

Exercise 2

Rectangles and triangles are two common types of polygons. They can be represented by their dimensions, w and h . As for a rectangle, w represents the width and h is the length of the rectangle. Whereas for a triangle, w and h are the base and height of the triangle, respectively (refer to Figure 1).

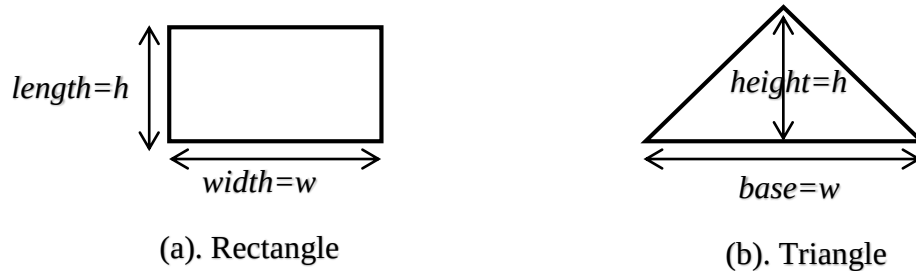


Figure 1: Representation of a rectangle and triangle.

Given an incomplete program source code, `program1.cpp` which contains a parent class named `Polygon` and two child classes named `Rectangle` and `Triangle`, respectively. Complete the program based on the tasks 1 to 5 below. Note that, the tasks are also stated in the program.

Task 1: In class `Polygon`, define two member functions (methods) and allow them to be polymorphic. The methods and their purpose are as follows:

- a) **display** : to display a message "*Generic polygon*" onto the screen.
- b) **calcArea**: to return a value of zero.

(6 marks)

Task 2: Specify the class `Rectangle` as a child of the class `Polygon` and complete the definitions the following methods:

- a) the constructor: to initialize the width and length of the rectangle.
- b) **display** : to display the width and length of the rectangle.
- c) **calcArea**: to calculate the area of the rectangle. **Formula:** $\text{area} = \text{width} \times \text{length}$.

(9 marks)

Task 3: Specify the class `Triangle` as another child of the class `Polygon` and complete the definitions the following methods:

- a) the constructor: to initialize the base and height of the triangle.
- b) **display** : to display the base and height of the triangle.
- c) **calcArea**: to calculate the area of the triangle. **Formula:** $\text{area} = \frac{1}{2} \times \text{base} \times \text{height}$.

(9 marks)

Task 4: Declare an array of pointers to polygons and fill in the array with different types of polygons that are allocated dynamically. The polygons are:

- a triangle with the base is 10 and height is 20,
- a rectangle with the width is 20 and length is 20,
- a generic polygon, and
- another rectangle with the width and length are 15 and 10, respectively.

(6 marks)

Task 5: Display the information of all polygons along with their area and calculate the total area of the polygons. The program should produce screen output as shown in Figure 2.

(5 marks)

```
Polygon #1
Triangle:
    Base = 10, Height = 20
    Area = 100

Polygon #2
Rectangle:
    Width = 20, Length = 20
    Area = 400

Polygon #3
Generic polygon:
    Area = 0

Polygon #4
Rectangle:
    Width = 15, Length = 10
    Area = 150

The total area of all polygons = 650
```

Figure 2: Program output