OOP with C++ by E Balagurusamy > Solution

Chapter 1

Review Questions

1.1: **What do you think are the major issues facing the software industry today?**

Ans: Many software products are either not finished or not used or not delivered for some major errors. Today some of the quality issues that must be considered for software industry are:
1. Correctness.
2. Maintainability.
3. Reusability.
4. Openness and interoperability.
5. Portability.
6. Security.
7. Integrity.
8. User friendliness.

1.2: **Briefly discuss the software evolution during the period 1950— 1990.**

Ans: In 1950, the first three modern programming languages whose descendants are still in widespread today.
1. FORTRAN (1955), the "FORmula TRANslator"
2. LISP (1958) the "LISt Procssor".
3. COBOL, the COmmon Business Oriented Language.

Some important language that were developed in 1950 to 1960 are:
1. Regional Assembly Language–1951
2. Autocode–19952
3. IPL–1954
4. FLOW-MATIC–1955
5. COMTRAN–1957
6. COBOL–1959
7. APL–1962

1.3: **What is procedure-oriented programming? What are its main characteristics?**

Ans: Conventional programming, using high level language such as COBOL, FORTAN and C is commonly known as procedure oriented programming.
Characteristics :

a) Emphasis is on doing things (algorithms)
b) Large programs are divided into small programs known as function.
c) Most of the function share global data.
d) Data move openly around the system from function to function.
e) Function transform data from one form to another.

1.4: **Discuss an approach to the development of procedure-oriented programs.**

Ans: In the procedure-oriented approach, the problem is viewed as a sequence of things to be done such as
1. reading
2. Calculating
3. Printing.
A number of functions are written to accomplish these tasks.

1.5: **Describe how data are shared by functions in a procedure-oriented program.**

Ans: In a multi-function program, many important data items are placed as global so that they may be accessed by all the functions. Each function may have its own local data.

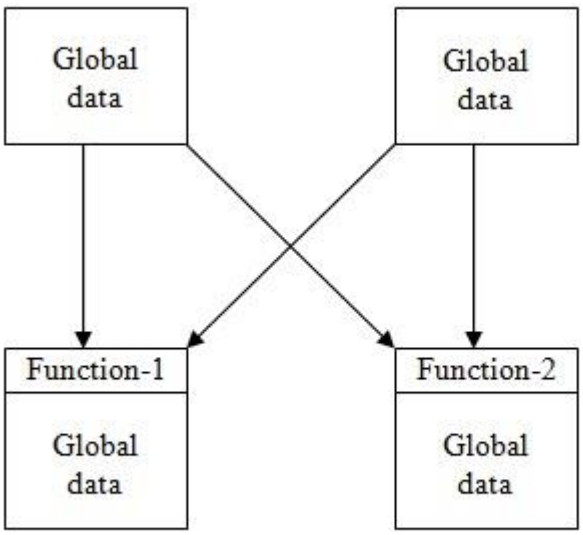


Fig: Data sharing in procedure oriented program

1.6: **What is object-oriented programming? How is it different from the procedure-oriented programming?**

Ans: Object oriented programming (OOP)is an approach that provides a way of modularizing programs by creating partitioned memory area for both data and functions that can be used as templates for creation copies of such modules on demand.
Different between OOP(Object oriented programming) & POP(Procedure oriented programming):
1. OOP has data hading feature for which the data of a class cannot be accessed by the member function of other class but POP has no such feature.
2. In OOP we can design our own data-type which is same as built in data type. But in POP we can not do this.

1.7: **How are data and functions organized in an object-oriented program?**

Ans: Data and functions are belongs to a class. Data is called data member and functions are called member functions. There is a visibility-mode such as public and private. Generally data is private and functions are public.

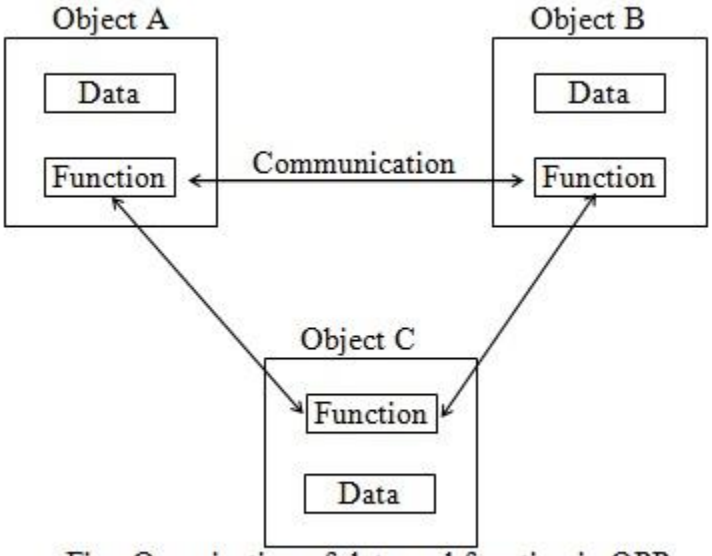


Fig : Organization of data and function in OPP

1.8: **What are the unique advantages of an object-oriented programming paradigm?**

Ans: The unique advantage of object-oriented program paradigm is to have a working definition of OOP before we proceed further.

1.9: D**istinguish between the following terms:**
(a) Objects and classes
(b) Data abstraction and data encapsulation
(c) Inheritance and polymorphism
(d) Dynamic binding and message passing

Ans: (a) Objects are the basic run-time entities which contain data and code to manipulate data where the entire set of data and code of an object can be made as a user-defined data type with the help of a class. In short, objects are numbers of classes.

(b) Describing the functionality of a class independent of its implementation is called data abstraction. Where data encapsulation means the wrapping up of data and functions into a single unit.

(c) The mechanism of deriving a new class from an old one is called inheritance, where polymorphism means one thing with several distinct terms.

(d) Binding refers to the linking of a procedure call to be executed in response to the call. When binding occurs at run-time, then it is known as dynamic-binding.

Massage passing involves specifying the name of the object, the name of the function and the information to be sent

1.10: **What kinds of things can become objects in 00P?**

Ans: Objects are the basic run-time entities in an object-oriented system. They may represent a person, a place, a bank account, a table of data or any item that the program has to handle.

1.11: **Describe inheritance as applied to OOP.**

Ans: Inheritance is one of the most powerful feature of object-oriented programming. Inheritance is the process of creating new class from existing class. The new class is called derived class and existing class is called base class.

1.12:**What do you mean by dynamic binding? How is it useful in OOP?**

Ans: Binding refers to the linking of a procedure call to be executed in response to the call. When binding occurs at run time it is known as dynamic binding. Dynamic binding is useful in OOP such as a function call associated with a polymorphic reference depends on the dynamic type of that reference.

1.13:**Now does object-oriented approach differ from object-based approach?**

Ans: Object-based programming do not support inheritance and dynamic binding but object-oriented programming do so.

1.14:**List a few areas of application of 001″ technology.**

Ans: Areas of application of OOP technology are :
1. Real-time system.
2. Simulation and modeling.
3. Object oriented database.
4. Hypertext, hypermedia .
5. Decision support and office automation system.

1.15:**State whether the following statements are TRUE or FALSE.**
(a) In procedure-oriented programming, all data are shared by all functions.
(b) The main emphasis of procedure-oriented programming is on algorithms rather than on data.
(c) One of the striking features of object-oriented programming is the division of programs into objects that represent real-world entities.
(d) Wrapping up of data of different types into a single unit is known as encapsulation.
(e) One problem with 00P is that once a class is created it can never be changed.
(f) Inheritance means the ability to reuse the data values of one object by
(g) Polymorphism is extensively used in implementing inheritance.
(h) Object oriented programs are executed much faster than conventional programs.
(i) Object-oriented systems can scale up better from small to large.
(j) Object-oriented approach cannot be used to create databases.

Ans:
a> FALSE
b> TRUE
c> TRUE
d> FALSE
e> FALSE
f> TRUE
g> TRUE
h> FALSE
i> TRUE
j> FALSE

Chapter 2

Review Questions

2.1: State whether the following statements are TRUE or FALSE.
(a) Since C is a subset of C++, all C peograms will run under C++ compilers.
(b) In C++, a function contained within a class is called a member function.
(c) Looking at one or two lines of code, we can easily recognize whether a program is written in C or C++.
(d) In C++, it is very easy to add new features to the existing structure of an object.
(e) The concept of using one operator for different purposes is known as aerator overloading. 10
The output function printfl) cannot be used in C++ programs.

Ans:
a> FALSE
b> TRUE
c> FALSE
*** most lines of codes are the same in C & C++
d> TRUE
e> TRUE
f> FALSE

2.2: Why do we need the preprocessor directive #include<iostream>?

Ans: '#include<iostream>' directive causes the preprocessor to add-the contents of iostream file to the program.
2.3: How does a main() function in C++ differ from main{} in C?

Ans: In C main () by default returns the void type but in C++ it returns integer by default.
2.4: What do you think is the main advantage of the comment / / in C++ as compared to the old C type comment?

Ans: '//' is more easy and time-saving than '/* */'

2.5:Describe the major parts of a C++ program.

Ans: Major parts of a C++ program :
1. Include files
2. Class declaration
3. Member function definitions
4. Main function program

Debugging Exercises

2.1: **Identify the error in the following program.**

```
#include<iostream.h>
void main()
{
   int i = 0;
   i = i + 1;
   cout « i « " ";
   /*comment \*//i = i + 1;
   cout << i;
}
```

Ans: Syntax error→/* comment*//i=i+1;

2.2: **Identify the error in the following program.**

```
#include<iostream.h>
void main()
{
    short i=2500, j=3000;
    cour>> "i+j=">> -(i+j);
}
```

Ans: cout >> "i+j=">> Illegal structure operation.→-(i + j);

2.3: **What will happen when you run the following program?**

```
#include<iostream.h>
void main()
{
    int i=10, j=5;
    int modResult=0;
    int divResult=0;
    modResult = i%j;
    cout<<modResult<<" ";
    divResult = i/modResult;
    cout<<divResult;
}
```

Ans: floating point Error or divide by zero→divResult = i/modResult;

Note: If this kind of Error exist in a program, the program will successfully compile but it will show Run Error.

2.4: **Find errors, if any, in the following C++ statements.**
(a) cout.<<“x=” x; (b) m = 5; // n = 10; // = m + n: (c) cin >>x; >>y;
(d) cout <<\h ‘Name:” <<name;
(e) cout <<“Enter value:”; cin >> x:
(f) /*Addition*/ z = x + y;

Ans:

	Error	Correction
A	Statement missing	cout<<“x=”<<x;
B	No error	
C	Expression-syntax-error	cin>>x>>y;
D	Illigal character ‘\’. Statement missing	cout<<“\n Name”<<name;
E	No error	
F	No error	

Programming Exercises

2.1: **Write a program to display the following output using a single cout statement**

Maths = 90
Physics = 77
Chemistry = 69

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  int main()
4  {
5
6           char *sub[]={"Maths","Physics","Chemestry"};
7           int mark[]={90,77,69};
8           for(int i=0;i<3;i++)
9            {
10cout<<setw(10)<<sub[i]<<setw(3)<<"="<<setw(4)<<mark[i]<<endl;
11           }
12    return 0;
13}
```

output

Maths = 90
Physics = 77
Chemistry = 69

2.2: **Write a program to read two numbers from the keyboard and display the larger value on the screen.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  int main()
5  {
6     float a,b;
7        cout<<" Enter two values  :"<<endl;
8     cin>>a>>b;
9     if(a>b)
10       cout<<" larger value = "<<a<<endl;
11    else
12       cout<<" larger value = "<<b<<endl;
13    return 0;
14}
```

output

Enter two values : 10 20
larger value = 20

2.3: **Write a program to input an integer from the keyboard and display on the screen "WELL DONE" that many times.**

Solution:

```
1  Solution:
2  #include<iostream.h>
3  #include<iomanip.h>
4  int main()
5  {
6     int n;
7     char *str;
8     str="WELL DONE";
```

```
9     cout<<" Enter an integer value ";
10    cin>>n;
11    for(int i=0;i<n;i++)
12    {
13       cout<<str<<endl;
14    }
15    return 0;
16}
```

output

```
Enter an integer value 5
WELL DONE
WELL DONE
WELL DONE
WELL DONE
WELL DONE
```

2.4: **Write a program to read the values a, b and c and display x, where x = a / b –c.**
Test the program for the following values:
(a) a = 250, b = 85, c = 25
(b) a = 300, b = 70, c = 70

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  int main()
4  {
5      float a,b,c,x;
6      cout<<" Enter the value of a,b, &c :"<<endl;
7      cin>>a>>b>>c;
8      if((b-c)!=0)
9      {
10          x=a/(b-c);
11          cout<<" x=a/(b-c) = "<<x<<endl;
12     }
13     else
14     {
15        cout<<"  x= infinity "<<endl;
16     }
17     return 0;
18}
```

During First Run:

output

Enter the value of a,b, &c : 250 85 25
x=a/(b-c) = 4.166667

During Second Run:

output

Enter the value of a,b, &c : 300 70 70
x= infinity

2.5: **Write a C++ program that will ask for a temperature in Fahrenheit and display it in Celsius**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  int main()
5  {
6      float f,theta;
7      cout<<" Enter  the temperature in Feranhite    scale  : ";
8      cin>>f;
9      theta=((f-32)/9)*5;
10     cout<<" Temperature in Celsius =  "<<theta<<endl;
11     return 0;
12}
```

output

Enter the temperature in Feranhite scale : 105
Temperature in Celsius = 40.555557

2.6: **Redo Exercise 2.5 using a class called temp and member functions.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  class temp
5  {
6      float f,theta;
7  public:
8      float conversion(float f);
9  };
10
11float temp::conversion(float f)
12{
13    theta=((f-32)/9)*5;
14    return theta;
15}
16int main()
17{
18    temp t;
19    float f;
20    cout<<" Enter temperature in Farenheite scale :"<<endl;
21    cin>>f;
22    cout<<" Temperature in Celsius scale = "<<t.conversion(f)<<endl;
23    return 0;
24}
```

output

Enter the temperature in Feranhite scale : 112
Temperature in Celsius = 44.444443

Chapter 3

Review Questions

3.1: **Enumerate the rules of naming variables in C++. How do they differ from ANSI C rules?**

Ans: Rules of naming variables in C++ are given below :
a. Any character from ‘a’ to ‘z’ or ‘A’ to ‘Z’ can be used.
b. Digit can be used but not at the beginning.
c. Underscore can be used but space is not permitted.
d. A keyword cannot be used as variable name.
In C++, a variable can be declared any where in the program but before the using of the variable.
In C all variables must be declared at the beginning of the program.

3.2: **An unsigned int can be twice as large as the signed int. Explain how?**

Ans:
In case of unsigned int the range of the input value is : 0 to $2^m - 1$. [where m is no. of bit]
In case of signed int the range of the input value is : -2^{m-1} to + $(2^{m-1} - 1)$

$$\frac{\text{maximum value for unsigned int}}{\text{value for signed int}} = \frac{2^m - 1}{\frac{(2^{m-1}-1) + 2^{m-1}}{2}}$$

$$= \frac{2^m - 1}{\frac{2.2^{m-1}-1}{2}}$$

$$= \frac{2^m - 1}{\frac{2^m-1}{2}}$$

$$= 2$$

So, maximum value for unsigned int can be twice as large as the signed int.
* Here the absolute value of lower value -2^{m-1} for signed int must be considered for finding average value of signed int.

3.3: **Why does C++ have type modifiers?**

Ans: To serve the needs of various situation.

3.4: **What are the applications of void data type in C++?**

Ans: Two normal uses of void are
(1) to specify the return type of a function when it is not returning any value.
(2) To indicate any empty argument list to a function.

Example : void function (void)

Another interesting use of void is in the declaration of generic pointers.

Example :
void *gp; //gp is generic pointer.
A pointer value of any basic data type can be assigned to a generic pointer
int * ip;
gp = ip; // valid.

3.5: **Can we assign a void pointer to an int type pointer? If not, why? Now can we achieve this?**

Ans: We cannot assign a void pointer to an int type pointer directly. Because to assign a pointer to another pointer data type must be matched. We can achieve this using casting.

Example :
void * gp;
int *ip;
ip = (int *) gp
/br<>
3.6: **Describe, with examples, the uses of enumeration data types.**

Ans: An enumerated data type is a user-defined type. It provides a way for attaching names to numbers in ANSIC

Example :
enum kuet (EEE, CSE, ECE, CE, ME, IEM);

The enum keyword automatically enumerates
EEE to 0
CSE to 1
ECE to 2
CE to 3
ME to 4
IEM to 5

In C++ each enumerated data type retains its own separate type.

3.7: **Describe the differences in the implementation of enum data type in ANSI C and C++.**

Ans: Consider the following example :
enum kuet (EEE, CSE, ECE, CE, ME, IEM);

Here, kuet is tag name.

In C++ tag name become new type name. We can declare a new variables Example:

kuet student;
ANSI C defines the types of enum to be int.

In C int value can be automatically converted to on enum value. But in C++ this is not permitted.

Example:
student cgp = 3.01 // Error in C++
// OK in C.

student cgp = (student) 3.01 //OK in C++

3.8: **Why is an army called a derived data type?**

Ans: Derived data types are the data types which are derived from the fundamental data types. Arrays refer to a list of finite number of same data types. The data can be accessed by an index number from o to n. Hence an array is derived from the basic date type, so array is called derived data type.

3.9: **The size of a char array that is declared to store a string should be one larger than the number of characters in the string. Why?**

Ans: An additional null character must assign at the end of the string that's why the size of char array that is declared to store a string should be one larger than the number of characters in the string.

3.10: **The const was taken from C++ and incorporated in ANSI C, although quite differently. Explain.**

Ans: In both C and C++, any value declared as const cannot be modified by the program in any way. However there are some differences in implementation. In C++ we can use const in a constant expression, such as const int size = 10; char name [size];
This would be illegal in C. If we use const modifier alone, it defaults to int. For example, const size = 10; means const int size = 10;
C++ requires const to be initialized. ANSI C does not require an initialization if none is given, it initializes the const to o. In C++ a const is local, it can be made as global defining it as external. In C const is global in nature , it can be made as local declaring it as static.

3.11: **How does a constant defined by cowl differ from the constant defined by the preprocessor statement %define?**

Ans: Consider a example : # define PI 3.14159

The preprocessor directive # define appearing at the beginning of your program specifies that the identifier PI will be replace by the text 3.14159 throughout the program.

The keyword const (for constant) precedes the data type of a variable specifies that the value of a variable will not be changed throughout the program.

In short, const allows us to create typed constants instead of having to use # define to create constants that have no type information.

3.12: **In C++. a variable can be declared anywhere in the scope. What is the significance of this feature?**

Ans: It is very easy to understand the reason of which the variable is declared.

3.13: **What do you mean by dynamic initialization of a variable? Give an example.**

Ans: When initialization is done at the time of declaration then it is know as dynamic initialization of variable

Example :
float area = 3.14159*rad * rad;

3.14: **What is a reference variable? What is its major use?**

Ans: A reference variable provides an alias (alternative name) for a previously defined variable. A major application of reference variables is in passing arguments to functions.

3.15: **List at least four new operators added by C++ which aid OOP.**

Ans:
New opperators added by C++ are :
1. Scope resolution operator ::
2. Memory release operator delete   delete
3. Memory allocation operator   new
4. Field width operator   setw
5. Line feed operator   endl

3.16: **What is the application of the scope resolution operator :: in C++?**

Ans: A major application of the scope resolution operator is in the classes to identify the class to which a member function belongs.

3.17: **What are the advantages of using new operator as compared to the junction ntallocOr**

Ans: Advantages of new operator over malloc ():
1. It automatically computes the size of the data object. We need not use the operator size of.
2. It automatically returns the correct pointer type, so that there is no need to use a type cast.
3. It is possible to initialize the object while creating the memory space.
4. Like any other operator, new and delete can be overloaded.

3.18: **Illustrate with an example, how the seize manipulator works.**

Ans:
setw manipulator specifies the number of columns to print. The number of columns is equal the value of argument of setw () function.

For example :

setw (10) specifies 10 columns and print the massage at right justified.

cout << set (10) << "1234"; will print

1 2 3 4

If argument is negative massage will be printed at left justified.

cout <<setw(-10)<< "1234"; will print

1 2 3 4

3.19: **How do the following statements differ?**
(a) char *const p;
(b) char canal *p;

Ans:
(a) Char * const P; means constant pointer.
(b) Char const * P; means pointer to a constant.

In case of (a) we con not modify the address of p.
In case of (b) we can not modify the contents of what it points to.

Debugging Exercises

3.1: **What will happen when you execute the following code?**

```
1#include <iostream.h>
2void main()
3{
4    int i=0;
5    i=400*400/400;
6    cout<<i;
7}
```

Ans: i = 400*400/400; Here, 400*400 = 160000 which exceeds the maximum value of int variable. So wrong output will be shown when this program will be run.

Correction :

1Int I = 0;

should be changed as

1long int i = 0;

to see the correct output.

3.2: **Identify the error in the following program.**

```
1include<iostream.h>
2void main()
3{
4     int num[]={1,2,3,4,5,6};
5     num[1]==[1]num ? cout<<"Success" : cout<<"Error";
6}
```

Ans: num [1] = [1] num?. You should write index number after *array name* but here index number is mention before array name in **[1] num**

So expression syntax error will be shown.

Correction : num[1] = num[1]? is the correct format

3.3: **Identify the errors in the following program.**

```
1  #include <iostream.h>
2  void main()
3  {
4       int i=5;
5       while(i)
6    {
7      switch(i)
8      {
9      default:
10     case 4:
```

```
11    case 5:
12    break;
13    case 1:
14    continue;
15    case 2:
16    case 3:
17    break;
18    }
19i-;
20 }
21}
```

Ans:

```
1case 1 :
2continue;
```

The above code will cause the following situation:
Program will be continuing while value of i is 1 and value of i is updating. So infinite loop will be created.
Correction: At last line i- should be changed as i–;

3.4: **Identify the errors in the following program.**

```
1  #include <iostream.h>
2  #define pi 3.14
3  int squareArea(int &);
4  int circleArea(int &);
5  void main()
6  {
7       int a-10;
8       cout << squareArea(a) << " ";
9       cout « circleArea(a) « ";
10     cout « a « endl;
11 {
12     int squareArea(int &a)
13  {
14     return a *== a;
15  }
16   int circleArea(int &r)
17  {
18   return r = pi * r * r;
19  }
```

Ans: Assignment operator should be used in the following line:

1return a *==a;

That means the above line should be changed as follows:

1return a *=a;

3.5: **Missing**

3.6: **Find errors, if any, in the following C++ statements.**
(a) long float x;
(b) char *cp = vp; // vp is a void pointer
(c) int code = three; // three is an enumerator
(d) int sp = new; // allocate memory with new
(e) enum (green, yellow, red);
(f) int const sp = total;
(g) const int array_size;
(h) for (i=1; int i<10; i++) cout << i << "/n"; (i) int & number = 100; (j) float *p = new int 1101;
(k) int public = 1000; (l) char name[33] = "USA";

Ans:

No.	Error	Correction
(a)	too many types	float x; or double x;
(b)	type must be matched	char *cp = (char*) vp;
(c)	No error	
(d)	syntax error	int*p = new int [10];
(e)	tag name missing	enum colour (green, yellow, red)
(f)	address have to assign instead of content	int const * p = &total;
(g)	C++ requires a const to be initialized	const int array-size = 5;
(h)	Undefined symbol i	for (int I = 1; i <10; i++) cout << i << “/n”;
(i)	invalid variable name	int number = 100;
(j)	wrong data type	float *p = new float [10];
(k)	keyword can not be used as a variable name	int public1 = 1000;
(l)	array size of char must be larger than the number of characters in the string	char name [4] = “USA”;

Programming Exercises

3.1: **Write a function using reference variables as arguments to swap the values of a pair of integers.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  void swap_func(int &a,int &b)
5  {
6
7      cout<<" Before swapping "<<endl
8          <<" a = "<<a<<endl<<" b = "<<b<<endl<<endl;
9      int temp;
10     temp=a;
11     a=b;
12     b=temp;
13     cout<<" After swapping "<<endl
14         <<" a = "<<a<<endl<<" b = "<<b<<endl<<endl;
15
16}
17
18int main()
19{
20     int x,y;
21     cout<<"  Enter two integer value : "<<endl;
22     cin>>x>>y;
23     swap_func (x,y);
24     return 0;
25}
```

output

```
Enter two integer value : 56 61
Before swapping
a = 56
b = 61
After swapping
a = 56
b = 61
```

3.2: **Write a function that creates a vector of user given size M using new operator.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  int main()
4  {
5     int m;
6     int *v;
7     cout<<"  Enter vector size : "<<endl;
8     cin>>m;
9     v=new int [m];
10    cout<<" to check your performance  insert "<<m<<" integer value"<<endl;
11    for(int i=0;i<m;i++)
12    {
13       cin>>v[i];
14    }
15    cout<<" Given integer value are :"<<endl;
16    for(i=0;i<m;i++)
17    {
18
19       if(i==m-1)
20       cout<<v[i];
21       else
22       cout<<v[i]<<",";
23
24    }
25    cout<<endl;
26    return 0;
27}
```

output

