Project 1 Developer's Guide

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CMSC 335: Object-Oriented and Concurrent Programming

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27 AUG 2021

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note: tables are start of new testing sequences.

Compile and Run Shapes Program

Note: Program was developed using openJDK 16.0.2.

COMPILING: unzip Lindley_Shapes.zip, open your preferred terminal and changed directory (cd) to the unzipped Lindley_Shapes folder. Once in folder, enter the command: javac main.java.

Running: Once program is compiled, remain in the same folder and enter the command java main.java, then you will be prompted for input through the terminal.

Alternatively can be compiled and run through an IDE by opening folder and running main.java, will need java support extensions for programs like visual studio code.

UML Diagram can be viewed from image included named “UML” for larger picture. Can also view UML.puml through an IDE extension like PlantUML.

Test Plan

First part of the test plan is to ensure that all parts of the program are reachable and the program is navigable with out issue.

- This will involve ensuring that each shape can be created and the program can be continued after each shape creation.
- Will also need to ensure that the program can be exited properly at all points the program allows for exit.

Second part of the Test plan is to ensure every part of the program can handle unexpected inputs for each part.

- This will involve:
  - Ensure main menu can handle invalid input (anything that is not 1 to 10)
  - Ensure exit prompt can handle invalid input (anything that is not capital or lower case y/n)
  - Ensure each shape can handle invalid input (anything that is not a positive number greater than zero)

Third part of Test plan is to ensure proper output.

- This involves calculation what outputs should be for inputs of each shape and testing them against what the program outputs

Testing Part 1 – Navigation and Reachability

Table 1.1

Menu navigation, continue after selection, and proper program exit from main menu

Test Run	Input	Expected Output / Behavior	Actual Output / Behavior	Pass /Fail
1	1, 12, y	You have selected circle. What is the radius? The area of the Circle is: 452.389 Would you like to continue Y/N? Select from the menu below:	You have selected circle. What is the radius? The area of the Circle is: 452.389342... Would you like to continue Y/N? Select from the menu below	Pass
2	2, 4, 8, y	You have selected rectangle What is the length? What is the width? The area of the rectangle is: 32 Would you like to continue y/n? Select from the menu below:	You have selected rectangle What is the length? What is the width? The area of the rectangle is: 32 Would you like to continue y/n? Select from the menu below:	Pass
3	3, 5.6, y	You have selected a square What is the length of one edge? The area of the square is: 11.2 Would you like to continue y/n? Select from the menu below:	You have selected a square What is the length of one edge? The area of the square is: 11.2 Would you like to continue y/n? Select from the menu below:	Pass
4	4, 22, 6.70127, 146.052, 12, 11, y	You have selected a triangle What is the base? What is the Height (from center of base)? What is the largest angle? If one of the sides is the same.. What is the length of the side to the left of the base? What is the length of the side to the right of the base? The Area of the Triangle is: 73.713 The type of triangle based on its angles is: obtuse The type of triangle based on its sides is: Scalene Would you like to continue? Select from the menu below:	You have selected a triangle What is the base? What is the Height (from center of base)? What is the largest angle? If one of the sides is the same.. What is the length of the side to the left of the base? What is the length of the side to the right of the base? The Area of the Triangle is: 73.71397 The type of triangle based on its angles is: obtuse The type of triangle based on its sides is: Scalene Would you like to continue? Select from the menu below:	Pass
5	5, 15, y	You have selected a Sphere What is the radius?	You have selected a Sphere What is the radius?	Pass

		The Volume of the Sphere is: 10602.875 Would you like to continue Y/N? Select from the menu below:	The Volume of the Sphere is: 10602.8752058... Would you like to continue Y/N: Select from the menu below:	
6	6, 2.0123, y	You have selected a cube What is the length of one edge? The volume of the cube is: 8.148 Would you like to continue Y/N? Select from the menu below:	You have selected a cube What is the length of one edge? The volume of the cube is: 8.148509... Would you like to continue Y/N? Select from the menu below:	Pass
7	7, 22, 50, y	You have selected a cone What is the radius? What is the height? The volume of the cone is: 25342.180 Would you like to continue Y/N: Select from the menu below:	You have selected a cone What is the radius? What is the height? The volume of the cone is: 25342.18073... Would you like to continue Y/N: Select from the menu below:	Pass
8	8, 15, 32, y	You have selected a cylinder What is the radius? What is the height? The volume of the cylinder is: 222619.467 Would you like to continue Y/N: Select from the menu below:	You have selected a cylinder What is the radius? What is the height? The volume of the cylinder is: 222619.46710... Would you like to continue Y/N: Select from the menu below:	Pass
9	9, 88, 33, y	You have selected a torus What is the major radius? What is the minor radius? The volume of the torus is: 1891647.857 Would you like to continue Y/N: Select from the menu below:	You have selected a torus What is the major radius? What is the minor radius? The volume of the torus is: 1891647.857930... Would you like to continue Y/N: Select from the menu below:	Pass
10	10	Thanks for using the program. Today is: (today’s data and time)	Thanks for using the program. Today is: Aug 27 at 13:10	Pass

Note: This is all one continuous run to ensure user able to use everything without issue.

Run 1:

```
[thomas@thomas-ge66 Lindley_Shapes]$ javac main.java
[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
1

You have selected a Circle
What is the radius?
12

The area of the Circle is: 452.3893421169302

Would you like to continue Y/N?
y

Select from the menu below:
```

Run 2:

```
Select 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
10. Exit the program
2

You have selected a Rectangle
What is the length?
4
What is the width?
8
The area of the Rectangle is: 32.0
This rectangle is also is not a square.

Would you like to continue Y/N?
y

Select from the menu below:
```

Run 3:

```
Select 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
10. Exit the program
3

You have selected a Square
What is the length of one edge?
5.6

The area of the Square is: 11.2

Would you like to continue Y/N?
y

Select from the menu below:
```

Run 4:

```
Select 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
10. Exit the program
4

You have selected a Triangle
What is the base?
22

What is the height (from center of base)?
6.70127

What is the largest angle?
146.052

If one of the sides is the same as the height, re-enter please!
What is the the length of side to the left of the base?
12

What is the the length of side to the right of the base?
11

The area of the Triangle is: 73.71397

The type of triangle based on its angles is:
Obtuse

The type of triangle based on its sides is:
Scalene

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 5:

```
Select 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
10. Exit the program
5

You have selected a Sphere
What is the radius?
15

The volume of the Sphere is: 10602.875205865552

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 6:

```
Select 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
10. Exit the program
6

You have selected a Cube
What is the length of one edge?
2.0123

The volume of the Cube is: 8.148509600867003

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 7:

```
Select 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
10. Exit the program
7

You have selected a Cone
What is the radius?
22
What is the height?
50

The volume of the cone is: 25342.180738957668

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 8:

```
Select 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
10. Exit the program
8

You have selected a Cylinder
What is the radius?
15
What is the height?
32

The volume of the Cylinder is: 22619.46710584651

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 9:

```
Select 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
10. Exit the program
9

You have selected a Torus
What is the major radius?
88
What is the minor radius?
33

The volume of the Torus is: 1891647.8579303906

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 10:

