

COMPUTER SCIENCE WITH C++

FOR CBSE CLASS 12

cppforschool
C++ Tutorial for school students

Revision Notes
Part -I

[Structure, Class and Object, Constructor and Destructor, Inheritance, File Handling, Pointer, Array, Data Structure and class 11th revision tour]

(Question 1,2,3,4 of Board Exam Paper)

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STRUCTURE

A structure is a collection of variable which can be same or different types. You can refer to a structure as a single variable, and to its parts as **members** of that variable by using the dot (.) operator. The power of structures lies in the fact that once defined, the structure name becomes a **user-defined data type** and may be used the same way as other built-in data types, such as int, double, char.

```
struct STUDENT
{
    int rollno, age;
    char name[80];
    float marks;
};

int main()
{
    STUDENT s1, s3;           // declare two variables of the new type
    cin >> s1.rollno >> s1.age >> s1.name >> s1.marks;
    cout << s1.rollno << s1.age << s1.name << s1.marks;
    STUDENT s2 = {100,17,"Aniket",92}; //initialization of variable
    cout << s2.rollno << s2.age << s2.name << s2.marks;
    s3=s2;                   //structure variable in assignment statement
    cout << s3.rollno << s3.age << s3.name << s3.marks;
}
```

Defining a structure

When dealing with the students in a school, many variables of different types are needed. It may be necessary to keep track of name, age, rollno and marks for example.

```
struct STUDENT
{
    int rollno, age;
    char name[80];
    float marks;
};
```

STUDENT is called the **structure tag**, and is your brand new data type, like int, double or char. **rollno, name, age, and marks** are **structure members**.

Declaring Variables of Type struct

The most efficient method of dealing with structure variables is to define the structure **globally**. This tells "the whole world", namely main and any functions in the program, that a new data type exists. To declare a structure globally, place it **BEFORE** int main(). The structure variables can then be defined locally in main, for example...

```
struct STUDENT
{
    int rollno, age;
    char name[80];
    float marks;
};

int main()
{
    // declare two variables of the new type
    STUDENT s1, s3;
    .....
}
```

Alternate method of declaring variables of type struct:

```
struct STUDENT
{
    int rollno, age;
    char name[80];
    float marks;
} s1, s3;
```



Accessing of data members

The accessing of data members is done by using the following format:

structure variable.member name

for example

```
cin >> s1.rollno >> s1.age >> s1.name >> s1.marks;
```

Initialization of structure variable

Initialization is done at the time of declaration of a variable. For example

```
STUDENT s2 = {100,17,"Aniket",92};
```

Structure variable in assignment statement

The statement

```
s3=s2;
```

assigns the value of each member of s2 to the corresponding member of s3. Note that one structure variable can be assigned to another only when they are of the same structure type, otherwise compiler will give an error.

Nested structure (Structure within structure)

It is possible to use a structure to define another structure. This is called nesting of structure. Consider the following program

```
struct DAY
{
    int month, date, year;
};

struct STUDENT
{
    int rollno, age;
    char name[80];
    day date_of_birth;
    float marks;
};
```



typedef

It is used to define new data type for an existing data type. It provides an alternative name for standard data type. It is used for self documenting the code by allowing descriptive name for the standard data type.

The general format is:

```
typedef existing datatype new datatype
```

for example:

```
typedef float real;
```

Now, in a program one can use datatype real instead of float.

Therefore, the following statement is valid:

```
real amount;
```

Enumerated data type

The enum specifier defines the set of names which are stored internally as integer constant. The first name was given the integer value 0, the second value 1 and so on.

for example:

```
enum months{jan, feb, mar, apr, may} ;
```

It has the following features:

- It is user defined.
- It works if you know in advance a finite list of values that a data type can take.
- The list cannot be input by the user or output on the screen.

#define preprocessor directive

The #define preprocessor allows to define symbolic names and constants e.g.

```
#define pi 3.14159
```

This statement will translate every occurrence of PI in the program to 3.14159

Macros



Macros are built on the #define preprocessor. Normally a macro would look like:

```
#define square(x) x*x
```

Its arguments substituted for replacement text, when the macro is expanded.

ASSIGNMENT

Question 1.

Rewrite the corrected code for the following program. Underline each correction (if any)

```
#include <iostream.h>
structure Supergym
{
    int member number;
    char membername[20];
    char membertype[] = "HIG";
};
```

```

void main()
{
    Supergym person1, person2;
    cin<<"Member Number:";
    cin>>person1.membernumber;
    cout<<"Member Name :";
    cin>>person1.membername;
    person1.member type = "MIG";
    person2 = person1;
    cin<<"Member Number:"<<person2.membernumber;
    cin<<"Member Name"<<person2.membername;
    cin<<"Member Number:"<<person2.membertype;
}

```

Question 2.

Give the output of the following program

```

#include<iostream.h>
struct Pixel
{
    int C,R;
};
void Display(Pixel P)
{
    cout << "Col" << P.C << "Row" << P.R << endl;
}
int main()
{
    Pixel X={40,50}, Y, Z;
    Z=X;
    X.C+=10;
    Y=Z;
    Y.C+=10;
    Y.R+=20;
    Z.C-=15;
    Display(X);
    Display(Y);
    Display(Z);
}

```



OOP CONCEPTS

Paradigm-: It means organizing principle of a program. It is an approach to programming.

Procedural Paradigm

In procedural programming paradigm, the emphasis is on doing things i.e., the procedure or the algorithm. The data takes the back seat in procedural programming paradigm. Also, this paradigm does not model real world well.

Object Oriented programming

The object oriented programming paradigm models the real world well and overcomes the shortcomings of procedural paradigm. It views a problem in terms of objects and thus emphasizes on both procedures as well as data.

The following are the **basic concepts used in object-oriented programming.**

Object-: An object is an identifiable entity with some characteristics and behavior.

Class-: A class represents a group of objects that share common properties, behavior and relationships.

Data Abstraction-: Abstraction refers to act of representing essential features without including the background details or explanations.

Encapsulation-: The wrapping up of data and associated functions into a single unit is known as Encapsulation. Encapsulation implements data abstraction.

Inheritance-: It is the capability of one class of things to inherit capabilities or properties from another class.

Polymorphism-: It is the ability for a message or data to be processed in more than one form. Polymorphism is a property by which the same message can be sent to objects of several different classes. Polymorphism is implemented in C++ through virtual functions and overloading- function overloading and operator overloading.

Advantages of Object oriented programming.

Software complexity can be easily managed

Object-oriented systems can be easily upgraded

It is quite easy to partition the work in a project based on object

Difference between Object Oriented Programming and Procedural Programming

Object Oriented Programming

- Emphasis on data
- Follow bottom up approach in program design
- Concept of Data hiding prevents accidental change in the data
- Polymorphism, inheritance, Data Encapsulation possible

Procedural Programming

- Emphasis on doing things (function)
- Follow top-down approach in program design
- Due to presence of global variables, there are possibilities of accidental change in data.

class enforce data-hiding, abstraction & encapsulation

A class groups its members into three sections : private, protected, and public.

The private and protected members remain hidden from outside world. Thus through private and protected members, a class enforces data-hiding.

The outside world is given only the essential and necessary information through public members, rest of the things remain hidden, which is nothing but abstraction. Abstraction means representation of essential features without including the background details and explanation.

CLASSES & OBJECTS

The mechanism that allows you to combine data and the function in a single unit is called a class. Once a class is defined, you can declare variables of that type. A class variable is called object or instance. In other words, a class would be the data type, and an object would be the variable.

Classes are generally declared using the keyword class, with the following format:

```
class class_name
{
    private:
        members1;
    protected:
        members2;
    public:
        members3;
};
```



Where class_name is a valid identifier for the class. The body of the declaration can contain members, that can be either data or function declarations, The members of a class are classified into three categories: private, public, and protected. Private, protected, and public are reserved words and are called member access specifiers. These specifiers modify the access rights that the members following them acquire.

private members of a class are accessible only from within other members of the same class. You cannot access it outside of the class.

protected members are accessible from members of their same class and also from members of their derived classes.

public members are accessible from anywhere where the object is visible.

By default, all members of a class declared with the class keyword have private access for all its members. Therefore, any member that is declared before one other class specifier automatically has private access.

