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DS210
HW7

Question 1:

For the first question, we design a data type shape where we store three different shapes. We use an Enum to store these shapes because they are all of data type f64.

Next, we create an auxiliary function that is used to make the four shapes. Then we implement the original shape Enum using 4 different methods which compute the area, perimeter, and double perimeter, and verify the parameters for each shape. The results are shown below:

```
   Compiling Q1 v0.1.0 (/Users/gshiv/projects/HW7/Q1)
warning: crate `Q1` should have a snake case name
  |
  = help: convert the identifier to snake case: `q1`
  = note: `#[warn(non_snake_case)]` on by default

warning: `Q1` (bin "Q1") generated 1 warning
    Finished dev [unoptimized + debuginfo] target(s) in 0.39s
     Running `target/debug/Q1`
Area of Triangle: 6
Area of Rectangle: 6
Area of Circle: 3.141592653589793
Double Perimeter of Triangle 24
Double Perimeter of Rectangle 20
Double Perimeter of Circle 12.566370614359172
verify_parameters: true
verify_parameter: true
verify_paramters: true
```

As we can see, the parameters are verified, and for the values of:

[3,4,5] – triangle the area and double perimeter are correct.

[2,3] – rectangle the area and double perimeter are correct.

[1.0] – circle the area and double perimeter are correct.

Question 2:
For the second question, we create a struct and a trait with the number and length of the sides being parameters.
The four methods produce the perimeter area radius and apothem for each different number and length of sides.

If we are showing the area of a circle that is circumscribed, the area of the circle is greater than the area of the polygon. In this case, the circle has the same radius as the length of the apothems. Hence, we can use the area of a circle with one radius length.

For different side numbers of [6,12,24,128,256,512,1024,2048,65536]
For side length with a radius of 5.0

```
Number of sides: 6
Radius: 5.773502691896258
Polygon area: 64.95190528383291
Circle area: 104.7197551196598
Ratio of Circumscribed to Regular 1.612266101541527
Number of sides: 12
Radius: 10.000000000000002
Polygon area: 279.9038105676658
Circle area: 314.15926535897944
Ratio of Circumscribed to Regular 1.122382952635911
Number of sides: 24
Radius: 19.318516525781366
Polygon area: 1139.3631169087728
Circle area: 1172.458339988224
Ratio of Circumscribed to Regular 1.0290471251774784
Number of sides: 128
Radius: 101.90008123548057
Polygon area: 32588.38709766664
Circle area: 32621.124905313438
Ratio of Circumscribed to Regular 1.001004585085745
Number of sides: 256
Radius: 203.73878167231433
Polygon area: 130373.18433047387
Circle area: 130405.91247408374
Ratio of Circumscribed to Regular 1.0002510343195032
Number of sides: 512
Radius: 407.446881033519
Polygon area: 521512.3725223999
Circle area: 521545.09825085185
Ratio of Circumscribed to Regular 1.0000627515859186
Number of sides: 1024
Radius: 814.878421922257
Polygon area: 2086069.125105289
Circle area: 2086101.8502300042
Ratio of Circumscribed to Regular 1.0000156874594046
Number of sides: 2048
Radius: 1629.7491738984622
Polygon area: 8344296.135390641
Circle area: 8344328.860364425
Ratio of Circumscribed to Regular 1.0000039218375347
Number of sides: 65536
Radius: 52151.8918322471
Polygon area: 8544565938.160411
Circle area: 8544565970.885334
Ratio of Circumscribed to Regular 1.0000000038299106
```

One can observe that as the side lengths increase the difference between the polygon area and circle area decreases. For example, the area of a polygon and circle with side length 6 is 64 and 104 approximately and the area for a side length of 65536 is 8544565838 and 8544565970 approximately. We can also see the ratios of these areas become closer to 1 as the side length increases. The ratio of difference is becoming more equal because a polygon with more side lengths begins to appear like a circle.