

Question 1

- A. Declare and implement the following class hierarchy:

Create a base class ***Circle*** that has 4 data members, ***x***, ***y***, ***r*** and ***area***, representing the coordinates of the center, the radius, and the area of a circle, and has a ***constructor*** that initializes the data members of ***Circle*** objects with given values. It also has 2 member functions: (1) ***show_data()*** to display the values of the center coordinates, radius, and area of a ***Circle*** object, and (2) ***getArea()*** that calculates the area of a ***Circle*** object by using the formula πr^2 , where $\pi=3.14$.

Create a child class ***Cylinder*** that has an additional data member ***h*** representing the cylinder height, and has a ***constructor*** that initializes the data members of the ***Cylinder*** objects with given values. It redefines the member function ***show_data()*** to display the values of the data members of the ***Cylinder*** object, and redefines the member function ***getArea()*** to calculate the surface area of a ***Cylinder*** object by using the formula: $(2 \times \pi \times r^2) + (2 \times \pi \times r \times h)$.

- B. Write a program that creates an array of 5 pointers to ***Circle***. In a loop, gets from the user data about a circle or a cylinder, and use ***new*** to create an object of type ***Circle*** or ***Cylinder*** to hold the data, and then put the pointer to the created object in the array. When the user has finished entering the data for all figures, display the data for all figures entered.

Question 2

- A. Define a base class ***clock*** that has 3 data members: ***hr*** and ***min***, which hold the time in hours and minutes, and ***is_pm***, which is set to 0 for ***am*** and 1 for ***pm***. It has a ***constructor*** that creates a clock object and sets its data members to given values, and two member functions: ***getdata()*** that reads the data members of a clock object, and ***showdata()*** that displays a clock object in the form hh:mm followed by ***am*** or ***pm***.

- B. Define another base class ***calendar*** that has 3 data members: ***day***, ***month***, and ***year***, which hold a date, a ***constructor*** that creates a calendar object and sets its data members to given values, and two member functions: ***getdata()*** that reads the data members of a calendar object, and ***showdata()*** that displays a calendar object in the form dd/mm/yy.

C. Define a child class ***clock_calendar*** that is derived from the two base classes ***clock*** and ***calendar***. It does not have data members of its own, but it has a ***constructor*** that creates a ***clock_calender*** object and sets its inherited data members to given values, and one member function: ***showdata()*** that overrides the function ***showdata()*** inherited from both base classes. It displays the calendar data followed by the clock data.

Question 3

A. Define a class **Point** that has two data members: ***x*** and ***y*** (of type double), representing the x- and y-coordinates of a point, and has a ***constructor*** that initializes the data members of a **Point** object with given values. It has a member function ***distance()*** that calculates and returns the distance between two points ***p1(x₁,y₁)*** and ***p2(x₂,y₂)*** using the formula:

$$\text{Distance} = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}.$$

It also has two Functions: ***getdata()*** to get its data from the keyboard, and ***showdata()*** to output its data on the screen.

B. Define a class **Triangle**, that has four data members: ***p1***, ***p2***, and ***p3*** (of type **Point**), representing the vertices of a triangle, and ***area*** (of type double), representing the area of a triangle, and has a ***constructor*** that initializes the data members ***p1***, ***p2***, and ***p3*** of a **Triangle** object with given values. It has a member function ***get_area()*** that calculates the area of a **Triangle** object, where the area of a triangle of sides a, b, and c is obtained by the formula:

$$\text{area} = \sqrt{s(s-a)(s-b)(s-c)}, \text{ where } s = \frac{a+b+c}{2}.$$

It also has two Functions: ***getdata()*** to get its data from the keyboard, and ***showdata()*** to output its data on the screen.

C. Write a program that creates an array of 5 objects of class **Triangle**. In a loop, gets from the user the data of the 5 **Triangle** objects, and calculate their areas. When the user has finished entering the data for all **Triangle** objects, display their data (3 vertices and area).