ASSIGNMENT

Question 3.

Define a class candidate in C++ with following Description:

Private Members

- A data member RNo (Registration Number) of type long
- A data member Name of type string
- A data member Score of type float
- A data member Remark of type string
- A member function AssignRem() to assign Remarks as per the Score obtained by a candidate. Score range and the respective Remarks are shown as follows:

Score	Remarks
≥ 50	Selected
less than 50	Not selected

Public members

- A function ENTER() to allow user to enter values for RNo, Name, Score & call function AssignRem() to assign the remarks.
- A function DISPLAY() to allow user to view the content of all the data members.



Question 4.

Define a class ITEM in C++ with the following description :

Private Members

- Code of type integer (Item Code)
- Iname of type string (Item Name)
- Price of type float (Price of each item)
- Qty of type integer (Quantity of item in stock)
- Offer of type float (Offer percentage on the item)
- A member function GetOffer() to calculate Offer percentage as per the following rule :
 - If Qty ≤ 50 Offer is 0
 - If $50 < \text{Qty} \leq 100$ Offer is 5
 - If Qty > 100 Offer is 10

Public Members

- A function GetStock() to allow user to enter values for Code, Iname, Price, Qty and call function GetOffer() to calculate the offer.
- A function ShowItem() to allow user to view the content of all the data members.

CONSTRUCTOR AND DESTRUCTOR

CONSTRUCTOR

It is a member function having same name as it's class and which is used to initialize the objects of that class type with a legal initial value. Constructor is automatically called when object is created.

Types of Constructor

Default Constructor-: A constructor that accepts no parameters is known as default constructor. If no constructor is defined then the compiler supplies a default constructor.

```
student :: student()
{
    rollno=0;
}
```

Parameterized Constructor -: A constructor that receives arguments/parameters, is called parameterized constructor.

```
student :: student(int r)
{
    rollno=r;
}
```



Copy Constructor-: A constructor that initializes an object using values of another object passed to it as parameter, is called copy constructor. It creates the copy of the passed object.

```
student :: student(student &s)
{
    rollno = s.rollno;
}
```

There can be multiple constructors of the same class, provided they have different signatures. This feature is called constructor overloading.

DESTRUCTOR

A destructor is a member function having sane name as that of its class preceded by ~(tilde) sign and which is used to destroy the objects that have been created by a constructor. It gets invoked when an object's scope is over.

```
~student() { }
```

ASSIGNMENT

Question 5.

Answer the questions (i) and (ii) after going through the following class:

```
class Exam
{
    int Marks;
    char Subject[20];
public:
    Exam () //Function 1
    {
        Marks = 0;
        strcpy (Subject,"Computer");
    }
    Exam(char S[]) //Function 2
    {
        Marks = 0;
        strcpy(Subject,S);
    }
    Exam(int M) //Function 3
    {
        Marks = M;
        strcpy(Subject,"Computer");
    }
    Exam(char S[], int M) //Function 4
    {
        Marks = M;
        strcpy (Subject,S);
    }

    Exam(Exam &E); //Function 5

    ~Exam() //Function 6
    {}
};
```

- (i) Write statements in C++ that would execute Function 3 and Function 4 of class Exam.
- (ii) Which feature of Object Oriented Programming is demonstrated using Function 1, Function 2, Function 3 and Function 4 in the above class Exam?
- iii) In Object Oriented Programming, what is Function 6 referred as and when does it get invoked/called?
- iv) Which category of constructor - Function 5 belongs to? Write complete definition of it.

INHERITANCE

Inheritance: It is the capability of one class to inherit properties from another class.

Base Class: It is the class whose properties are inherited by another class. It is also called Super Class.

Derived Class: It is the class that inherit properties from base class(es). It is also called Sub Class.

Forms of inheritance

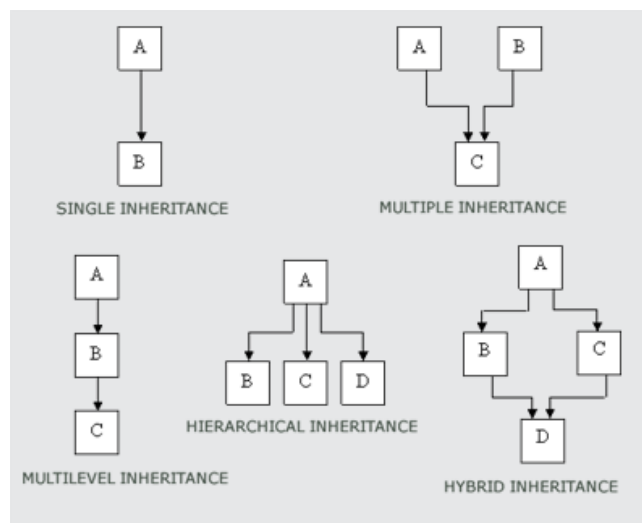
Single Inheritance: It is the inheritance hierarchy wherein one derived class inherits from one base class.

Multiple Inheritance: It is the inheritance hierarchy wherein one derived class inherits from multiple base class(es)

Hierarchical Inheritance: It is the inheritance hierarchy wherein multiple subclasses inherits from one base class.

Multilevel Inheritance: It is the inheritance hierarchy wherein subclass acts as a base class for other classes.

Hybrid Inheritance: The inheritance hierarchy that reflects any legal combination of other four types of inheritance.



Visibility Mode: It is the keyword that controls the visibility and availability of inherited base class members in the derived class. It can be either private or protected or public.

Private Inheritance: It is the inheritance facilitated by private visibility mode. **In private inheritance, the protected and public members of base class become private members of the derived class.**

Public Inheritance: It is the inheritance facilitated by public visibility mode. **In public inheritance, the protected members of base class become protected members of the derived class and public members of the base class become public members of derived class.**

Protected Inheritance: It is the inheritance facilitated by protected visibility mode. **In protected inheritance, the protected and public members of base class become protected members of the derived class.**

ASSIGNMENT

Question 6.

Answer the questions (i) to (iv) based on the following:

```
class PUBLISHER
{
    char Pub[12];
    double Turnover;
protected:
    void Register();
public:
    PUBLISHER();
    void Enter();
    void Display();
};
class BRANCH
{
    char CITY[20];
protected:
    float Employees;
public:
    BRANCH();
    void Haveit();
    void Giveit();
};
class AUTHOR : private BRANCH, public PUBLISHER
{
    int Acode;
    char Aname[20];
```



```

        float Amount;
    public:
        AUTHOR();
        void Start();
        void Show();
};

```

i) Write the names of data members, which are accessible from objects belonging to class AUTHOR.

ii) Write the names of all the member functions which are accessible from objects belonging to class AUTHOR.

iii) Write the names of all the members which are accessible from member functions of class AUTHOR.

iv) How many bytes will be required by an object belonging to class AUTHOR?

Question 7.



Answer the questions (i) to (iv) based on the following code :

```

class Drug
{
    char Category[10];
    char Date_of_manufacture[10];
    char Company[20];
public:
    Drug();
    void enterdrugdetails();
    void showdrugdetails();
};
class Tablet : public Drug
{
protected:
    char tablet_name[30];
    char Volume_label[20];
public:
    float Price;
    Tablet();
    void entertabletdetails();
    void showtabletdetails ();
};

```

```
};  
class PainReliever : public Tablet  
{  
    int Dosage_units;  
    char Side_effects[20];  
    int Use_within_days;  
public:  
    PainReliever();  
    void enterdetails();  
    void showdetails();  
};
```

- (i) How many bytes will be required by an object of class Drug and an object of class PainReliever respectively ?
- (ii) Write names of all the data members which are accessible from the object of class PainReliever.
- (iii) Write names of all the members accessible from member functions of class Tablet.
- (iv) Write names of all the member functions which are accessible from objects of class PainReliever.

DATA FILE HANDLING IN C++

File. The information / data stored under a specific name on a storage device, is called a file.

Stream. It refers to a sequence of bytes.

Text file. It is a file that stores information in ASCII characters. In text files, each line of text is terminated with a special character known as EOL (End of Line) character or delimiter character. When this EOL character is read or written, certain internal translations take place.

Binary file. It is a file that contains information in the same format as it is held in memory. In binary files, no delimiters are used for a line and no translations occur here.