```
Enter vector size : 5
to check your performance insert 5 integer value
7 5 9 6 1
Given integer value are :
7, 5, 9, 6, 1
```

3.3: **Write a program to print the following outputs using for loops**

```
1
22
333
4444
```

55555
……

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  int main()
4  {
5     int n;
6     cout<<" Enter your desired number :"<<endl;
7     cin>>n;
8     cout<<endl<<endl;
9     for(int i=1;i<=n;i++)
10    {
11       for(int j=1;j<=i;j++)
12       {
13          cout<<i;
14       }
15       cout<<endl;
16    }
17    return 0;
18}
```

output

```
Enter your desired number : 6
1
22
333
4444
55555
666666
```

3.4: **Write a program to evaluate the following investment equation**
$V = P(1+r)^n$
and print the tables which would give the value of V for various
of the following values of P, r and n:
P: 1000, 2000, 3000,……,10,000
r: 0.10, 0.11, 0.12,…….,0.20
n: 1, 2, 3,……..,10
(Hint: P is the principal amount and V is the value of money at the end of n years. This equation can be recursively written as
V = P(1 + r)
P = V
In other words, the value of money at the end of the first year becomes the principal amount for the next year and so on)

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<math.h>
4  #define  size 8
5
6  int main()
7  {
8     float v,pf;
9     int n=size;
10    float p[size]={1000,2000,3000,4000,5000,6000,7000,8000};//9000,1000};
11    float r[size]={0.11,0.12,0.13,0.14,0.15,0.16,0.17,0.18};//,0.19,0.20};
12
13    cout<<setw(5)<<"n=1";
14       for(int i =2;i<=size;i++)
15    cout<<setw(9)<<"n="<<i;
16    cout<<"\n";
17
18    for(i=0;i<size;i++)
19    {
20       cout<<setw(-6)<<"p=";
21       for(int j=0;j<size;j++)
22       {
23          if(j==0)
24           pf=p[i];
25
26           v=pf*(1+r[i]);
27
28           cout.precision(2);
29                 cout.setf(ios::fixed, ios::floatfield);
30           cout<<v<<setw(10);
31             pf=v;
32        }
33        cout<<"\n";
34
35     }
36    return 0;
37}
```

output

```
n=1          n=2          n=3          n=4          n=5          n=6          n=7
p=1110     1232.1      1367.63     1518.07     1685.06     1870.41     2076.16
p=2240    2508.8     2809.86     3147.04     3524.68     3947.65    4421.36
p=3390    3830.7     4328.69     4891.42     5527.31     6245.86    7057.82
p=4560    5198.4     5926.18      67 55.84     7701.66     8779.89    10009.08
p=5750     6612.5     7604.37     8745.03     10056.79    11565.3     13300.1
p=6960    8073.6     9365.38     10863.84    12602.05   14618.38   16957.32
```

p=8190 9582.3 11211.29 13117.21 15347.14 17956.15 21008.7
p=9440 11139.2 13144.26 15510.22 18302.06 21596.43 25483.79

3.5: **An election is contested by five candidates. The candidates are numbered 1 to 5 and the voting is done by marking the candidate number on the ballot paper. Write a program to read the ballots and count the vote cast for each candidate using an array variable count. In case, a number read is outside the range 1 to 5, the ballot should be considered as a "spoilt ballot" and the program should also count the numbers of "spoilt ballots".**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  int main()
4  {
5      int count[5];
6      int test;
7      for(int i=0;i<5;i++)
8      {
9          count[i]=0;
10     }
11     int spoilt_ballot=0;
12     cout<<" You can vot candidate 1 to 5 "<<endl
13      <<" press 1 or 2 or 3 or 4 or 5 to vote "<<endl
14      <<" candidate 1 or 2 or 3 or 4 or 5 respectively "<<endl
15      <<" press any integer value outside the range 1 to 5 for NO VOTE    "<<endl<<" press any
16negative value to terminate  and see result :"<<endl;
17
18     while(1)
19        {
20           cin>>test;
21
22           for(int i=1;i<=5;i++)
23           {
24              if(test==i)
25              {
26                 count[i-1]++;
27              }
28           }
29          if(test<0)
30              break;
31         else if(test>5)
32              spoilt_ballot++;
33        }
34        for(int k=1;k<=5;k++)
35        cout<<" candidate "<<k<<setw(12);
36        cout<<endl;
37        cout<<setw(7);
```

```
38      for(k=0;k<5;k++)
39      cout<<count[k]<<setw(13);
40      cout<<endl;
41      cout<<" spoilt_ballot "<<spoilt_ballot<<endl;
42      return 0;
   }
```

output

```
You can vot candidate 1 to 5
press 1 or 2 or 3 or 4 or 5 to vote
candidate 1 or 2 or 3 or 4 or 5 respectively
press any integer value outside the range 1 to S for NO VOTE
press any negative value to terminate and see result :
1
1
1
5
4
3
5
5
2
1
3
6
-1
candidate 1 candidate 2 candidate 3 candidate 4 candidate S
4   1   2   1   3
spoilt_ballot 1
```

3.6: **A cricket has the following table of batting figure for a series of test matches:**

Player's name Run Innings Time not outSachin 8430 230 18Saurav 4200 130

. . . .

Write a program to read the figures set out in the above forms, to calculate the batting arranges and to print out the complete table including the averages.

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  char *serial[3]={" FIRST "," SECOND " ," THIRD "};//global declaration
```

```
5
6  int main()
7  {
8      int n;
9       char name[100][40];
10     int *run;
11     int *innings;
12     int *time_not_out;
13     cout<<" How many players' record would you insert ? :";
14     cin>>n;
15     //name=new char[n];
16     run=new int[n];
17     innings=new int[n];
18     time_not_out=new int[n];
19
20     for(int i=0;i<n;i++)
21     {
22        if(i>2)
23        {
24           cout<<"\n Input details of "<<i+1<<"th"<<" player's"<<endl;
25        }
26        else
27        {
28           cout<<" Input details of "<<serial[i]<<"player's : "<<endl;
29        }
30
31           cout<<" Enter name : ";
32
33           cin>>name[i];
34           cout<<" Enter run : ";
35           cin>>run[i];
36           cout<<" Enter innings : ";
37           cin>>innings[i];
38           cout<<" Enter times not out : ";
39           cin>>time_not_out[i];
40     }
41
42        float *average;
43        average=new float[n];
44        for(i=0;i<n;i++)
45        {
46           float avrg;
47           average[i]=float(run[i])/innings[i];
48
49        }
50        cout<<endl<<endl;
51        cout<<setw(12)<<"player's name "<<setw(11)<<"run"<<setw(12)<<"innings"<<setw(16)<<"Average"<<setw(
52out"<<endl;
53        for(i=0;i<n;i++)
54        {
55           cout<<setw(14)<<name[i]<<setw(11)<<run[i]<<setw(9)<<innings[i]<<setw(18)<<average[i]<<setw(15)<<t
```

```
56      }
57      cout<<endl;
58
59      return 0;
   }
```

output

```
How many players record would you insert ? :2
Input details of FIRST player's :
Enter name : Sakib-Al-Hassan
Enter run : 1570
Enter innings : 83
Enter times not out : 10
Input details of SECOND player's :
Enter name : Tamim
Enter run : 2000
Enter innings : 84
Enter times not out : 5
player's name run innings Average times not out
Sakib-Al-Hassan 1570 83 18.915663 10
Tamim 2000 84 23.809525 5
```

3.7: **Write a program to evaluate the following function to 0.0001% accuracy**

(a) $\sin x = x - x^3/3! + x^5/5! - x^7/7! + \ldots\ldots\ldots$

(b) $SUM = 1+(1/2)^2 + (1/3)^3 +(1/4)^4 + \ldots\ldots\ldots$

(c) $\cos x = 1 - x^2/2! + x^4/4! - x^6/6! + \ldots\ldots\ldots$

Solution (a):

```
1  #include<iostream.h>
2  #include<math.h>
3  #include<iomanip.h>
4  #define accuracy 0.0001
5  #define pi 3.1416
6
7  long int fac(int a)
8  {
9     if(a<=1)
10       return 1;
11    else
12       return a*fac(a-1);
13}
14int main()
```

```
15{
16   float y,y1,x,fx;
17   int n=1;
18   int m;
19   //const float pi=3.1416;
20   cout<<" Enter the value of angle in terms of degree:  ";
21      cin>>x;
22      float d;
23      d=x;
24   int sign;
25      sign=1;
26if(x<0)
27{
28      x=x*(-1);
29      sign=-1;
30 }
31again:
32   if(x>90 && x<=180)
33   {
34
35      x=180-x;
36
37   }
38   else if(x>180 && x<=270)
39   {
40      x=x-180;
41      sign=-1;
42   }
43   else if(x>270 && x<=360)
44   {
45      x=360-x;
46      sign=-1;
47   }
48
49   else if(x>360)
50   {
51      int m=int(x);
52      float fractional=x-m;
53      x=m%360+fractional;
54      if(x>90)
55         goto again;
56      else
57      sign=1;
58
59   }
60   x=(pi/180)*x;
61   m=n+1;
62   fx=0;
63   for(;;)
64   {
65        long int h=fac(n);
```

```
66          y=pow(x,n);
67          int factor=pow(-1,m);
68          y1=y*factor;
69          fx+=y1/h;
70          n=n+2;
71          m++;
72          if(y/h<=accuracy)
73             break;
74    }
75
76    cout<<"sin("<<d<<")= "<<fx*sign<<endl;
77    return 0;
78}
```

output

```
Enter the value of angle in terms of degree: 120
sin(120)= 0.866027
```

Solution (b):

```
1  #include<iostream.h>
2  #include<math.h>
3  #define accuracy 0.0001
4  int main()
5  {
6     int n;
7     float sum,n1,m;
8     n=1;sum=0;
9     for(int i=1;;i++)
10    {
11          n1=float(1)/n;
12          m=pow(n1,i);
13          sum+=m;
14          if(m<=accuracy)
15            break;
16
17          n++;
18          }
19    cout<<sum<<"\n";
20    return 0;
21}
22       Sample Output(b)
23
24         Solution: (c)
25        #include<iostream.h>
26#include<math.h>
27#define accuracy 0.0001
```

```
28
29      long int fac(int n)
30{
31   if(n<=1)
32      return 1;
33   else
34      return n*fac(n-1);
35}
36
37      int main()
38{
39
40    float y,y1,x,fx;
41    int n=1;
42    int m;
43    const float pi=3.1416;
44    cout<<" Enter the value of angle in terms of degree:  ";
45    cin>>x;
46    if(x<0)
47      x=x*(-1);
48    x=(pi/180)*x;
49
50      fx=1;
51
52       m=2;
53      float y2;
54      long int h;
55      for(;;)
56      {
57         h=fac(m);
58         int factor=pow(-1,n);
59         y1=pow(x,m);
60         y2=(y1/h)*factor;
61         fx+=y2;
62         if(y1/h<=accuracy)
63            break;
64         m=m+2;
65         n++;
66      }
67      cout<<fx<<"\n";
68}
```

output

Enter the value of angle in terms of degree: 60
0.866025

3.8: **Write a program to print a table of values of the function**

$Y = e^{-x}$

For x varying from 0 to 10 in steps of 0.1. The table should appear as follows

TABLE FOR Y =EXP[-X];

X 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.900

1.0

.

.

9.0

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<math.h>
4           int main()
5  {
6         float x,y;
7         cout<<"                    TABLE FOR  Y=EXP(-X)          :\n\n";
8         cout<<"x";
9         for(float k=0;k<.7;k=k+0.1)
10        cout<<setw(10)<<k;
11        cout<<"\n";
12        for(k=0;k<10*.7;k=k+0.1)
13        cout<<"-";
14        cout<<"\n";
15              for(float j=0;j<10;j++)
16        {
17           cout<<j<<setw(4);
18           for(float i=0;i<.7;i=i+0.1)
19           {
20                 x=i+j;
21                 y=exp(-x);
22                 cout.precision(6);
23                              cout.setf(ios::fixed,ios::floatfield);
24                 cout<<setw(10)<<y;
25           }
```

```
26          cout<<"\n";
27      }
28      return 0;
29}
```

Note: Here we work with 0.4 for a good looking output.

output

TABLE FOR Y=EXP(-X)

x	0	0.1	0.2	0.3	0.4
0	1	0.904837	0.818731	0.740818	0.67032
1	0.367879	0.332871	0.301194	0.272532	0.246597
2	0.135335	0.122456	0.110803	0.100259	0.090718
3	0.049787	0.045049	0.040762	0.036883	0.033373
4	0.018316	0.016573	0.014996	0.013569	0.012277
5	0.006738	0.006097	0.005517	0.004992	0.004517
6	0.002479	0.002243	0.002029	0.001836	0.001662
7	0.000912	0.000825	0.000747	0.000676	0.000611
8	0.000335	0.000304	0.000275	0.000249	0.000225
9	0.000123	0.000112	0.000101	0.000091	0.000083

3.9: **Write a program to calculate the variance and standard deviation of**

N numbers

Variance $=1/N \sum(x_i - x)^2$

Standard deviation$=\sqrt{1/N \sum(x_i - x)^2}$

Where $x = 1/N \sum x_i$

Solution:

```
1  #include<iostream.h>
```

```
2  #include<math.h>
3          int main()
4  {
5      float *x;
6              cout<<" How many number ? :";
7      int n;
8      cin>>n;
9      x=new float[n];
10     float sum;
11     sum=0;
12     for(int i=0;i<n;i++)
13     {
14           cin>>x[i];
15           sum+=x[i];
16     }
17     float mean;
18     mean=sum/n;
19     float v,v1;
20     v1=0;
21     for(i=0;i<n;i++)
22     {
23           v=x[i]-mean;
24           v1+=pow(v,2);
25     }
26     float variance,std_deviation;
27     variance=v1/n;
28     std_deviation=sqrt(variance);
29     cout<<"\n\n variance = "<<variance<<"\n standard deviation = "<<std_deviation<<"\n";
30
31    return 0;
32}
```

output

```
How many number ? :5
10
2
4
15
2
variance = 26.24
standard deviation = 5.122499
```

3.10: **An electricity board charges the following rates to domestic users to**

discourage large consumption of energy:

For the first 100 units – 60P per unit

For the first 200 units – 80P per unit

For the first 300 units – 90P per unit

All users are charged a minimum of Rs. 50.00. If the total amount is more than Rs. 300.00 then an additional surcharge of 15% is added.

Write a program to read the names of users and number of units consumed and print out the charges with names.

Solution:

```
#include<iostream.h>
#include<iomanip.h>
int main()
{
    int unit;
    float charge,additional;
    char name[40];
    while(1)

    {
       input:
            cout<<" Enter consumer name & unit consumed :";
             cin>>name>>unit;
             if(unit<=100)
             {
                charge=50+(60*unit)/100;
             }
             else if(unit<=300 && unit>100)
             {
                charge=50+(80*unit)/100;
             }
             else if(unit>300)
             {
                charge=50+(90*unit)/float(100);
                additional=(charge*15)/100;
                charge=charge+additional;
             }
             cout<<setw(15)<<"Name"<<setw(20)<<"Charge"<<endl;
             cout<<setw(15)<<name<<setw(20)<<charge<<endl;
             cout<<" Press o for exit / press 1 to input again :";
             int test;
             cin>>test;
             if(test==1)
             goto input;
             else if(test==0)
             break;
    }
```

```
38    return 0;
39}
```

output

```
Enter consumer name & unit consumed :sattar 200
Name              Charge

sattar            210

Press o for exit / press 1 to input again :1

Enter consumer name & unit consumed :santo 300

Nmae          Charge

santo         290

Press o for exit / press 1 to input again : 0
```

Chapter 4

Review Questions

4.1: **State whether the following statements are TRUE or FALSE.**
(a) A function argument is a value returned by the function to the calling program.
(b) When arguments are passed by value, the function works with the original arguments in the calling program.
(c) When a function returns a value, the entire function call can be assigned to a variable.
(d) A function can return a value by reference.
(e) When an argument is passed by reference, a temporary variable is created in the calling program to hold the argument value.
(f) It is not necessary to specify the variable name in the function prototype.

Ans:

(a) FALSE
(b) FALSE
(c) TRUE
(d) TRUE
(e) FALSE
(f) TRUE

4.2: **What are the advantages of function prototypes in C++?**

Ans: Function prototyping is one of the major improvements added to C++ functions. The prototype describes the function interface to the compiler by giving details such as the number and type of arguments and the type of return values.

4.3: **Describe the different styles of writing prototypes.**

Ans:
General form of function prototyping :
return_type function_name (argument_list)

Example :
int do_something (void);
float area (float a, float b);
float area (float, float);

4.4: **Find errors, if any, in the following function prototypes.**
(a) float average(x,y);
(b) int mul(int a,b);
(c) int display(….);
(d) void Vect(int? &V, int & size);
(e) void print(float data[], size = 201);

Ans:

No.	Error	Correction
(a)	Undefined symbol x, y	float average (float x, floaty)
(b)	Undefined symbol b	int mul (int a, int b);
(c)	No error	
(d)	invalid character in variable name	void vect (int &v, int &size);
(e)	Undefined symbol ‘s’	void print (float data [ ], int size = 20);

4.5: **What is the main advantage of passing arguments by reference?**

Ans: When we pass arguments by reference, the formal arguments in the called function become aliases to the ‘actual’ arguments in the calling function.

4.6: **When will you make a function inline? Why?**

Ans: When a function contains a small number of statements, then it is declared as inline function.

By declaring a function inline the execution time can be minimized.

4.7: **How does an inline function differ from a preprocessor macro?**

Ans: The macos are not really functions and therefore, the usual error checking does not occur during compilation. But using inline-function this problem can be solved.

4.8: **When do we need to use default arguments in a function?**

Ans: When some constant values are used in a user defined function, then it is needed to assign a default value to the parameter.
Example :

```
1Float area (float r, float PI = 3.1416)
2    {
3          return PI*r*r;
4    }
```

4.9: **What is the significance of an empty parenthesis in a function declaration?**

Ans: An empty parentheses implies arguments is void type.

4.10: **What do you meant by overloading of a function? When do we use this concept?**

Ans: Overloading of a function means the use of the same thing for different purposes.
When we need to design a family of functions-with one function name but with different argument lists, then we use this concept.

4.11: **Comment on the following function definitions:**
(a)

```
1int *f( )
2{
3int m = 1;
4.....
5.....
6return(&m);
7}
```

(b)

```
1double f( )
2{
3.....
4.....
5return(1);
6}
```

(c)

```
1int & f()
2{
3int n - 10;
4.....
5.....
6return(n);
7}
```

Ans:

No.	Comment
(a)	This function returns address of m after execution this function.
(b)	This function returns 1 after execution.
(c)	returns address of n

Debugging Exercises

4.1: **Identify the error in the following program.**

```
#include <iostream.h>
int fun()
{
    return 1;
}
float fun()
{
    return 10.23;
}
void main()
{
    cout <<(int)fun() << ' ';
    cout << (float)fun() << ' ';
}
```

Solution: Here two function are same except return type. Function overloading can be used using different argument type but not return type.

Correction : This error can be solved as follows :

```
#include<iostream.h>

int fun()
{
   return 1;
}
float fun1()
{
   return 10.23;
}

void main()
{
    cout<<fun()<<"  ";
    cout<<fun1()<<"  ";
}
```

4.2: **Identify the error in the following program.**

```
#include <iostream.h>
void display(const Int constl=5)
{
  const int const2=5;
  int arrayl[constl];
  int array2[const2];
  for(int 1=0; i<5; 1++)
 {
    arrayl[i] = i;
    array2[i] = i*10;
    cout <<arrayl[i]<< ' ' << array2[i] << ' ' ;
 }
}
void main()
{
  display(5);
}
```

Solution:

```
#include<iostream.h>
```

```
void display()
{
    const int const1=5;
    const int const2=5;
    int array1[const1];
    int array2[const2];

      for(int i=0;i<5;i++)
      {
         array1[i]=i;
         array2[i]=i*10;
         cout<<array1[i]<<"  "<<array2[i]<<"  ";
      }
}

void main()
{
   display();
}
```

4.3: **Identify the error in the following program.**

```
#include <iostream.h>
int gValue=10;
void extra()
{
    cout << gValue << ' ';
}
void main()
{
   extra();
   {
   int gValue = 20;
   cout << gValue << ' ';
   cout << : gValue << ' ';
   }
}
```

Solution:
Here cout << : gvalue << " "; replace with cout <<::gvalue<< " ";

```
#include <iostream.h>
int gValue=10;
void extra()
{
```

```
    cout << gValue << ‘ ‘;
}
void main()
{
   extra();
   {
   int gValue = 20;
   cout << gValue << ‘ ‘;
   cout <<::gvalue<< " ";
   }
}
```

4.4: **Find errors, if any, in the following function definition for displaying a matrix: void display(int A[][], int m, int n)**

```
{
  for(1=0; i<m; i++)
  for(j=o; j<n; j++)
   cout<<" "<<A[i][j];
   cout<<"\n";
}
```

Solution:
First dimension of an array may be variable but others must be constant.

Here int A [ ] [ ] replace by the following code:
int A [ ] [10];
int A[10] [10];
int A[ ] [size];
int A [size] [size];

Where const int size = 100;
any other numerical value can be assigned to size.