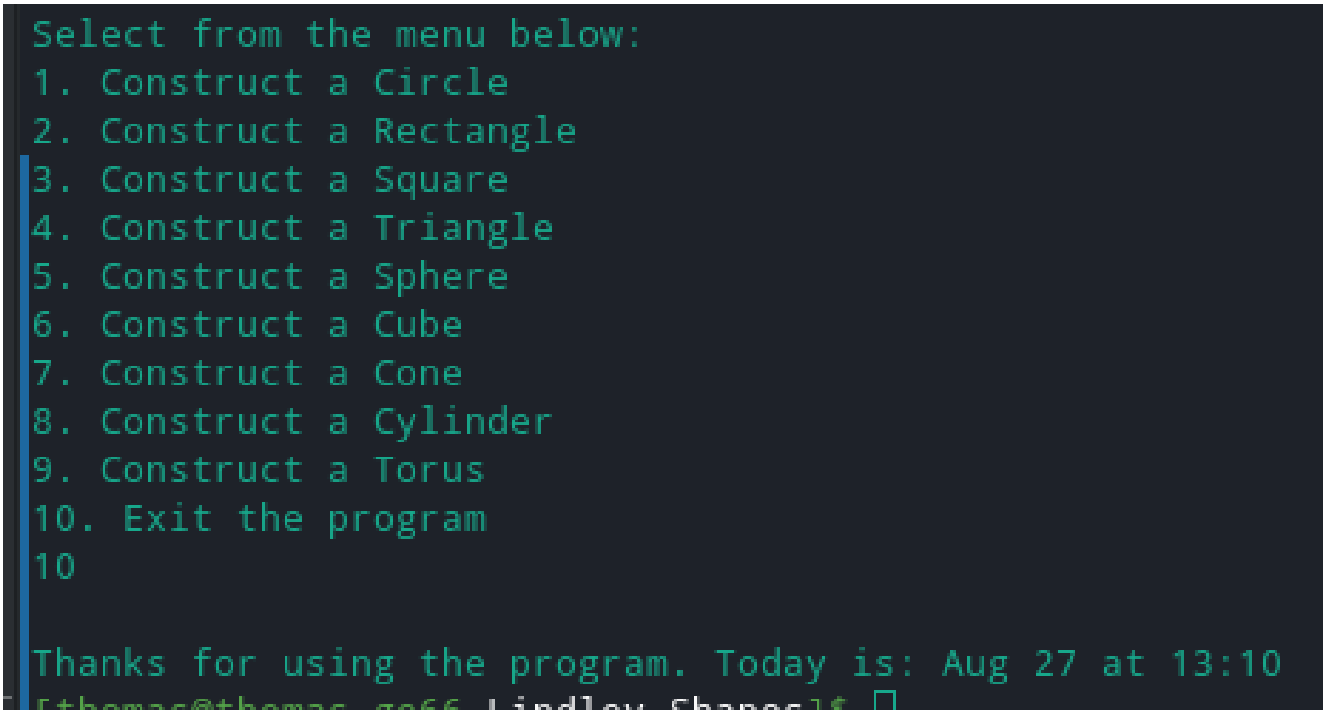

Select from the menu below:
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
10. Exit the program
10
Thanks for using the program. Today is: Aug 27 at 13:10

Table 1.2

Test exit after each shape

Test Run	Input	Expected Output / Behavior	Actual Output / Behavior	Pass /Fail
1	1, 12, n	You have selected circle. What is the radius? The area of the Circle is: 452.389 Would you like to continue Y/N? Thanks for using the program. Today is: (today’s data and time)	You have selected circle. What is the radius? The area of the Circle is: 452.389342... Would you like to continue Y/N? Thanks for using the program. Today is: Aug 27 at 13:	Pass
2	2, 4, 8, n	You have selected rectangle What is the length? What is the width? The area of the rectangle is: 32 Would you like to continue y/n? Thanks for using the program. Today is: (today’s data and time)	You have selected rectangle What is the length? What is the width? The area of the rectangle is: 32 Would you like to continue y/n? Thanks for using the program. Today is: Aug 27 at 13:	Pass
3	3, 5.6, n	You have selected a square What is the length of one edge? The area of the square is: 11.2 Would you like to continue y/n? Thanks for using the program. Today is: (today’s data and time)	You have selected a square What is the length of one edge? The area of the square is: 11.2 Would you like to continue y/n? Thanks for using the program. Today is: Aug 27 at 13:	Pass
4	4, 22, 6.70127, 146.052, 12, 11, n	You have selected a triangle What is the base? What is the Height (from center of base)? What is the largest angle? If one of the sides is the same.. What is the length of the side to the left of the base? What is the length of the side to the right of the base? The Area of the Triangle is: 73.713 The type of triangle based on its angles is: obtuse The type of triangle based on its sides is: Scalene Would you like to continue? Thanks for using the program. Today is: (today’s data and time)	You have selected a triangle What is the base? What is the Height (from center of base)? What is the largest angle? If one of the sides is the same.. What is the length of the side to the left of the base? What is the length of the side to the right of the base? The Area of the Triangle is: 73.71397 The type of triangle based on its angles is: obtuse The type of triangle based on its sides is: Scalene Would you like to continue? Thanks for using the program. Today is: Aug 27 at 13:	Pass

5	5, 15, n	You have selected a Sphere What is the radius? The Volume of the Sphere is: 10602.875 Would you like to continue Y/N? Thanks for using the program. Today is: (today’s data and time)	You have selected a Sphere What is the radius? The Volume of the Sphere is: 10602.8752058... Would you like to continue Y/N: Thanks for using the program. Today is: Aug 27 at 13:	Pass
6	6, 2.0123, n	You have selected a cube What is the length of one edge? The volume of the cube is: 8.148 Would you like to continue Y/N? Thanks for using the program. Today is: (today’s data and time)	You have selected a cube What is the length of one edge? The volume of the cube is: 8.148509... Would you like to continue Y/N? Thanks for using the program. Today is: Aug 27 at 13:	Pass
7	7, 22, 50, n	You have selected a cone What is the radius? What is the height? The volume of the cone is: 25342.180 Would you like to continue Y/N: Thanks for using the program. Today is: (today’s data and time)	You have selected a cone What is the radius? What is the height? The volume of the cone is: 25342.18073... Would you like to continue Y/N: Thanks for using the program. Today is: Aug 27 at 13:	Pass
8	8, 15, 32, n	You have selected a cylinder What is the radius? What is the height? The volume of the cylinder is: 222619.467 Would you like to continue Y/N: Thanks for using the program. Today is: (today’s data and time)	You have selected a cylinder What is the radius? What is the height? The volume of the cylinder is: 222619.46710... Would you like to continue Y/N: Thanks for using the program. Today is: Aug 27 at 13:	Pass
9	9, 88, 33, n	You have selected a torus What is the major radius? What is the minor radius? The volume of the torus is: 1891647.857 Would you like to continue Y/N: Thanks for using the program. Today is: (today’s data and time)	You have selected a torus What is the major radius? What is the minor radius? The volume of the torus is: 1891647.857930... Would you like to continue Y/N: Thanks for using the program. Today is: Aug 27 at 13:	Pass
10	10	Thanks for using the program. Today is: (today’s data and time)	Thanks for using the program. Today is: Aug 27 at 13:10	Pass

Note: This is to only test exiting at each point, so will use same inputs as before, also ensures program quits after initial launch if user chooses to do so.