Classes for file stream operation

ofstream: Stream class to write on files

ifstream: Stream class to read from files

fstream: Stream class to both read and write from/to files.

Opening a file

Opening file using constructor

```
ofstream fout("results.txt"); //output only
ifstream fin("data.txt"); //input only
```

Opening file using open()

```
ofstream ofile;
ofile.open("data1.txt");

ifstream ifile;
ifile.open("data2.txt");
```

File mode parameter	Meaning
ios::app	Append to end of file
ios::ate	go to end of file on opening
ios::binary	file open in binary mode
ios::in	open file for reading only
ios::out	open file for writing only

All these flags can be combined using the bitwise operator OR (`|`). For example, if we want to open the file `example.bin` in binary mode to add data we could do it by the following call to member function `open()`:

```
fstream file;
file.open ("example.bin", ios::out | ios::app | ios::binary);
```

Closing file

```
file.close();
```

Input and output operation

put() and get() function

the function `put()` writes a single character to the associated stream. Similarly, the function `get()` reads a single character form the associated stream.

example :

```
file.get(ch);
file.put(ch);
```



write() and read() function

`write()` and `read()` functions write and read blocks of binary data.

example:

```
file.read((char *)&obj, sizeof(obj));
file.write((char *)&obj, sizeof(obj));
```

File pointers and their manipulation

All I/O streams objects have, at least, one internal stream pointer:

`ifstream`, like `istream`, has a pointer known as the `get` pointer that points to the element to be read in the next input operation.

`ofstream`, like `ostream`, has a pointer known as the `put` pointer that points to the location where the next element has to be written.

Finally, `fstream`, inherits both, the `get` and the `put` pointers, from `iostream` (which is itself derived from both `istream` and `ostream`).

These internal stream pointers that point to the reading or writing locations within a stream can be manipulated using the following member functions:

<code>seekg()</code>	moves get pointer(input) to a specified location
<code>seekp()</code>	moves put pointer (output) to a specified location
<code>tellg()</code>	gives the current position of the get pointer
<code>tellp()</code>	gives the current position of the put pointer

The other prototype for these functions is:

```
seekg(offset, reposition );  
seekp(offset, reposition );
```

The parameter `offset` represents the number of bytes the file pointer is to be moved from the location specified by the parameter `reposition`. The `reposition` takes one of the following three constants defined in the `ios` class.

`ios::beg` start of the file

`ios::cur` current position of the pointer

`ios::end` end of the file

example:

```
file.seekg(-10, ios::cur);
```

Basic operation on text file

Program to write in a text file

```
#include<fstream.h>  
int main()  
{  
    ofstream fout;  
    fout.open("out.txt");  
    char str[300]="Time is a great teacher but unfortunately it kills  
all its pupils. Berlioz";  
    fout << str;  
    fout.close();  
    return 0;  
}
```

Program to read from text file and display it

```
#include<fstream.h>  
int main()  
{
```

```

    ifstream fin;
    fin.open("out.txt");
    char ch;
    while(!fin.eof())
    {
        fin.get(ch);
        cout << ch;
    }
    fin.close();
    return 0;
}

```

Program to count number of characters.

```

#include<fstream.h>
int main()
{
    ifstream fin;
    fin.open("out.txt");
    char ch;
    int count=0;
    while(!fin.eof())
    {
        fin.get(ch);
        count++;
    }
    cout << "Number of characters in file is " << count;
    fin.close();
    return 0;
}

```



Program to count number of words

```


#include<fstream.h>
int main()
{
    ifstream fin;
    fin.open("out.txt");
    char word[30];
    int count=0;
    while(!fin.eof())
    {
        fin >> word;
        count++;
    }
}

```

```
    }
    cout << "Number of words in file is " << count;
    fin.close();
    return 0;
}
```

Program to count number of line

```
#include<fstream.h>
int main()
{
    ifstream fin;
    fin.open("out.txt");
    char str[80];
    int count=0;
    while(!fin.eof())
    {
        fin.getline(str,80);
        count++;
    }
    cout << "Number of lines in file is " << count;
    fin.close();
    return 0;
}
```

The logo for 'cppforschool' is located in the middle of the code block. It features the text 'cppforschool' in a stylized font, with 'cpp' in blue, 'for' in orange, and 'school' in blue. Below the text, there is a small tagline: 'C++ tutorial for school students'.

Program to copy contents of file to another file.

```
#include<fstream.h>
int main()
{
    ifstream fin;
    fin.open("out.txt");
    ofstream fout;
    fout.open("sample.txt");
    char ch;
    while(!fin.eof())
    {
        fin.get(ch);
        fout << ch;
    }
    fin.close();
    fout.close();
    return 0;
}
```

ASSIGNMENT

Question 8.

Write a function to count number of words in a text file named "OUT.TXT"

Question 9.

Write a function in C++ to print the count of word the as an independent word in a text file STORY.TXT.

for example, if the content of the file STORY.TXT is

There was a monkey in the zoo. The monkey was very naughty.

Then the output of the program should be 2.

Question 10.

Write a function in C++ to count and display the number of lines starting with alphabet 'A' present in a text file "STORY.TXT".

Example:

If the file "STORY.TXT" contains the following lines,

The rose is red.

A girl is playing there.

There is a playground.

An aeroplane is in the sky.

Numbers are not allowed in the password.

The function should display the output as 2.

BASIC OPERATION ON BINARY FILE IN C++

```
class student
{
    int admno;
    char name[20];
public:
    void getdata()
    {
        cout << "\nEnter The admission no. ";
        cin >> admno;
        cout << "\nEnter The Name of The Student ";
        gets(name);
    }
    void showdata()
    {
        cout << "\nAdmission no. : " << admno;
        cout << "\nStudent Name : ";
        puts(name);
    }
    int retadmno()
    {
        return admno;
    }
};
```



Function to write in a binary file

```
void write_data()
{
    student obj;
    ofstream oFile;
    oFile.open("student.dat",ios::binary|ios::app);
    obj.getdata();
    oFile.write((char*)&obj,sizeof(obj));
    oFile.close();
}
```

function to display records of file

```
void display()
{
    student obj;
```

```

    ifstream iFile;
    iFile.open("student.dat",ios::binary);
    while(iFile.read((char*)&obj,sizeof(obj)))
    {
        obj.showdata();
    }
    iFile.close();
}

```

Function to search and display from binary file

```

void search (int n)
{
    student obj;
    ifstream iFile;
    iFile.open("student.dat",ios::binary);
    while(iFile.read((char*)&obj,sizeof(obj)))
    {
        if(obj.retadmno()==n)
            obj.showdata();
    }
    iFile.close();
}

```



ASSIGNMENT

Question 11.

Given a binary file STUDENT.DAT, containing records of the following class Student type

```

class Student
{
    char S_Admno[10]; //Admission number of student
    char S_Name[30]; //Name of student
    int Percentage; //Marks Percentage of student
public:
    void EnterData()
    {
        gets(S_Admno);
        gets(S_Name);
        cin >> Percentage;
    }
    void DisplayData()
    {
        cout << setw(12) << S_Admno;
        cout << setw(32) << S_Name;
    }
}

```



```

        cout << setw(3) << Percentage << endl;
    }
    int ReturnPercentage()
        {return Percentage;}
};

```

- a) Write a function in C++ to add more record in file STUDENT.DAT.
- b) Write a function in C++, that would read contents of file STUDENT.DAT and display the details of those Students whose Percentage is above 75.

Question 12.

Observe the program segment given below carefully and fill the blanks marked as Statement 1 and Statement 2 using seekg(), seekp(), tellp() and tellg() functions for performing the required task.

```

#include<fstream.h>
class PRODUCT
{
    int Pno; char Pname[20]; int Qty;
public :
    :
    void ModifyQty( ) ;
    // The function is to modify quantity of a PRODUCT
} ;
void PRODUCT: :ModifyQty ( )
{
    fstream File ;
    Fil.open ("PRODUCT.DAT", ios::binary |ios :: in| ios::out) ;
    int MPno;
    cout<<"Product No to modify quantity : "; cin>>MPNo;
    while (Fil.read ((char*) this, sizeof(PRODUCT))
    {
        if (MPno == Pno)
        {
            cout<<"Present Quantity:"<<Qty<<endl ;
            cout<<"Changed Quantity:";cin>>Qty ;
            int Position = _____; //Statement 1
            _____; // Statement 2
            Fil.write ((char*) this, sizeof (PRODUCT)) ;
            //Re-writing the record
        }
    }
    Fil.close ( ) ;
}

```

ARRAY

An array is a collection of data elements of same data type. It is described by a single name and each element of an array is referenced by using array name and its subscript no.