Programming Exercises

4.1: **Write a function to read a matrix of size m*n from the keyboard.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  void matrix(int m,int n)
```

```
5  {
6     float **p;
7     p=new float*[m];
8     for(int i=0;i<m;i++)
9     {
10       p[i]=new float[n];
11    }
12    cout<<" Enter "<<m<<"by"<<n<<" matrix elements one by one "<<endl;
13    for(i=0;i<m;i++)
14    {
15       for(int j=0;j<n;j++)
16       {
17          float value;
18          cin>>value;
19          p[i][j]=value;
20       }
21    }
22    cout<<" The given matrix is :"<<endl;
23    for(i=0;i<m;i++)
24    {
25       for(int j=0;j<n;j++)
26       {
27          cout<<p[i][j]<<"   ";
28       }
29       cout<<"\n";
30    }
31}
32
33int main()
34{
35    int r,c;
36    cout<<" Enter size of matrix : ";
37    cin>>r>>c;
38    matrix(r,c);
39    return 0;
40}
```

output

Enter size of matrix : 3 4

Enter 3 by 4 matrix elements one by one

1 2 3 4

2 3 4 5

3 4 5 6

The given matrix is :

1 2 3 4

2 3 4 5

3 4 5 6

4.2: **Write a program to read a matrix of size m*n from the keyboard and display the same on the screen using function.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  void matrix(int m,int n)
5  {
6     float **p;s
7     p=new float*[m];
8     for(int i=0;i<m;i++)
9     {
10       p[i]=new float[n];
11    }
12    cout<<" Enter "<<m<<" by "<<n<<" matrix elements one by one "<<endl;
13    for(i=0;i<m;i++)
14    {
15       for(int j=0;j<n;j++)
16       {
17          float value;
18          cin>>value;
19          p[i][j]=value;
20       }
21    }
22    cout<<" The given matrix is :"<<endl;
23    for(i=0;i<m;i++)
24    {
25       for(int j=0;j<n;j++)
26       {
27          cout<<p[i][j]<<"   ";
28       }
29       cout<<"\n";
30    }
31}
32
33int main()
34{
35    int r,c;
36    cout<<" Enter size of matrix : ";
```

```
37    cin>>r>>c;
38    matrix(r,c);
39    return 0;
40}
```

output

Enter size of matrix : 4 4

Enter 4 by 4 matrix elements one by one

1 2 3 4 7

2 3 4 5 8

3 4 5 6 9

The given matrix is :

1 2 3 4 7

2 3 4 5 8

3 4 5 6 9

4.3: **Rewrite the program of Exercise 4.2 to make the row parameter of the matrix as a default argument.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  void matrix(int n,int m=3)
5  {
6     float **p;
7     p=new float*[m];
8     for(int i=0;i<m;i++)
9     {
10       p[i]=new float[n];
11    }
12    cout<<" Enter "<<m<<" by "<<n<<" matrix elements one by one "<<endl;
13    for(i=0;i<m;i++)
14    {
15       for(int j=0;j<n;j++)
16       {
```

```
17          float value;
18          cin>>value;
19          p[i][j]=value;
20      }
21   }
22   cout<<" The given matrix is :"<<endl;
23   for(i=0;i<m;i++)
24   {
25      for(int j=0;j<n;j++)
26      {
27         cout<<p[i][j]<<"   ";
28      }
29      cout<<"\n";
30   }
31}
32
33int main()
34{
35   int c;
36   cout<<" Enter column of matrix : ";
37   cin>>c;
38   matrix(c);
39   return 0;
40}
```

output

Enter column of matrix : 3

Enter 3 by 3 matrix elements one by one

1 2 3

2 3 4

3 4 5

The given matrix is :

1 2 3

2 3 4

3 4 5

4.4: **The effect of a default argument can be alternatively achieved by overloading. Discuss with examples.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  void matrix(int m,int n)
5  {
6     float **p;
7     p=new float*[m];
8     for(int i=0;i<m;i++)
9     {
10       p[i]=new float[n];
11    }
12    cout<<" Enter "<<m<<"by"<<n<<" matrix elements one by one "<<endl;
13    for(i=0;i<m;i++)
14    {
15       for(int j=0;j<n;j++)
16       {
17          float value;
18          cin>>value;
19          p[i][j]=value;
20       }
21    }
22    cout<<" The given matrix is :"<<endl;
23    for(i=0;i<m;i++)
24    {
25       for(int j=0;j<n;j++)
26       {
27          cout<<p[i][j]<<"   ";
28       }
29       cout<<"\n";
30    }
31}
32void matrix(int m,long int n=3)
33{
34    float **p;
35    p=new float*[m];
36
37         for(int i=0;i<m;i++)
38    {
39       p[i]=new float[n];
40    }
41    cout<<" Enter "<<m<<" by "<<n<<" matrix elements one by one "<<endl;
42    for(i=0;i<m;i++)
43    {
44       for(int j=0;j<n;j++)
45       {
46          float value;
47          cin>>value;
48          p[i][j]=value;
```

```
49       }
50    }
51    cout<<" The given matrix is :"<<endl;
52    for(i=0;i<m;i++)
53    {
54       for(int j=0;j<n;j++)
55       {
56          cout<<p[i][j]<<"   ";
57       }
58       cout<<"\n";
59    }
60}
61
62int main()
63{
64    int r;
65    cout<<" Enter row of matrix : ";
66    cin>>r;
67    matrix(r);
68    return 0;
69}
```

output

Enter column of matrix : 2

Enter 2 by 3 matrix elements one by one

1 0 1

0 2 1

The given matrix is :

1 0 1

0 2 1

4.5: **Write a macro that obtains the largest of the three numbers.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3
4  float  large(float a,float b,float c)
5  {
```

```
6     float largest;
7     if(a>b)
8     {
9        if(a>c)
10          largest=a;
11       else
12          largest=c;
13    }
14    else
15    {
16       if(b>c)
17          largest=b;
18       else
19          largest=c;
20    }
21    return largest;
22}
23
24int main()
25{
26    float x,y,z;
27    cout<<" Enter three values : ";
28    cin>>x>>y>>z;
29    float largest=large(x,y,z);
30    cout<<" large = "<<largest<<endl;
31    return 0;
32}
```

output

Enter three values : 4 5 8

large = 8

4.6: **Redo Exercise 4.16 using inline function. Test the function using a main function.**

Solution:

Blank

4.7: **Write a function power() to raise a number m to power n. The function takes a double value for m and int value for n and returns the result correctly. Use a default value of 2 for n to make the function to calculate the squares when this argument is omitted. Write a main that gets the values of m and n from the user to test the function.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<math.h>
4
5  long double power(double m,int n)
6  {
7      long double mn=pow(m,n);
8      return mn;
9  }
10long double power(double m,long int n=2)
11{
12    long double mn=pow(m,n);
13    return mn;
14}
15int main()
16{
17    long double mn;
18    double m;
19    int n;
20
21    cout<<" Enter the value of m & n"<<endl;
22    cin>>m>>n;
23    mn=power(m,n);
24    cout<<" m to power n : "<<mn<<endl;
25    mn=power(m);
26    cout<<" m to power n : "<<mn<<endl;
27    return 0;
28}
```

output

Enter the value of m & n

12 6

m to power n : 2985984

m to power n: 144

4.6: **Redo Exercise 4.16 using inline function. Test the function using a main function.**

Solution:

Blank

4.7: **Write a function power() to raise a number m to power n. The function takes a double value for m and int value for n and returns the result correctly. Use a default value of 2 for**

n to make the function to calculate the squares when this argument is omitted. Write a main that gets the values of m and n from the user to test the function.

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<math.h>
4
5  long double power(double m,int n)
6  {
7      long double mn=pow(m,n);
8      return mn;
9  }
10long double power(double m,long int n=2)
11{
12    long double mn=pow(m,n);
13    return mn;
14}
15int main()
16{
17    long double mn;
18    double m;
19    int n;
20
21    cout<<" Enter the value of m & n"<<endl;
22    cin>>m>>n;
23    mn=power(m,n);
24    cout<<" m to power n : "<<mn<<endl;
25    mn=power(m);
26    cout<<" m to power n : "<<mn<<endl;
27    return 0;
28}
```

output

Enter the value of m & n

12 6

m to power n : 2985984

m to power n: 144

4.8: **Write a function that performs the same operation as that of Exercise 4.18 but takes an int value for m. Both the functions should have the same name. Write a main that calls both the functions. Use the concept of function overloading.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<math.h>
4
5  long double power(int m,int n)
6  {
7      long double mn= (long double)pow(m,n);
8      return mn;
9  }
10long double power(int m,long int n=2)
11{
12    long double mn=(long double)pow(m,n);
13    return mn;
14}
15int main()
16{
17    long double mn;
18    int m;
19    int n;
20
21    cout<<" Enter the value of m & n"<<endl;
22    cin>>m>>n;
23    mn=power(m,n);
24    cout<<" m to power n : "<<mn<<endl;
25    mn=power(m);
26    cout<<" m to power n : "<<mn<<endl;
27    return 0;
28}
```

output

Enter the value of m & n

15 16

m to power n : 6.568408e+18

m to power n: 225

Chapter 5

Review Questions

5.1: **How do structures in C and C++ differ?**

Ans:
C structure member functions are not permitted but in C++ member functions are permitted.

5.2: **What is a class? How does it accomplish data hiding?**

Ans:
A class is a way to bind the data and its associated functions together. In class we can declare a data as private for which the functions accomplish data−outside the class can not access the data and thus if hiding.

5.3: **How does a C++ structure differ from a C++ class?**

Ans:
Initially (in C) a structure was used to bundle different of data types together to perform a particular functionality C++ extended the structure to contain functions also. The difference is that all declarations inside a structure are default public.

5.4: **What are objects? How are they created?**

Ans:
Object is a member of class. Let us consider a simple example. int a; here a is a variable of int type. Again consider class fruit.
{
}
here fruit is the class-name. We can create an object as follows:
fruit mango;
here mango is a object.

5.5: **How is a member function of a class defined?**

Ans:
member function of a class can be defined in two places:
* Outside the class definition.
* Inside the class definition.

Inside the class definition : same as other normal function.

Outside the class definition : general form:
return-type class-name : function-name (argument list)

```
{
function body
}
```

5.6: **Can we use the same function name for a member function of a class and an outside function in the same program file? If yes, how are they distinguished? If no, give reasons.**

Ans:
Yes, We can distinguish them during calling to main ( ) function. The following example illustrates this:

```
1  #include<iostream.h>
2  void f()
3  {
4  cout<<"Outside Of class \n";
5  }
6
7  class santo
8  {
9  public:
10void f()
11{
12              cout<<"Inside of class \n";
13}
14};
15
16void main()
17{
18f();  // outside f() is calling.
19santo robin;
20robin.f();  // Inside f() is calling.
21}
```

5.7: **Describe the mechanism of accessing data members and member functions in the following cases:**
(a) Inside the main program.
(b) Inside a member function of the same class.
(c) Inside a member function of another class.

Ans:
(a) Using object and dot membership operator.
(b) Just like accessing a local variable of a function.
(c) Using object and dot membership operator.

The following example explains how to access data members and member functions inside a member function of another class.

```
1  #include<iostream.h>
2
3  class a
4  {
5       public:
6             int x;
7        void display()
8         {
9            cout<<"This is class a \n";
10           x=111;
11        }
12};
13
14class b
15{
16     public:
17      void display()
18      {
19         a  s;
20         cout<<" Now member function 'display()' of class a is calling from class b \n";
21         s.display();
22         cout<<" x = "<<s.x<<"\n";
23      }
24};
25
26void main()
27{
28         b  billal; // billal is a object of class b.
29          billal.display();
30}
```

5.8: **When do we declare a member of a class static?**

Ans:
When we need a new context of a variable the n we declare this variable as static.

5.9: **What is a friend function? What are the merits and demerits of using friend functions?**

Ans:
A function that acts as a bridge among different classes, then it is called friend function.

Merits :
We can access the other class members in our class if we use friend keyword. We can access the members without inheriting the class.

demerits :
Maximum size of the memory will occupied by objects according to the size of friend members.

5.10: **State whether the following statements are TRUE or FALSE.**
(a) Data items in a class must always be private.
(b) A function designed as private is accessible only to member functions of that class.
(c) A function designed as public can be accessed like any other ordinary functions.
(d) Member functions defined inside a class specifier become inline functions by default.
(e) Classes can bring together all aspects of an entity in one place.
(f) Class members are public by default.
(g) Friend junctions have access to only public members of a class.
(h) An entire class can be made a friend of another class.
(i) Functions cannot return class objects.
(j) Data members can be initialized inside class specifier.

Ans:
(a) FALSE
(b) TRUE
(c) FALSE

*A function designed as public can be accessed like any other ordinary functions from the member function of same class.
(d) TRUE
(e) TRUE
(f) FALSE
(g) FALSE
(h) TRUE
(i) FALSE
(j) FALSE

Debugging Exercises

5.1: **Identify the error in the following program**

```
1  #include <iosream.h>
2  struct Room
3  {
4     int width;
5     int length;
6     void setValue(int w, int l)
7     {
8          width = w;
9          length = l;
```

```
10    }
11};
12void main()
13{
14Room objRoom;
15objRoom.setValue(12, 1,4);
16}
```

Solution:
Void setvalue (in w, int l) function must be public.

5.2: **Identify the error in the following program**

```
1  #include <iosream.h>
2  class Room
3  {
4     int width, int length;
5     void setValue(int w, int h)
6     {
7          width = w;
8          length = h;
9      }
10};
11void main()
12{
13Room objRoom;
14objRoom.width=12;
15}
```

Solution:
Void setvalue (int w, int l) function must be public.

5.3: **Identify the error in the following program**

```
1  #include <iosream.h>
2  class Item
3  {
4     private:
5           static int count;
6     public:
7          Item()
8          {
9          count++;
10}
```

```
11int getCount()
12{
13    return count;
14}
15int* getCountAddress()
16{
17    return count;
18   }
19};
20int Item::count = 0;
21void main()
22{
23    Item objlteml;
24    Item objltem2;
25
26    cout << objlteml.getCount() << ' ';
27    cout << objltem2.getCount() << ' ';
28
29    cout << objlteml.getCountAddress() << ' ';
30    cout << objltem2.getCountAddress() << ' ';
31}
```

Solution:

```
1
2int* getCountAddress ( )
3     {
4        return &count;
5    }
```

Note: All other code remain unchanged.

5.4: **Identify the error in the following program**

```
1  #include <iosream.h>
2  class staticfunction
3  {
4     static int count;
5  public:
6     static void setCounto()
7      {
8        count++;
9      }
10    void displayCount()
11   {
12      cout << count;
13   }
```

```
14};
15int staticFunction::count = 10;
16void main()
17{
18    staticFunction obj1;
19    obj1setcount(5);
20    staticFunction::setCount();
21    obj1.displayCount();
22}
```

Solution:
setCount ( ) is a void argument type, so here obj1.setCount (5); replace with obj1.setcount( );

5.5: **Identify the error in the following program**

```
1  #include <iosream.h>
2  class Length
3  {
4      int feet;
5      float inches;
6  public:
7        Length()
8     {
9         feet = 5;
10        inches = 6.0;
11    }
12    Length(int f, float in)
13    {
14        feet = f;
15        inches=in;
16    }
17    Length addLength(Length 1)
18    {
19
20       1.inches this->inches;
21       1.feet += this->feet;
22       if(1.inches>12)
23    {
24
25       1.inches-=12;
26       1.feet++;
27    }
28    return 1;
29 }
30 int getFeet()
31 {
32     return feet;
33  }
```

```
34  float getInches()
35  {
36     return inches;
37  }
38};
39void main()
40{
41
42   Length objLength1;
43   Length objLenngth1(5, 6.5);
44   objLength1 = objLength1.addLength(objLength2);
45   cout << objLenth1.getFeet() << ' ';
46   cout << objLength1.getInches() << ' ';
47}
```

Solution:
Just write the main function like this:

```
1  #include<iostream.h>
2
3  void main()
4  {
5      Length objLength1;
6      Length objLength2(5,6.5);
7      objLength1=objLength1.addLenghth(objLenghth2);
8
9      cout<<objLength1.getFeet()<<"  ";
10     cout<<objLength1.getInches()<<"  ";
11}
```

5.6: **Identify the error in the following program**

```
1  #include <iosream.h>
2  class Room
3  void Area()
4  {
5     int width, height;
6     class Room
7     {
8         int width, height;
9         public:
10        void setvalue(int w, int h)
11        {
12            width = w;
13            height = h;
14        }
```

```
15      void displayvalues()
16      {
17         cout << (float)width << ' ' << (float)height;
18      }
19  };
20  Room objRoom1;
21  objRoom1.setValue(12, 8);
22  objRoom1.displayvalues();
23}
24
25void main()
26{
27Area();
28Room objRoom2;
29}
```

Solution:
Undefined structure Room in main ( ) function.
Correction : Change the main ( ) Function as follow:

```
1void main()
2{
3 Area();
4}
```

Programming Exercises

5.1: **Define a class to represent a bank account. Include the following members:**

Data members:

1. Name of the depositor.
2. Account number.
3. Type of account.
4. Balance amount in the account.

Member functions:

1. To assign initial values.
2. To deposit an amount.
3. To withdraw an amount after checking the balance.
4. To display the name and balance.

Write a main program to test the program.

Solution:

```
#include<iostream.h>
#include<iomanip.h>
class bank
{
    char name[40];
    int ac_no;
    char ac_type[20];
    double balance;
public:
   int assign(void);
   void deposite(float b);
   void withdraw(float c);
   void display(void);
};

int bank::assign(void)
{
   float initial;
   cout<<" You have to pay   500 TK to open your account \n"
   <<" You have to store at least 500 TK to keep your account active\n"
   <<"Would you want to open a account????\n"
   <<" If Yes press 1 \n"
   <<" If No press 0 : ";
   int test;
   cin>>test;
   if(test==1)
   {
      initial=500;
      balance=initial;
     cout<<" Enter name ,account number & account type to creat account : \n";
       cin>>name>>ac_no>>ac_type;
   }
   else
   ;// do nothing

   return  test;

}
void bank::deposite(float b)
{
   balance+=b;
}
void bank::withdraw(float c)
{
   balance-=c;
   if(balance<500)
   {
      cout<<" Sorry your balance is not sufficient to withdraw "<<c<<"TK\n"
```

```
49          <<" You have to store at least 500 TK to keep your account active\n";
50            balance+=c;
51   }
52}
53void bank::display(void)
54{
55   cout<<setw(12)<<"Name"<<setw(20)<<"Account type"<<setw(12)<<"Balance"<<endl;
56   cout<<setw(12)<<name<<setw(17)<<ac_type<<setw(14)<<balance<<endl;
57}
58
59int main()
60{
61   bank account;
62
63   int  t;
64   t=account.assign();
65   if(t==1)
66   {
67      cout<<" Would you want to deposite: ?"<<endl
68      <<"If NO press 0(zero)"<<endl
69      <<"If YES enter deposite ammount :"<<endl;
70      float dp;
71      cin>>dp;
72      account.deposite(dp);
73      cout<<" Would you want to withdraw : ?"<<endl
74      <<"If NO press 0(zero)"<<endl
75      <<"If YES enter withdrawal ammount :"<<endl;
76      float wd;
77      cin>>wd;
78      account.withdraw(wd);
79      cout<<" see details :"<<endl<<endl;
80      account.display();
81   }
82         else if(t==0)
83   cout<<" Thank you ,see again\n";
84   return 0;
85}
```

output

```
You have to pay 500 TK to open your account
You have to store at least 500 TK to keep your account active
Would you want to open a account????
If Yes press 1
If No press 0 : 0
Thank you ,see again
```

5.2: **Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks:**

(a) To create the vector.

(b) To modify the value of a given element.

(c) To multiply by a scalar value.

(d) To display the vector in the form (10, 20, 30 …)

Write a program to test your class.

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  class vector
4  {
5      float *p;
6      int size;
7  public:
8      void creat_vector(int a);
9      void set_element(int i,float value);
10     void modify(void);
11     void multiply(float b);
12     void display(void);
13};
14
15void vector::creat_vector(int a)
16{
17    size=a;
18    p=new float[size];
19}
20void vector::set_element(int i,float value)
21{
22    p[i]=value;
23}
24void vector :: multiply(float b)
25{
26    for(int i=0;i<size;i++)
27        p[i]=b*p[i];
28}
29void vector:: display(void)
30{
31      cout<<"p["<<size<<"] = ( ";
32      for(int i=0;i<size;i++)
33      {
34          if(i==size-1)
```

```
35            cout<<p[i];
36          else
37          cout<<p[i]<<" , ";
38
39       }
40       cout<<")"<<endl;
41}
42
43void vector::modify(void)
44{
45    int i;
46    cout<<" to edit a given element enter position of the element : ";
47    cin>>i;
48    i--;
49    cout<<" Now enter new value of "<<i+1<<"th  element : ";
50    float v;
51    cin>>v;
52    p[i]=v;
53    cout<<" Now new contents : "<<endl;
54    display();
55
56    cout<<" to delete an element enter position of the element :";
57    cin>>i;
58    i--;
59
60    for(int j=i;j<size;j++)
61    {
62       p[j]=p[j+1];
63    }
64    size--;
65    cout<<" New contents : "<<endl;
66    display();
67}
68
69int main()
70{
71    vector santo;
72    int s;
73    cout<<" enter size of vector : ";
74    cin>>s;
75    santo.creat_vector(s);
76    cout<<" enter "<<s<<" elements  one by one :"<<endl;
77    for(int i=0;i<s;i++)
78    {
79       float v;
80       cin>>v;
81       santo.set_element(i,v);
82    }
83    cout<<" Now contents  :"<<endl;
84    santo.display();
85    cout<<" to multiply this vector by a scalar quantity enter this scalar quantity : ";
```

```
86    float m;
87    cin>>m;
88    santo.multiply(m);
89    cout<<" Now contents : "<<endl;
90    santo.display();
91    santo.modify();
92    return 0;
93}
```

output

```
enter size of vector : 5

enter 5 elements one by one :

11     22     33     44     55

Now contents p[5] = ( 11  ,  22  ,  33  ,  44  ,  55)

to multiply this vector by a scalar quantity enter this scalar quantity : 2

Now contents :

p[5] = ( 22  ,  44  ,  66  ,  88  ,  110)

to edit a given element enter position of the element : 3

Now enter new value of 3th element : 100

Now new contents :

p[5] = ( 22  ,  44  ,  100  ,  88  ,  110)

to delete an element enter position of the element :2

New contents :

p[4] = ( 22  ,  100  ,  88  ,  110)
```

5.3: **Modify the class and the program of Exercise 5.1 for handling 10 customers.**

Solution:

```
1    #include<iostream.h>
2    #include<iomanip.h>
3    #define size 10
4    char *serial[size]={" FIRST "," SECOND "," THIRD "," 4th "," 5th "," 6th "," 7th "," 8th ","
```

```
9th ","10th"};

class bank
{
    char name[40];
    int ac_no;
    char ac_type[20];
    double balance;
public:
    int assign(void);
    void deposit(float b);
    void withdraw(float c);
    void displayon(void);
        void displayoff(void);
};

int bank::assign(void)
{
    float initial;
    cout<<" You have to pay   500 TK to open your account \n"
    <<" You have to store at least 500 TK to keep your account active\n"
    <<"Would you want to open a account????\n"
    <<" If Yes press 1 \n"
    <<" If No press 0 : ";
    int test;
    cin>>test;
    if(test==1)
    {
       initial=500;
       balance=initial;
cout<<" Enter name ,account number & account type to create account : \n";
        cin>>name>>ac_no>>ac_type;
    }
    else
    ;// do nothing

    return  test;

}
void bank::deposit(float b)
{
    balance+=b;
}
void bank::withdraw(float c)
{
    balance-=c;
    if(balance<500)
    {
    cout<<" Sorry your balance is not sufficient to withdraw "<<c<<"TK\n"
    <<" You have to store at least 500 TK to keep your account active\n";
            balance+=c;
```

```
56      }
57  }
58  void bank::displayon(void)
59  {
60      cout<<setw(12)<<name<<setw(17)<<ac_type<<setw(14)<<balance<<endl;
61  }
62  void bank::displayoff(void)
63  {       cout<<" Account has not created"<<endl;  }
64  int main()
65  {
66      bank account[size];
67           int  t[10];
68      for(int i=0;i<size;i++)
69      {
70                    cout<<" Enter information for "<<serial[i]<<"customer : "<<endl;
71          t[i]=account[i].assign();
72                    if(t[i]==1)
73                    {
74              cout<<" Would you want to deposit: ?"<<endl
75              <<"If NO press 0(zero)"<<endl
76              <<"If YES enter deposit amount :"<<endl;
77              float dp;
78              cin>>dp;
79              account[i].deposit(dp);
80              cout<<" Would you want to with draw : ?"<<endl
81              <<"If NO press 0(zero)"<<endl
82              <<"If YES enter withdrawal amount :"<<endl;
83              float wd;
84              cin>>wd;
85              account[i].withdraw(wd);
86              cout<<endl<<endl;
87                    }
88                    else if(t[i]==0)
89                    cout<<"Thank  you , see again  \n";
90
91      }
92
93       cout<<" see details :"<<endl<<endl;
94       cout<<setw(12)<<"Name"<<setw(20)<<"Account type"
95                   <<setw(12)<<"Balance"<<endl;
96
97      for(i=0;i<size;i++)
98      {
99                      if(t[i]==1)
100           account[i].displayon();
101                     else  if(t[i]==0)
102                       account[i].displayoff();
103     }
104     return 0;
    }
```

Note: Here we will show output only for **Three** customers. But when you run this program you can see output for 10 customer.

output

Enter information for FIRST customer :
You have to pay 500 TR to open your account
You have to store at least 500 TR to keep your account active Would you want to open a account????
If Yes press 1
If No press 0 : 0
Thank you , see again
Enter information for SECOND customer :
You have to pay 500 TR to open your account
You have to store at least 500 TR to keep your account active Would you want to open a account????
If Yes press 1
If No press 0 : 1
Enter name ,account number & account type to create account :
Robin 11123 saving
Would you want to deposit: ?
If HO press 0(zero)
If YES enter deposit amount :
0
Would you want to with draw : ?
If HO press 0(zero)
If YES enter withdrawal amount :
0
Enter information for 3rd customer :
You have to pay 500 TK to open your account
You have to store at least 500 TK to keep your account active Would you want to open a account????
If Yes press 1
If No press 0 : 1
Enter name ,account number & account type to create account :
Billal 11123 fixed
Would you want to deposit: ?
If HO press 0(zero)
If YES enter deposit amount :
1000000
Would you want to with draw : ?
If HO press 0(zero)
If YES enter withdrawal amount :
100000

see details :

Name Account type Balance

Account has not created

Robin	saving	500
Billal	fixed	900500

5.4: **Modify the class and the program of Exercise 5.12 such that the program would be able to add two vectors and display the resultant vector. (Note that we can pass objects as function arguments)**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #define size 8
4  class vector
5  {
6      float *p;
7
8  public:
9      void creat_vector(void);
10     void set_element(int i,float value);
11     friend void add(vector v1,vector v2);
12
13};
14void vector::creat_vector(void)
15{
16    p=new float[size];
17}
18void vector::set_element(int i,float value)
19{
20    p[i]=value;
21}
22void add(vector v1,vector v2)
23{
24
25    float *sum;
26    cout<<"sum["<<size<<"] = (";
27    sum= new float[size];
28
29    for(int i=0;i<size;i++)
30    {
31        sum[i]=v1.p[i]+v2.p[i];
32        if(i==size-1)
33            cout<<sum[i];
34        else
35            cout<<sum[i]<<" , ";
36    }
37    cout<<")"<<endl;
```

```
38
39}
40
41int main()
42{
43    vector x1,x2,x3;
44    x1.creat_vector();
45    x2.creat_vector();
46    x3.creat_vector();
47    cout<<" Enter "<<size<<" elements of FIRST vector : ";
48    for(int i=0;i<size;i++)
49    {
50        float v;
51        cin>>v;
52        x1.set_element(i,v);
53    }
54
55    cout<<" Enter "<<size<<" elements of SECOND vector : ";
56    for(i=0;i<size;i++)
57    {
58            float v;
59        cin>>v;
60        x2.set_element(i,v);
61    }
62    add(x1,x2);
63
64    return 0;
65}
```

output

Enter 8 elements of FIRST vector : 4 7 8 2 4 3 2 9

Enter 8 elements of SECOND vector : 1 2 3 4 5 6 7 8

sum[8] = (5 , 9 , 11 , 6 , 9 , 9 , 9 , 17)

5.5: **Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB.**
Use a friend function to carry out the addition operation. The object that stores the results may be a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

Solution:

```
1  #include<iostream.h>
2  #define factor 0.3048
3  class DB;
4  class DM
5  {
6                   float d;
7          public:
8          void store(float x){d=x;}
9          friend void sum(DM,DB);
10         void show();
11};
12class DB
13{
14        float d1;
15        public:
16        void store(float y){d1=y;}
17        friend void sum(DM,DB);
18        void show();
19};
20
21void DM::show()
22{
23
24      cout<<"\n Distance = "<<d<<" meter or "<<d*100<<" centimeter\n";
25}
26
27void DB::show()
28{
29
30      cout<<"\n Distance = "<<d1<<" feet or "<<d1*12<<" inches \n";
31}
32void sum(DM m,DB b)
33{
34
35         float sum;
36
37         sum=m.d+b.d1*factor;
38         float f;
39         f=sum/factor;
40         DM m1;
41         DB b1;
42
43         m1.store(sum);
44         b1.store(f);
45
46       cout<<" press 1 to display result in meter\n"
47          <<" press 2 to display result in feet \n"
48          <<" What is your option ? : ";
49          int test;
50          cin>>test;
51
```

```
52          if(test==1)
53          m1.show();
54          else if(test==2)
55          b1.show();
56
57
58}
59
60
61int main()
62{
63     DM dm;
64     DB db;
65     dm.store(10.5);
66     db.store(12.3);
67    sum(dm,db);
68     return 0;
69}
```

output

```
Press 1 to display result in meter
Press 2 to display result in feet
What is your option ? 1
Distance = 14.24904 meter or 1424.903931 centimeter
```

Chapter 6

Review Questions

6.1: **What is a constructor? Is it mandatory to use constructors in a class?**

Ans:A constructor is a 'special' member function whose task is to initialize the object of its class. It is not mandatory to use constructor in a class.

