

CS-203 Lab 10

Write a program using inheritance and polymorphism. The base class will be abstract. It will have one or more PVFs and it will be called `Polygon`. It will be used to derive four other classes named: `Rectangle`, `Square`, `Pentagon` and `Hexagon`. The program will have the following features:

- a. Use inheritance and polymorphism.
- b. The base class will have the following pure virtual functions: `perimeter()`, `area()`, `center_of_gravity()` (coordinates of x and y)
- c. The derived classes should have a member function to display **all the properties** of a particular object: Perimeter, area, center of gravity and its side (s).
- d. The base class should have only the following variables defined:
`double x, y; // Coordinates of lower left corner`
- e. Each derived class should have a default and a general constructor.
- f. The main program should have a function to display the menu with choices.
- g. There should be a function to input the location of your object (x and y coordinates)

Note:

1. All functions must be MEMBER functions, except for the input.
2. All the variables in both classes must be declared protected or private.
3. The program should display a menu and let the user select one of the 4 objects above.
4. The main program should have **an array of 4 pointers** to objects of type `Polygon`.
5. All these variables should be dynamically allocated.
6. After the selection there will be a single function call using the array of pointers.
(Polymorphism will determine the appropriate function to call)
7. Make sure the destructors are made virtual.

Test your program with the following objects:

- | | |
|------------------------------------|------------------------------------|
| 1. Square - side 4 - (3, 2) | 5. Square - side 0.7 - (2, 3) |
| 2. Rectangle - sides 3, 5 - (0, 3) | 6. Rectangle - sides 3, 5 - (3, 4) |
| 3. Pentagon - side 6 - (-2, 1) | 7. Pentagon - side 5.4 - (1, -4) |
| 4. Hexagon - side 7 - (2, 2) | 8. Hexagon - side 2.1 - (5, 0) |

Formulas: Area, Perimeter and Center of Gravity

(Input: Only 1 or 2 sides depending on the object)

Square: (Input: 1 side: s)

- $A = s^2$
- $P = 4s$
- $C = \left(\frac{s}{2}, \frac{s}{2}\right)$ (*Center of Gravity is a coordinate vector in 2 dimensional space assuming that one of the vertices is positioned at the origin*)

Rectangle: (Input: 2 sides: l, w)

- $A = lw$
- $P = 2l + 2w$
- $C = \left(\frac{l}{2}, \frac{w}{2}\right)$

Pentagon: (Input: 1 side: s)

- $A = \frac{5s^2 \tan 54}{4}$ (*There are other ways to find this area*)
- $P = 5s$
- $C = \left(\frac{s}{2}, \frac{s \tan 54}{2}\right)$

Hexagon: (Input: 1 side: s)

- $A = \frac{3\sqrt{3}s^2}{2}$
- $P = 6s$
- $C = \left(\frac{s}{2}, \frac{\sqrt{3}s}{2}\right)$