Declaration of Array

Type arrayName[numberOfElements];

For example,

```
int Age[5] ;
```

Initialization of One Dimensional Array

An array can be initialized along with declaration. For array initialization it is required to place the elements separated by commas enclosed within braces.

```
int A[5] = {11,2,23,4,15};
```

It is possible to leave the array size open. The compiler will count the array size.

```
int B[] = {6,7,8,9,15,12};
```

Referring to Array Elements

In any point of a program in which an array is visible, we can access the value of any of its elements individually as if it was a normal variable, thus being able to both read and modify its value. The format is as simple as:

name[index]

Examples:

```
cout << age[4]; //print an array element
age[4]=55; // assign value to an array element
cin >> age[4]; //input element 4
```

Using Loop to input an Array from user

```
int age [10] ;
for (int i=0 ; i<10; i++)
{
    cin >> age[i];
}
```

Arrays as Parameters

At some moment we may need to pass an array to a function as a parameter. In C++ it is not possible to pass a complete block of memory by value as a parameter to a function, but we are allowed to pass its address.

For example, the following function:

```
void print(int A[])
```

accepts a parameter of type "array of int" called A.

In order to pass to this function an array declared as:

```
int arr[20];
```

we need to write a call like this:

```
print(arr);
```

Here is a complete example:

```
#include <iostream.h>
void print(int A[], int length)
{
    for (int n=0; n<length; n++)
        cout << A[n] << " ";
    cout << "\n";
}
int main ()
{
    int arr[] = {5, 10, 15};
    print(arr,3);
}
```



BASIC OPERATION ON ONE DIMENSIONAL ARRAY

Function to traverse the array A

```
void display(int A[], int n)
{
    cout << "The elements of the array are:\n";
    for(int i=0;i<n;i++)
        cout << A[i];
}
```

Function to Read elements of the array A

```
void Input(int A[], int n)
{
    cout << "Enter the elements:";
    for(int i=0;i<n;i++)
        cin >> A[i];
}
```

Function to Search for an element from A by Linear Search

```
int Lsearch(int A[], int n, int Data)
{
    for(int I=0; I<n; I++)
    {
        if(A[I]==Data)
        {
            cout << "Data Found at : " << I;
            return;
        }
    }
    cout << "Data Not Found in the array" << endl;
}
```

Function to Search an element from Array A by Binary Search

```
int BsearchAsc(int A[], int n, int data)
{
    int Mid,Lbound=0,Ubound=n-1,Found=0;
    while((Lbound<=Ubound) && !(Found))
    {
        Mid=(Lbound+Ubound)/2;
        if(data>A[Mid])
            Lbound=Mid+1;
        else if(data<A[Mid])
            Ubound=Mid-1;
        else
            Found++;
    }
    if(Found)
        return(Mid+1); //returning location, if present
    else
        return(-1); //returning -1,if not present
}
```

Function to Sort the array A by Bubble Sort

```
void BSort(int A[], int n)
{
    int I,J,Temp;
    for(I=0;I<n-1;I++)
    {
```

```

        for (J=0;J<(n-1-I);J++)
            if (A[J]>A[J+1])
            {
                Temp=A[J];
                A[J]=A[J+1];
                A[J+1]=Temp;
            }
    }
}

```

Function to Sort the array ARR by Insertion Sort

```

void ISort(int A[], int n)
{
    int I,J,Temp;
    for(I=1;I<n;I++) //sorting
    {
        Temp=A[I];
        J=I-1;
        while((Temp<A[J]) && (J>=0))
        {
            A[J+1]=A[J];
            J--;
        }
        A[J+1]=Temp;
    }
}

```



Function to Sort the array ARR by Selection Sort

```

void SSort(int A[], int n)
{
    int I,J,Temp,Small;
    for(I=0;I<n-1;I++)
    {
        Small=I;
        for(J=I+1;J<n;J++) //finding the smallest element
            if (A[J]<A[Small])
                Small=J;
        if (Small!=I)
        {
            Temp=A[I]; //Swapping
            A[I]=A[Small];
            A[Small]=Temp;
        }
    }
}

```

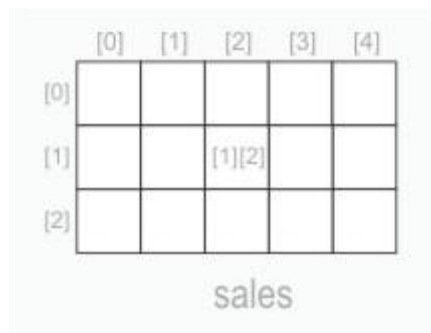
TWO DIMENSIONAL ARRAYS

It is a collection of data elements of same data type arranged in rows and columns (that is, in two dimensions).

Declaration of Two-Dimensional Array

Type arrayName[numberOfRows][numberOfColumn];

For example, int Sales[3][5];



Initialization of Two-Dimensional Array

An two-dimensional array can be initialized along with declaration. For two-dimensional array initialization, elements of each row are enclosed within curly braces and separated by commas. All rows are enclosed within curly braces.

```
int A[4][3] =    {{22, 23, 10},
                  {15, 25, 13},
                  {20, 74, 67},
                  {11, 18, 14}};
```

Referring to Array Elements

To access the elements of a two-dimensional array, we need a pair of indices: one for the row position and one for the column position. The format is as simple as:
name[rowIndex][columnIndex]

Examples:

```
cout<<A[1][2];    //print an array element
A[1][2]=13;      // assign value to an array element
cin>>A[1][2];    //input element
```

Using Loop to input an Two-Dimensional Array from user

```
int mat[3][5], row, col ;
for (row = 0; row < 3; row++)
    for (col = 0; col < 5; col++)
        cin >> mat[row][col];
```

Arrays as Parameters

Two-dimensional arrays can be passed as parameters to a function, and they are passed by reference. When declaring a two-dimensional array as a formal parameter, we can omit the size of the first dimension, but not the second; that is, we must specify the number of columns. For example: `void print(int A[][3],int N, int M)`In order to pass to this function an array declared as: `int arr[4][3]`;we need to write a call like this: `print(arr)`;

Here is a complete example:

```
#include <iostream.h>
void print(int A[][3],int N, int M)
{
    for (R = 0; R < N; R++)
        for (C = 0; C < M; C++)
            cin >> A[R][C];
}
int main ()
{
    int arr[4][3] ={{12, 29, 11},
                   {25, 25, 13},
                   {24, 64, 67},
                   {11, 18, 14}};
    print(arr,4,3);
    return 0;
}
```



Function to read the array A

```
void Read(int A[][20], int N, int M)
{
    for(int R=0;R<N;R++)
        for(int C=0;C<M;C++)
        {
            cout << "(R << ', ' << ")?";
            cin >> A[R][C];
        }
}
```

Function to display content of a two dimensional array A

```
void Display(int A[][20],int N, int M)
{
    for(int R=0;R<N;R++)
    {
        for(int C=0;C<M;C++)
            cout << A[R][C];
        cout << endl;
    }
}
```

Function to find the sum of two dimensional arrays A and B

```
void Addition(int A[][20], int B[][20],int N, int M)
{
    for(int R=0;R<N;R++)
        for(int C=0;C<M;C++)
            C[R][C]=A[R][C]+B[R][C];
}
```

Function to multiply arrays A and B of order NxL and LxM

```
void Multiply(int A[][20], int B[][20], int C[][20],int N, int L, int M)
{
    for(int R=0;R<N;R++)
        for(int C=0;C<M;C++)
        {
            C[R][C]=0;
            for(int T=0;T<L;T++)
                C[R][C]+=A[R][T]*B[T][C];
        }
}
```

Function to find & display sum of rows & cols. of array A

```
void SumRowCol(int A[][20], int N, int M)
{
    for(int R=0;R<N;R++)
    {
        int SumR=0;
        for(int C=0;C<M;C++)
            SumR+=A[R][C];
        cout << "Row(" << R << ")=" << SumR << endl;
    }
}
```



```

for(int R=0;R<N;R++)
{
    int SumR=0;
    for(int C=0;C<M;C++)
        SumR+=A[R][C];
    cout << "Row(" << R << ")=" << SumR << endl;
}
}

```

Function to find sum of diagonal elements of square matrix A

```

void Diagonal(int A[][20], int N, int &Rdiag, int &Ldiag)
{
    for(int I=0,Rdiag=0;I<N;I++)
        Rdiag+=A[I][I];
    for(int I=0,Ldiag=0;I<N;I++)
        Ldiag+=A[N-I-1][I];
}

```

Function to find out transpose of a two dimensional array A

```

void Transpose(int A[][20], int B[][20],int N, int M)
{
    for(int R=0;R<N;R++)
        for(int C=0;C<M;C++)
            B[R][C]=A[C][R];
}

```

Address Calculation of 2D array

ROW MAJOR

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[C*(I-LBI) + (J-LBJ)]$$

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[C*I + J]$$

COLUMN MAJOR

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[R*(J-LBJ) + (I-LBI)]$$

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[R*J + I]$$

ASSIGNMENT

Question 13.