Run 1:

```
[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
1

You have selected a Circle
What is the radius?
12

The area of the Circle is: 452.3893421169302

Would you like to continue Y/N?
n

Thanks for using the program. Today is: Aug 27 at 13:31
```

Run 2:

```
[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
2

You have selected a Rectangle
What is the length?
4
What is the width?
8
The area of the Rectangle is: 32.0
This rectangle is also is not a square.

Would you like to continue Y/N?
n

Thanks for using the program. Today is: Aug 27 at 13:32
```

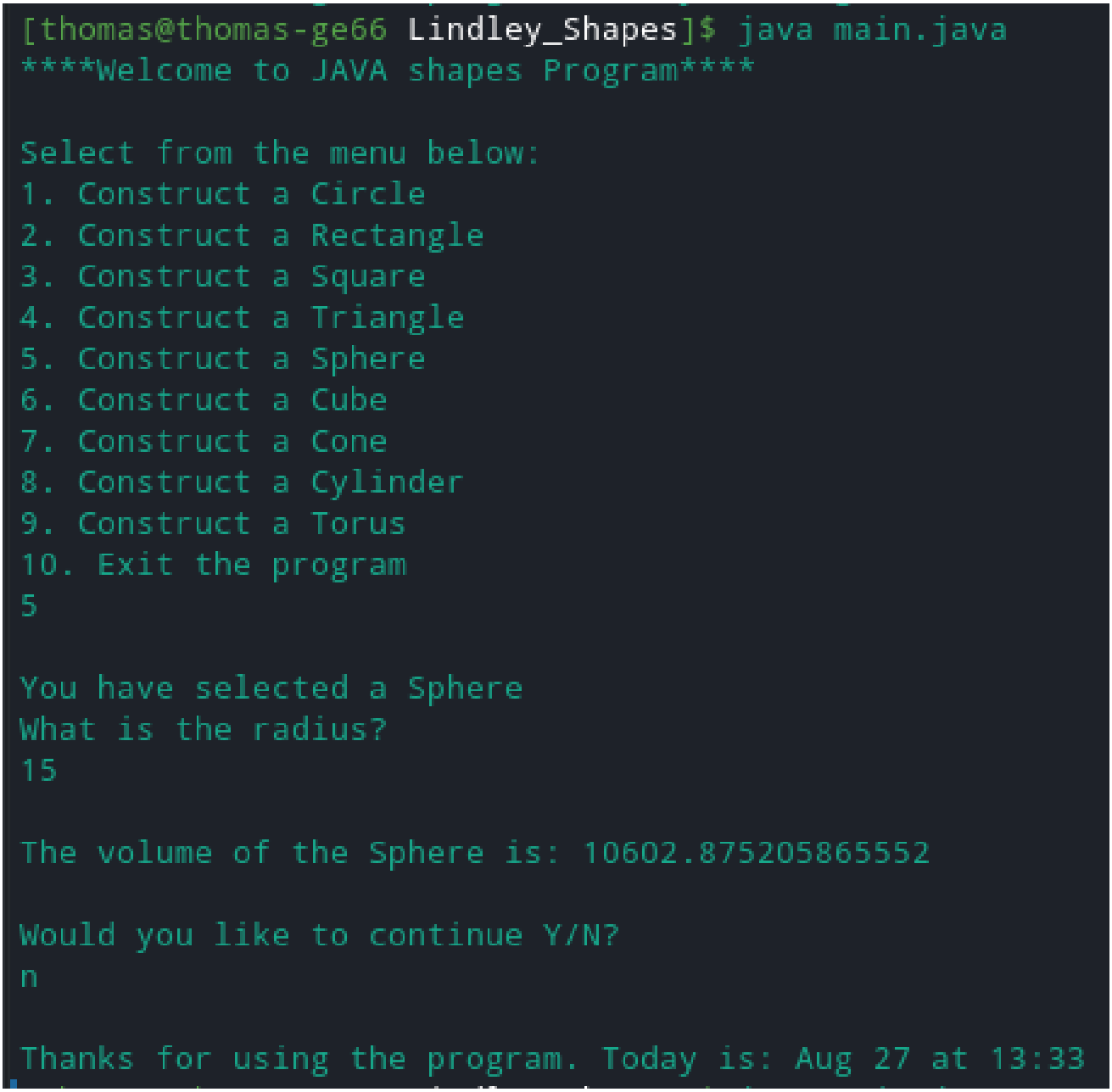
Run 3:

```
[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
3

You have selected a Square
What is the length of one edge?
5.6

The area of the Square is: 11.2

Would you like to continue Y/N?
n

Thanks for using the program. Today is: Aug 27 at 13:33
```

Run 4:

```
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
4

You have selected a Triangle
What is the base?
22

What is the height (from center of base)?
6.70127

What is the largest angle?
146.052

If one of the sides is the same as the height, re-enter please!
What is the the length of side to the left of the base?
12

What is the the length of side to the right of the base?
11

The area of the Triangle is: 73.71397

The type of triangle based on its angles is:
Obtuse

The type of triangle based on its sides is:
Scalene

Would you like to continue Y/N?
n

Thanks for using the program. Today is: Aug 27 at 13:33
```

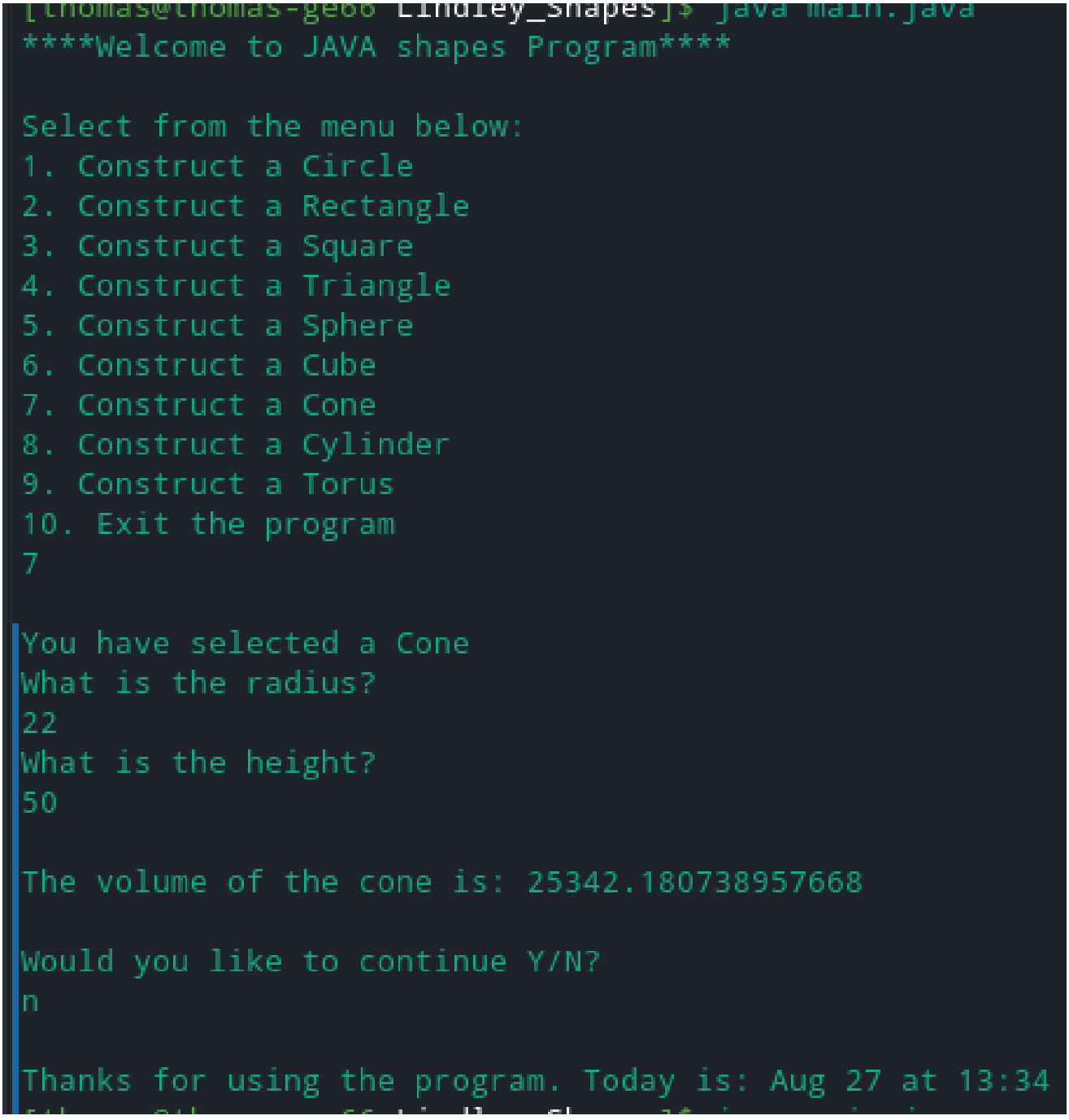
Run 5:


[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****
Select 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
10. Exit the program
5
You have selected a Sphere
What is the radius?
15
The volume of the Sphere is: 10602.875205865552
Would you like to continue Y/N?
n
Thanks for using the program. Today is: Aug 27 at 13:33

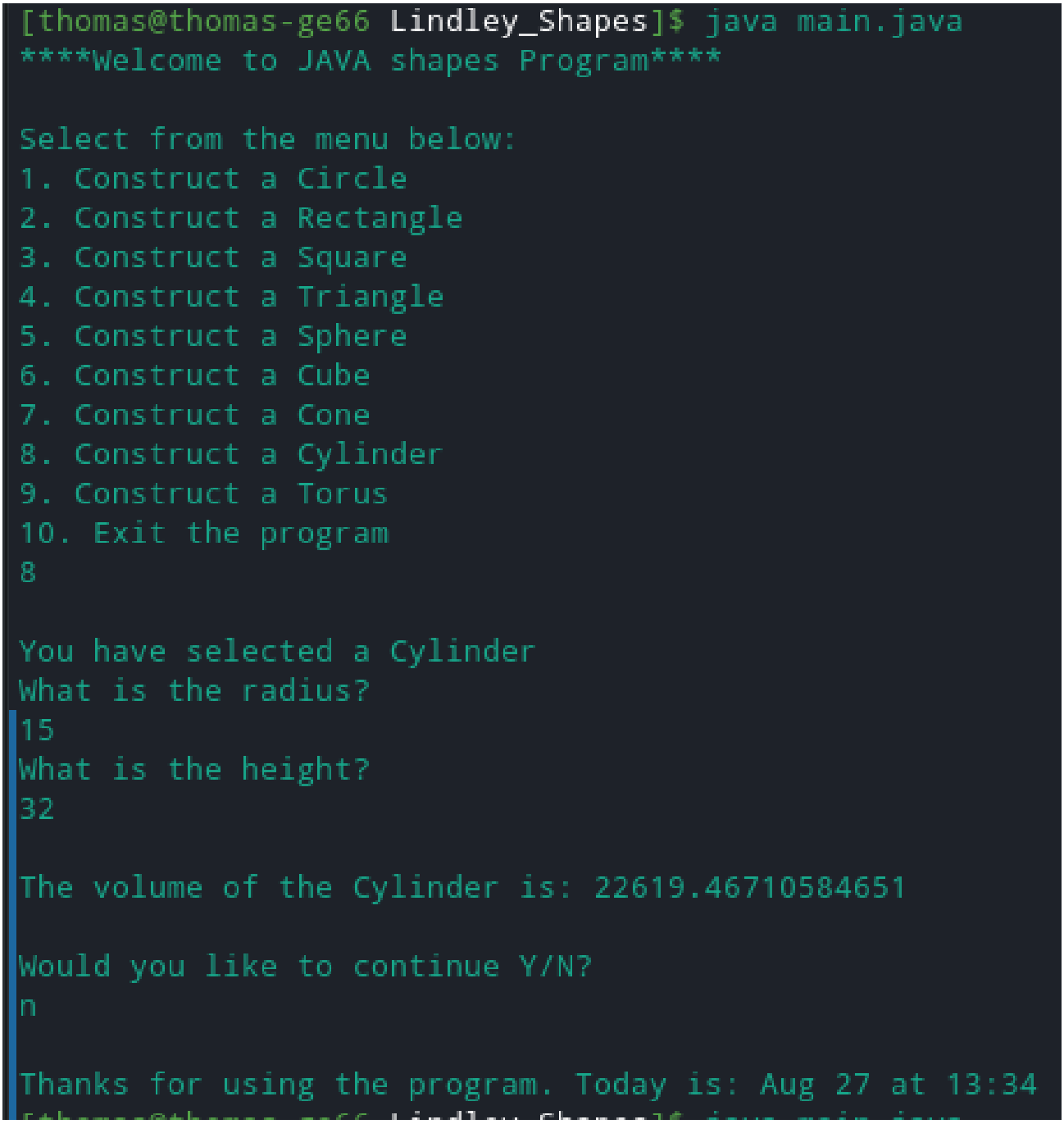
Run 6:

```
[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
6

You have selected a Cube
What is the length of one edge?
2.0123

The volume of the Cube is: 8.148509600867003

Would you like to continue Y/N?
n

Thanks for using the program. Today is: Aug 27 at 13:34
```

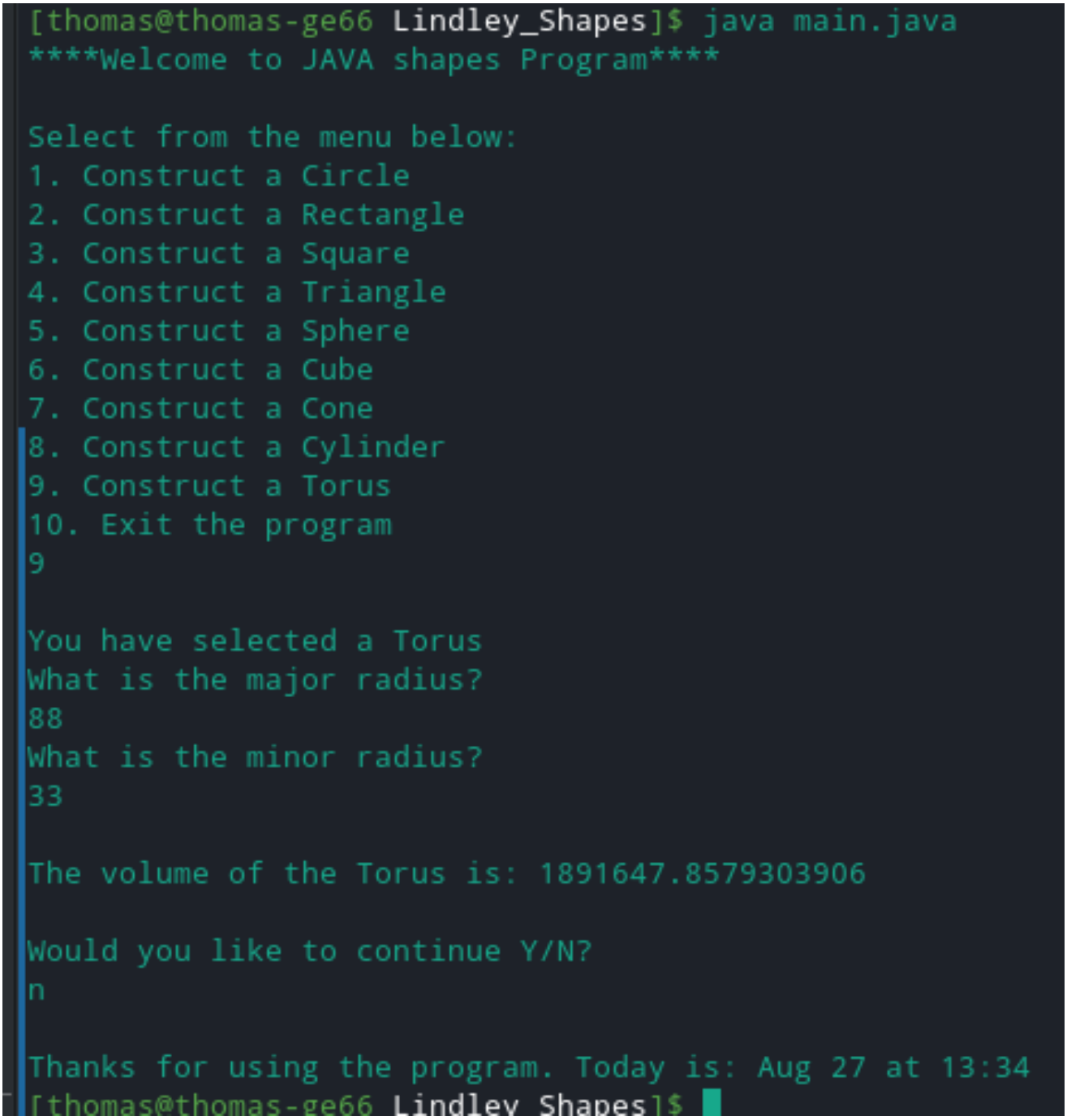
Run 7:


[thomas@thomas-ge66 Lindley_Shapes]$ java Main.java
****Welcome to JAVA shapes Program****
Select 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
10. Exit the program
7
You have selected a Cone
What is the radius?
22
What is the height?
50
The volume of the cone is: 25342.180738957668
Would you like to continue Y/N?
n
Thanks for using the program. Today is: Aug 27 at 13:34

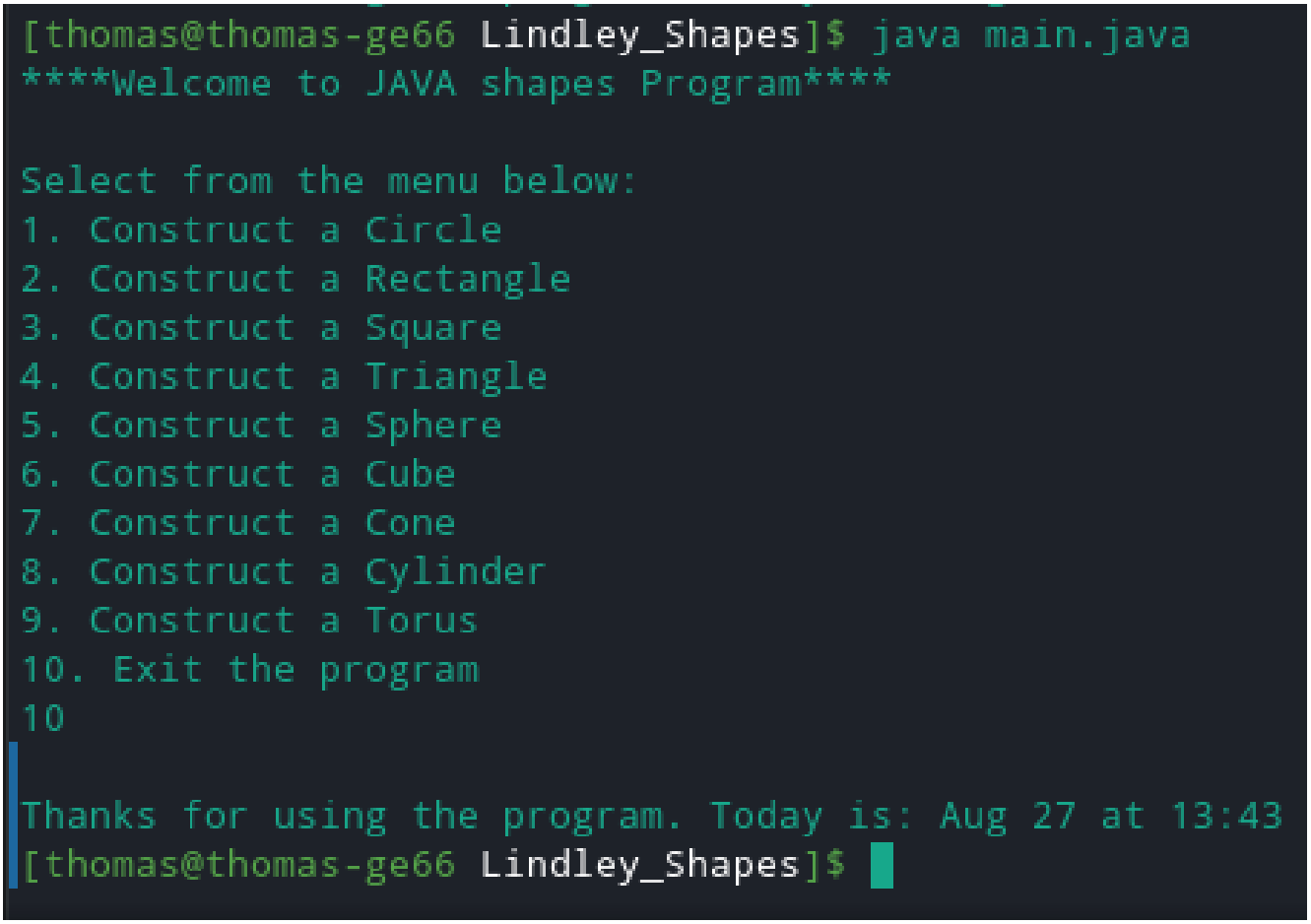
Run 8:


[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****
Select 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
10. Exit the program
8
You have selected a Cylinder
What is the radius?
15
What is the height?
32
The volume of the Cylinder is: 22619.46710584651
Would you like to continue Y/N?
n
Thanks for using the program. Today is: Aug 27 at 13:34

Run 9:


[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****
Select 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
10. Exit the program
9
You have selected a Torus
What is the major radius?
88
What is the minor radius?
33
The volume of the Torus is: 1891647.8579303906
Would you like to continue Y/N?
n
Thanks for using the program. Today is: Aug 27 at 13:34
[thomas@thomas-ge66 Lindley_Shapes]$

Run 10:


[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****
Select 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
10. Exit the program
10
Thanks for using the program. Today is: Aug 27 at 13:43
[thomas@thomas-ge66 Lindley_Shapes]$

Testing Part 2 – Error Checking / Invalid Inputs

Table 2.1

Test main menu handling of invalid inputs / error checking

Test Run	Input	Expected Output / Behavior	Actual Output / Behavior	Pass /Fail
1	a	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
2	0.56	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
3	-56	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	FAIL, then Pass
4	1231231231231231231231	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
5	blank	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
6	!!!@@	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
7	-99999999999999999999999999999999999999	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass

Note: after further testing main menu fails to display correct output when input is 0 and negative, this is because I only parseInt (line 43) to figure out if input for main menu is correct, but I also need to ensure the input is in the range of selection FIX: added an if statement to ensure input is in range of selections on line 47. Shown on **RUN 6,** program returning to normal operation after input is corrected.

Run 1:

```
Select 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
10. Exit the program
a
Incorrect input, please make an integer input from 1 to 10.
```

Run 2:

```
Select 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
10. Exit the program
0.56
Incorrect input, please make an integer input from 1 to 10.
```