6.2: **How do we invoke a constructor function?**

Ans:Constructor function are invoked automatically when the objects are created.

6.3: **List some of the special properties of the constructor functions.**

Ans:Special properties of the constructor functions:

1. They should be declared in the public section.
2. They are invoked automatically when the objects are created.
3. They do not have return type, not even void.
4. They cannot be inherited.
5. Like other C++ functions, they can have default arguments.
6. Constructors cannot be virtual.

6.4: **What is a parameterized constructor?**

Ans:The constructors that can take arguments are called parameterized constructors.

6.5: **Can we have more than one constructors in a class? If yes, explain the need for such a situation.**

Ans:Yes, we have when we need to overload the constructor, then we have to do this.

6.6: **What do you mean by dynamic initialization of objects? Why do we need to this?**

Ans:Initializing value of object during run time is called dynamic initialization of objects.
One advantage of dynamic initialization is that we can provide various initialization formats using overloaded constructors.

6.7: **How is dynamic initialization of objects achieved?**

Ans:Appropriate function of a object is invoked during run-time and thus dynamic initialization of object is achieved.
Consider following constructor:
santo (int p, int q, float r);
santo (int p, int q, int r);
It two int type value and one float type value are passed then sant (int p, int q, float r) is invoked.
It three int type value are passed then santo (int p, into q, int r) is invoked.

6.8: **Distinguish between the following two statements:**
time T2(T1);
time T2 = T1;
T1 and T2 are objects of time class.

Ans:
time T2 (T1); ==> explicitly called of copy constructor
time T2 = T1; ==> implicitly called of copy constructor.

6.9: **Describe the importance of destructors.**

Ans:Destructors are important to release memory space for future use.

6.10: **State whether the following statements are TRUE or FALSE.**
(a) Constructors, like other member functions, can be declared anywhere in the class.
(b) Constructors do not return any values.
(c) A constructor that accepts no parameter is known as the default constructor.
(d) A class should have at least one constructor.
(e) Destructors never take any argument.

Ans:
(a) FALSE
(b) TRUE
(c) TRUE
(d) TRUE
(e) TRUE

Debugging Exercises

6.1: **Identify the error in the following program.**

```
1  #include <iostream.h>
2  class Room
3  {
4
5       int length;
6       int width;
7  public:
8       Room(int 1, int w=0):
9            width(w),
10           length(1)
11      {
12      }
13};
14void main()
15{
16Room objRooml;
17Room objRoom2(12, 8);
18}
191
20</br>
21<span class="a">Solution:</span>Here there is no default constructor, so object could not be
22written without any argument.
```

```
23<strong>Correction :</strong>
241
25    Void main ( )
26       {
27                  Room Objroom2(12,8);
          }.
```

6.2: **Identify the error in the following program.**

```
1  #include <iostream.h>
2  class Room
3  {
4
5       int length;
6       int width;
7  public:
8     Room()
9     {
10          length=0;
11          width=0;
12    }
13Room(int value=8)
14  {
15         length = width =8;
16  }
17void display()
18  {
19        cout<<length<< ' ' <<width;
20  }
21};
22void main()
23{
24Room objRooml;
25objRoom1.display();
```

Solution:Room() and Room(int value=8) Functions are same, so it show Ambiguity error.
Correction : Erase Room() function and then error will not show.

6.3: **Identify the error in the following program.**

```
1  #include <iostream.h>
2  class Room
3  {
4       int width;
5       int height;
```

```
6  public:
7   void Room()
8    {
9          width=12;
10         height=8;
11   }
12Room(Room& r)
13  {
14        width =r.width;
15        height=r.height;
16        copyConsCount++;
17  }
18void discopyConsCount()
19  {
20       cout<<copyConsCount;
21  }
22};
23int Room::copyConsCount = 0;
24void main()
25{
26Room objRooml;
27Room objroom2(objRoom1);
28Room objRoom3 = objRoom1;
29Room objRoom4;
30objRoom4 = objRoom3;
31objRoom4.dicopyConsCount();
32}
```

Solution: Just erase “objRoom4 = objRoom3; invalid to call copy constructor.” for successfully run.

6.4: **Identify the error in the following program.**

```
1  #include <iostream.h>
2  class Room
3  {
4      int width;
5      int height;
6      static int copyConsCount;
7  public:
8   void Room()
9    {
10         width=12;
11         height=8;
12   }
13Room(Room& r)
14  {
15        width =r.width;
```

```
16        height=r.height;
17        copyConsCount++;
18  }
19void discopyConsCount()
20  {
21        cout<<copyConsCount;
22  }
23};
24int Room::copyConsCount = 0;
25void main()
26{
27Room objRooml;
28Room objroom2(objRoom1);
29Room objRoom3 = objRoom1;
30Room objRoom4;
31objRoom4 = objRoom3;
32objRoom4.dicopyConsCount();
33}
```

Solution: Same as 6.3 problem solution.

Programming Exercises

6.1: **Design constructors for the classes designed in Programming Exercise 5.1 through 5.5 of Chapter 5.**

Solution: Study on Constructor and then see solution of chapter 5.

6.2: **Define a class String that could work as a user-defined string type. Include constructors that will enable us to create an uninitialized string:**

String s1; // string with length 0
And also initialize an object with a string constant at the time of creation like
String s2("Well done!");
Include a function that adds two strings to make a third string. Note that the statement
S2 = s1;
will be perfectly reasonable expression to copy one string to another.
Write a complete program to test your class to see that it does the following tasks:
(a) Creates uninitialized string objects.
(b) Creates objects with string constants.
(c) Concatenates two strings properly.
(d) Displays a desired string object.

Solution:

```
1  #include
2  #include
3  class string
4  {
5  char *str;
6  int length;
7
8  public:
9  string()
10{
11length = 0;
12str = new char [length + 1] ;
13}
14string(char *s);
15void concat(string &amp;amp;m,string &amp;amp;n);
16string(string &amp;amp;x);
17void display();
18
19};
20string::string(string &amp;amp;x)
21{
22length = x.length + strlen(x.str);
23str = new char[length + 1];
24strcpy(str, x.str);
25
26}
27void string:: concat(string &amp;amp;m,string &amp;amp;n)
28{
29length=m.length+n.length;
30delete str;
31str=new char[length+1];
32strcpy(str,m.str);
33strcat(str,n.str);
34}
35void string:: display()
36{
37cout&amp;lt;&amp;lt;str&amp;lt;&amp;lt;"\n";
38}
39string::string(char *s)
40{
41length = strlen(s);
42str = new char[length + 1];
43strcpy(str,s);
44}
45
46int main()
47{
48string s1;
```

```
49string s2(" Well done ");
50string s3(" Badly done ");
51s2.display();
52s1.concat(s2,s3);
53s2=s3;
54s2.display();
55s1.display();
56return 0;
57}
```

output

```
Well done
Badly done
Well done Badly done
```

6.3: **A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book, the sales person inputs the title and author and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed. If it is, then the system displays the book details and requests for the number of copies required. If the requested copies are available, the total cost of the requested copies is displayed; otherwise "Required copies not in stock" is displayed.**
Design a system using a class called books with suitable member functions and constructors. Use new operator in constructors to allocate memory space required.

Solution:

```
1   #include
2   #include
3   #include
4   #include
5   #include
6
7   class book
8   {
9   char **author;
10  char **title;
11  float *price;
12  char **publisher;
13  int *stock_copy;
14  int size;
15
16  public:
17  book();
18  void book_detail(int i);
19  void buy(int i);
```

```
20  int search();
21  };
22
23  book :: book()
24  {
25  size=4;
26  author=new char*[80];
27  title=new char*[80];
28  publisher=new char*[80];
29
30  for(int i=0;i&lt;size;i++)
31  {
32  author[i]=new char[80];
33  title[i]=new char[80];
34  publisher[i]=new char[80];
35  }
36  stock_copy=new int[size];
37  price=new float[size];
38
39  title[0]="object oriented programming with c++";
40  title[1]="programming in ANCI";
41  title[2]="electronic circuit theory";
42  title[3]="computer algorithm";
43
44  author[0]="balagurusamy";
45  author[1]="balagurusamy";
46  author[2]="boyelstade";
47  author[3]="shahani";
48
49  stock_copy[0]=200;
50  stock_copy[1]=150;
51  stock_copy[2]=50;
52  stock_copy[3]=80;
53
54  price[0]=120.5;
55  price[1]=115.75;
56  price[2]=140;
57  price[3]=180.5;
58
59  }
60  void book::book_detail(int i)
61  {
62  cout&lt;&lt;" **********book detail **********\n";
63  cout&lt;&lt;setw(12)&lt;&lt;"Title"&lt;&lt;setw(25)&lt;&lt;"Author Name"
64  &lt;&lt;setw(18)&lt;&lt;"Stock copy\n";
65  cout&lt;&lt;setw(15)&lt;&lt;title[i]&lt;&lt;setw(16)&lt;&lt;author[i]&lt;&lt;setw(15)
66  &lt;&lt;stock_copy[i]&lt;&lt;"\n";
67
68  }
69  int book::search()
70  {
```

```
 char name[80],t[80];
 cout&lt;&lt;"Enter author name : ";

 gets(name);
 cout&lt;&lt;"and title of book in small letter : ";
 gets(t);

 int count=-1;
 int a,b;
 for(int i=0;i&lt;size;i++)
 {

 a=strcmp(name,author[i]);
 b=strcmp(t,title[i]);
 if(a==0 &amp;&amp; b==0)

 count=i;

 }

 return count;
 }

 void book::buy(int i)
 {
 if(i&lt;0)
 cout&lt;&lt;" This book is not available \n";

 else
{
book_detail(i);
cout&lt;&lt;" How many copies of this book is required : ? "; int copy; cin&gt;&gt;copy;
int remaining_copy;
if(copy&lt;=stock_copy[i])
{
remaining_copy=stock_copy[i]-copy;
float total_price;
total_price=price[i]*copy;
cout&lt;&lt;"Total price = "&lt;&lt;total_price&lt;&lt;" TK\n";
}
else
cout&lt;&lt;" Sorry your required copies is not available \n";
}
}

int main()
{
book b1;
int result;

result=b1.search();
```

```
122b1.buy(result);
123return 0;
124}
```

output

Enter author name : shahani

and title of book in small latter : computer algorithm

**********book detail **********

Title	Author Name	Stock copy
computer algorithm	shahani	80

How many copies of this book is required : ? 78

Total price = 14079 TK

6.4: **Improve the system design in Exercise 6.3 to incorporate the following features:**
(a) The price of the books should be updated as and when required. Use a private member function to implement this.
(b) The stock value of each book should be automatically updated as soon as a transaction is completed.
(c) The number of successful and unsuccessful transactions should be recorded for the purpose of statistical analysis. Use static data members to keep count of transactions.

Solution:

```
1   #include
2   #include
3   #include
4   #include
5   #include
6
7   class book
8   {
9   static int successful,unsuccessful;
10  char **author;
11  char **title;
12  float *price;
13  char **publisher;
14  int *stock_copy;
15  int size;
16
17  public:
```

```
18  book();
19  void book_detail(int i);
20  void buy(int i);
21  int search();
22  void showtransaction();
23  void showdetail();
24  void edit_price();
25  };
26  int book::successful=0;
27  int book::unsuccessful=0;
28
29  book :: book()
30  {
31  size=5;
32  author=new char*[80];
33  title=new char*[80];
34  publisher=new char*[80];
35
36  for(int i=0;i&lt;size;i++)
37  {
38  author[i]=new char[80];
39  title[i]=new char[80];
40  publisher[i]=new char[80];
41  }
42  stock_copy=new int[size];
43
44  price=new float[size];
45
46  title[0]="object oriented programming with c++";
47  title[1]="programming in ANCI";
48  title[2]="electronic circuit theory";
49  title[3]="computer algorithm";
50  title[4]="complete solution of balagurusamy(c++)";
51
52  author[0]="balagurusamy";
53  author[1]="balagurusamy";
54  author[2]="boyelstade";
55  author[3]="shahani";
56  author[4]="abdus sattar";
57
58  stock_copy[0]=200;
59  stock_copy[1]=150;
60  stock_copy[2]=50;
61  stock_copy[3]=80;
62  stock_copy[4]=300;
63
64  price[0]=120.5;
65  price[1]=115.75;
66  price[2]=140;
67  price[3]=180.5;
68  price[4]=120;
```

```
69
70  }
71
72  void book::book_detail(int i)
73  {
74  cout&lt;&lt;" *********book detail **********\n";
75  cout&lt;&lt;setw(25)&lt;&lt;"Title"&lt;&lt;setw(30)&lt;&lt;"Author Name"
76  &lt;&lt;setw(18)&lt;&lt;"Stock copy\n";
77  cout&lt;&lt;setw(15)&lt;&lt;title[i]&lt;&lt;setw(16)&lt;&lt;author[i]&lt;&lt;setw(15)
78  &lt;&lt;stock_copy[i]&lt;&lt;"\n";
79
80  }
81
82  int book::search()
83  {
84  char name[80],t[80];
85  cout&lt;&lt;"Enter author name in small letter : ";
86  gets(name);
87  cout&lt;&lt;" title of book in small letter : ";
88  gets(t);
89
90  int count=-1;
91  int a,b;
92  for(int i=0;i&lt;size;i++)
93  {
94
95  a=strcmp(name,author[i]);
96  b=strcmp(t,title[i]);
97  if(a==0 &amp;&amp; b==0)
98
99  count=i;
100
101}
102
103return count;
104}
105
106void book::buy(int i)
107{
108if(i&lt;0)
109{
110cout&lt;&lt;" This book is not available \n";
111unsuccessful++;
112}
113
114else
115{
116book_detail(i);
117cout&lt;&lt;" How many copies of this book is required : ? "; int copy; cin&gt;&gt;copy;
118
119if(copy&lt;=stock_copy[i])
```

```
120{
121stock_copy[i]=stock_copy[i]-copy;
122float total_price;
123total_price=price[i]*copy;
124cout&lt;&lt;"Total price = "&lt;&lt;total_price&lt;&lt;" TK\n";
125successful++;
126}
127else
128{
129cout&lt;&lt;" Sorry your required copies is not available \n";
130unsuccessful++;
131}
132}
133}
134
135void book::edit_price()
136{
137cout&lt;&lt;" To edit price ";
138int i;
139i=search();
140cout&lt;&lt;"Enter new price : "; float p; cin&gt;&gt;p;
141price[i]=p;
142}
143void book::showdetail()
144{
145cout&lt;&lt;setw(22)&lt;&lt;"Title"&lt;&lt;setw(30)&lt;&lt;" stock copy "&lt;&lt;setw(20)
146&lt;&lt;" Price per book "&lt;&lt;endl;
147for(int i=0;i&lt;size;i++)
148{
149cout&lt;&lt;setw(35)&lt;&lt;title[i]&lt;&lt;setw(10)&lt;&lt;stock_copy[i]
150&lt;&lt;setw(18)&lt;&lt;price[i]&lt;&lt;endl;
151}
152}
153void book::showtransaction()
154{
155cout&lt;&lt;setw(22)&lt;&lt;"Successful transaction"&lt;&lt;setw(34)
156&lt;&lt;"unsuccessful transaction "&lt;&lt;endl&lt;&lt;setw(10)
157&lt;&lt;successful&lt;&lt;setw(32)&lt;&lt;unsuccessful&lt;&lt;endl;
158}
159
160int main()
161{
162book b1;
163int result;
164
165result=b1.search();
166b1.buy(result);
167b1.showdetail();
168b1.showtransaction();
169b1.edit_price();
170cout&lt;&lt;"**********details after edit price
```

```
171******************"&lt;&lt;endl;
172b1.showdetail();
173
174return 0;
175}
```

output

```
Enter author name in small letter  :  abdus sattar

title of book in small letter  :  complete solution of balagurusamy(c++)

**********book detail **********

Title                                    Author Name              Stock copy

complete solution of balagurusamy(c++) abdus sattar              300

How many copies of this book is required : ? 100

Total price = 12000  TK

Title                                stock copy            Price per book

object oriented programming with c++ 200            120.5

programming in ANCI            150                       115.75

electronic circuit theory          50                        140

computer algorithm                 80                        180.5

complete solution of balagurusamy(c++)  200         120

Successful transaction                    unsuccessful transaction

1                                                 0

To edit price Enter author name in small letter : shahani

title of book in small letter : computer algorithm

Enter new price : 200

**********details after edit price**********

Title                                stock copy              Price per book
```

object oriented programming with c++ 200 120.5

programming in ANCI 150 115.75

electronic circuit theory 50 140

computer algorithm 80 200

complete solution of balagurusamy(c++) 200 120

Chapter 7

Review Questions

7.1: **What is operator overloading?**

Ans: The mechanism of giving special meaning to an operator is known as operator overloading.

7.2: **Why is it necessary to overload an operator?**

Ans: We can almost create a new language of our own by the creative use of the function and operator overloading techniques.

7.3: **What is an operator function? Describe the syntax of an operator function.**

Ans: To define an additional task to an operator, we must specify what it means in relation to the class to which the operator is applied. By which function this is done, is called operator function. Syntax of operator function:

```
return type class name : : operator OP (argument list)
  {
 function body // task defined
   }
```

7.4: **How many arguments are required in the definition of an overloaded unary operator?**

Ans: No arguments are required.

7.5: **A class alpha has a constructor as follows:**
alpha(int a, double b);
Can we use this constructor to convert types?

Ans: No. The constructors used for the type conversion take a single argument whose type is to be converted.

7.6: **What is a conversion function How is it created Explain its syntax.**

Ans: C++ allows us to define an overloaded casting operator that could be used to convert a class type data to a basic type. This is referred to conversion function.
Syntax:

```
Operator type name ( )
 {
    (Function Statements)
  }
```

7.7: **A friend function cannot be used to overload the assignment operator =. Explain why?**

Ans: A friend function is a non-member function of the class to which it has been defined as friend. Therefore it just uses the functionality (functions and data) of the class. So it does not consist the implementation for that class. That's why it cannot be used to overload the assignment operator.

7.8: **When is a friend function compulsory? Give an example.**

Ans: When we need to use two different types of operands for a binary operator, then we must use friend function.
Example:
A = B + 2;
or
A = B * 2;
is valid
But A = 2 + B
or
A = 2 * B will not work.
Because the left hand operand is responsible for invoking the member function. In this case friend function allows both approaches.

7.9: **We have two classes X and Y. If a is an object of X and b is an object of Y and we want to say a = b; What type of conversion routine should be used and where?**

Ans: We have to use one class to another class type conversion. The type-conversion function to be located in the source class or in the destination class.

7.10: **State whether the following statements are TRUE or FALSE.**
(a) Using the operator overloading concept, we can change the meaning of an operator.
(b) Operator overloading works when applied to class objects only.
(c) Friend functions cannot be used to overload operators.
(d) When using an overloaded binary operator, the left operand is implicitly passed to the member function.
(e) The overloaded operator must have at least one operand that is user-defined type.
(f)Operator functions never return a value.
(g) Through operator overloading, a class type data can be converted to a basic type data.
(h) A constructor can be used to convert a basic type to a class type data.

Ans:
(a) FALSE
(b) TRUE
(c) FALSE
(d) FALSE
(e) TRUE
(f) FALSE
(g) TRUE
(h) TRUE

Debugging Exercises

7.1: **Identify the error in the following program.**

```
#include <iostream.h>
class Space
{
    int mCount;
public:
    Space()
    {
        mCount = 0;
    }

     Space operator ++()
     {
         mCount++;
         return Space(mCount);
```

```
    }
};
void main()
{
    Space objSpace;
    objSpace++;
}
```

Solution: The argument of Space() function is void type, so when this function is called there are no argument can send to it. But ‘mCount’ argument is sending to Space() function through return space(mCount); Statement.
Here return space (mCount); replaced by return space();

7.2: **Identify the error in the following program.**

```
#include <iostream.h>
enum WeekDays
{
    mSunday'
    mMonday,
    mtuesday,
    mWednesday,
    mThursday,
    mFriday,
    mSaturday
};
bool op==(WeekDays& w1, WeekDays& w2)
{
    if(w1== mSunday && w2==mSunday)
        return 1;
    else if(w1==mSunday && w2==mSunday)
        return 1;
    else if(w1==mSunday && w2==mSunday)
        return 1;
    else if(w1==mSunday && w2==mSunday)
        return 1;
    else if(w1==mSunday && w2==mSunday)
        return 1;
    else if(w1==mSunday && w2==mSunday)
        return 1;
    else if(w1==mSunday && w2==mSunday)
        return 1;
   else
        return 0;
}
void main()
{
    WeekDays w1 = mSunday, w2 = mSunday;
```

```
    if(w1==w2)
    cout<<"Same day";
    else
    cout<<"Different day";
}
```

Solution: bool OP = = (WeekDays & w1, WeekDays & w2) replaced by bool operator = = (Weekdays & w1, WeekDays & w2). All other code will remain same.

7.3: **Identify the error in the following program.**

```
#include <iostream.h>
class Room
{
    float mWidth;
    float mLength;
public:
    Room()
    {
    }
    Room(float w, float h)
          :mWidth(w), mLength(h)
   {
   }
   operator float ()
   {
      return (float)mWidth * mLength;
   }

   float getWidth()
   {
   }
   float getLength()
   {
       return mLength;
   }
};

void main()
{
    Room objRoom1(2.5, 2.5)
    float fTotalArea;
    fTotalArea = objRoom1;
    cout<< fTotalArea;
}
```

Solution: The float getWidth() function return float type data, but there is no return statement in getWidth() function. So it should write as follows.

```
float getWidth()
{
   return mWidth;
}
```

All other code will remain unchanged.