Write a function in C++ which accepts an integer array and its size as arguments/parameters and exchanges the values of first half side elements with the second half side elements of the array.

Example:

If an array of eight elements has initial content as

2,4,1,6,7,9,23,10

The function should rearrange the array as

7,9,23,10,2,4,1,6

Question 14.

Write a function in C++ which accepts a 2D array of integers and its size as arguments and displays the elements of middle row and the elements of middle column.

[Assuming the 2D Array to be a square matrix with odd dimension i.e. 3x3, 5x5, 7x7 etc...]

Example, if the array contents is

3 5 4

7 6 9

2 1 8

Output through the function should be:

Middle Row : 7 6 9

Middle column : 5 6 1

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Question 15.

An array P[20][30] is stored in the memory **along the column** with each of the element occupying 4 bytes, find out the memory location for the element P[5][15], if an element P[2][20] is stored at the memory location 5000.

Question 16.

An array P[20][30] is stored in the memory **along the row** with each of the element occupying 4 bytes, find out the memory location for the element P[5][15], if an element P[2][20] is stored at the memory location 5000.

POINTER

C++ Memory Map

Once a program is compiled, C++ creates four logically distinct regions of memory:

Code Area : Area to hold the compiled program code

Data Area : Area to hold global variables

Stack Area : Area to hold the return address of function calls, argument passed to the functions, local variables for functions and the current state of the CPU.

Heap : Area from which the memory is dynamically allocated to the program.

Accessing address of a variable

Computer's memory is organized as a linear collection of bytes. Every byte in the computer's memory has an address. Each variable in program is stored at a unique address. We can use address operator & to get address of a variable:

```
int num = 23;
cout << &num; // prints address in hexadecimal
```

POINTER



A pointer is a variable that holds a memory address, usually the location of another variable in memory.

Defining a Pointer Variable

```
int *iptr;
iptr can hold the address of an int
```

Pointer Variables Assignment:

```
int num = 25;
int *iptr;
iptr = &num;
```

To access num using iptr and indirection operator *

```
cout << iptr; // prints 0x4a00
cout << *iptr; // prints 25
```

Similarly, following declaration shows:

```
char *cptr;  
float *fptr;
```

cptr is a pointer to character and fptr is a pointer to float value.

Pointer Arithmetic

Some arithmetic operators can be used with pointers:

- Increment and decrement operators ++, --
- Integers can be added to or subtracted from pointers using the operators +, -, +=, and -=

Each time a pointer is incremented by 1, it points to the memory location of the next element of its base type.

If “p” is a character pointer then “p++” will increment “p” by 1 byte.

If “p” were an integer pointer its value on “p++” would be incremented by 2 bytes.

Pointers and Arrays

Array name is base address of array

```
int vals[] = {4, 7, 11};  
cout << vals; // displays 0x4a00  
cout << vals[0]; // displays 4
```

Lets take an example:

```
int arr[]={4,7,11};  
int *ptr = arr;
```

What is ptr + 1?

It means (address in ptr) + (1 * size of an int)

```
cout << *(ptr+1); // displays 7  
cout << *(ptr+2); // displays 11
```

Array Access

Array notation arr[i] is equivalent to the pointer notation *(arr + i)

Assume the variable definitions

```
int arr[]={4,7,11};  
int *ptr = arr;
```

Examples of use of ++ and --

```
ptr++; // points at 7  
ptr--; // now points at 4
```

Character Pointers and Strings

Initialize to a character string.

```
char* a = "Hello";
```

a is pointer to the memory location where 'H' is stored. Here "a" can be viewed as a character array of size 6, the only difference being that a can be reassigned another memory location.

```
char* a = "Hello";
```

a gives address of 'H'

*a gives 'H'

a[0] gives 'H'

a++ gives address of 'e'

*a++ gives 'e'

Pointers as Function Parameters

A pointer can be a parameter. It works like a reference parameter to allow change to argument from within function

```
void swap(int *x, int *y)
```

```
{  
    int temp;  
    temp = *x;  
    *x = *y;  
    *y = temp;  
}
```

.....

.....

```
swap(&num1, &num2);
```



Pointers to Constants and Constant Pointers

Pointer to a constant: cannot change the value that is pointed at

Constant pointer: address in pointer cannot change once pointer is initialized

Pointers to Structures

We can create pointers to structure variables

```
struct Student {int rollno; float fees;};
```

```
Student stu1;
```

```
Student *stuPtr = &stu1;
```

```
(*stuPtr).rollno= 104;
```

-or-

Use the form ptr->member:

```
stuPtr->rollno = 104;
```

Static allocation of memory

In the static memory allocation, the amount of memory to be allocated is predicted and preknown. This memory is allocated during the compilation itself. All the declared variables declared normally, are allocated memory statically.

Dynamic allocation of memory

In the dynamic memory allocation, the amount of memory to be allocated is not known. This memory is allocated during run-time as and when required. The memory is dynamically allocated using new operator.

Free store

Free store is a pool of unallocated heap memory given to a program that is used by the program for dynamic allocation during execution.



Dynamic Memory Allocation

We can allocate storage for a variable while program is running by using new operator

To allocate memory of type integer

```
int *iptr=new int;
```

To allocate array

```
double *dptr = new double[25];
```

To allocate dynamic structure variables or objects

```
Student *sptr = new Student; //Student is tag name of structure
```

Releasing Dynamic Memory

Use delete to free dynamic memory

```
delete iptr;
```

To free dynamic array memory

```
delete [] dptr;
```

To free dynamic structure

```
delete sptr;
```

Memory Leak

If the objects, that are allocated memory dynamically, are not deleted using delete, the memory block remains occupied even at the end of the program. Such memory blocks are known as orphaned memory blocks. These orphaned memory blocks when increase in number, bring adverse effect on the system. This situation is called memory leak

Self Referential Structure

The self referential structures are structures that include an element that is a pointer to another structure of the same type.

```
struct node
{
    int data;
    node* next;
}
```

ASSIGNMENT

Question 17.

Find the output of the following program:

```
# include <iostream.h>
void main()
{
    int Track [] = {10,20,30,40,}, *Striker ;
    Striker=Track ;
    Track [1] += 30 ;
    cout<<"Striker"<<*Striker<<endl ;
    *Striker -=10 ;
    Striker++;
    cout<<"Next @"<<*Striker <<endl ;
    Striker+=2 ;
    cout<<"last @"<<*Striker<<endl ;
    cout<<"Reset To " <<Track [0] <<endl ;
}
```

Question 18.