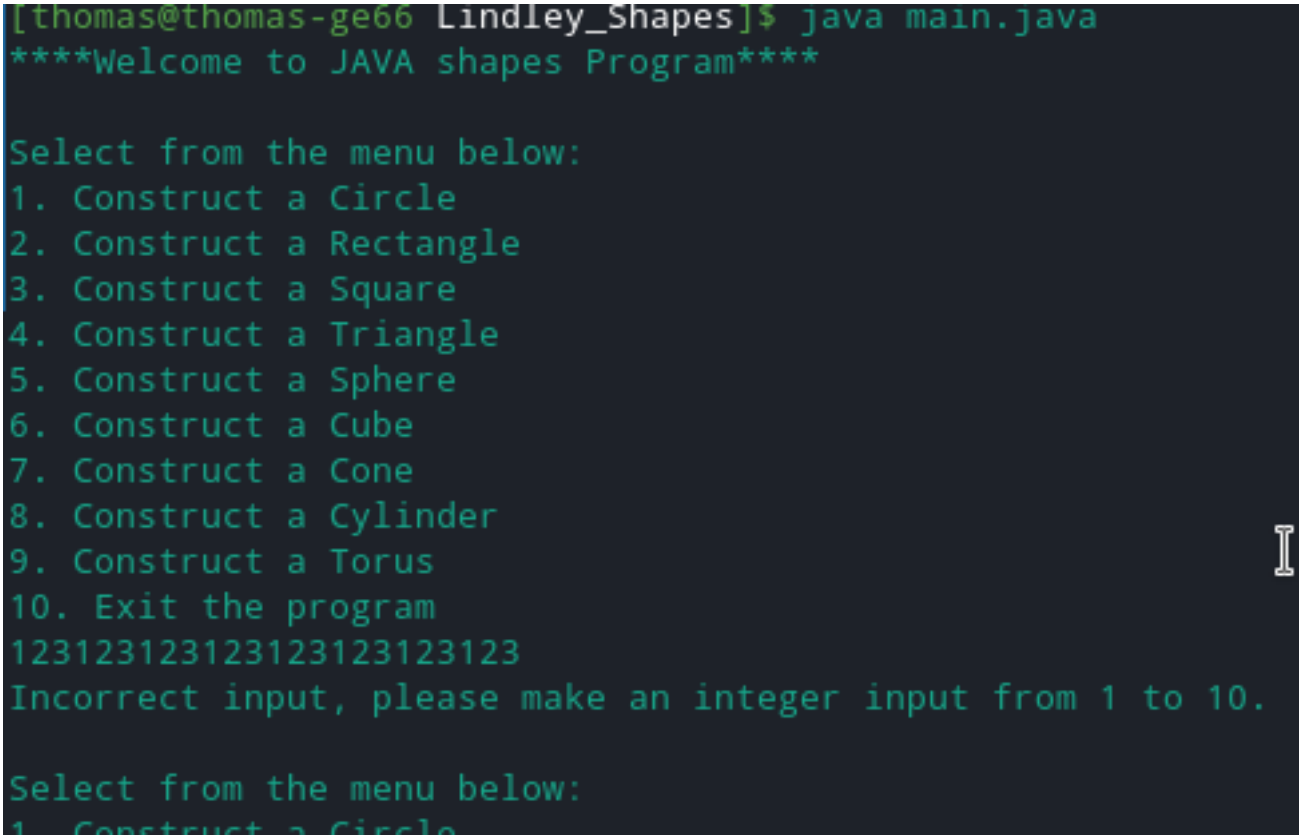
Run 3:

```
Select 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
10. Exit the program
-56
Would you like to continue Y/N?
```

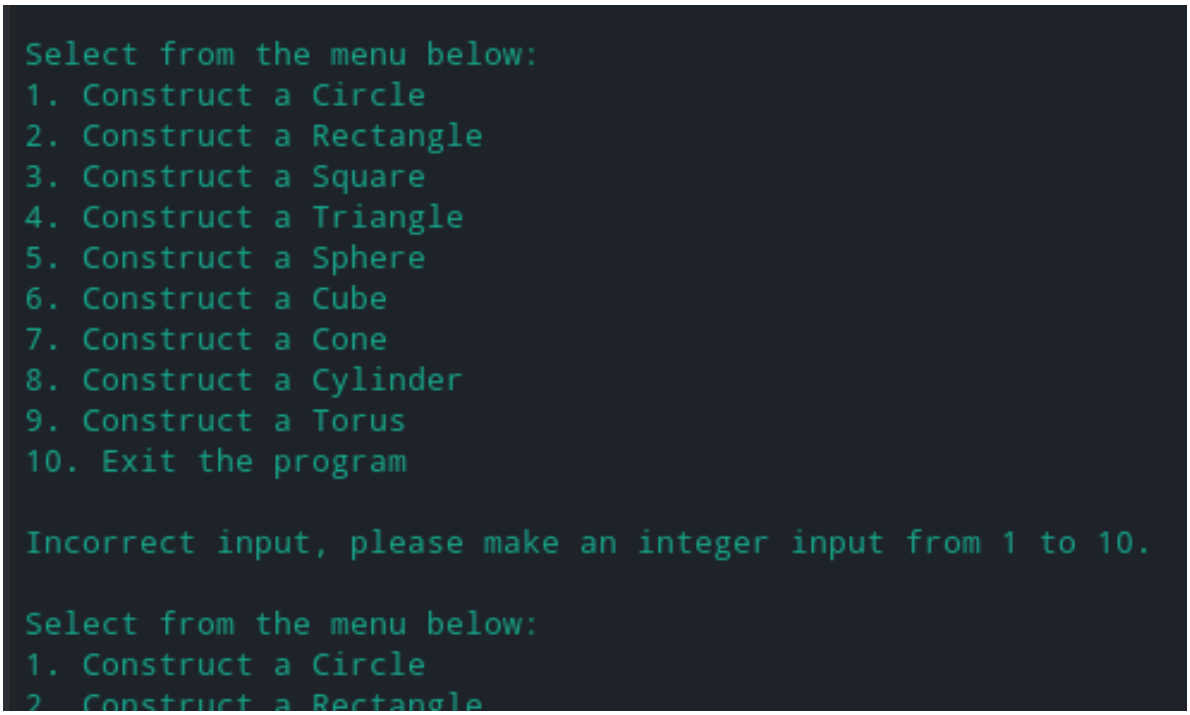
Run 3, after fix:

```
[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****

Select 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
10. Exit the program
-56
Incorrect input, please make an integer input from 1 to 10.
```

Run 4:


[thomas@thomas-ge66 Lindley_Shapes]$ java main.java
****Welcome to JAVA shapes Program****
Select 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
10. Exit the program
123123123123123123123123
Incorrect input, please make an integer input from 1 to 10.
Select from the menu below:

Run 5:


Select 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
10. Exit the program
Incorrect input, please make an integer input from 1 to 10.
Select from the menu below:
1. Construct a Circle

Run 6:

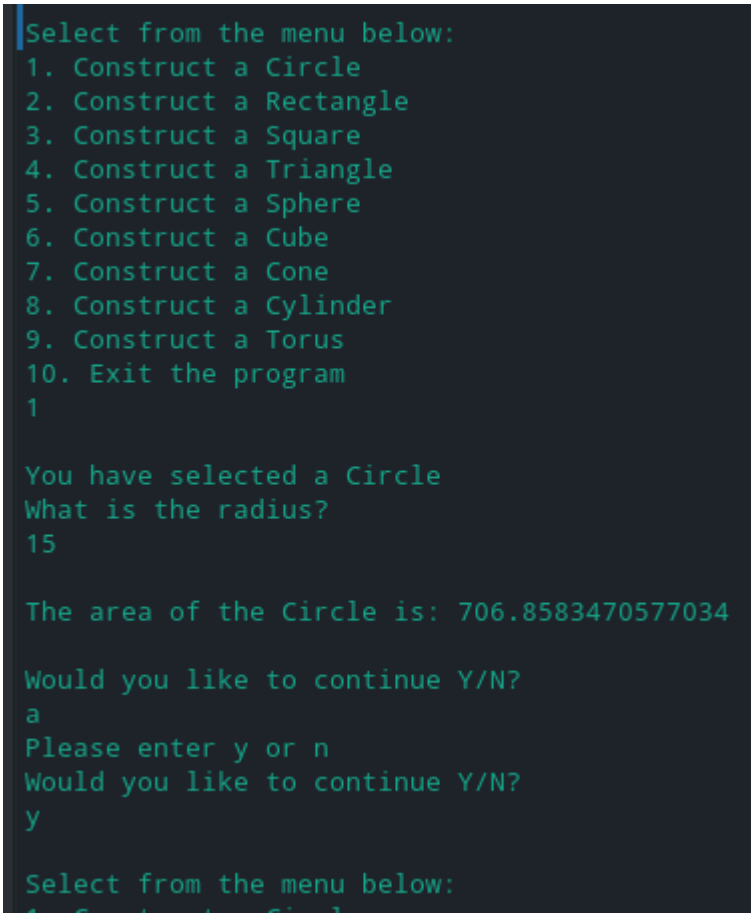
```
Select from the menu below:
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
10. Exit the program
-99999999999999999999999999999999999999999999
Incorrect input, please make an integer input from 1 to 10.

Select 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
10. Exit the program
5

You have selected a Sphere
What is the radius?
15

The volume of the Sphere is: 10602.875205865552

Would you like to continue Y/N?
y

Select 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
10. Exit the program
```