Programming Exercises

7.1: **Crate a class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.**

Solution:

```
1  #include<iostream.h>
2
3  class FLOAT
4  {
5          float data;
6           public:
7           FLOAT(){};
8           FLOAT(float d)
9           { data=d;}
10          FLOAT operator+(FLOAT f1);
11          FLOAT operator-(FLOAT f2);
12          FLOAT operator*(FLOAT f3);
13          FLOAT operator/(FLOAT f4);
14         void display();
15};
16FLOAT FLOAT::operator+(FLOAT f1)
17{
18          FLOAT temp;
19          temp.data=data+f1.data;
20         return (temp);
21}
22FLOAT FLOAT::operator-(FLOAT f2)
23{
24         FLOAT temp;
25         temp.data=data-f2.data;
26         return temp;
27}
28FLOAT FLOAT::operator*(FLOAT f3)
```

```
29{
30          FLOAT temp;
31      temp.data=data*f3.data;
32         return temp;
33}
34FLOAT FLOAT::operator/(FLOAT f4)
35{
36            FLOAT temp;
37            temp.data=data/f4.data;
38            return (temp);
39}
40void FLOAT:: display()
41{
42            cout<<data<<"\n";
43}
44int main()
45{
46                    FLOAT F1,F2,F3,F4,F5,F6;
47                    F1=FLOAT(2.5);
48                    F2=FLOAT(3.1);
49                    F3=F1+F2;
50                    F4=F1-F2;
51                    F5=F1*F2;
52                    F6=F1/F2;
53                    cout<<" F1 = ";
54                    F1.display();
55                   cout<<" F2 = ";
56                   F2.display();
57                   cout<<" F1+F2 = ";
58                   F3.display();
59                  cout<<" F1-F2 = ";
60                  F4.display();
61                  cout<<" F1*F2 = ";
62                  F5.display();
63                  cout<<" F1/F2= ";
64                  F6.display();
65     return 0;
66}
```

output

```
F1 = 2.5
F2 = 3.1
F1+F2 = 5.6
F1-F2 = -0.6
F1*F2 = 7.75
F1/F2= 0.806452
```

7.2: **Design a class Polar which describes a point in the plane using polar coordinates radius and angle. A point in polar coordinates is shown below figure 7.3**
Use the overload + operator to add two objects of Polar.
Note that we cannot add polar values of two points directly. This requires first the conversion of points into rectangular coordinates, then adding the respective rectangular coordinates and finally converting the result back into polar coordinates. You need to use the following trigonometric formula:
x = r *
cos(a);

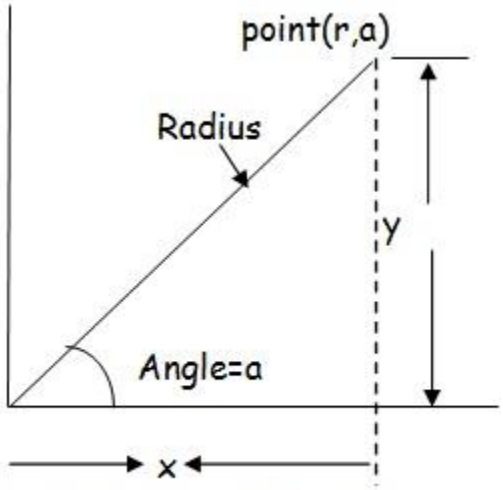


fig: polar coordinates of a point

y = r * sin(a);
a = atan(y/x); //arc tangent
r = sqrt(x*x + y*y);

Solution:

```
1  #include<iostream.h>
2  #include<math.h>
3  #define pi 3.1416
4  class polar
5  {
6                  float r,a,x,y;
7                  public:
8                  polar(){};
9                  polar(float r1,float a1);
10                 polar operator+(polar r1);
11                 void display(void);
12};
13
14polar :: polar(float r1,float a1)
15{
16              r=r1;
17             a=a1*(pi/180);
```

```
18              x=r*cos(a);
19              y=r*sin(a);
20}
21
22polar polar :: operator+(polar r1)
23{
24              polar R;
25
26              R.x=x+r1.x;
27              R.y=y+r1.y;
28              R.r=sqrt(R.x*R.x+R.y*R.y);
29              R.a=atan(R.y/R.x);
30
31    return R;
32}
33
34void polar::display()
35{
36            cout<<"radius = "<<r<<"\n angle = "<<a*(180/pi)<<"\n";
37}
38
39int main()
40{
41  polar p1,p2,p3;
42  float r,a;
43  cout<<" Enter radius and angle : ";
44  cin>>r>>a;
45  p1=polar(r,a);
46  p2=polar(8,45);
47  p3=p1+p2;
48  cout<<" p1 : \n";
49  p1.display();
50  cout<<" p2 : \n ";
51  p2.display();
52  cout<<" p3 : \n ";
53  p3.display();
54  return 0;
55}
```

output

```
Enter radius and angle : 10 45
P1:
radius = 10
angle = 44.999998
P2 :
radius = 8
angle = 44.999998
P3 :
radius = 18
angle = 44.999998
```

7.3: **Create a class MAT of size m * n. Define all possible matrix operations for MAT type objects.**

Solution:

```
#include<iostream.h>
#include<iomanip.h>

class mat
{
        float **m;
        int rs,cs;
        public:
         mat(){}
         void creat(int r,int c);
         friend istream & operator >>(istream &,mat &);
         friend ostream & operator <<(ostream &,mat &);
         mat operator+(mat m2);
         mat operator-(mat m2);
         mat operator*(mat m2);
};

void mat::creat(int r,int c)
{
     rs=r;
     cs=c;
     m=new float *[r];
     for(int i=0;i<r;i++)
    m[i]=new float1;
}

istream &  operator>>(istream &din, mat &a)
{
   int r,c;
   r=a.rs;
   c=a.cs;
   for(int i=0;i<r;i++)
    {
          for(int j=0;j<c;j++)
            {
                din>>a.m[i][j];
            }
    }
  return (din);
}
ostream & operator<<(ostream &dout,mat &a)
{
         int r,c;
```

```
44              r=a.rs;
45              c=a.cs;
46                    for(int i=0;i<r;i++)
47              {
48                  for(int j=0;j<c;j++)
49                    {
50                                  dout<<setw(5)<<a.m[i][j];
51                          }
52                          dout<<"\n";
53              }
54   return (dout);
55  }
56  mat mat::operator+(mat m2)
57  {
58              mat mt;
59              mt.creat(rs,cs);
60             for(int i=0;i<rs;i++)
61              {
62                 for(int j=0;j<cs;j++)
63                          {
64                         mt.m[i][j]=m[i][j]+m2.m[i][j];
65                    }
66              }
67       return mt;
68  }
69
70  mat mat::operator-(mat m2)
71  {
72          mat mt;
73          mt.creat(rs,cs);
74           for(int i=0;i<rs;i++)
75            {
76                for(int j=0;j<cs;j++)
77                 {
78                      mt.m[i][j]=m[i][j]-m2.m[i][j];
79                 }
80            }
81      return mt;
82  }
83
84  mat mat::operator*(mat m2)
85  {
86           mat mt;
87                mt.creat(rs,m2.cs);
88
89      for(int i=0;i<rs;i++)
90          {
91              for(int j=0;j<m2.cs;j++)
92               {
93                      mt.m[i][j]=0;
94                      for(int k=0;k<m2.rs;k++)
```

```
95                      mt.m[i][j]+=m[i][k]*m2.m[k][j];
96                  }
97          }
98
99       return mt;
100  }
101int main()
102{
103        mat m1,m2,m3,m4,m5;
104        int r1,c1,r2,c2;
105        cout<<" Enter first matrix size : ";
106        cin>>r1>>c1;
107        m1.creat(r1,c1);
108        cout<<"m1 = ";
109        cin>>m1;
110        cout<<" Enter second matrix size : ";
111        cin>>r2>>c2;
112        m2.creat(r2,c2);
113        cout<<"m2 = ";
114        cin>>m2;
115        cout<<" m1:"<<endl;
116        cout<<m1;
117        cout<<" m2: "<<endl;
118        cout<<m2;
119        cout<<endl<<endl;
120       if(r1==r2 && c1==c2)
121         {
122                m3.creat(r1,c1);
123                        m3=m1+m2;
124                cout<<" m1 + m2: "<<endl;
125                cout<<m3<<endl;
126               m4.creat(r1,c1);
127
128                m4=m1-m2;
129               cout<<" m1 - m2:"<<endl;
130               cout<<m4<<endl<<endl;
131
132       }
133    else
134     cout<<" Summation & substraction are not possible n"<<endl
135         <<"Two matrices must be same size for summation &   substraction "<<endl<<endl;
136if(c1==r2)
137{
138            m5=m1*m2;
139            cout<<" m1 x m2: "<<endl;
140            cout<<m5;
141}
142else
143cout<<" Multiplication is not possible "<<endl
144<<" column of first matrix must be equal to the row of second matrix ";
145 return 0;
```

146}

output

Enter first matrix size : 2 2

m1 =

1 2

3 4

Enter second matrix size : 2 2

m2 =

5 6

7 8

m1 =

1 2

3 4

m2 =

5 6

7 8

m1+m2:

6 8

10 12

m1-m2:

-4 -4

-4 -4

m1 x m2:

19 22

7.4: **Define a class String. Use overload == operator to compare two strings.**

Solution:

```
1  #include<iostream.h>
2  #include<string.h>
3  #include<stdio.h>
4
5  class string
6  {
7                 char str[1000];
8                 public:
9                 void input(){gets(str);}
10                      int operator==(string s2);
11};
12int string::operator==(string s2)
13{
14                    int t= strcmp(str,s2.str);
15          if(t==0)
16                      t=1;
17          else
18          t=0;
19       return t;
20}
21
22int main()
23{
24
25       char st1[1000],st2[1000];
26       string s1,s2;
27        cout<<" Enter 1st string : ";
28        s1.input();
29        cout<<" enter 2nd string : ";
30        s2.input();
31
32       if(s1==s2)
33       cout<<" Two strings are equal ";
34       else
35       cout<<" Two string are not equal ";
36    return 0;
37}
```

output

Enter 1st string : our sweetest songs tel our saddest thought
enter 2nd string : a burning desire lead to success.
Two string are not equal

7.5: **Define two classes Polar and Rectangle to represent points in the polar and rectangle systems. Use conversion routines to convert from one system to the other.**

Solution:

```
1  #include<iostream.h>
2  #include<math.h>
3  #define pi 3.1416
4  class conversion_point
5  {
6                float x,y,r,theta;
7                 public:
8                  void set_xy();
9                  void set_r_theta();
10                 void show_xy();
11                 void show_r_theta();
12                 void conversion(int t);
13};
14       void conversion_point::set_xy()
15{
16        cout<<"Enter the value of x & y : ";
17        cin>>x>>y;
18}
19        void conversion_point::set_r_theta()
20{
21          cout<<"Enter the value of r & theta :";
22          cin>>r>>theta;
23          theta=(pi/180)*theta;
24}
25
26        void conversion_point::show_xy()
27{
28            cout<<" CERTECIAN FORM :\n"
29                 <<" x = "<<x<<"\n"
30                 <<" y = "<<y<<"\n";
31}
32void conversion_point::show_r_theta()
33{
34              cout<<" POLAR FORM :\n"
35                   <<" r = "<<r<<"\n"
36                   <<" theta = "<<(180/pi)*theta<<" degree \n";
37}
38
39void conversion_point::conversion(int t)
```

```
40{
41          if(t==1)
42           {
43                    r=sqrt(x*x+y*y);
44
45                   if(x!=0)
46                    {
47                         theta=atan(y/x);
48                         show_r_theta();
49                    }
50
51                  else
52                    {
53                          cout<<" POLAR FORM :\n"
54                               <<" r = "<<r<<"\n"
55                               <<" theta = 90 degree\n";
56                    }
57
58            }
59       else if(t==2)
60          {
61                    x=r*cos(theta);
62                    y=r*sin(theta);
63                   show_xy();
64          }
65}
66
67int main()
68{
69              conversion_point santo;
70               int test;
71              cout<<" press 1 to input certecian point \n"
72                   <<" press 2 to input polar point \n "
73                   <<" what is your input ? : ";
74                  cin>>test;
75                  if(test==1)
76                  santo.set_xy();
77                  else if(test==2)
78                  santo.set_r_theta();
79                  santo.conversion(test);
80
81       return 0;
82}
```

output

```
Press 1 to input certecian point
Press 2 to input polar point
what is your input ? 1
Enter the value of x & y : 4 5
POLAR FORM :
```

r = 6.403124
theta = 51.340073 degree

Chapter 8

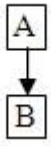
Review Questions

8.1: **What does inheritance mean in C++?**

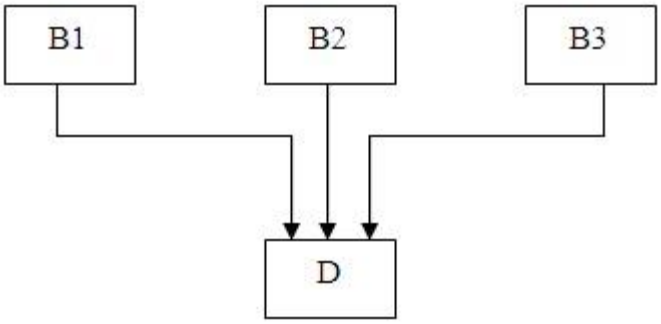
Ans:The mechanism of deriving a new class from an old one is called inheritance. The old class is referred to as the base class and the new one is called derived class.

8.2: **What are the different forms of inheritance? Give an example for each.**

Ans:Different forms of inheritence:
1. Single inheritence : Only one derived class inherited from only one base class is called single inheritence.
Example: Let A is a base class
and B is a new class derived from A



This is written in program as following:
class A {…….};
class B : Public A {……..};
2.Multiple inheritence : A class can inherit the attributes of two or more classes. This is known as multiple inheritence.
Example :



Class D : visibilityB1, visibility.B2, visibility B3

{
(Body of D)
}

* visibility may be public or private.

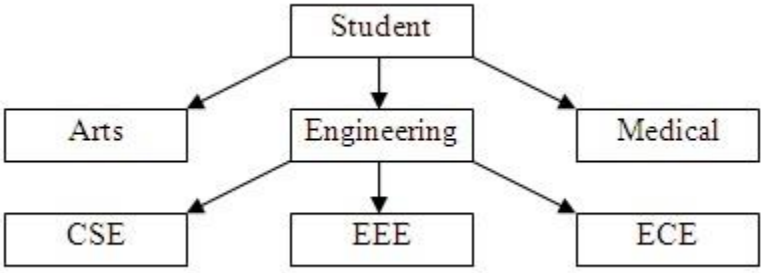
3.Multilevel inheritance : It a class is derived from a base class, and another class is derived from this derived class and so on, then it is called multilevel inheritance.

Example :

Class A { ….. };
Class B : Public A { ….. };
Class C : Private B{ ….. };

4.Hierarchical inheritance: It the inheritance follows the hierarchical design of a program, then it is called hierarchical inheritance.

Example :



This design is implemented in program as follows:

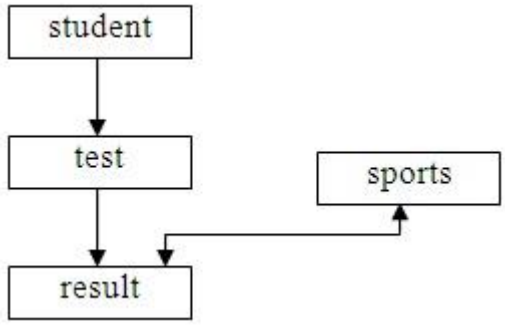
Class student { …… }; // base class,
Class Arts : Public student { ……};
Class Medical : Public student {…….};
Class Engineering : Public student { ……};
Class CSE : Public Engineering { ……. };

Class EEE : Public Engineering { …… };
Class ECE : Public Engineering { …… };

* here all inheritance are considered as public you can private inheritance also. as you wish.

5.Hybrid inheritance: When multi level and multiple inheritances are applied to an inheritance, then it is called Hybrid inheritance.

Example :



In program :
Class student {……};
Class test : public student {……};
Class result : public test {…….};
Class result : public sports {…….};

8.3: **Describe the syntax of the single inheritance in C++.**

Ans:Syntax of single inheritance:
Class Derived name : visibility mode Base_class name

```
{
    Body of derived class
};
```

* visibility mode may be public or private.
or protected

8.4: **We know that a private member of a base class is not inheritable. Is it anyway possible for the objects of a derived class to access the private members of the base class? If yes, how? Remember, the base class cannot be modified.**

Ans:Yes. It is possible for the objects of derived class to access the private member of the base class by a member function of base class which is public. The following example explains this :

```
#include<iostream.h>
class B
{
```

```
    int a; // a is private that can not be inherited.
    public:
          int get_a();
          void set_a();
};
class D:public B
{
       int b;
       public:
         void display_a();
};

void D :: display_a()
{
   cout<<" a = "<<get_a()<<"\n"; // a is accessed by member function get_a().
}

void B :: set_a()
{
   a=156271;
}

int B :: get_a()
{
   return a;
}

void main()
{
        D d;
        d.set_a();
        d.display_a();
}
```

8.5: **How do the properties of the following two derived classes differ?**
(a) class D1: private B(// ….);
(b) class D2: public B(//….);

Ans:(a) Private member of B can not be inherited in D1 Protected member of B become private in D1 public member of B become private in D1.
(b) Private member of B can not be inherited in D2 Protected member of B remains protected in D2 Public member of B remains public in D2

8.6: **When do we use the protected visibility specifier to a class member?**

Ans:When we want access a data member by the member function within its class and by the

member functions immediately derived from it, then we use visibility modifier protected.

8.7: **Describe the syntax of multiple inheritance. When do we use such an inheritance?**

Ans: **Syntax :**

```
Class D : Visibility B1, Visibility B2, ... ... ...
 {
    (Body of D)
 }
```

Then we want of combine several feature to a single class then we use multiple inheritance.

8.8: **What are the implications of the following two definitions?**
(a) class A: public B, public C(//….);
(b) class A: public C, public B(//….);

Ans:Two are same.

8.9: **WWhat is a virtual base class?**

Ans:Whey multiple paths between a bass class and a derived class are exist then this base class is virtual base class. A base class can be made as virtual just adding ‘virtual’ keyword before this base class.

8.10: **When do we make a class virtual?**

Ans:To avoid the duplication of inherited members due to multiple paths between base and derived classes we make base class virtual.

8.11: **What is an abstract class?**

Ans:An abstract class is one that is not used to create objects.

8.12: **In what order are the class constructors called when a derived class object is created?**

Ans:According to the order of derived class header lines

8.13: **Class D is derived from class B. The class D does not contain any data members of its own. Does the class D require constructors? If yes, why?**

Ans:D does not require any construct or because a default constructor is always set to class by default.

8.14: **What is containership? How does it differ from inheritance?**

Ans:Containership is another word for composition. That is, the HAS-A relationship where A has-a member that is an object of class B.
Difference : In inheritance the derived class inherits the member data and functions from the base class and can manipulate base public/protected member data as its own data. By default a program which constructs a derived class can directly access the public members of the base class as well. The derived class can be safely down cast to the base class, because the derived is-a" base class.

Container : a class contains another object as member data. The class which contains the object cannot access any protected or private members of the contained class(unless the container it was made a friend in the definition of the contained class).The relationship between the container and the contained object is "has-a" instead of "is-a"

8.15: **Describe how an object of a class that contains objects of other classes created?**

Ans:By inheriting an object can be created that contains the objects of other class.

Example :

```
class  A
{
       int a;
      public:
          void dosomething();
};

class B: class A
{
        int  b;
       public:
       void donothing();
};
```

Now if object of B is created ; then if contains:
1. void dosomething ( );
2. int b;
3. void donothing ( );

8.16: **State whether the following statements are TRUE or FALSE:**
(a) Inheritance helps in making a general class into a more specific class.
(b) Inheritance aids data hiding.
(c) One of the advantages of inheritance is that it provides a conceptual framework.
(d) Inheritance facilitates the creation of class libraries.
(e) Defining a derived class requires some changes in the base class.
(f) A base class is never used to create objects.
(g) It is legal to have an object of one class as a member of another class.
(h) We can prevent the inheritance of all members of the base class by making base class virtual in the definition of the derived class.

Ans:
(a) TRUE
(b) FALSE
(c) TRUE
(d) TRUE
(e) FALSE
(f) TRUE
(g) TRUE
(h) FALSE

Debugging Exercises

8.1: **Identify the error in the following program.**

```
#include <iostream.h>;
class Student {
     char* name;
     int rollNumber;
public:
     Student() {
          name = "AlanKay";;
          rollNumber = 1025;
     }

      void setNumber(int no) {
           rollNumber = no;
      }
      int getRollNumber() {
          return rollNumber;
     }
};

class AnualTest: Student {
         int mark1, mark2;
```

```
public:
        AnualTest(int m1, int m2)
                :mark1(m1), mark2(m2) {
      }
      int getRollNumber() {
         return Student::getRollNumber();
      }
};
void main()
{
    AnualTest test1(92 85);
    cout<< test1.getRollNumber();
}
```

Solution: Constructor and Private (data & function) can not be inherited.

8.2: **Identify the error in the following program.**

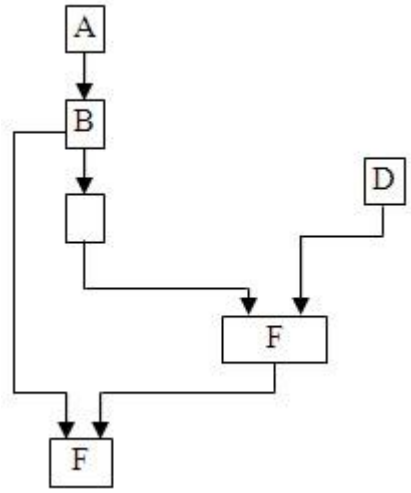
```
#include <iostream.h>;
class A
{
public:
     A()
     {

      cout<< "A";
     }
};

class B: public A
{
public:
     B()
      {
           cout<< "B";
      }
};
class C: public B
{
public:
     C()
      {
           cout << "C";
      }
};
class D
{
public:
```

```
    D()
     {
          cout << "D";
     }
};
class E: public C, public D
{
public:
    E()
     {
          cout<< "D";
     }
};
class F: B, virtual E
{
public:
    F()
     {
          cout<< "F";
     }
};
void main()
{
   F f;
}
```

Solution: The inheritance can be represented as follows :



Here B is virtual, but not E.

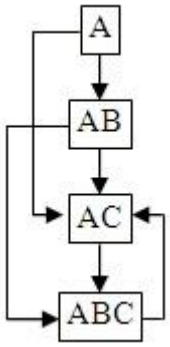
8.3: **Identify the error in the following program.**

```
#include <iostream.h>;
```

```
class A
{
    int i;
};

class AB: virtual A
{
        int j;
};
class AC: A, ABAC
{
        int k;
};
class ABAC: AB, AC
{
        int l;
};
void main()
{
    ABAC abac;
    cout << "sizeof ABAC:" << sizeof(abac);
}
```

Solution: The inheritance can be represented as follows:



Class AC: A, Here there is no identification of ABAC. If we write class ABAC; after #include it will not show any error massage.

8.4: **Find errors in the following program. State reasons.**

```
// Program test
#include <iostream.h>
class X
{
     private:
        int x1;
     Protected:
```

```
        int x2;
      public:
       int x3;
};

class Y: public X
{
        public:
          void f()
          {
               int y1,y2,y3;
               y1 = x1;
               y2 = x2;
               y3 = x3;
          }
};
class Z: X
{
      public:
          void f()
          {
               int z1,z2,z3;
               z1 = x1;
               z2 = x2;
               z3 = x3;
          }
};
main()
{
    int m,n,p;
    Y y;
    m = y.x1;
    n = y.x2;
    p = y.x3;
    Z z;
    m = z.x1;
    n = z.x2;
    p = z.x3;
}
```

Solution: Here x1 is private, so x1 cannot be inherited.
y1 = x1; is not valid
z1 = x1; is not valid
m = y, x1; is not valid
m = z, x1; is not valid

8.5: **Debug the following program.**

```
// Test program
#include <iostream.h>
class B1
{
     int b1;
     public:
       void display();
       {
            cout << b1 <<"\n";
       }
};

class B2
{
     int b2;
     public:
       void display();
       {
            cout << b2 <<"\n";
       }
};
class D: public B1, public B2
{
      //nothing here
};
main()
{
   D d;
   d.display()
   d.B1::display();
   d.B2::display();
}
```

Programming Exercises

8.1: **Assume that a bank maintains two kinds of accounts for customers, one called as savings and the other as current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level a service charge is imposed.**
Create a class account that stores customer name, account number and type of account. From this derive the classes cur_acct and sav_acct to make them more specific to their requirements. Include necessary member functions in order to achieve the following tasks:
(a) Accept the deposit from a customer and update the balance.
(b) Display the balance.
(c) Compute and deposit interest.
(d) Permit withdrawal and update the balance.
(e) Check for the minimum balance, impose penalty, necessary and update the balance.

Do not use any constructors. Use member functions to initialize class members.