Find the output of the following program :

```
#include <iostream.h>
void main ()
{
    intArray[] = {4,6,10,12};
    int *pointer = Array;
    for (int I=1 ; I<=3 ; I++)
    {
        cout<<*pointer<<"#";
        pointer++;
    }
    cout<<endl;
    for (I=1 ; I<=4 ; I++)
    {
        (*pointer)*=3 ;
        -- pointer;
    }
    for(I=1; I<5; I++ )
        cout << Array [I-1] << "@";
    cout << endl;
}
```



STATIC STACK

Stack is a linear data structure in which insertion and deletion of elements takes place only one end known as TOP.

```
#include<iostream.h>
#define size 4
class stack
{
    int data[size];
    int top;
public:
    stack()
    {
        top=-1;
    }
    void push();
    void pop();
    void display();
};

void stack::push()
{
    if(top==size-1)
    {
        cout << "\nStack is full";
        return;
    }
    else
    {
        top++;
        cout << "Enter Data : ";
        cin >> data[top];
    }
}

void stack::pop()
{
    if(top==--1)
        cout << "\n Stack is empty";
    else
    {
        cout << data[top] << "deleted " << endl;
        top--;
    }
}
```

The logo for 'cppforschool' is centered on the page. It features the text 'cppforschool' in a stylized font, with 'cpp' in orange, 'for' in blue, and 'school' in orange. Below the main text, there is a smaller tagline: 'C++ Tutorial for school students'.

```

    }
}

void stack::display()
{
    int t=top;
    while(t>=0)
    {
        cout << data[t] << endl;
        t--;
    }
}

int main()
{
    stack st;
    int ch;
    do
    {
        cout<<"\n1.Push\n2.Pop\n3.Display\n4.Quit\nChoice (1-4) ";
        cin >> ch;
        switch(ch)
        {
            case 1: st.push();break;
            case 2: st.pop();break;
            case 3: st.display();
        }
    }while(ch!=4);
}

```

STATIC CIRCULAR QUEUE

```

#include<iostream.h>
#define size 4
class cqueue
{
    int data[size];
    int front,rear;
public:
    cqueue()
    {
        front=-1;
        rear=-1;
    }
    void insert();
    void remove();
};

```

```

void cqueue::insert()
{
    if(rear==size-1&&front==0 || front==rear+1)
    {
        cout << "\nCircular queue is full";
        return;
    }
    else if(rear==size-1)
    {
        rear++;
        front++;
    }
    else if(rear==0)
        rear=size-1;
    else
        rear++;
    cout << "Enter Data : ";
    cin >> data[rear];
}

void cqueue::remove()
{
    if(front==size-1)
    {
        cout << "\n Circular Queue is empty";return;
    }
    cout << data[front] << " deleted" << endl;
    if(front==rear)
    {
        front=-1;rear=-1;
    }
    else if(front==size-1)
        front=0;
    else
        front++;
}

int main()
{
    cqueue cq;
    int ch;
    do
    {
        cout << "\n1. Insert\n2. Remove\n3. Quit\n Choice(1-3) ";
        cin >> ch;
        switch(ch)
        {
            case 1: cq.insert();break;
            case 2: cq.remove();break;
        }
    }
}

```

```

        }
    }while(ch!=3);
}

```

DYNAMIC STACK

Stack is a linear data structure in which insertion and deletion of elements takes place only one end known as TOP.

```

#include<iostream.h>
#include<conio.h>
struct node
{
    int data;
    node *next;
};

class stack
{
    node *top;
public :
    stack()
    {
        top=NULL;
    }
    void push();
    void pop();
    void display();
    ~stack();
};

void stack::push()
{
    node *temp;
    temp=new node;
    cout << "Enter data :";
    cin >> temp->data;
    temp->next=top;
    top=temp;
}

void stack::pop()
{

```



```

    if(top!=NULL)
    {
        node *temp=top;
        top=top->next;
        cout << temp->data << "deleted";
        delete temp;
    }
    else
        cout << "Stack empty";
}

void stack::display()
{
    node *temp=top;
    while(temp!=NULL)
    {
        cout << temp->data << " ";
        temp=temp->next;
    }
}

stack::~~stack()
{
    while(top!=NULL)
    {
        node *temp=top;
        top=top->next;
        delete temp;
    }
}

int main()
{
    stack st;
    char ch;
    do
    {
        cout<<"stack options\nP for push\nO for Pop";
        cout<<"\nD for Display\nQ for quit";
        cin >> ch;
        switch(ch)
        {
            case 'P': st.push();break;
            case 'O': st.pop();break;
            case 'D': st.display();break;
        }
    }while(ch!='Q');
}

```

DYNAMIC QUEUE

Queue is a linear data structure in which insertion and deletion of elements takes place from two opposite ends rear and front respectively.

```
#include<iostream.h>
#include<conio.h>
struct node
{
    int data;
    node *next;
};
class queue
{
    node *rear,*front;
public:
    queue()
    {
        rear=NULL;front=NULL;
    }
    void qinsert();
    void qdelete();
    void qdisplay();
    ~queue();
};

void queue::qinsert()
{
    node *temp;
    temp=new node;
    cout << "Data :";
    cin >> temp->data;
    temp->next=NULL;
    if(rear==NULL)
    {
        rear=temp;
        front=temp;
    }
    else
    {
        rear->next=temp;
        rear=temp;
    }
}

void queue::qdelete()
{

```



```

    if(front!=NULL)
    {
        node *temp=front;
        cout << front->data << "deleted \n";
        front=front->next;
        delete temp;
        if(front==NULL)
            rear=NULL;
    }
    else
        cout << "Queue Empty..";
}

void queue::qdisplay()
{
    node *temp=front;
    while(temp!=NULL)
    {
        cout << temp->data << endl;
        temp=temp->next;
    }
}

queue::~~queue()
{
    while(front!=NULL)
    {
        node *temp=front;
        front=front->next;
        delete temp;
    }
}

int main()
{
    queue obj; char ch;
    do
    {
        cout << "i. insert\n d. Delete\n s. Display\n q. quit ";
        cin >> ch;
        switch(ch)
        {
            case 'i' : obj.qinsert();break;
            case 'd' : obj.qdelete();break;
            case 's' : obj.qdisplay();
        }
    }while(ch!='q');
}

```

ASSIGNMENT

Question 19.

Change the following infix expression postfix expression.

$(A + B) * C + D / E - F$

Question 20.

Evaluate the following postfix expression using a stack and show the contents of stack after execution of each operation :

20, 30, +, 50, 40, -, *

C++ BASIC CONCEPTS (REVISION TOUR OF CLASS 11)

Question : Why main function is special in C++ ?

Answer : Whenever a C++ program is executed, execution of the program starts and ends at main(). The main is the driver function of the program. If it is not present in a program, no execution can take place.

Question : What is run-time error, logical error and syntax error?

Answer : Syntax error - the errors which are traced by the compiler during compilation, due to wrong grammar for the language used in the program, are called syntax errors.

For example, `cin >> a; //` instead of extraction operator insertion operator is used.

Run time Error - The errors encountered during execution of the program, due to unexpected input or output are called run-time error.

For example - `a=n/0; //` division by zero

Logical Error - These errors are encountered when the program does not give the desired output, due to wrong logic of the program.

For example : `remainder = a+b //` instead of using % operator + operator is used.

Question : What is the role of #include directive in C++?

Answer : The preprocessor directive `#include` tells the compiler to insert another file into your source file. In effect, `#include` directive is replaced by the contents of the file indicated.

Question : What is compiler and linker?

Answer : Compiler - It is a program which converts the program written in a programming language to a program in machine language.

Linker - It is a program which links a compiled program to the necessary library routines, to make it an executable program.

Question : Why is char often treated as integer data type in C++ ?

Answer : The memory implementation of char data type is in terms of the number code. Therefore, it is said to be another integer data type.

Question : What is type conversation in C++ ?

Answer : When two operands of different data types are encountered in the same expression, the variable of lower data type is automatically converted to the data types of variable with higher data type, and then the expression is calculated.

For example: `int a=98; float b=5; cout << a/3.0; //converts to float type, since 3.0 is of float type.`
`cout << a/b; // converts a temporarily to float type, since b is of float type, and gives the result 19.6.`



Question : What is type casting in C++ ?

Answer : Type casting refers to the data type conversions specified by the programmer, as opposed to the automatic type conversions. This can be done when the compiler does not do the conversions automatically. Type casting can be done to higher or lower data type.

For example : `cout << (float)12/5; //displays 2.4, since 12 is converted to float type.`

Question : What is the effect of absence of break in switch case statement in C++ ?

Answer : The break keyword causes the entire switch statement to exit, and the control is passed to statement following the switch.. case construct. Without break, the control passes to the statements for the next case. The break statement is optional in switch..case construct.