Table 2.2

Test invalid inputs / error checking with "Do you want to continue Y/N?) prompt

Test Run	Input	Expected Output / Behavior	Actual Output / Behavior	Pass /Fail
1	1, 15, a, then Y	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
2	2, 4, 15, 0.56, then Y	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Pass
3	3, 16, @@!!, then N	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	Incorrect Input, please make an integer input from 1 to 10 Select from the menu below	FAIL, then Pass

Run 1:



Run 2:

```
Select 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
10. Exit the program
2

You have selected a Rectangle
What is the length?
4
What is the width?
15
The area of the Rectangle is: 60.0
This rectangle is also is not a square.

Would you like to continue Y/N?
0.56
Please enter y or n
Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 3:

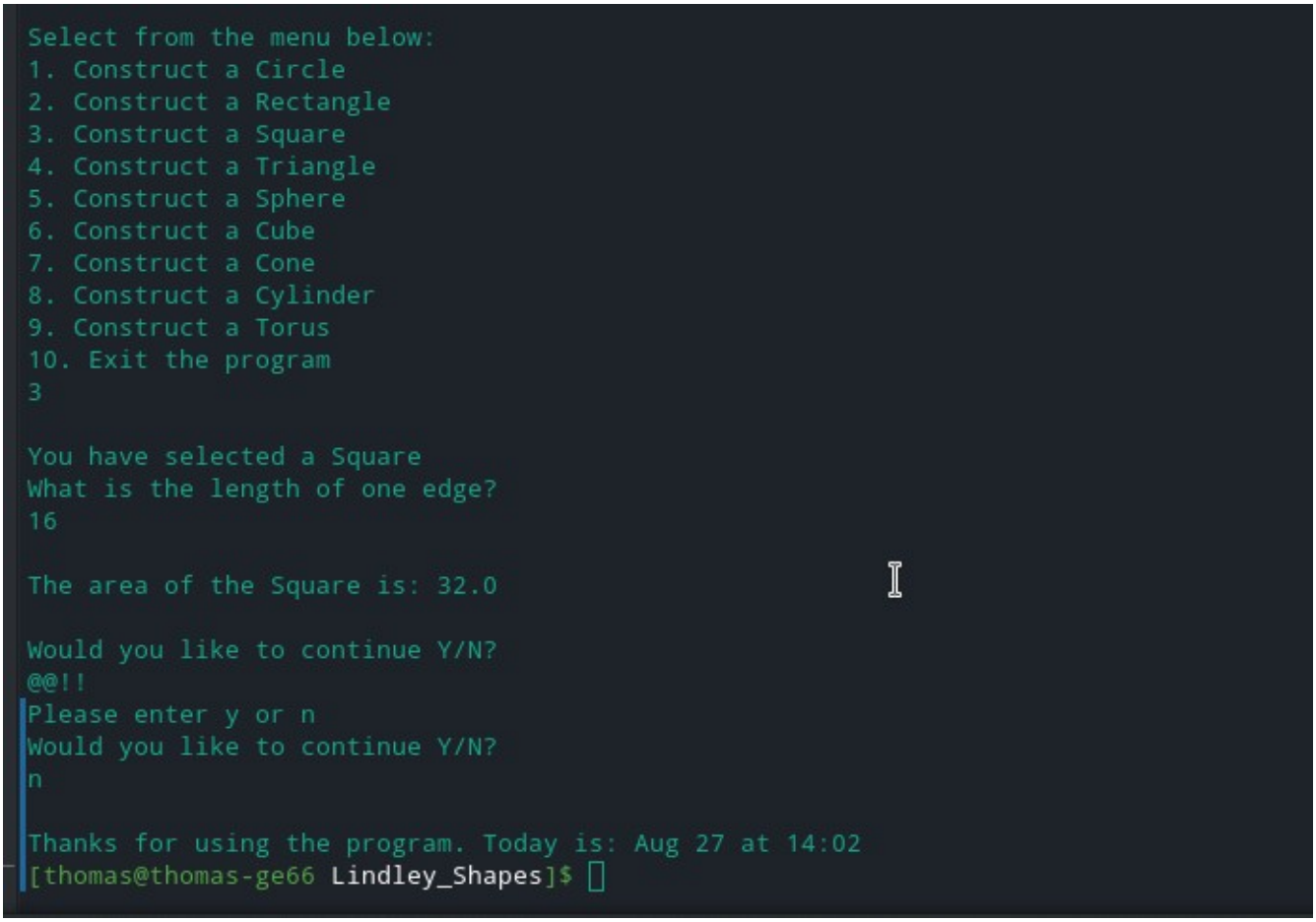

Select from the menu below:
1. Construct a Circle
2. Construct a Rectangle
3. Construct a Square
4. Construct a Triangle
5. Construct a Sphere
6. Construct a Cube
7. Construct a Cone
8. Construct a Cylinder
9. Construct a Torus
10. Exit the program
3
You have selected a Square
What is the length of one edge?
16
The area of the Square is: 32.0
Would you like to continue Y/N?
@@!!
Please enter y or n
Would you like to continue Y/N?
n
Thanks for using the program. Today is: Aug 27 at 14:02
[thomas@thomas-ge66 Lindley_Shapes]$

Table 2.3

Ensure logic that is used to ensure correct input for all shapes works for invalid inputs

Test Run	Input	Expected Output / Behavior	Actual Output / Behavior	Pass /Fail
1	**1 - circle** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
2	**2 - rectangle** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
3	**3 - square** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
4	**4 - triangle** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass

5	**5 - sphere** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
6	**6 - cube** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
7	**7 - cone** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
8	**8 - cylinder** 0 -0 ab !@ -38 -.023423 ^^&&(1/4	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass
9	**9 - torus** 0 -0 ab !@	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!	Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero! Allows continue after	Pass

	-38 -.023423 ^^&&(1/4	Allows continue after		

Note: for shapes that require more than one input I just enter next input from list. Since anything that is not a number will immediately throw an exception, and anything that can be parsed to a double will not throw an exception until it is evaluated by my invalidMeasurse() helper function on line 360, different behavior will show depending on how many inputs a shape needs, and what will trigger the throwing of the exception. In all, no matter what case program will not allows invalid inputs. I could have made it to where when any kind of invalid input is entered user is immediately prompted until correct input, but this would have made it to where there would need to be multiple nested while loops for each shape and thought my solution the better option.

Run 1:

```
10. Exit the program
1

You have selected a Circle
What is the radius?
0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-36
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-.o23423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1

The area of the Circle is: 3.141592653589793

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 2:

```
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
-38
What is the width?
-38
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
-.023423
What is the width?
-0.023423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length?
13
What is the width?
13
The area of the Rectangle is: 169.0
This rectangle is also is a square.

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 3:

```
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
-38
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
-.023423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
-23
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
1

The area of the Square is: 2.0

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 4

```
What is the the length of side to the right of the base?
-0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the base?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the base?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the base?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the base?
-38

What is the height (from center of base)?
-38

What is the largest angle?
-38

If one of the sides is the same as the height, re-enter please!
What is the the length of side to the left of the base?
-38

What is the the length of side to the right of the base?
-38
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the base?
-38

What is the height (from center of base)?
-38

What is the largest angle?
-38
```

Run 5:

```
You have selected a Sphere
What is the radius?
0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-38
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-.023423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1

The volume of the Sphere is: 3.141592653589793

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 6:

```
You have selected a Cube
What is the length of one edge?
0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
-0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
-38
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
-.23423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the length of one edge?
1