Solution:

```
#include<iostream.h>
#include<stdio.h>
#include<string.h>
#include<math.h>
#define minimum 500
#define service_charge 100
#define r 0.15

class account
{
        protected:
         char name[100];
                 int ac_number;
         char ac_type[100];
               public:
        void creat( char *t);
};

void account::creat(char *t)
{

       cout<<" Enter customer name :";
        gets(name);
        strcpy(ac_type,t);
        cout<<" Enter account number :";
        cin>>ac_number;
}
class cur_acct: public account
{
           private:
            float balance;
           public:
            void deposite(float d);
            void withdraw(float w);
            void display();
};
void cur_acct::deposite(float d)
{
        balance=d;
}

void cur_acct::withdraw(float w)
{
          if(balance<w)
        cout<<" sorry your balance is less than your withdrawal amount \n";
         else
```

```
47            {
48                  balance-=w;
49                  if(balance<minimum)
50  cout<<"\n your current balance is :"<<balance<<" which is less    than"<<minimum<<"\n
51  your account is discharged by "<<service_charge<<"TK \n"<<" You must store
52  "<<minimum<<"TK to avoid discharge \n "<<" Do you want to withdraw ? press 1 for yes
53  press 0 for no \n"<<" what is your option ?";
54                int test;
55                      cin>>test;
56                 if(test==0)
57                   balance+=w;
58          }
59
60  }
61
62  void cur_acct::display()
63  {
64                cout<<"\n Now balance = "<<balance<<"\n";
65  }
66  class sav_acct:public account
67  {
68                        float balance;
69                       int d,m,y;
70               public:
71               void deposite(float d);
72               void withdraw(float w);
73              void display();
74              void set_date(int a,int b,int c){d=a;m=b;y=c;}
75              void interest();
76  };
77
78  void sav_acct::deposite(float d)
79  {
80            int x,y,z;
81            cout<<" Enter today's date(i,e day,month,year) : ";
82           cin>>x>>y>>z;
83            set_date(x,y,z);
84            balance=d;
85  }
86
87        void sav_acct::withdraw(float w)
88  {
89                 if(balance<w)
90               cout<<" sorry your balance is less than your withdrawal amount \n";
91                 else
92                 {
93                       balance-=w;
94
95                             if(balance<minimum)
96                        {
97   cout<<"\n your current balance is :"<<balance<<" which is   less than"<<minimum<<"\n
```

```
98  your account is discharged by "<<service_charge<<"TK \n"<<" You must store
99  "<<minimum<<"TK to avoid discharge \n "<<" Do you want to withdraw ? press 1 for yes
100press 0 for no \n"<<" what is your option ?";
101
102                         int test;
103                          cin>>test;
104                         if(test==0)
105                          balance+=w;
106                    }
107              }
108
109}
110void sav_acct::display()
111{
112               cout<<"\n Now balance = "<<balance;
113}
114void sav_acct::interest()
115{
116           int D[12]={31,28,31,30,31,30,31,31,30,31,30,31};
117           int d1,y1,m1;
118           cout<<" Enter today's date :(i,e day,month,year) ";
119           cin>>d1>>m1>>y1;
120           int iday,fday;
121           iday=d;
122          fday=d1;
123         for(int i=0;i<m1;i++)
124         {
125                 fday+=D[i];
126         }
127        for(i=0;i<m;i++)
128        {
129                  iday+=D[i];
130        }
131       int tday;
132         tday=fday-iday;
133         float ty;
134         ty=float(tday)/365+y1-y;
135         float intrst;
136
137          intrst=ty*r*balance;
138          cout<<" Interest is : "<<intrst<<"\n";
139          balance+=intrst;
140}
141
142int main()
143{
144           sav_acct santo;
145           santo.creat("savings");
146           float d;
147           cout<<" Enter your deposit amount : ";
148           cin>>d;
```

```
149          santo.deposite(d);
150          santo.display();
151          int t;
152         cout<<"\n press 1 to see your interest : \n"
153              <<" press 0 to skip : ";
154
155          cin>>t;
156
157        if(t==1)
158         santo.interest();
159
160        cout<<"\n Enter your withdrawal amount :";
           float w;
           cin>>w;
            santo.withdraw(w);
             santo.display();
            return 0;
    }
```

output

```
Enter customer name :Rimo
Enter account number :10617
Enter your deposit amount : 10000
Enter today's date(i,e day,month,year) : 13   7   2010

Now balance = 10000
press 1 to see your interest :
press 0 to skip : 1
Enter today's date :(i,e day,month,year) 15   8   2010

Interest is : 135.61644
Enter your withdrawal amount :500
Now balance = 9635.616211
```

8.2: **Modify the program of exercise 8.1 to include constructors for all three classes.**

Solution:

```
1   #include<iostream.h>
2   #include<stdio.h>
3   #include<string.h>
4   #include<math.h>
5   #define minimum 500
6   #define service_charge 100
7   #define r 0.15
8
```

```
class account
{
        protected:
         char name[100];
          int ac_number;
         char ac_type[100];
        public:
         account( char *n,char *t,int no);
};
 account::account(char *n,char *t,int no)
{
         strcpy(name,n);
         strcpy(ac_type,t);
         ac_number=no;

}

      class cur_acct: public account
{
     private:
      float balance,d,w;
     public:
             void withdraw(float ww);
             void deposit(float d){balance=d;}
    cur_acct(char  *n,char *t,int number,float dp,float wd):
    account(n,t,number)
       {
                d=dp;
                w=wd;
                deposit(d);
                withdraw(w);

               }
              void display();
};

void cur_acct::withdraw(float ww)
{

      if(balance<ww)
      cout<<" sorry your balance is less than your withdrawal amount \n";
      else
       {
              balance-=ww;
             if(balance<minimum)
              {
 cout<<"\n your current balance is :"<<balance<<" which is less than"<<minimum<<"\n your
account is discharged by "<<service_charge<<"TK \n"<<" You must store
"<<minimum<<"TK to avoid discharge \n "<<" Do you want to withdraw ? press 1 for yes
press 0 for no \n"<<" what is your option ?";
                        int test;
```

```
60                          cin>>test;
61                          if(test==0)
62                           balance+=w;
63                  }
64                         else
65                  ;
66              }
67  }
68
69        void cur_acct::display()
70  {
71              cout<<"\n Now balance = "<<balance<<"\n";
72  }
73  class sav_acct:public account
74  {
75              float balance;
76              int d,m,y;
77              public:
78              void deposite(float d){balance=d;set_date();}
79              void withdraw(float w);
80              void display();
81              void set_date(){d=12;m=1;y=2010;}
82              void interest();
83              sav_acct(char *n,char *t,int number,float dp,float wd):
84           account(n,t,number)
85               {
86                     float d,w;
87                           d=dp;
88                     w=wd;
89                     deposite(d);
90                    interest();
91                     withdraw(w);
92
93              }
94  };
95      void sav_acct::withdraw(float w)
96  {
97                       if(balance<w)
98               cout<<" sorry your balance is less than your withdrawal amount \n";
99                      else
100                     {
101                           balance-=w;
102                           if(balance<minimum)
103                           {
104 cout<<"\n your current balance is :"<<balance<<" which is less than"<<minimum<<"\n your
105account is discharged by "<<service_charge<<"TK \n"<<" You must store
106"<<minimum<<"TK to avoid discharge \n "<<" Do you want to withdraw ? press 1 for yes
107press 0 for no \n"<<" what is your option ?";
108                                 int test;
109                                 cin>>test;
110                                 if(test==0)
```

```
111                                 balance+=w;
112                             }
113                                 else
114                             ;
115                     }
116
117}
118void sav_acct::display()
119{
120             cout<<"\n Now balance = "<<balance;
121}
122void sav_acct::interest()
123{
124          int D[12]={31,28,31,30,31,30,31,31,30,31,30,31};
125          int d1,y1,m1;
126          cout<<" Enter today's date :(i,e day,month,year) ";
127           cin>>d1>>m1>>y1;
128          int iday,fday;
129          iday=d;
130          fday=d1;
131          for(int i=0;i<m1;i++)
132           {
133                    fday+=D[i];
134                   }
135          for(i=0;i<m;i++)
136          {
137                 iday+=D[i];
138          }
139         int tday;
140         tday=fday-iday;
141         float ty;
142         ty=float(tday)/365+y1-y;
143         balance=balance*pow((1+r),ty);
144}
145
146int main()
147{
148
149         float d;
150          cout<<" Enter customer name :";
151          char name[100];
152          gets(name);
153          cout<<" Enter account number :";
154          int number;
155          cin>>number;
156          cout<<" Enter your deposit amount : ";
157          cin>>d;
158
159         cout<<" Enter your withdrawal amount :";
160         float w;
161         cin>>w;
```

```
        //cur_acct s("current",name,number,d,w);
        //s.display();
        sav_acct c("savings",name,number,d,w);
        c.display();
    return 0;
}
```

output

Enter customer name :mehedi

Enter account number :1457

Enter your deposit amount : 5000

Enter your withdrawal amount :1200

Enter today's date :(i,e day,month,year) 13 7 2010
Now balance = 4160.875977

8.3: **An educational institution wishes to maintain a database of its employees. The database is divided into a number of classes whose hierarchical relationships are shown in following figure. The figure also shows the minimum information required for each class. Specify all classes and define functions to create the database and retrieve individual information as and when required.**

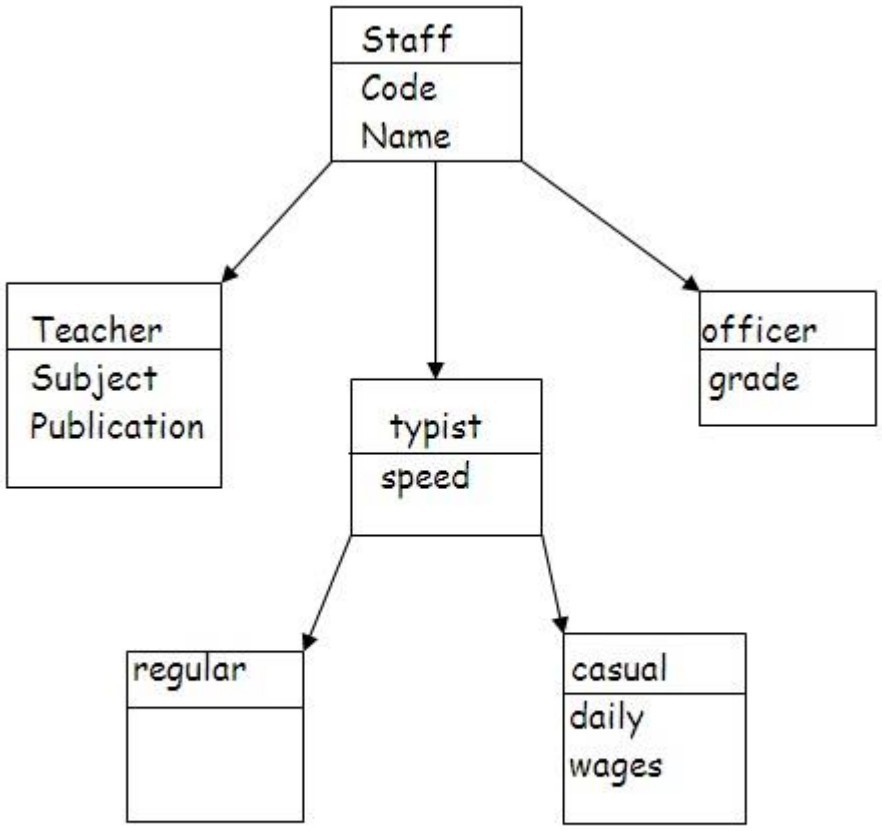


fig: class relationships (for exercise 8.3)

Solution:

```
1   #include<iostream.h>
2   #include<iomanip.h>
3   #include<string.h>
4
5   class staff
6   {
7              public:
8                int code;
9                char name[100];
10                     public:
11             void set_info(char *n,int c)
12              {
13                      strcpy(name,n);
14                      code=c;
15                      }
16  };
17
18  class teacher : public staff
```

```
{
             protected:
            char sub[100],publication[100];
             public:
             void set_details(char *s,char *p)
             {
                    strcpy(sub,s);strcpy(publication,p);
             }
            void show()
             {
                                    cout<<"name"<<setw(8)<<"code"<<setw(15)<<"subject"<<setw(25)
<<"publication"<<endl<<name<<setw(8)<<code<<setw(25)<<sub<<setw(22)<<publication<<endl;
            }
};

class officer:public staff
{
          char grade[100];
           public:
          void set_details(char *g)
           {
                 strcpy(grade,g);
           }

          void show()
                   {
             cout<<" name "<<setw(15)<<"code"<<setw(15)<<"Category "<<endl
             <<name<<setw(10)<<code<<setw(15)<<grade<<endl;
         }
};
        class typist: public staff
{
          protected:
          float speed;
            public:
            void set_speed(float s)
              {
                    speed=s;
              }
};
class regular:public typist
{
      protected:
      float wage;
       public:
       void set_wage(float w){wage=w;}
       void show()
        {
              cout<<"name"<<setw(16)<<"code"<<setw(15)<<"speed"<<setw(15)
<<"wage"<<endl<<name<<setw(10)<<code<<setw(15)<<speed
<<setw(15)<<wage<<endl;
```

```
70        }
71  };
72  class causal:public typist
73  {
74                      float wage;
75              public:
76              void set_wage(float w){wage=w;}
77              void show()
78              {
79                          cout<<"name"<<setw(16)<<"code"<<setw(15)<<"speed"<<setw(15)
80  <<"wage"<<endl<<name<<setw(10)<<code<<setw(15)<<speed
81  <<setw(15)<<wage<<endl;
82            }
83
84  };
85
86  int main()
87  {
88
89          teacher t;
90                t.set_info("Ataur",420);
91              t.set_details("programming with c++"," Tata McGraw Hill");
92
93              officer o;
94              o.set_info("Md. Rashed",222);
95              o.set_details("First class");
96
97                      regular rt;
98                rt.set_info("Robiul Awal",333);
99              rt.set_speed(85.5);
100             rt.set_wage(15000);
101
102          causal ct;
103ct.set_info("Kawser Ahmed",333);
104ct.set_speed(78.9);
105ct.set_wage(10000);
106         cout<<"  About teacher: "<<endl;
107         t.show();
108         cout<<" About officer:"<<endl;
109          o.show();
110         cout<<" About regular typist :"<<endl;
111         rt.show();
112         cout<<" About causal typist :"<<endl;
113         ct.show();
114
115         return 0;
116}
```

output

About teacher:

name code subject publication

Ataur 420 programming with c++ Tata McGraw Hill

About officer:

name code Category

Md. Rashed 222 First class

About regular typist :

name code speed wage

Robiul Awal 333 85.5 15000

About causal typist :

name code speed wage

Kawser Ahmed 333 78.900002 10000

8.4: **The database created in exercise 8.3 does not include educational information of the staff. It has been decided to add this information to teachers and officers (and not for typists) which will help management in decision making with regard to training, promotions etc. Add another data class called education that holds two pieces of educational information namely highest qualification in general education and highest professional qualification. This class should be inherited by the classes teacher and officer. Modify the program of exercise 8.19 to incorporate these additions.**

Solution:

```
1   #include<iostream.h>
2   #include<iomanip.h>
3   #include<string.h>
4
5   class staff
6   {
7           protected:
8               int code;
9               char name[100];
10             public:
11             void set_info(char *n,int c)
12             {
13                      strcpy(name,n);
14                       code=c;
```

```
15              }
16 };
17 class education:public staff
18 {
19    protected:
20            char quali[100];
21             public:
22             void set_qualification(char *q){strcpy(quali,q);}
23 };
24
25 class teacher : public education
26 {
27                protected:
28                char sub[100],publication[100];
29                public:
30                        void set_details(char *s,char *p)
31                {
32                    strcpy(sub,s);strcpy(publication,p);
33                }
34                void show()
35                {
36                        cout<<" name "<<setw(8)<<"code"<<setw(15)
37                            <<"subject"<<setw(22)<<"publication"
38                            <<setw(25)<<"qualification"<<endl
39                            <<name<<setw(8)<<code<<setw(25)
40                      <<sub<<setw(18)<<publication<<setw(25)<<quali<<endl;
41                 }
42 };
43
44     class officer:public education
45 {
46              char grade[100];
47              public:
48              void set_details(char *g)
49              {
50                    strcpy(grade,g);
51
52              }
53
54               void show()
55               {
56                    cout<<" name "<<setw(15)<<"code"<<setw(15)<<"Catagory "
57                        <<setw(22)<<"Qualification"<<endl<<name<<setw(10)
58                         <<code<<setw(15)<<grade<<setw(25)<<quali<<endl<<endl;
59               }
60 };
61
62 class typist: public staff
63 {
64         protected:
65           float speed;
```

```
66            public:
67            void set_speed(float s)
68                    {
69                         speed=s;
70                    }
71  };
72  class regular:public typist
73  {
74        protected:
75             float wage;
76         public:
77            void set_wage(float w){wage=w;}
78            void show()
79            {
80                    cout<<" name "<<setw(16)<<"code"<<setw(15)<<"speed"
81                        <<setw(15)<<"wage"<<endl<<name<<setw(10)<<code
82                        <<setw(15)<<speed<<setw(15)<<wage<<endl<<endl;
83            }
84  };
85  class causal:public typist
86  {
87         float wage;
88          public:
89          void set_wage(float w){wage=w;}
90          void show()
91          {
92                cout<<" name "<<setw(16)<<"code"<<setw(15)<<"speed"
93                    <<setw(15)<<"wage"<<endl<<name<<setw(10)<<code
94                    <<setw(15)<<speed<<setw(15)<<wage<<endl<<endl;
95          }
96
97  };
98
99  int main()
100{
101
102       teacher t;                              t.set_info("Ataur",420);
103t.set_details("programming with c++"," Tata McGraw Hill");
104t.set_qualification("PHD from programming ");
105
106        officer o;
107
108         o.set_info("Md. Rashed",222);
109         o.set_details("First class");
110         o.set_qualification("2 years experienced");
111
112                regular rt;
113                      rt.set_info("Robiul Awal",333);
114rt.set_speed(85.5);
115rt.set_wage(15000);
116
```

```
117         causal ct;
118             ct.set_info("Kawser Ahmed",333);
119          ct.set_speed(78.9);
120          ct.set_wage(10000);
121
122        cout<<"  About teacher: "<<endl;
123          t.show();
124
125         cout<<" About officer:"<<endl;
126          o.show();
127
128          cout<<" About regular typist :"<<endl;
129           rt.show();
130          cout<<" About causal typist :"<<endl;
131           ct.show();
132
133        return 0;
134}
```

output

About teacher:

name code subject publication qualification

Ataur 420 programming with c++ Tata McGraw Hill PHD from programming-
About officer:

name code Catagory Qualification

Md. Rashed 222 First class 2 years experienced

About regular typist :

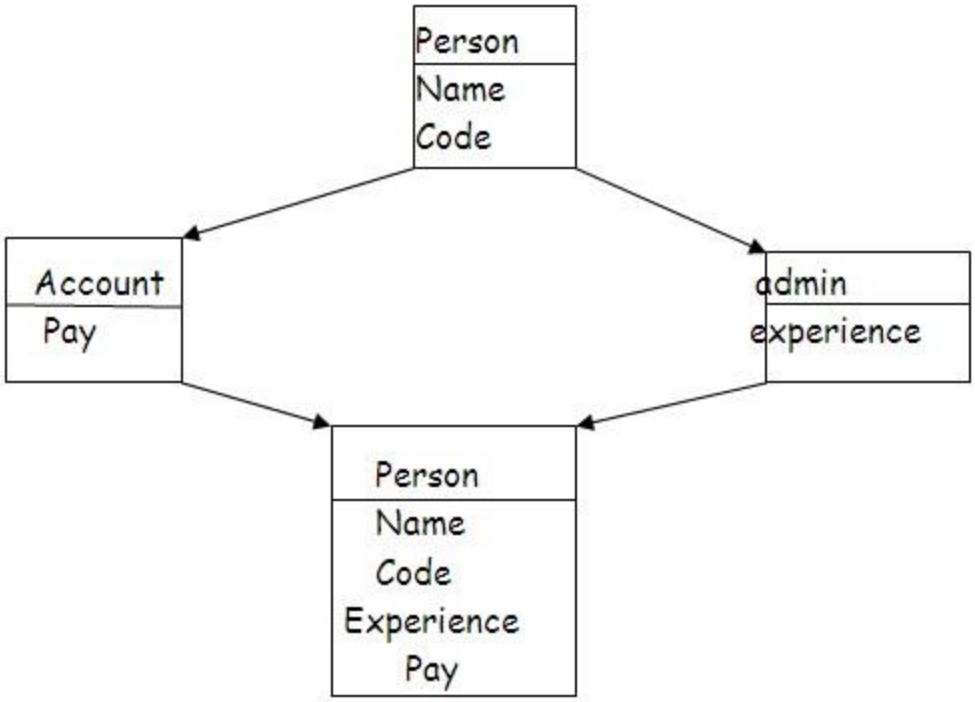
name code speed wage

Robiul Awal 333 85.5 15000
About causal typist :

name code speed wage

Kawser 333 78.900002 10000

8.5: **Consider a class network of the following figure. The class master derives information from both account and admin classes which in turn derives information from the class person. Define all the four classes and write a program to create, update and display the information contained in master objects.**



Solution:

```
1   #include<iostream.h>
2   #include<iomanip.h>
3   #include<string.h>
4
5   class staff
6   {
7               protected:
8                int code;
9                char name[100];
10               public:
11               void set_info(char *n,int c)
12               {
13                    strcpy(name,n);
14                    code=c;
15               }
16  };
17
18  class education:public staff
19  {
20              protected:
21              char quali[100];
22              public:
23              void set_qualification(char *q){strcpy(quali,q);}
24  };
25
```

```
class teacher : public education
{
          protected:
          char sub[100],publication[100];
                  public:
          void set_details(char *s,char *p)
                  {
                strcpy(sub,s);strcpy(publication,p);

          }

                void show()
          {
                  cout<<"name"<<setw(8)<<"code"<<setw(15)<<"subject"<<setw(22)
<<"publication"<<setw(25)<<"qualification"<<endl<<name<<setw(8)
<<code<<setw(25)<<sub<<setw(18)<<publication<<setw(25)<<quail
<<endl;
          }
};

class officer:public education
{
        char grade[100];
         public:
         void set_details(char *g)
                  {
                  strcpy(grade,g);
         }

          void show()
           {
             cout<<"name"<<setw(15)<<"code"<<setw(15)<<"Catagory"
               <<setw(22)<<"Qualification"<<endl<<name<<setw(10)
              <<code<<setw(15)<<grade<<setw(25)<<quali<<endl<<endl;
                  }
};

class typist: public staff
{
       protected:
        float speed;
      public:
      void set_speed(float s)
                {
            speed=s;
       }
};
       class regular:public typist
{
          protected:
          float wage;
```

```
77          public:
78          void set_wage(float w){wage=w;}
79          void show()
80           {
81                    cout<<"name"<<setw(16)<<"code"<<setw(15)<<"speed"<<setw(15)
82  <<"wage"<<endl<<name<<setw(10)<<code<<setw(15)<<speed
83  <<setw(15)<<wage<<endl<<endl;
84           }
85  };
86  class causal:public typist
87  {
88          float wage;
89          public:
90          void set_wage(float w){wage=w;}
91
92          void show()
93          {
94                        cout<<"name"<<setw(16)<<"code"<<setw(15)<<"speed"<<setw(15)
95  <<"wage"<<endl<<name<<setw(10)<<code<<setw(15)<<speed
96  <<setw(15)<<wage<<endl<<endl;
97          }
98
99  };
100
101int main()
102{
103
104         teacher t;
105           t.set_info("Ataur",420);
106          t.set_details("programming with c++"," Tata McGraw Hill");
107          t.set_qualification("PHD from programming ");
108        officer o;
109       o.set_info("Md. Rashed",222);
110       o.set_details("First class");
111       o.set_qualification("2 years experienced");
112       regular rt;
113       rt.set_info("Robiul Awal",333);
114       rt.set_speed(85.5);
115       rt.set_wage(15000);
116             causal ct;
117      ct.set_info("Kawser Ahmed",333);
118      ct.set_speed(78.9);
119      ct.set_wage(10000);
120      cout<<"  About teacher: "<<endl;
121       t.show();
122       cout<<" About officer:"<<endl;
123       o.show();
124       cout<<" About regular typist :"<<endl;
125       rt.show();
126       cout<<" About causal typist :"<<endl;
127       ct.show();
```

```
128
129 return 0;
130}
```

output

name	code	Experience	payment
Hasibul	111	3 years	1500tk

8.6: **In exercise 8.3 the classes teacher, officer, and typist are derived from the class staff. As we know we can use container classes in place of inheritance in some situations. Redesign the program of exercise 8.3 such that the classes teacher, officer and typist contain the objects of staff.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<string.h>
4
5  class staff
6  {
7             public:
8                    int code;
9             char name[100];
10            public:
11            void set_info(char *n,int c)
12             {
13                   strcpy(name,n);
14                   code=c;
15            }
16};
17
18class teacher : public staff
19{
20       protected:
21       char sub[100],publication[100];
22       public:
23       void set_details(char *s,char *p)
24        {
25             strcpy(sub,s);strcpy(publication,p);
26        }
27               void show()
28       {
29                  cout<<"name"<<setw(8)<<"code"<<setw(15)<<"subject"<<setw(25)
30<<"publication"<<endl<<name<<setw(8)<<code<<setw(25)<<sub
```