Question : In a control structure switch-case what is the purpose of default in C++ ?

Answer : This keyword gives the switch...case construct a way to take an action if the value of the switch variable does not match with any of the case constants. No break statement is necessary after default case, since the control is already at the end of switch..case construct. The default is optional in case of switch...case construct.

Question : What is the difference between while and do-while loop in C++ ?

Answer : While is an Entry Controlled Loop, the body of the loop may not execute even once if the test expression evaluates to be false the first time, whereas in do..while, the loop is executed at least once whether the condition holds true the first time or not.

Question : What is the difference between call by value and call by reference in a user defined function in C++?

Answer : The value of the actual parameters in the calling function do not get affected when the arguments are passed using call by value method, since actual and formal parameters have different memory locations.

The values of the formal parameters affect the values of actual parameters in the calling function, when the arguments are passed using call by reference method. This happens since the formal parameters are not allocated any memory, but they refer to the memory locations of their corresponding actual parameters

Question : What is preprocessor directive?

Answer : A preprocessor directive is an instruction to the compiler itself. A part of compiler called preprocessor deals with these directives, before real compilation process. # is used as preprocessor directive in C++.

Question : What is the difference between local variable and global variable?

Answer : Local variables are those variables which are declared within a function or a compound statement and these variables can only be used within that function/scope. They cannot be accessed from outside the function or a scope of its declaration. This means that we can have variables with the same names in different functions/scope. Local variables are local to the function/scope in which they are declared.

Global variables are those variables which are declared in the beginning of the program. They are not declared within a function. So, these variables can be accessed by any function of the program. So, global variables are global to all the functions of the program.

Question : What is the role of #define in C++?

Answer : It is a preprocessor directive to define a macro in a C++ program. Macros provide a mechanism for token replacement with or without a set of formal, function line parameters. For example :

```
#define PIE 3.1416
#define AVG(A,B,C) (A+B+C)/3
```

Question : What are the major differences between Object Oriented Programming and Procedural Programming?

<i>Object Oriented Programming</i>	<i>Procedural Programming</i>
------------------------------------	-------------------------------

Emphasis on data	Emphasis on doing things (function)
Follow bottom up approach in program design	Follow top-down approach in program design
Concept of Data hiding prevents accidental change in the data	Due to presence of global variables, there is possibilities of accidental change in data.
Polymorphism, inheritance, Data Encapsulation possible	Not applicable

LIBRARY FUNCTION

include Directive

The # include directive instructs the compiler to read and include another file in the current file. The compiler compiles the entire code. A header file may be included in one of two ways.

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

or

```
include "iostream.h"
```

The header file in angle brackets means that file reside in standard include directory. The header file in double quotes means that file reside in current directory.

LIBRARY FUNCTION

C++ provides many built in functions that saves the programming time

Mathematical Functions

Some of the important mathematical functions in header file **math.h** are

Function	Meaning
sin(x)	Sine of an angle x (measured in radians)
cos(x)	Cosine of an angle x (measured in radians)
tan(x)	Tangent of an angle x (measured in radians)
asin(x)	Sin-1 (x) where x (measured in radians)
acos(x)	Cos-1 (x) where x (measured in radians)
exp(x)	Exponential function of x (ex)
log(x)	logarithm of x
log 10(x)	Logarithm of number x to the base 10
sqrt(x)	Square root of x
pow(x, y)	x raised to the power y
abs(x)	Absolute value of integer number x
fabs(x)	Absolute value of real number x

Character Functions

All the character functions require **ctype.h** header file. The following table lists the function.

Function	Meaning
isalpha(c)	It returns True if C is an uppercase letter and False if c is lowercase.
isdigit(c)	It returns True if c is a digit (0 through 9) otherwise False.
isalnum(c)	It returns True if c is a digit from 0 through 9 or an alphabetic character (either uppercase or lowercase) otherwise False.

islower(c)	It returns True if C is a lowercase letter otherwise False.
isupper(c)	It returns True if C is an uppercase letter otherwise False.
toupper(c)	It converts c to uppercase letter.
tolower(c)	It converts c to lowercase letter.

String Functions

The string functions are present in the **string.h** header file. Some string functions are given below:

strlen(S)	It gives the no. of characters including spaces present in a string S.
strcat(S1, S2)	It concatenates the string S2 onto the end of the string S1. The string S1 must have enough locations to hold S2.
strcpy(S1, S2)	It copies character string S2 to string S1. The S1 must have enough storage locations to hold S2.
strcmp((S1, S2)==0) strcmp((S1, S2)>0) strcmp((S1, S2)<0)	It compares S1 and S2 and finds out whether S1 equal to S2, S1 greater than S2 or S1 less than S2.
strncmp((S1, S2)==0) strncmp((S1, S2)>0) strncmp((S1, S2)<0)	It compares S1 and S2 ignoring case and finds out whether S1 equal to S2, S1 greater than S2 or S1 less than S2.
strrev(s)	It converts a string s into its reverse
strupr(s)	It converts a string s into upper case
strlwr(s)	It converts a string s into lower case

Console I/O functions

The following are the list of functions are in **stdio.h**

getchar()	It returns a single character from a standard input device (keyboard). It takes no parameter and the returned value is the input character.
putchar()	It takes one argument, which is the character to be sent to output device. It also returns this character as a result.
gets()	It gets a string terminated by a newline character from the standard input stream stdin.
puts()	It takes a string which is to be sent to output device.

General purpose standard library functions

The following are the list of functions are in **stdlib.h**

randomize()	It initializes / seeds the random number generator with a random number
random(n)	It generates a random number between 0 to n-1
atoi(s)	It converts string s into a numerical representation.
itoa(n)	It converts a number to a string

Some More Functions

The getch() and getche() functions

The general form of the getch() and getche() is

```
ch=getche();
```

```
ch1=getch();
```

ch and ch1 are the variables of type character. They take no argument and require the **conio.h** header file. On execution, the cursor blinks, the user must type a character and press enter key. The value of the character returned from getche() is assigned to ch. The getche() function echoes the character to the screen. Another function, getch(), is similar to getche() but does not echo character to the screen.

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Question 21.

Observe the following program SCORE.CPP carefully, if the value of Num entered by the user is 5, choose the correct possible output(s) from the options from (i) to (iv), and justify your option.

```
//program : SCORE.CPP
#include<stdlib.h>
#include<iostream.h>
int main()
{
    randomize ();
    int Num, Rndnum;
    cin >> Num;
    Rndnum = random (Num) + 5;
    for (int N = 1; N<=Rndnum; N++)
        cout << N << " ";
}
```

Output Options:

- (i) 1 2 3 4
- (ii) 1 2
- (iii) 1 2 3 4 5 6 7 8 9
- (iv) 1 2 3

Question 22.

Give the output of the following program segment

```
char *NAME = "CoMPuTeR";
for (int x = 0; x < strlen(NAME); x++)
    if (islower(NAME [x]))
        NAME [x] = toupper (NAME[x]);
    else
        if (isupper (NAME[x]))
            if (x%2 ==0)
                NAME[x] = tolower (NAME [x]);
            else
                NAME [x] =NAME [x-1];
puts (NAME);
```



SOLUTION OF ASSIGNMENTS

Solution of question 1.

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

struct Supergym
{
    int membrnumber;
    char membername[20];
    char membertype[4];
};

void main()
{
    Supergym person1, person2;
    cout<<"Member Number:";
    cin>>person1.membrnumber;
    cout<<"Member Name :";
    cin>>person1.membername;
    strcpy(person1.membertype, "MIG");
    person2 = person1;
    cout<<"Member Number:"<<person2.membrnumber;
    cout<<"Member Name"<<person2.membername;
    cout<<"Member Number:"<<person2.membertype;
}
```

Solution of question 2.

Col50Row50
Col50Row70
Col25Row50

Solution of question 3.

```
class Candidate
{
    long RNo;
    char Name[20];
    float Score;
    char Remarks[20];
    void AssignRem( );
}
```



```

public:
    void Enter( );
    void Display( );
};

void Candidate: :AssignRem( )
{
    if (Score>=50)
        strcpy (Remarks,"Selected") ;
    else
        strcpy(Remarks,"Not Selected") ;
}

void Candidate: : Enter ( )
{
    cin>>RNo ;
    gets (Name) ;
    cin>>Score;
    AssignRem( ) ;
}

void Candidate: :Display()
{
    cout<<RNo<<Name<<Score<<Remarks<<endl;
}

```

Solution of question 4.

