of Objects

```
#include <iostream>
using namespace std;
class employee
{
      char name[30];                    //string as class member
      float age;
  public:
       void getdata(void);
       void putdata(void);
```

```
};
void employee :: getdata(void)
{
        cout  <<  "Enter name:  ";
        cin    >>  name;
        cout  <<  "Enter age:  ";
        cin    >> age;
}
void employee :: putdata(void)
{
       cout  << "Name: " <<  name  <<  "\n";
       cout  << "Age: " <<  age  <<  "\n";
}
const   int  size =3;
main()
{      employee  manager[size];                //Array of managers
    for (int  i = 0;  i < size;  i++)
        {
                cout << "\nDetails of manager" <<  i+1 << "\n";
                manager[i] . getdata();
        }
    cout << "\n";
   for (int  t = 0;  t < size;  t++)
       {
                cout << "\nManager" <<  t+1 << "\n";
                manager[t] . putdata();
        }
}
```

3.9 Objects as Function Arguments

Like any other data type, an object may be used as function argument. This can be done in two ways:

- A copy of the entire object is passed to the function.
- Only the address of the object is transferred to the function.

The first method is called *pass-by-value*. Since a copy of the object is passed to the function, any changes made to the object inside the function do not affect the object used to call the function. The second method is call *pass-by-reference*. When an address of the object is passed, the called function works directly on the actual object used in the call.

[Objects As Arguments]

```
# include <iostream>
using namespace std;
class time
{       int hours, minutes ;
    public:
        void gettime (int h , int m )
        {   hours =   h; minutes = m; }
        void puttime (void)
        {
            cout << hours <<" hours and ";
            cout << minutes <<"minutes  "  << "\n";
        }
         void  sum(time, time);          //objects are arguments
};
void time :: sum(time t1, time t2)       // t1, t2 are objects
{
```

```
        minutes = t1 . minutes+ t2 . minutes;
        hours = minutes/60;
        minutes = minutes %60;
        hours = hours + t1 . hours + t2 . hours;
   }
main()
{       time T1 , T2 , T3;
        T1. gettime (2,45);     //get T1
        T2. gettime (3,30);     //get T2
        T3 . sum(T1,T2);        //T3=T1+T2
         cout <<  "T1= ";  T1.puttime ( );     //display T1
         cout <<  "T2= ";  T2.puttime ( );     //display T2
         cout <<  "T3= ";  T3.puttime ( );     //display T3
}
```

The output of program would be:

T1 = 2 hours and 45 minutes

T2 = 3 hours and 30 minutes

T3 = 6 hours and 15 minutes