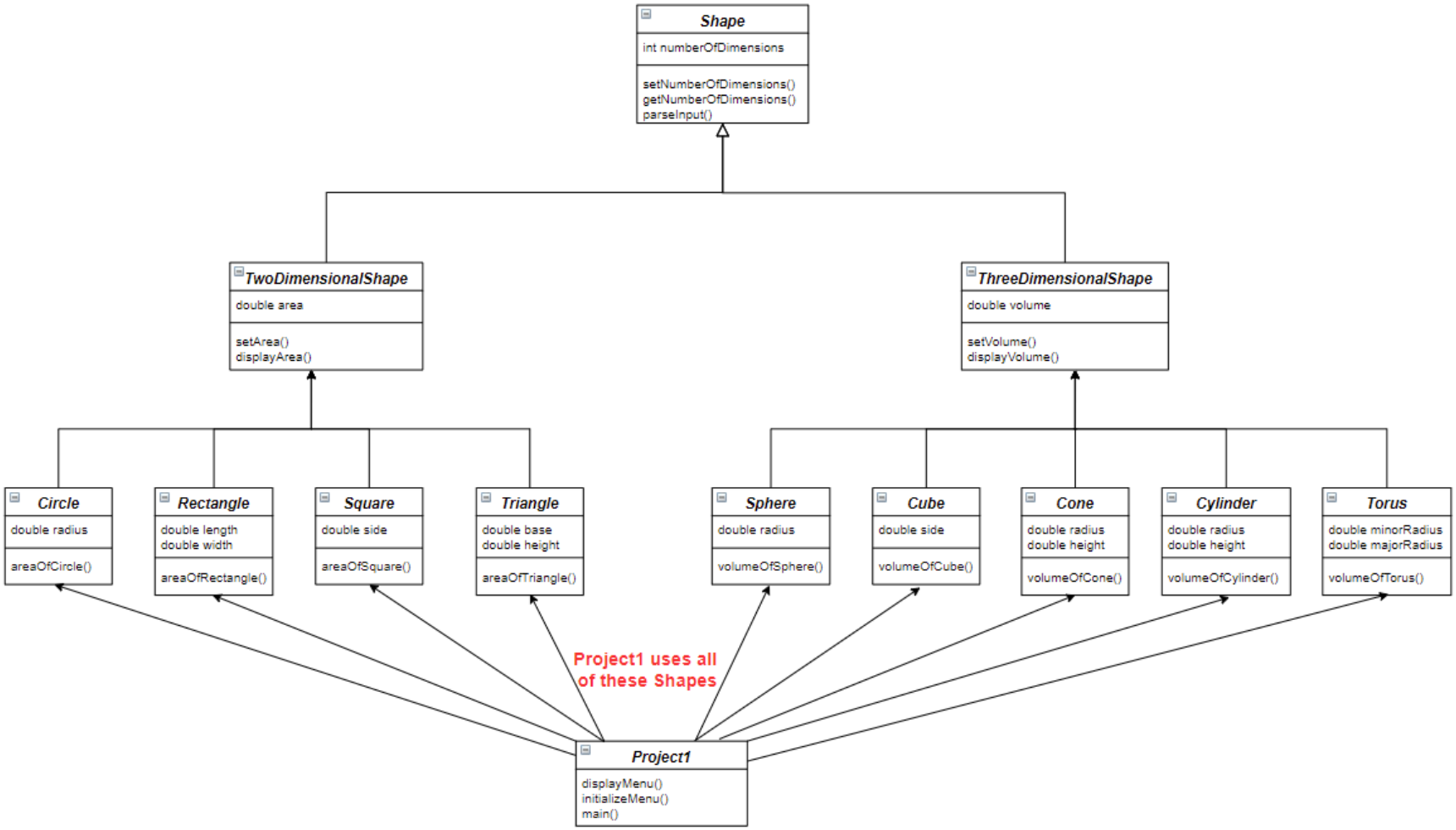


Figure 1. UML diagram of class relationships

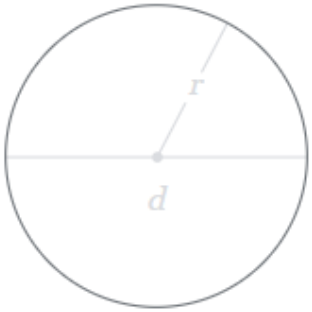
Lessons learned:

This project helped my cement my knowledge of how hierarchies work and why they are indispensable in terms of reducing duplicated code. The best example of reused code was the parseInput() method within the Shape class. It was used in all of the 9 shapes to determine their attributes (length/width/height/radius/base). I suppose I also could have combined displayVolume() and displayArea() in Shape by passing a string (volume or area) and an int (volume or area in integer/double representation) but I think things are fine they way they are now. The program is very simple to operate, simply run Project1.java and follow the prompts from the menu. Test cases showcasing all functionality begins on the next page.

```
*********Welcome to the Java OO Shapes Program **********

Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
1

You have chosen to create a Circle

What is the radius?
16.3

A Circle has 2 dimensions, its area is 834.69
```

$$A \approx 834.69$$

r Radius 16.3



Solution

$$A = \pi r^2 = \pi \cdot 16.3^2 \approx 834.68975$$

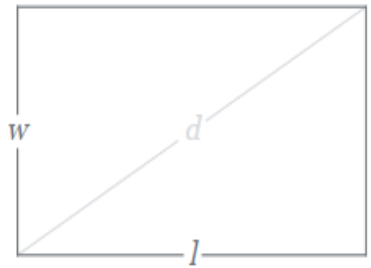
Figure 2. Test case #1 showcasing the welcome message and the area of an inputted circle being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
2