```

class ITEM
{
    int Code;
    char Iname[20];
    float Price;
    int Qty;
    float Offer;
    void GetOffer();
public :
    void GetStock();
    void ShowItem();
};

void ITEM::GetOffer()
{
    if(Qty<=50)
        Offer = 0;
    else if (Qty <=100)

```

```

        Offer = 5;
    else
        Offer = 10;
}
void ITEM::GetStock()
{
    cin >> Code;
    gets(Iname);
    cin >> Price >> Qty;
    GetOffer();
}
void ITEM::ShowItem()
{
    cout << Code << Iname << Price << Qty << Offer;
}

```

Solution of question 5.

- i) Exam obj(98);
Exam obj("Maths",89);
- ii) Function overloading or polymorphism
- iii) Destructor. It invokes automatically when object goes out of its scope.
- iv) Copy constructor.

```

Exam::Exam(Exam &T)
{
    Marks = T.Marks;
    strcpy(Subject,T.subject);
}

```

Solution of question 6.

- i) None of the data member is accessible from object of class AUTHOR
- ii) Enter(), Display(), Start(), Show()
- iii) **member functions** : Register(), Enter(), Display(),Haveit(), Giveit(),Start(), Show()
data members : Amount, Acode, Aname[20], Employees,
- iv) 70

Solution of Question 7.

- i) Drug : 40 bytes
PainReliever: 118 bytes
- ii) Price
- iii) Data Members: tablet_name, Volume_label, Price
Member Functions : enterdrugdetails(), showdrugdetails(), entertabletdetails(), showtabletdetails
- iv) enterdrugdetails(), showdrugdetails(), entertabletdetails(), showtabletdetails(), enterdetails(), showdetails()

Solution of Question 8.

```
void countword()
{
    int count=0;
    char word[30];
    ifstream fin;
    fin.open("OUT.TXT");
    while(!fin.eof())
    {
        fin >> word;
        count++;
    }
    cout << "The number of words in file are " << count;
    fin.close();
}
```

Solution of Question 9.

```
void countthe()
{
    int count=0;
    char word[30];
    ifstream fin;
    fin.open("STORY.TXT");
    while(!fin.eof())
    {
        fin >> word;
        if(strcmpi(word,"the")==0)
            count++;
    }
    cout << "The number of word in file are " << count;
    fin.close();
}
```

Solution of Question 10.

```
void countline()
{
    int count=0;
    char str[80];
    ifstream fin;
    fin.open("STORY.TXT");
    while(!fin.eof())
    {
        fin.getline(str,80);
        if(str[0]=='A')
            count++;
    }
    cout << "The number of lines starting with A are " << count;
    fin.close();
}
```

Solution of question 11.

```
void addrecord()
{
    ofstream ofile;
    ofile.open("STUDENT.DAT",ios::binary|ios::app);
    Student obj;
    obj.EnterData();
    ofile.write((char*)&obj,sizeof(obj));
    ofile.close();
}
```

```
void displayrecord()
{
    ifstream ifile;
    ifile.open("STUDENT.DAT",ios::binary);
    Student obj;
    while(ifile.read((char*)&obj,sizeof(obj)))
    {
        if(obj.ReturnPercentage()>75)
            obj.DisplayData();
    }
    ifile.close();
}
```



Solution of question 12.

Statement 1: File.tellg () ;

Statement 2:

File.seekg (FilePos - sizeof (PRODUCT));

OR File.seekg (-sizeof (PRODUCT), ios::cur));

Solution of question 13.

```
void exchange(int arr[],int s)
{
    int temp, mid=s/2;
    for(int i=0;i<s/2;i++,mid++)
    {
        temp=arr[i];
        arr[i]=arr[mid];
        arr[mid]=temp;
    }
}
```

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Solution of question 14.

```
void mrowmcol(int ARR[3][3],int s)
{
    int mid=s/2;
    for(int i=0;i<s;i++)
    {
        cout << ARR[mid][i] << " ";
    }
    cout << endl;
    for(i=0;i<s;i++)
    {
        cout << ARR[i][mid] << " ";
    }
}
```

Solution of Question 15.

COLUMN MAJOR FORMULA

$LOC(A[I][J]) = BASE(A) + W*[R*J + I]$

Given,

$$\text{LOC}(A[2][20])=5000$$

$$W=4$$

$$I=2$$

$$J=20$$

$$R=20$$

$$C=30$$

$$\text{BASE}(A)=?$$

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[R*J + I]$$

$$5000 = \text{BASE}(A) + 4[20*20 + 2]$$

$$5000 = \text{BASE}(A) + 4*402$$

$$\text{BASE}(A) = 5000 - 1608$$

$$\text{BASE}(A) = 3392$$

$$\text{LOC}(A[5][15])=?$$

$$W=4$$

$$I=5$$

$$J=15$$

$$R=20$$

$$C=30$$

$$\text{BASE}(A) = 3392$$

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[R*J + I]$$

$$= 3392 + 4*[20*15 + 5]$$

$$= 3392 + 4*305$$

$$= 3392 + 1220$$

$$= 4612$$



Solution of question 16.

ROW MAJOR FORMULA

$$\text{LOC}(A[I][J]) = \text{BASE}(A) + W*[C*I + J]$$

Given,

$$\text{LOC}(A[2][20])=5000$$

$$W=4$$

$$I=2$$

$$J=20$$

$$R=20$$

$$C=30$$

$$\text{BASE}(A)=?$$

$$\text{LOC (A[I][J])} = \text{BASE(A)} + \text{W} * [\text{C} * \text{I} + \text{J}]$$

$$5000 = \text{BASE(A)} + 4[30 * 2 + 20]$$

$$5000 = \text{BASE(A)} + 4 * 80$$

$$\text{BASE(A)} = 5000 - 320$$

$$\text{BASE(A)} = 4680$$

$$\text{LOC(A[5][15])} = ?$$

$$\text{W} = 4$$

$$\text{I} = 5$$

$$\text{J} = 15$$

$$\text{R} = 20$$

$$\text{C} = 30$$

$$\text{BASE(A)} = 4680$$

$$\text{LOC (A[I][J])} = \text{BASE(A)} + \text{W} * [\text{C} * \text{I} + \text{J}]$$

$$= 4680 + 4 * [30 * 5 + 15]$$

$$= 4680 + 4 * 165$$

$$= 4680 + 660$$

$$= 5340$$



Solution of question 17.

Striker > 10

Next @ 50

Last @ 40

Reset To 0

Solution of question 18.

4#6#10#

12@18@30@36@

Solution of question 19.

infix expression (A + B)*C+D/E-F

ITEM SCANNED	STACK	OPREATION	EXPRESSION
((PUSH	
A	(A

+	(+	PUSH	A
B	(+		AB
)		POP	AB+
*	*	PUSH	AB+
C	*		AB+C
+	+	PUSH,POP	AB+C*
D	+		AB+C*D
/	+/	PUSH	AB+C*D
E	+/		AB+C*DE
-	+-	PUSH,POP	AB+C*DE/
F	+-		AB+C*DE/F
	EMPTY	POP	AB+C*DE/F-+

Postfix Expression AB+C*DE/F-+

Solution of question 20.

EVALUATION OF **20, 30, +, 50, 40, -, ***

ITEM SCANNED	OPERATION	STACK	
20	PUSH 20	20	
30	PUSH 30	20,30	
+	POP 30, POP 20		20+30=50
	PUSH 50	50	
50	PUSH 50	50,50	
40	PUSH 40	50,50,40	
-	POP 40, POP 50		50-40=10
	PUSH 10	50,10	
*	POP 10, POP 50		50*10=500
	PUSH 500	500	
	POP 500		

Ans : 500

Solution of question 21.

(iii) 1 2 3 4 5 6 7 8 9

Justification is as follows:

Num	Rndnumber	
	Minimum	Maximum
5	5	10

All possible combinations :

1 2 3 4 5
1 2 3 4 5 6
1 2 3 4 5 6 7
1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9 10

The only option that satisfies these values is option (iii)

Solution of question 22.

cOmmUTee



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