```
31<<setw(22)<<publication<<endl;
32          }
33};
34
35        class officer:public staff
36{
37          char grade[100];
38          public:
39          void set_details(char *g)
40          {
41              strcpy(grade,g);
42         }
43         void show()
44         {
45            cout<<" name "<<setw(15)<<"code"<<setw(15)<<"Catagory "<<endl
46                <<name<<setw(10)<<code<<setw(15)<<grade<<endl;
47        }
48};
49
50class typist: public staff
51{
52       protected:
53        float speed;
54        public:
55         void set_speed(float s)
56         {
57                speed=s;
58        }
59                void show()
60                 {
61                cout<<" name "<<setw(15)<<"code"<<setw(15)<<"speed"<<endl
62                     <<name<<setw(10)<<code<<setw(15)<<speed<<endl<<endl;
63         }
64};
65
66       int main()
67{
68
69        teacher t;
70        t.set_info("Ataur",420);
71        t.set_details("programming with c++"," Tata McGraw Hill");
72
73        officer o;
74        o.set_info("Md. Rashed",222);
75        o.set_details("First class");
76
77               typist tp;
78       tp.set_info("Robiul Awal",333);
79       tp.set_speed(85.5);
80
81                cout<<"  About teacher: "<<endl;
```

```
82      t.show();
83      cout<<" About officer:"<<endl;
84      o.show();
85      cout<<" About  typist :"<<endl;
86      tp.show();
87     return 0;
88}
```

output

About teacher:

name code subject publication

Ataur 420 programming with c++ Tata McGraw Hill

About officer:

name code Catagory

Md. Rashed 222 First class

About typist :

name code speed

Robiul Awal 333 85.5

8.7: **We have learned that OOP is well suited for designing simulation programs. Using the techniques and tricks learned so far, design a program that would simulate a simple real-world system familiar to you**

Solution:

```
1   #include<iostream.h>
2   #include<stdio.h>
3   #include<string.h>
4   #include<iomanip.h>
5   #include<conio.h>
6
7   char *sub[10]={"Bangla 1st paper","Bangla 2nd paper","English 1st paper",
8                  "English 2nd paper","Mathematics","Religion",
9                  "Physics","Chemistry","Sociology","Higher Mathematics"};
10
11  class student_info
12  {
```

```
13
14          public:
15            char  name[40];
16             char  roll[20];
17          public:
18            void set_info();
19  };
20
21  void student_info::set_info()
22  {
23           cout<<"Enter student name : ";
24            gets(name);
25            cout<<"Enter roll: ";
26            gets(roll);
27  }
28
29          class subject :public student_info
30  {
31
32          public:
33           float mark[10];
34
35           public:
36           void set_mark();
37  };
38
39  void subject::set_mark()
40  {
41           cout<<" marks  of  : \n";
42              for(int i=0;i<10;i++)
43                 {
44                        cout<<sub[i]<<" = ? ";
45                                 cin>>mark[i];
46                 }
47
48  }
49       class conversion :public  subject
50  {
51                  float gpa[10];
52          char grade[20][20];
53           public:
54          void convert_to_gpa();
55           void show();
56  };
57          void conversion::convert_to_gpa()
58  {
59                for(int i=0;i<10;i++)
60                  {
61                      if(mark[i]>=80)
62                        {
63                                    gpa[i]=5.00;
```

```
                        strcpy(grade[i],"A+");
                    }
                    else if(mark[i]>=70 && mark[i]<80)
                    {
                        gpa[i]=4.00;
                            strcpy(grade[i],"A");
                    }
                    else if(mark[i]>=60 && mark[i]<70)
                    {
                            gpa[i]=3.50;
                        strcpy(grade[i],"A-");
                    }
                    else if(mark[i]>=50 && mark[i]<60)
                    {
                        gpa[i]=3.00;
                            strcpy(grade[i],"B");
                    }
                    else if(mark[i]>=40 && mark[i]<50)
                    {
                            gpa[i]=2.00;
strcpy(grade[i],"C");
                    }
                        else if(mark[i]>=33 && mark[i]<40)
                    {
                        gpa[i]=1.00;
                        strcpy(grade[i],"D");
                    }
                    else
                    {
                            gpa[i]=0.00;
                            strcpy(grade[i],"Fail");
                    }
                }
    }

void conversion::show()
{
        cout<<" result of \n";
        cout<<"name :"<<name<<"\n";
        cout<<"Roll : "<<roll<<"\n";
      cout<<setw(25)<<"Subject"<<setw(17)<<"Marks"
          <<setw(14)<<"GPA"<<setw(12)<<"Grade \n";
        for(int i=0;i<10;i++)
        {
                cout<<setw(25)<<sub[i]<<setw(15)<<mark[i]
              <<setw(15)<<gpa[i]<<setw(10)<<grade[i]<<"\n";
        }
}
int main()
{
      clrscr();
```

```
115         conversion A;
116         A.set_info();
117         A.set_mark();
118         A.convert_to_gpa();
119          A.show();
120          getch();
121         return 0;
122}
```

output

Enter student name : santo

Enter roll: 156271

marks of :

Bangla 1st paper = ? 74

Bangla 2nd paper = ? 87

English 1st paper = ? 45

English 2nd paper = ? 56

Mathematics = ? 87

Religion = ? 59

Physics = ? 75

Chemistry = ? 65

Sociology = ? 39

Higher Mathematics = ? 86

result of

name :santo

Roll : 156271

Subject	Marks	GPA	Grade
Bangla 1st paper	74	4	A
Bangla 2nd paper	87	5	A+

English 1st paper	45	2	C
English 2nd paper	56	3	B
Mathematics	87	5	A+
Religion	59	3	B
Physics	75	4	A
Chemistry	65	3.5	A-
Sociology	39	1	D
Higher Mathematics	86	5	A+

Chapter 9

Review Questions

9.1: **What does polymorphism mean in C++ language?**

Ans:In short, polymorphism means one thing with several district forms.
–In details, using operators or functions in different ways, depending on what they are Operating on, is called polymorphism.

9.2: **How is polymorphism achieved at (a) compile time, and (b) run time?**

Ans:Polymorphism can be achieved at compile time by early binding. Early binding means an object is bound to its function call at compile time.
And we can achieve run time polymorphism by a mechanism known as virtual function.

9.3: **Discuss the different ways by which we can access public member functions of an object.**

Ans:We can access public member functions of an object by
(i) Object name and dot membership operator.
(ii) Pointer to object and function name.

9.4: **Explain, with an example, how you would create space for an array of objects using pointers.**

Ans:We can also create an array of objects using pointers. For example, the statement
item *ptr = new item [10]; // array of 10 objects.
creates memory space for an array of 10 objects of item.

9.5: **What does this pointer point to?**

Ans:'this' pointer point to invoking object.

9.6: **What are the applications of this pointer?**

Ans:One important application of the pointer this is to return the object it points to. For example, the statement.
return * this;
inside a member function will return the object that invoked the function.

9.7: **What is a virtual junction?**

Ans:When we use the same function name in both the base and derived classes the function in the base class is declared as virtual using the keyword virtual preceding its normal declaration.

9.8: **Why do we need virtual functions?**

Ans:It we need same function name at base class and derived class then, we need virtual function.

9.9: **When do we make a virtual function "pure"? What are the implications of making a function a pure virtual function?**

Ans:When a function is defined as empty, then this function is called do nothing function.
The implications of making a function a pure virtual function is to achieve run time polymorphism.

9.10: **State which of the following statements are TRUE or FALSE.**
(a) Virtual functions are used to create pointers to base classes.
(b) Virtual functions allow us to use the same junction call to invoke member functions of objects of different classes.

(c) A pointer to a base class cannot be made to point to objects of derived class.
(d) this pointer points to the object that is currently used to invoke a function.
(e) this pointer can be used like any other pointer to access the members of the object it points to.
(f) this pointer can be made to point to any object by assigning the address of the object.
(g) Pure virtual functions force the programmer to redefine the virtual function inside the derived classes.

Ans:
(a) TRUE
(b) TRUE
(c) FALSE
(d) TRUE
(e) TRUE
(f) TRUE
(g) TRUE

Debugging Exercises

9.1: **Identify the error in the following program.**

```
#include <iostream.h>;
class  Info
{
     char* name;
     int Number;
public:
     void getInfo()
     {
          cout << "Info::getInfo";
          getName();
     }

      void getName()
      {
           cout << "Info::getName";
      }
};

class Name: public Info
{
        char *name;
public:
       void getName()
      {
              cout << "Name::getName";
      }
};
```

```
void main()
{
    Info *P;
    Name n;
    P = n;
    p->getInfo();
}
/*
```

Solution: Here P=n will replace with P=&n in the main() function. Because P is a pointer.

9.2: **Identify the error in the following program.**

```
#include <iostream.h>;
class  Person
{
     int age;
public:
     Person()
     {
     }

      Person(int age)
      {
          this.age = age;
      }
      Person& operator < (Person &p)
      {
          return age < p.age? p: *this;
      }
      int getAge()
      {
         return age;
      }
};

void main()
{
    Person P1 (15);
    Person P2 (11);
    Person P3;
    //if P1 is less than P2
     P3 =  P1 < P2; P1.lessthan(P2)
     cout << P3.getAge();
}
/*
```

Solution: The function

```
person (int age)
{
        this.age = age;
}
```

should write like as…

```
person (int age)
{
        –this > age = age;
}
```

9.3: **Identify the error in the following program.**

```
#include <iostream.h>;
class  Human
{
public:
     Human()
     {
     }

      virtual -Human()
      {
          cout << "Human::-Human";
      }
};
class Student: public Human
{
public:
     Student()
     {
     }
     -Student()
    {
         cout << "Student::-Student()";
    }
};

void main()
{
    Human *H = new Student();
    delete H;
```

```
}
```

Solution: Here we cannot write Human *H = new student(); in the main() function because base class's member includes in derived class's object so we should write this as follow
student *H = new Student();

9.4: **Correct the errors in the following program.**

```
class  Human
{
private:
     int m;
public:
     void getdata()
     {
          cout << " Enter number:";
          cin >> m;
     }
};
main()
{
    test T;
    T->getdata();
    T->display();

    test *p;
    p = new test;
    p.getdata();
    (*p).display();
}
```

Solution: Here T->getdata replace with T.getdata and T->display replace with T.display in the main() function. Because in this program T is object to pointer.

9.5: **Debug and run the following program. What will be the output?**

```
#include<iostream.h>
class  A
{
protected:
     int a,b;
public:
     A(int x = 0, int y)
     {
```

```
            a = x;
            b = y;
      }
      virtual void print ();
};
class B: public A
{
    private:
      float p,q;
    public:
      B(intm, int n, float u, float v)
       {
           p = u;
           q = v;
       }
       B() {p = p = 0;}
       void input(float u, float v);
       virtual void print(loat);
};
void A::print(void)
{
    cout << A values: << a <<""<< b << "\n";
}
void B:print(float)
{
    cout << B values: << u <<""<< v << "\n";
}
void B::input(float x, float y)
{
    p = x;
    q = y;
}
main()
{
    A a1(10,20), *ptr;
    B b1;
    b1.input(7.5,3.142);

    ptr = &a1;
    ptr->print();

    ptr = &b1;
    ptr->print();
}
```

Programming Exercises

9.1: **Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data() to initialize base class data members and another member function display_area() to compute and display the area of figures. Make display_area() as a virtual function and redefine this function in the derived classes to suit their requirements.**

Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively, and display the area.

Remember the two values given as input will be treated as lengths of two sides in the case of rectangles and as base and height in the case of triangles, and used as follows:

Area of rectangle = x * y

Area of triangle = ½ * x * y

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  class shape
4  {
5        public:
6        double x,y;
7        public:
8         void get_data()
9          {
10             cin>>x>>y;
11
12         }
13       double get_x(){return x;}
14              double get_y(){return y;}
15       virtual void display_area(){}
16};
17
18class triangle:public shape
19{
20    public:
21    void display_area()
22              {
23                    double a;
24              a=(x*y)/2;
25              cout<<" Area of triangle = "<<a<<endl;
26
27      }
28};
29class rectangle:public shape
30{
```

```
31      public:
32      void display_area()
33       {
34              double a;
35              a=x*y;
36              cout<<" Area of rectangle = "<<a<<endl;
37      }
38};
39        int main()
40{
41
42       shape *s[2];
43       triangle t;
44       s[0]=&t;
45              rectangle r;
46      s[1]=&r;
47             cout<<" Enter the value of x & y for triangle: ";
48      s[0]->get_data();
49      cout<<" Enter the value of x & y for rectangle: ";
50      s[1]->get_data();
51             s[0]->display_area();
52      s[1]->display_area();
53            return 0;
54  }
```

output

Enter the value of x & y for triangle: 12 26

Enter the value of x & y for rectangle: 24 14

Area of triangle = 156

Area of rectangle = 336

9.2: **Extend the above program to display the area of circles. This requires addition of a new derived class 'circle' that computes the area of a circle. Remember, for a circle we need only one value, its radius, but the get_data() function in base class requires two values to be passed.(Hint: Make the second argument of get_data() function as a default one with zero value.)**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #define pi 3.1416
4  class shape
```

```
5  {
6        public:
7        double x,y;
8        public:
9         void get_data(double a,double b)
10        {
11                x=a;
12                y=b;
13
14                  }
15        double get_x(){return x;}
16        double get_y(){return y;}
17       virtual void display_area(){}
18};
19
20class triangle:public shape
21{
22    public:
23      void display_area()
24       {
25                double a;
26                a=(x*y)/2;
27               cout<<" Area of triangle = "<<a<<endl;
28
29      }
30};
31
32        class rectangle:public shape
33{
34     public:
35      void display_area()
36        {
37                double a;
38                a=x*y;
39                cout<<" Area of rectangle = "<<a<<endl;
40        }
41};
42class circle:public shape
43{
44     public:
45     void display_area()
46      {
47                      double a;
48             a=pi*x*x;
49             cout<<" Area of circle = "<<a<<endl;
50       }
51};
52
53int main()
54{
55
```

```
56              shape *s[3];
57
58        triangle t;
59        s[0]=&t;
60
61        rectangle r;
62        s[1]=&r;
63
64        circle c;
65        s[2]=&c;
66        double x,y;
67         cout<<" Enter the value of x & y for triangle: ";
68         cin>>x>>y;
69         s[0]->get_data(x,y);
70         cout<<" Enter the value of x & y for rectangle: ";
71         cin>>x>>y;
72         s[1]->get_data(x,y);
73         cout<<" Enter the radius of circle : ";
74         double rd;
75         cin>>rd;
76         s[2]->get_data(rd,0);
77         cout<<endl<<endl;
78         s[0]->display_area();
79         s[1]->display_area();
80         s[2]->display_area();
81
82        return 0;
83}
```

output

Enter the value of x & y for triangle: 10 24

Enter the value of x & y for rectangle: 14 23

Enter the radius of circle : 12

Area of triangle = 120

Area of rectangle = 322

Area of circle = 452.3904

9.3: **Run the program above with the following modifications:**
(a) Remove the definition of display_area() from one of the derived classes.

(b) In addition to the above change, declare the display_area() as virtual in the base class shape.
Comment on the output in each case.

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #define pi 3.1416
4  class shape
5  {
6    public:
7    double x,y;
8    public:
9    void get_data(double a,double b)
10  {
11        x=a;
12        y=b;
13
14 }
15double get_x(){return x;}
16double get_y(){return y;}
17 virtual void display_area(){}
18};
19class triangle:public shape
20{
21    public:
22    void display_area()
23   {
24                              double a;
25         a=(x*y)/2;
26         cout<<" Area of triangle = "<<a<<endl;
27  }
28};
29class rectangle:public shape
30{
31        public:
32         void display_area()
33          {
34                 double a;
35                 a=x*y;
36                cout<<" Area of rectangle = "<<a<<endl;
37          }
38};
39class circle:public shape
40{
41    public:
42   void display_area()
43    {
44            double a;
```

```
45          a=pi*x*x;
46          cout<<" Area of circle = "<<a<<endl;
47     }
48};
49
50int main()
51{
52
53     shape *s[3];
54     triangle t;
55    s[0]=&t;
56
57  rectangle r;
58  s[1]=&r;
59 circle c;
60 s[2]=&c;
61 double x,y;
62 cout<<" Enter the value of x & y for triangle: ";
63 cin>>x>>y;
64 s[0]->get_data(x,y);
65 cout<<" Enter the value of x & y for rectangle: ";
66 cin>>x>>y;
67 s[1]->get_data(x,y);
68 cout<<" Enter the radius of circle : ";
69 double rd;
70 cin>>rd;
71 s[2]->get_data(rd,0);
72 cout<<endl<<endl;
73 s[0]->display_area();
74 s[1]->display_area();
75 s[2]->display_area();
76
77 return 0;
78}
```

output

Enter the value of x & y for triangle: 28 32

Enter the value of x & y for rectangle: 25 36

Enter the radius of circle : 20

Area of triangle = 448

Area of rectangle = 900

Area of circle = 1256.64

Chapter 10

Review Questions

10.1:**What is a stream?**

Ans: The I/O system in C++ is designed to work with a wide variety of devices including terminals, disks and tape drives. Although each device is very different, the I/O system supplies an interface to the programmer that is independent of the actual device being accessed. This interface is known as stream.

10.2: **Describe briefly the features of I/O system supported by C++.**

Ans: See table 10.1, page 293 of Balagurusamy.

10.3: **How do the I/O facilities in C++ differ from that in C?**

Ans:We can design our own manipulators for certain special purposes in C++ but not in C.
Example :

```
1Ostream & unit (ostream & output)
2     {
3       output << “TK”;
4       return output;
5     }
6   The statement
7       cout << 100 << unit;
8   will print
9       100 Tk.
```

10.4: **Why are the words such as cin and cout not considered as keywords?**

Ans: cin and cout are related to iostream object, that’s why we must include iostream header file in our program to use cin and cout.

Hence cin and cout are considered as iostream objects, not keywords.

10.5: **How is cout able to display various types of data without any special instructions?**

Ans:The biggest single advantage to the stream methods is: they are type-safe. If you change a variable's type, the sub sequent stream operations using that variable will either automatically accommodate the change, or will indicate an incompatibility at compile time. Thus cout is able to display various types of data without any special instructions.

10.6: **Why is it necessary to include the file iostream in all our programs?**

Ans:Because any program has input or output statements and without iostream header file we can not use input or output statements, that's why it is necessary to include the file iostream in all our programs.

10.7: **Discuss the various forms of get() function supported by the input stream. How are they used?**

Ans:There are two types of get ( ) functions. We can use both get(char*) and get(void) prototype to fetch a character including the blank space.

10.8: **How do the following two statements differ in operation?**
cin >> c;
cin.get(c);

Ans:cin>>c will read a character but it will skip the white space and new line character.
cin.get (c); will read a character including white space and newline character.

10.9: **Both cin and getline() function can be used for reading a string. Comment.**

Ans: cin reads a string and stops when a space or newline is encountered.
getline ( ) function reads a whole line of text that ends with a newline character.

10.10:**Discuss the implications of size parameter in the following statement:**
cout.write(line, size);

Ans: cout.write (line, size)
The first argument line represents the name of the string to be displayed and the secon d argument size indicates the number of characters to display.

10.11:**What does the following statement do?**
cout.write(s1,m).write(s2,n);

Ans: The statement
cout.write(s1,m).write (s2,n);
is equivalent to the following two statements;
cout.write(s1,m);
cout.write(s2,n);
So, cout.write (s1,m).write (s2,n); will print two string s1 and s2

10.12: **What role does the iomanip file play?**

Ans: The header file iomanip provides a set of functions called manipulators which can be used to manipulate the output formats.

10.13: **What is the role of file() function? When do we use this function?**

Ans: fill ( ) is known as filling and padding function. The unused positions of the field are filled with white spaces, by default. We can use the fill ( ) function to fill the unused positions by any desired character.

General form :
cout.fill (ch);
Example :
cout.fill ('*');

10.14: **Discuss the syntax of set() function.**

Ans: syntax of set function:
cout.setf (arg1, arg2);
here arg1 is one of the formatting flags
and arg2 is bit field.

Example:
cout.setf (ios::left, ios :: adjust field);

10.15: **What is the basic difference between manipulators and ioa member functions in implementation? Give examples.**

Ans: We can design our manipulator using manipulator function, which can not be done by ios member functions

Example :

```
1ostream & show (ostream & output)
2{
3output.setf (ios :: showpoint);
4output.setf(ios :: showpos);
5output << setw(10);
6return output;
7}
```

This function defines a manipulator called show that turns on the flags showpoint and showpos declared in the class ios and sets the field width to 10.

10.16: **State whether the following statements are TRUE or FALSE.**
(a) A C++ stream is a file.
(b) C++ never truncates data.
(c) The main advantage of width() junction is that we can use one width specification for more than one items.
(d) The get(void) function provides a single-character input that does not skip over the white spaces.
(e) The header file iomanip can be used in place of iostream.
(f) We cannot use both the C 110 functions and C++ 110 functions in the same program.
(g) A programmer can define a manipulator that could represent a set of format functions.

Ans:
(a) TRUE
(b) FALSE
(c) FALSE
(d) TRUE
(e) TRUE
(f) FALSE
(g) TRUE

Debugging Exercises

10.1:**Sorry this question is missed. We will try to give this question with solution very soon. Stay with us**

10.2: **Will the statement cout.setf(ios::right) work or not?**

```
1  #include <iostream.h>
2  void main()
3  {
4       cout.width(5);
5       cout << "99" << endl;
```

```
6
7       cout.setf(ios::left);
8       cout.width(5);
9       cout << "99" << endl;
10
11      cout.setf(ios::right);
12      cout << "99" << endl;
13}
```

Solution: cout.setf(ios :: right) will not work because width() function was not invoked before cout.setf(ios :: right)

10.3: **State errors, if any, in the following statements.**
(a) cout << (void*) amount; (b) cout << put ("John") ; (c) cout << width(); (d) int p = cout.width(10); (e) cout.width(10).precision(3); (f) cout.setf(ios::scientific,ios::left); (g) ch = cin.get(); (h) cin.get().get(); (i) cin.get(c).get(); (j) cout << setw(5) << setprecision(2); (k) cout << resetiosflags(ios::left lios::showpos);

Solution:
(a) missing
(b) put ( ) a member function of ostream class. It is used to output a character. Hence it does not return any value; so cout<<("John"); is not valid. **Correction :**
cout.put ('John');
(c) width ( ) function does not return any value. So cout <**Correction : cout.width ( );**

(e) cout.width (10) precision (3); must be written separately
cout.width (10);
cout.preasion (3);

(f) If you want to see output as scientfic format you can acheive this as follow:
cout.setf (ios :: scientific, ios :: floatfield);

If you want to see output at left field you can achieve this as flows:
cout.setf (ios :: left, ios :: adjustfield);
(g) No error
(h) cannot be concatenated;

Correction :
cin.get ( )
cin.get ( )

(i) No error
(j) No error
(k) No error

Programming Exercises

10.1: **Write a program to read a list containing item name, item code, and cost interactively and produce a three column output as shown below.**

Name	Code	Cost
Turbo C++	1001	250.95
C primer	905	95.70
……	……	……
……	……	……

Note that the name and code are left-justified and the cost is right justified with a precision of two digits. Trailing zeros are shown.