You have chosen to create a Rectangle

What is the length?
70.3

What is the width?
3.5

A Rectangle has 2 dimensions, its area is 246.05
```

$$A \approx 246.05$$

l Length 70.3

w Width 3.5



Solution

$$A = w\,l = 3.5 \cdot 70.3 \approx 246.05$$

Figure 3. Test case #2 showcasing the area of an inputted rectangle being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
3

You have chosen to create a Square

How long is a side?
197

A Square has 2 dimensions, its area is 38,809
```

$$A = 38809$$

a Side 197

Solution

$$A = a^2 = 197^2 = 38809$$

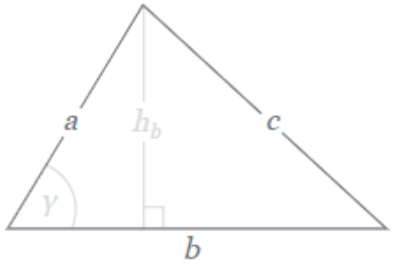
Figure 4. Test case #3 showcasing the area of an inputted square being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
4

You have chosen to create a Triangle

What is the base?
10

What is the height?
63.2

A Triangle has 2 dimensions, its area is 316
```

$$A = 316$$

b Base 10

h_b Height 63.2



Solution

$$A = \frac{h_b b}{2} = \frac{63.2 \cdot 10}{2} = 316$$

Figure 5. Test case #4 showcasing the area of an inputted triangle being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
5

You have chosen to create a Sphere

What is the radius?
25.3

A Sphere has 3 dimensions, its volume is 67,834.43
```

$$V \approx 67834.43$$

r Radius 25.3

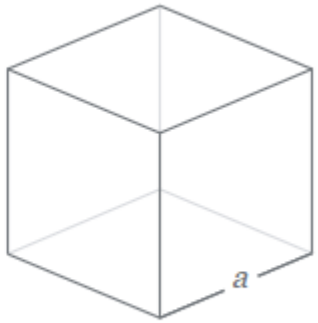
Solution

$$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\cdot\pi\cdot 25.3^3 \approx 67834.42887$$

Figure 6. Test case #5 showcasing the volume of an inputted sphere being displayed with matching results.

$$V \approx 92959.68$$

a Edge 45.3



Solution

$$V = a^3 = 45.3^3 \approx 92959.677$$

Figure 7. Test case #6 showcasing the volume of an inputted cube being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
7

You have chosen to create a Cone

What is the radius?
8.7

What is the height?
15.4

A Cone has 3 dimensions, its volume is 1,220.64
```

$$V \approx 1220.64$$

r Radius 8.7

h Height 15.4

Solution

$$V = \pi r^2 \frac{h}{3} = \pi \cdot 8.7^2 \cdot \frac{15.4}{3} \approx 1220.64069$$

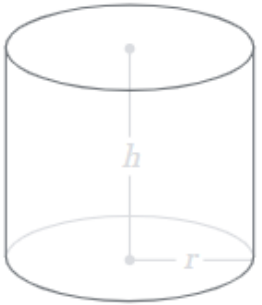
Figure 8. Test case #7 showcasing the volume of an inputted cone being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
8

You have chosen to create a Cylinder

What is the radius?
9

What is the height?
10

A Cylinder has 3 dimensions, its volume is 2,544.69
```

$$V \approx 2544.69$$

r Radius 9

h Height 10



Solution

$$V = \pi r^2 h = \pi \cdot 9^2 \cdot 10 \approx 2544.69005$$

Figure 9. Test case #8 showcasing the volume of an inputted cylinder being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
9

You have chosen to create a Torus

What is the minor radius?
1

What is the major radius?
1000

A Torus has 3 dimensions, its volume is 19,739.21
```

$$V \approx 19739.21$$

Solution

$$V = (\pi r^2)(2\pi R) = (\pi \cdot 1^2) \cdot (2 \cdot \pi \cdot 1000) \approx 19739.2088$$

Figure 10. Test case #9 showcasing the volume of an inputted torus being displayed with matching results.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
q

Thank you for using the program!
The current date and time is March 25, 2021 at 14:18PM
BUILD SUCCESSFUL (total time: 4 minutes 6 seconds)
```

Figure 11. Test case #10 showcasing the successful quitting of the program upon q key press.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
a
That was not a vailid selection, please try again

Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
```

Figure 12. Test case #11 showcasing an invalid menu selection.

```
Please select an option from the menu below
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
Q. Quit program
1

You have chosen to create a Circle

What is the radius?
wow

wow is not a valid selection. Input must be a positive decimal or integer, please try again
-3

The value can't be negative, please try again
3

A Circle has 2 dimensions, its area is 28.27
```

Figure 13. Test case #12 showcasing how invalid input is handled within shape creation.