



**Question 2:** Declare a structure to represent a complex number ( $r+mi$  where  $r$  is the real part and  $mi$  is the imaginary part). Then Write C++ functions to add, subtract, multiply and divide two complex numbers as the following. 5 points

$$(r1 + m1i) + (r2 + m2i) = (r1 + r2) + (m1 + m2)i$$

$$(r1 + m1i) - (r2 + m2i) = (r1 - r2) + (m1 - m2)i$$

$$(r1 + m1i)(r2 + m2i) = (r1r2 - m1m2) + (r1m2 - r2m1)i$$

$$\frac{(r1 + m1i)}{(r2 + m2i)} = \frac{(r1r2 + m1m2) + (r2m1 - r1m2i)}{(r2)^2 + (m2)^2}$$

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**Question 3:** Declare a class called ComplexType that represent the complex numbers as defined in the structure above then define the operation above using operator overloading (as a member function) and define the << (output operation) as a friend function. 5 points

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**Question 4:** Write the definition of a class that has the following properties using C++: 8 points

1. The name of the class is Person.
2. The class Person has four member variables: name of type string, age and weight of type int, and height of type double.
3. The class Person has the following member functions.
  - a. Print which outputs the data stored in the member variables
  - b. setName which is a function to set the name
  - c. setAge which is a function to set the age
  - d. setWeight which is a function to set the weight
  - e. setHeight which is a function to set the height
  - f. getName which is a value-returning function to return the name
  - g. getAge which is a value-returning function to return the age
  - h. getWeight which is a value-returning function to return the weight
  - i. getHeight which is a value-returning function to return the height
  - j. constructor with default parameters: The default value of name is the empty string " ", and the default values of age, weight, and height are 0.
4. Write the definition of the member functions of the class Person, as described in Part c (all get function should be constant).
5. Write a main function which use the class. Person above to create a number of instances of class Person defined by the user then the main function should store the information in a sequential access file.

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**Question 5:** Create a class called PersonType which will contain the following information 5 points

- a. FirstName, Lastname, Address of type string
- b. Phone of type int
- c. SSN of type long.

Use the class PersonType as a base class to create the following classes (using the appropriate data for each)

- a. Employee (which may be a salaried employee or hourly paid employee)
- b. Student

1- draw the class hierarchy.

2- Create the classes above using inheritance and polymorphism in C++ code ( PersonType should be abstract class).

**Question 6:** Given the following class convert it with its methods to template format

3 points

```
class Test
{
public:
    Test(int,int);
    intGet_x();
    intGet_y();
    void Set(int,int);
private:
    intx,y;
};
Test::Test(inta,int b)
{
    x=a;
    y=b;
}
intGet_x()
{
    return x;
}
intGet_y()
{
    return y;
}
void Test::Set(inta,int b)
{
    x=a;
    y=b;
}
```

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**Question 7:** Given the following code which represent a program to find matrix inversion. If the determinant of the matrix is ZERO (0) then the matrix has no inverse. Adjust the program so you can generate an exception if the determinant of a given matrix is zero. NOTE( the exception should be generated in inv function and should be handled in main function) **use exception class**

4 points

```
floatdet(float** arr,int size)
{
    if(size==2)
        return (arr[0][0]*arr[1][1]-arr[0][1]*arr[1][0]);

    float d=0.0;
    float** ar;
    ar=new float*[size-1];
    for(inti=0;i<size-1;i++)
        ar[i]=new float[size-1];

    for(inti=0;i<size;i++)
    {
        for(int r=1;r<size;r++)
        {
            for(int j=0,k=0;j<size;j++)
            {
                if(i==j)
                    continue;
                ar[r-1][k]=arr[r][j];
                k++;
            }
        }
        d+=pow(-1,i)*arr[0][i]*det(ar,size-1);
    }
    return d;}
float** inv(float** arr,int size)
{
    float d;
    d=det(arr,size);
    float** carr=new float*[size];
    for(inti=0;i<size;i++)
        carr[i]=new float[size];
```

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float** darr=new float*[size-1];
for(inti=0;i<size-1;i++)
    darr[i]=new float[size-1];

for(inti=0;i<size;i++)
{
    for(int j=0;j<size;j++)
    {
        for(int r1=0,r2=0;r1<size;r1++)
        {
            if(r1==i)
                continue;
            for(int c1=0,c2=0;c1<size;c1++)
            {
                if(c1==j)
                    continue;
                darr[r2][c2]=arr[r1][c1];
                c2++;
            }
            r2++;
        }
        carr[j][i]=det(darr,size-1);
    }
}
for(inti=0;i<size;i++)
{
    for(int j=0;j<size;j++)
    {
        carr[i][j]/=d;
    }
}
returncarr; }

int main()
{
    int size;
    cin>>size;
    float** test;
    test=new float*[size];
    for(inti=0;i<size;i++)
        test[i]=new float[size];

    for(inti=0;i<size;i++)
        for(int j=0;j<size;j++)
            cin>>test[i][j];
    float** test_inv;
    test_inv=inv(test,size);
    return 0;
}

```

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*Good Luck*

*Eng. Sultan M. Al-Rushdan.*