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<string.h>
4  class item
5  {
6            char name[40];
7             int code;
8             float cost;
9             public:
10            void get_data(char *n,int c,float co)
11            {
12                  strcpy(name,n);
13                   code=c;
14                    cost=co;
15            }
16            void display();
17
18 };
19
20void item:: display()
21{
22             cout.precision(2);
23             cout.setf(ios::fixed,ios::floatfield);
24             cout.setf(ios::showpoint);
25             cout.setf(ios::left,ios::adjustfield);
26             cout<<setw(40)<<name<<code;
27             cout.setf(ios::right,ios::adjustfield);
28             cout<<setw(15)<<cost<<endl;
29 }
30
```

```
31 int main()
32 {
33            item a[5];
34            a[0].get_data("Tarbo C++",1001,250.95);
35            a[1].get_data("C primer",905,95.7);
36            a[2].get_data("algorithm",1111,120.5);
37            a[3].get_data("principle of electronics",2220,150.85);
38            a[4].get_data("solution of balagurusamy",6666,145.00);
39        cout<<setw(10)<<"name"<<setw(34)<<"code"<<setw(15)<<"cost"<<endl;
40         for(int i=0;i<60;i++)
41          cout<<"-";
42          cout<<endl;
43          for(i=0;i<5;i++)
44          a[i].display();
45          return 0;
46}
```

output

```
name                                code              cost

------------------------------------------------------------

Tarbo C++                          1001               250.95

C Primer                           905                95.70

algorithm                          1111                120.50

Principle of electronics       2220                150.85

Solution of balaguruswamy 6666                145.00
```

10.2: **Modify the above program to fill the unused spaces with hyphens.**

Solution:

```
1  #include<iostream.h>
2  #include<iomanip.h>
3  #include<string.h>
4  class item
5  {
6          char name[40];
7          int code;
8          float cost;
9          public:
10         void get_data(char *n,int c,float co)
```

```
11        {
12                strcpy(name,n);
13                code=c;
14                cost=co;
15        }
16     void display();
17
18};
19void item:: display()
20{
21
22          cout.precision(2);
23           cout.fill('-');
24          cout.setf(ios::fixed,ios::floatfield);
25           cout.setf(ios::showpoint);
26           cout.setf(ios::left,ios::adjustfield);
27           cout<<setw(40)<<name<<code;
28          cout.setf(ios::right,ios::adjustfield);
29          cout<<setw(15)<<cost<<endl;
30 }
31
32 int main()
33 {
34         item a[5];
35          a[0].get_data("Tarbo C++",1001,250.95);
36          a[1].get_data("C primer",905,95.7);
37       a[2].get_data("algorithm",1111,120.5);
38          a[3].get_data("principle of electronics",2220,150.85);
39          a[4].get_data("solution of balagurusamy",6666,145.00);
40         cout<<setw(10)<<"name"<<setw(34)<<"code"<<setw(15)<<"cost"<<endl;
41          for(int i=0;i<60;i++)
42           cout<<"-";
43            cout<<endl;
44            for(i=0;i<5;i++)
45              a[i].display();
46        return 0;
47}
```

output

name code cost

———————————————————————————————-

Tarbo C++ ——————— 1001————250.95

C Primer ——————————-905—————-95.70

algorithm——————————-1111————120.50

Principle of electronics——2220————150.85

Solution of balaguruswamy–6666——— 145.00

10.3: **Write a program which reads a text from the keyboard and displays the following information on the screen in two columns:**
(a) Number of lines
(b) Number of words
(c) Number of characters
Strings should be left-justified and numbers should be right-justified in a suitable field width.

Solution:

```
#include<iostream.h>
#include<iomanip.h>
#include<string.h>
#include<stdio.h>

int main()
{
        char line[1000];
        char ch;
         int c;
         int word,lines,chr;
         word=0;
         lines=0;
         chr=0;
         int end=0;
        cout<<" Enter text : \n";
        while(end==0)
         {
              c=0;
                    while((ch=getchar())!='\n')
          line1=ch;
          line1='\0';
          if(line[0]=='\0')
                 break;
                 else
                 {
                         word++;
                         for(int i=0;line[i]!='\0';i++)
                    if(line[i]==' ' || line[i]=='\t' || line[i]=='\n')
                                word++;
                  }
                  lines++;
          chr+=strlen(line);
        }
```

```
35
36          cout.setf(ios::left,ios::adjustfield);
37       cout<<setw(25)<<"Number of lines"<<setw(25)
38        <<"Number of words "<<"Number of characters "<<endl;
39        cout.setf(ios::right,ios::adjustfield);
40        cout<<setw(10)<<lines<<setw(24)<<word<<setw(25)<<chr<<endl<<endl;
41    return 0;
42}
```

output

Enter text :

santo reads in class five.

He always speak the truth.

He respects his teachers.

He feels shy when I admire him.

I like his morality.

Number of lines	Number of words	Number of characters
5	25	128

Note: If you press the Enter button two times, the program will terminate.

Chapter 11

Review Questions

11.1: **What are input and output streams?**

Ans:The stream that supplies data to the program is known as input stream and one that receives data from the program is known as output stream.

11.2: **What are the steps involved in using a file in a C++ program?**

Ans:The I/O system of C++ handles file operations which are very much similar to the console

input and output operations. The input stream extracts data from the file and output stream inserts data to the file.

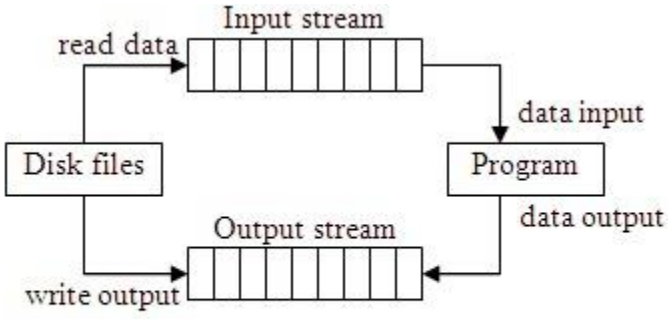


Fig : File input and output streams

11.3: **Describe the various classes available for file operations.**

Ans:See fig 11.3 of Balagurusamy, Page-325

11.4: **What is the difference between opening a file with a constructor function and opening a file with open() function? When is one method preferred over the other?**

Ans:When we open a file with a constructor a file name must be supplied during creation of object.

Example : ofstream outfile ("result"); //output only.

But when we use open ( ) function we can provide file name later.

Example :
ofstream outfile;
outfile.open ("Result");

Another difference is we can provide file modes using open ( ) function.
stream-object open ("file name", mode);
constructor method is proffered for only one file in the stream.
member function open ( ) of the class is preffered when we want to manage multiple files using one stream.

11.5: **Explain how while(fin) statement detects the end of a file that is connected to fin stream**

Ans:The given statement is
while (fin)

An ifstream object, such as fin, returns a value of o if any error occurs in the file operation including the end-of-file condition. We know while loop will terminate when fin returns zero. Thus end of file is detected.

11.6: **What is a file mode? Describe the various file mode options available.**

Ans: File-mode specifies the purpose for which the file is opened.

Various file mode options :

Parameter	Meaning
ios::app	Append to end of file
ios::ate	Go to end of file on opening
ios::binary	Binary file
ios::in	open file for reading only
ios::nocreate	open fails if the file does not exist
ios::noreplace	open fails if file already exist
ios::out	open file for writing only.
ios::trunc	Delete the contents of the file if it exist.

11.7: **Write a statement that will create an object called fob for writing, and associate it with a file name DATA**
Ans: ofsteam fob;
fob.open ("DATA");

11.8: **How many file objects would you need to create to manage the following situations?**
(a) To process four files sequentially.
(b) To merge two sorted files into a third file. Explain.

Ans: (a) only a single stream object.
(b) In such case we need to create two separate input stream for handling the two input files and one output stream for handling the output file. That means require three stream object.

11.9: **Both ios::ate and ios::app place the file pointer at the end of the file (when it is opened). What then, is the difference between them?**

Ans: Both ios::ate and ios::app take us to the end of the file when it is opened. The difference between the two parameters is that the ios::app allows us to add data to the end of the file only. While ios::ate mode permits us to add data or to modify the existing data anywhere in the file.

11.10: **What does the "current position" mean when applied to files?**

Ans: The 'curren position' applied to file means the byte location at which the next read or write operation will take place.

11.11: **Write statements using seekg() to achieve the following:**
(a) To move the pointer by 15 positions backward from current position.
(b) To go to the beginning after an operation is over.
(c) To go backward by 20 bytes from the end.
(d) To go to byte number 50 in the file.

Ans: Let, fout be an ofstream object.
(a) fout.seekg (-15,ios::cur);
(b) fout.seekg(0,ios::beg);
(c) fout.seekg (-20,ios::end);
(d) fout.seekg (49,ios::beg);

11.12: **What are the advantages of saving data in binary form?**

Ans: The binary format is more accurate for storing the numbers as they are stored in the exact internal representation. There are no comuensions while saving the data and therefore saving is much faster read ( ) and write ( ) function do this job.

11.13: **Describe how would you determine number of objects in a file. When do you need such information?**

Ans: We can find out the total number of objects in a file using object_length as follows:
in n = file_size/object_length;
This information is required to
1. Display the contents of a file.
2. Modify an existing item
3. Adding new item
4. Deleting an existing item

11.14: **Describe the various approaches by which we can detect the end•of-file condition successfully.**

Ans: Let, fin be an object of if stream. If end of file occurs fin returns zero. So we can use while (fin) to detect end of file.

11.15: **State whether the following statements are TRUE or FALSE.**
(a) A stream may be connected to more than one file at a time.
(b) A file pointer always contains the address of the file.
(c) The statement
outfile.wrttel(char *) & obj.sizeof(obj));
writes only data in obi to outfit..
(d) The ios::ate mode allows us to write data anywhere in the file.
(e) We can add data to an existing file by opening in write mode.
(f) The parameter ios::app can be used only with the files capable of output.
(g) The data written to a file with write) function can be read with the get() function.
(h) We can use the functions tellp() and tellg() interchangeably for any file.
(i) Binary files store floating point values more accurately and compactly than the text files.
(j) The fin.fail()call returns non-zero when an operation on the file has failed.

Ans:
(a) FALSE
(b) FALSE
* file pointer can be a synonym for current position.
(c) TRUE
(d) TRUE
(e) TRUE
(f) TRUE
(g) FALSE
(h) FALSE
* tell ( ) is for output file and tell g ( ) for input file
(i) TRUE
(j) FALSE
* fin.fail ( ) cau returns non-zero when an input or output operation on the file has failed.

Debugging Exercises

NOTE: We are sorry to say that Debugging Exercise question no 11.1 , 11.2 and 11.3 is unfortunately missed. We will come back with this question and answers very soon. Stay tune with us. Happy coding

11.4: **Find errors in the following statements.**

(a) ifstream.infile(“DATA”);
(b) finl.getline(); //finl is input stream
(c) if(finl.eof() == 0) exit(1);
(d) close(f1);
(e) infile.open(argc);
(g) sfinout.open(file,ios::in |ios::out| ios::ate);

Solution:
(a) Error : Improper use of ifstream.

Correction : ifstream infile (“DATA”);
(b) Here you must give two argument for getline ( ) function one is string type variable name and another is string size. Such as
char s[20];
getline(s, 20);

(c) If we write
if (fin1, eof ( ) = = 0)
exit (1);
it input only one character from file and then it will exit.
(d) close ( ) is void type argument function so it will be fl.close ( )
(e) argc is called argument counter and agrv is called argument vector so to open data file we can write the statement like this:
infile.open (argv[1]) :

(f) The argument file must write as ” file” because this is string type.
Correction :
fstream sfinout;
ios::out, ios::ate); | sfinout.open (“file”, ios::in

Programming Exercises

11.1 **Write a program that reads a text file and creates another file that is identical except that every sequence of consecutive blank spaces is replaced by a single space.**

Solution:

```
#include<iostream.h>
#include<fstream.h>
#include<stdio.h>
#include<string.h>

int main()
```

```
{
        ofstream of;     // of is a object of  ofstream file.
        of.open("hasib.txt");    // open a text document file named “hasib” to write.
        char c;
        ifstream inf("santo.txt");      // open a text document file named “santo” to read.
        inf.get(c);                     // retrieve  a single character  from “santo” file.

        while(inf)      // is character is ‘/0’  ? if not  go inside loop
          {

                if(c==' ')  // is character is a space? If yes  execute “if” statement.
                {
                      while(inf)   // is character is ‘/0’  ? if not  go inside loop
                        {
                              inf.get(c); // retrieve  a single character from “santo” file.
                              if(c!=' ')          // is character is not a space?
                              {                   // If yes  go outside the while loop.
                                   break;         // this is just for skip  the space.
                              }
                         }
                      of<<" ";         // write single space to “hasib”  text document file.
                      of<<c;         // write  next charcter to “hasib”  text document file.

                         }
               else
               of<<c;             // write  single character where no space exits.
              inf.get(c);      // retrieve a single character from “santo” text document again.
       }
   return 0;
}
```

Note: Before you run this program you just create a ‘.txt’ document to a particular drive where your compiler was installed.

11.2 A file contains a list of telephone numbers in the following form

John 23456

Ahmed 9876

…… ……

the names contain only one word and the names and telephone numbers are separated by white spaces. Write program to read this file and output the list in two columns. The names should be left justified and the numbers should be right justified.

Solution:

```
#include<iostream.h>
#include<fstream.h>
#include<string.h>
#include<iomanip.h>

int main()
{
          char name[100],n[100],number[100];

           ifstream  santo("robin.txt");
          cout<<" Enter your desired name to find mobile number :" ;
           cin>>n;

       again:
         santo>>name;
         if(!strcmp(name,n))
          {
                santo.getline(number,100);
                cout<<setw(-20)<<name<<setw(25)<<number<<"\n";

          }
        else
         {
              if(santo.eof()!=0)
              cout<<" Sorry your input name is not found in list \n";
               else
               goto again;
         }
    return 0;
}
```

Note: You just create a '.txt' document like as question no 11.1 which contains peoples name and phone number.

output

```
Enter your desired name to find mobile number : john
john 23456
```

11.3 Write a program that will create a data file containing the list of telephone numbers given in exercise in 11.2. Use a class object to store each set of data.

Solution:

```
#include<iostream.h>
#include<fstream.h>
#define size 5

class phone
{
      public:
      void set_data();

};



void phone:: set_data()
{

       ofstream  santo("phone.txt");
       char  *name[size]={"sattar","santo","kamruzzaman","robin","kawser"};
      char  *number[size]
  ={"01673050495","01723783117","01818953250","+214324513","+455652132"};
    for(int i=0;i<size;i++)
     {
          santo.setf(ios::left,ios::adjustfield);
          santo.width(20);
          santo<<name[i];
          santo.setf(ios::right,ios::adjustfield);
          santo.width(15);
          santo<<number[i]<<"\n";
    }
}

int main()
{
      phone book;
      book.set_data();

    return 0;
}
```

Note: When you run this program, It will create a txt document named ‘phone’.

11.4 Write an interactive, menu-driven program that will access the file created in exercise 11.3 and implement the tasks:
(a) Determine the telephone number of the specified person.

(b) Determine the name if a telephone number is known.
(c) Update, the telephone number, whenever there is a change.

Solution:

```
#include<iostream.h>
#include<fstream.h>
#include<string.h>
#include<iomanip.h>

int main()
{
        char name[100],n[100],m[100],number[100];

         ifstream  santo("robin.txt");
         int test;
        cout<<" Press 1  to find mobile number of specified person\n "
            <<" Press 2  to find name of specified number \n"
            <<" Press 3 to update number \n"
            <<" What is your option ?: ";
        cin>>test;

       if(test==1)
       {
              cout<<" Enter the desired name : ";
              cin>>n;
              cout<<"\n";
              again1:
             santo>>name;
             if(!strcmp(name,n))
             {
                   santo.getline(number,100);
                   cout<<setw(-20)<<name<<setw(25)<<number<<"\n";

              }
              else
               {
                     if(santo.eof()!=0)
                     cout<<" Sorry your input name is not found in list \n";
                     else
                     goto again1;
              }

       }



      else if(test==2)
       {
```

```
        cout<<" Enter the desired number : ";
        cin>>n;
        cout<<"\n";
        again2:
        santo>>name;
        santo>>number;

        if(!strcmp(number,n))
         {

              cout<<setw(-20)<<number<<setw(25)<<name<<"\n";

         }
        else
       {
            if(santo.eof()!=0)
            cout<<" Sorry your input number is not found in list \n";

            else
            goto again2;
        }
 }
else if(test == 3)
  {
          ofstream hasib("modified.txt");
          cout<<"Enter the name whose number have to change : ";
          cin>>n;
          again3:
          santo>>name>>number;

           if(!strcmp(n,name))
             {
                  cout<<" Enter changed mobile number of"<<name<<":   ";
                    cin>>m;
                    hasib.setf(ios::left,ios::adjustfield);
                    hasib.width(20);
                    hasib<<name;
                  hasib.setf(ios::right,ios::adjustfield);
                  hasib.width(15);
                  hasib<<m<<"\n";
                  while(santo)
                    {
                      santo>>name>>number;
                      hasib.setf(ios::left,ios::adjustfield);
                      hasib.width(20);
                      hasib<<name;
                      hasib.setf(ios::right,ios::adjustfield);
                      hasib.width(15);
                      hasib<<number<<"\n";
                    }
             }
```

```
      else
        {
              if(santo.eof()!=0)
              cout<<" Sorry your input name is not available \n";
              else
              {
                    hasib.setf(ios::left,ios::adjustfield);
                    hasib.width(20);
                    hasib<<name;
                    hasib.setf(ios::right,ios::adjustfield);
                    hasib.width(15);
                    hasib<<number<<"\n";
                    goto again3;
                                                                              }
       }


   }

   return 0;
}
```

During First Run :

output

```
Press 1 to find mobile number of specified person
Press 2 to find name of specified number
Press 3 to update number
What is your option ?: 1
Enter the desired name : john
john 23456
```

During Second Run :

output

```
Press 1 to find mobile number of specified person
Press 2 to find name of specified number
Press 3 to update number
What is your option ?: 3
Enter the name whose number have to change : Ahmed
Enter changed mobile number of Ahmed : 9876
```

Chapter 12

Review Questions

12.1: **What is generic programming? How is it implemented in C++?**

Ans: Generic programming is an approach where generic types are used as parameters in algorithms so that they work for variety of suitable data types and data structures.

It is implemented in C++ using class templetes.

12.2: **A template can be considered as a kind of macro. Then, what is the difference between them?**

Ans: Temples are a feature of the C++ programming language at allows functions and classes to be operated with generic types. This allows a functions or class to work on many different data types without being written for each one. Temples are of great utility programmers in C++, especially when combined with multiple inheritance and operator overloading. The C++ STL provides many useful functions within a framework of connected templates.

On the other hand the # define directive is typically used to associate meaningful identifiers with constants, keywords and commonly used statements or expressions. Identifiers that represent constants are sometimes called “symbolic constant” or “manifest constant”.

Identifiers that represents statements or expressions are called “macros”. In this preprocessor documentation only the term ‘macro’ is used.

12.3: **Distinguish between overloaded functions and junction templates.**

Ans: Basic difference is function body will not differ in function overloading.

12.4: **Distinguish between the terms class template and template class.**

Ans:Class template is a generic class. The class template definition is very similar to an ordinary class definition except the prefix template and the use of type T.

On the other hand a class created from a class template is called a template class. The process of creating a specific class from a class template is called instantiation.

12.5: **A class (or function) template is known as a parameterized class (or function).**

Comment.

Ans:When an object of specific type is defined for actual use, the template definition for that class is substituted with the required data type. Since a template is defined with a parameter that would be replaced by a specified data type at the time of actual use of the class or function, the templates are called parameterized classes or functions.

12.6: **State which of the following definitions are illegal.**
(a) temnplate
class city
{…… };

(b) template
class city
{….. }

(c) template
class city
{…… };

(d) template
class city
{….. };

(e) class
class list
{….. };

(f) class
class list
{….. };

Ans:
(a) Ok
(b) Illegal (type name expected)
template < class P, class R, class s>
class city
{……}

(c) Ok
(d) Ok
(e) Ok

(f) Ok

12.7: **Identify which of the following junction template definitions are illegal.**
(a) template
void fun(A, B)
{…. };

(b) template
void fun(A, A)
{….. };

(c) template
void fun(A, A)
{….. };

(d) template
T fun(T, R)
{….. };

(c) template
A fun(int A)
{….. };

Ans:
(a) Illegal
(b) Ok
(c) Ok
(d) Ok

Debugging Exercises

12.1: **Identify the error in the following program.**

```
1  #include<iostream.h>
2  class Test
3  {
4       int intNumber;
5       float floatNumber;
6  public:
7       Test()
8       {
```

```
9           intNumber = 0;
10          floatNumber = 0.0;
11      }
12      int getNumber()
13      {
14          return intNumber;
15      }
16      float getNumber()
17      {
18          return floatNumber;
19      }
20};
21void main ()
22      {
23          Test objTest1;
24          objTest1.getNumber();
25      }
```

Solution:It show ambiguity error, because the compiler consider int getNumber() and float getNumber() as same function. It happened because you write objtest1.getNumber(); in the main() function

12.2: **Identify the error in the following program.**

```
1  #include<iostream.h>
2  template <class R1, class T2>
3  class Person
4  {
5       T1 m_t1;
6       T2 m_t2;
7  public:
8       Person(T1 t1, T2 t2)
9       {
10          m_t1 = t1;
11          m_t2 = t2;
12          cout << m_t1 << " " << m_t2 <<end1;
13      }
14      Person(T2 t2, T1 t1)
15      {
16          m_t2 = t2;
17          m_t1 = t1;
18          cout << m_t1 << " " << m_t2 <<end1;
19      }
20};
21void main ()
22      {
23          Person< int, float> objPerson1(1, 2.345);
24          Person<float, char> objPerson2(2.132, 'r');
```

```
25    }
```

Solution: Here the two functions [‘person (T1 t1, T2, t2)’ and ‘person (T2 t2, T1, t1)’] are same. So you can write one of them.

12.3: **Identify the error in the following program.**

```
1  #include<iostream.h>
2  template<class T1, class T2>
3  T1& MinMax(T1 t1, T1 t2)
4  {
5     return t1 > t2 ? ta : t2;
6     cout << " ";
7  }
8  void main()
9  {
10    cout << ++MinMax(2, 3);
11}
```

Solution: There is no error in this program. It will run successfully.

12.4: **Find errors, if any, in the following code segment.**

```
1template<class T>
2T max(T, T)
3{..... };
4unsigned int m;
5int main()
6{
7   max(m, 100);
8}
```

/
Solution: First you declared T as int type data and then declared as unsigned int type. So it will show error. If you write this as,
unsigned int n = 100; [N.B must be in main() function]
and max (m, n);
then it will not show any error.
Note: Write ‘return 0;’ in the main() function.

Programming Exercises

12.1: **Write a function template for finding the minimum value contained in an array.**

Solution:

```
#include<iostream.h>
const int size=5;
template <class T>
class vector
{
             T v[size];
             public:
              vector(){}
              vector(T *b);
               void show();
              minimum(vector<T> &m);
};
template <class T>
vector<T>::vector(T *b)
{
       for(int i=0;i<size;i++)
         v[i]=b[i];

}
template<class T>
T vector<T>::minimum(vector<T> &m)
{
       int j=0;
       for(int k=1;k<size;k++)
         {
                if(m.v[j]>m.v[k])
                 j=k;
         }
  return m.v[j];
}
template<class T>
void vector<T>::show()
{
               cout<<"("<<v[0];
               for(int i=1;i<size;i++)
                cout<<","<<v[i];
                 cout<<")";
                cout<<"\n";
}
int main()
{

            int x[size]={5,7,3,1,8};//size is 5;
           float y[size]={1.2,1.5,2.3,1.0,0.501};
           vector<int> v1;
           vector<float> v2;
```

```
        v1=x;
        v2=y;
      cout<<" minimum value = "<<v1.minimum(v1)<<" of array";
      v1.show();
      cout<<" minimum value = "<<v2.minimum(v2)<<" of array";
      v2.show();

    return 0;
}
```

output

```
minimum value = 1 of array(5,7,3,1,8)
minimum value = 0.501 of array(1.2,1.5,2.3,1,0.501)
```

12.2: **Write a class template to represent a generic vector. Include member functions to perform the following tasks:**
(a) To create the vector
(b) To modify the value of a given element
(c) To multiply by a scalar value
(d) To display the vector in the following form (10, 20, 30 …)

Solution:

```
#include<iostream.h>
#include<iomanip.h>
template <class santo>
class vector
{
        float *p;
        int size;
        public:
        void creat_vector(santo a);
        void set_element(int i,santo value);
        void modify(void);
        void multiply(santo b);
        void display(void);
};
template <class santo>
void vector<santo>::creat_vector(santo a)
{
        size=a;
        p=new float[size];
}
template <class santo>
void vector<santo>::set_element(int i,santo value)
{
```

```
        p[i]=value;
}

template <class santo>
void vector<santo> :: multiply(santo b)
{
        for(int i=0;i<size;i++)
        p[i]=b*p[i];
}
template <class santo>
void vector<santo>:: display(void)
{
        cout<<"p["<<size<<"] = ( ";
          for(int i=0;i<size;i++)
          {
                if(i==size-1)
                cout<<p[i];
                else
                 cout<<p[i]<<" , ";

          }
                        cout<<")"<<endl;
}

template <class santo>
void vector<santo>::modify(void)
{
                 int i;
                cout<<" to edit a given element enter position of the element : ";
                cin>>i;
                i--;
                cout<<" Now enter new value of "<<i+1<<"th  element : ";
                santo v;
                cin>>v;
                p[i]=v;
                cout<<" Now new contents : "<<endl;
                display();

              cout<<" to delete an element enter position of the element :";
                cin>>i;
                 i--;

        for(int j=i;j<size;j++)
           {
         p[j]=p[j+1];
            }
         size--;
        cout<<" New contents : "<<endl;
        display();
}
```

```
int main()
{
		vector<float> hasib;
		int s;
		cout<<" enter size of vector : ";
		cin>>s;
		hasib.creat_vector(s);
		cout<<" enter "<<s<<" elements  one by one :"<<endl;
		for(int i=0;i<s;i++)
		{
			float v;
			cin>>v;
			hasib.set_element(i,v);
		}
		cout<<" Now contents  :"<<endl;
		hasib.display();
   cout<<" to multiply this vector by a scalar quantity enter this scalar quantity : ";
		float m;
		cin>>m;
		hasib.multiply(m);
		cout<<" Now contents : "<<endl;
		hasib.display();
		hasib.modify();
		return 0;
}
```

output

enter size of vector : 4

enter 4 elements one by one :

4 3 2 5

Now contents :

p[4] = (4 , 3 , 2 , 5)

to multiply this vector by a scalar quantity enter this scalar quantity : 3

Now contents :

p[4] = (12 , 9 , 6 , 15)

to edit a given element enter position of the element : 2

Now enter new value of 2th element : 222

Now new contents :

p[4] = (12 , 222 , 6 , 15)

to delete an element enter position of the element :3

New contents :

p[3] = (12 , 222 , 15)

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