The volume of the Cube is: 1.0

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 7:

```
You have selected a Cone
What is the radius?
-0
What is the height?
0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-38
What is the height?
-.23423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1
What is the height?
1

The volume of the cone is: 1.0471975511965976

Would you like to continue Y/N?
y
```

Run 8:

```
You have selected a Cylinder
What is the radius?
-0
What is the height?
0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
-38
What is the height?
-.023423
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the radius?
1
What is the height?
1

The volume of the Cylinder is: 3.141592653589793

Would you like to continue Y/N?
y

Select from the menu below:
1. Construct a Circle
```

Run 9:

```
You have selected a Torus
What is the major radius?
-0
What is the minor radius?
0
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?
ab
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?
!@
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?
-38
What is the minor radius?
38
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?
-.023423
What is the minor radius?
^^&&(
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?
1/4
Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?

Incorrect input, please enter positive numerical data only (int or float), measurement can not be zero!
What is the major radius?
1
What is the minor radius?
1

The volume of the Torus is: 19.739208802178716

Would you like to continue Y/N?
Y
```

Test Part 3 – Output Validation

Table 3.1

Ensure program produces correct results from calculations of shapes volume and area.

Test Run	Input	Expected Output / Behavior	Actual Output / Behavior	Pass /Fail
1	**1 – Circle** **Radii:** .00000123 999999999 5873.82726384	The area of the Circle Is: 4.75x10^-12 The area of the Circle Is: 3.14x10^18 The area of the Circle Is: 1.08x10^8	The area of the Circle Is: 4.753x10^-12 The area of the Circle Is: 3.142x10^18 The area of the Circle Is: 1.083x10^8	Pass
2	**2- Rectangle** **Lengths:** .000000453 98989898989 97854.09342 800 **Widths:** .00000432 9997878989 456723.0000234 800	The area of the rectangle is: 1.95696x10^-12 This rectangle is also not a square The area of the rectangle is: 9.89689×10^20 This rectangle is also not a square The area of the rectangle is: 4.46922×10^10 This rectangle is also not a square The area of the rectangle is 640000.00 This rectangle is also a square	The area of the rectangle is: 1.95696E-12 This rectangle is also not a square The area of the rectangle is: 9.896890312253554E20 This rectangle is also not a square The area of the rectangle is: 4.469221511135245E10 This rectangle is also not a square The area of the Rectangle is: 640000.0 This rectangle is also a square.	Pass
3	**3 – Square** **Edges:** .0000453 98987968799 4758344.0000432	The area of the square is: 2.05209×10^-9 The area of the square is: 9.79862×10^21	The area of the square is: 2.0520900000000005E-9 The area of the square is: 9.798617966951797E21	Pass

		The area of the square is: 2.26418×10^13	The area of the square is: 2.2641837622747125E13	
4	4 – Triangle (paired together for ease- Base, Height, largest angle left side, right side) Group 1: .00022, 0.019053, 60, 0.00022, 0.00022 Group 2: 50, 69.64912, 95.739, 70, 90	The area of the triangle is: (something close to zero) The type of triangle based on its angles is: acute the type of triangle based on its sides is: equilateral The area of the triangle is: 1,741.22801 The type of triangle based on its angles is: obtuse the type of triangle based on its sides is: scalene	The area of the triangle is: 2.0958300000000003E-6 The type of triangle based on its angles is: acute the type of triangle based on its sides is: equilateral The area of the triangle is: 1,741.22801 The type of triangle based on its angles is: obtuse the type of triangle based on its sides is: scalene	Pass
5	**5- Sphere Radii:** .00000923 9980940499 323445.668579	The volume of the Sphere is: 3.2937733578947E-15 The volume of the Sphere is: 4.16488×10^30 The volume of the Sphere is: 1.4174×10^17	The volume of the Sphere is: 3.293773357894708E-15 The volume of the Sphere is: 4.164884949628862E30 The volume of the Sphere is: 1.41740065230077312E17	Pass
6	**6 – Cube Edges:** .00000345 97896879869 47983.00043455	The Volume of the Cube is: 4.1063625E-17 The Volume of the Cube is: 9.3822402801493E+32 The Volume of the Cube is: 1.1047454061257E+14	The Volume of the Cube is: 4.1063625E-17 The Volume of the Cube is: 9.382240280149298E32 The Volume of the Cube is: 1.1047454061256944E14	Pass

7	**7 – Cone:** **Radii:** .0000021234 978978999 7686.000432 **Heights:** .00002221 97979797999 4567.0000345	The Volume of the Cone is: 1.0486747291891E-16 The Volume of the Cone is: 9.8335857359846E+28 The Volume of the Cone is: 282527314846.88	The Volume of the Cone is: 1.048674729189100 2E-16 The Volume of the Cone is: 9.833585735984604E28 The Volume of the Cone is: 2.825273148468828E11	Pass
8	**8 – Cylinder:** **Radii:** .0000021234 978978999 7686.000432 **Heights:** .00002221 97979797999 4567.0000345	The volume of the Cylinder is: 3.1460241875673E-16 The volume of the Cylinder is: 2.95008×10^29 The volume of the Cylinder is: 8.47582×10^11	The volume of the Cylinder is: 3.146024187567300 5E-16 The volume of the Cylinder is: 2.9500757207953814E29 The volume of the Cylinder is: 8.475819445406484E11	Pass
9	**9 – Torus:** **Major Radii:** .00021234 978978999 7686.000432 **Minor Radii:** .0000123 923245565 500.0002342	The volume of the Torus is: 6.3412×10^-13 The volume of the Torus is: 1.64717×10^28 The volume of the Torus is: 3.79289×10^10	The volume of the Torus is: 6.341204759983949E-13 The volume of the Torus is: 1.6471667869898933E28 The volume of the Torus is: 3.792892737701516E10	Pass

Note: each test run is focused on a single shape, each input will be used one after another.

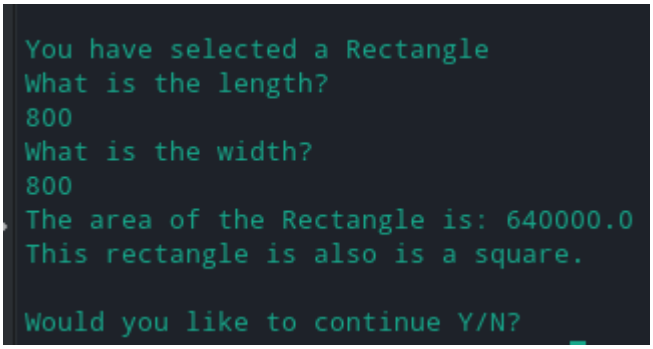
Run 1:

```
You have selected a Circle
What is the radius?
.00000123

The area of the Circle is: 4.7529155256159985E-12

Would you like to continue Y/N?
y

Select 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
10. Exit the program
1

You have selected a Circle
What is the radius?
999999999

The area of the Circle is: 3.1415926473066076E18

Would you like to continue Y/N?
y

Select 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
10. Exit the program
1

You have selected a Circle
What is the radius?
5873.82726384

The area of the Circle is: 1.0839074820789228E8

Would you like to continue Y/N?
y
```

Run 2.1:

```
You have selected a Rectangle
What is the length?
.000000453
What is the width?
.00000432
The area of the Rectangle is: 1.95696E-12
This rectangle is also is not a square.

Would you like to continue Y/N?
y

Select 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
10. Exit the program
2

You have selected a Rectangle
What is the length?
98989898989
What is the width?
9997878989
The area of the Rectangle is: 9.896890312253554E20
This rectangle is also is not a square.

Would you like to continue Y/N?
y

Select 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
10. Exit the program
2

You have selected a Rectangle
What is the length?
97854.09342
What is the width?
456723.0000234
The area of the Rectangle is: 4.469221511135245E10
```

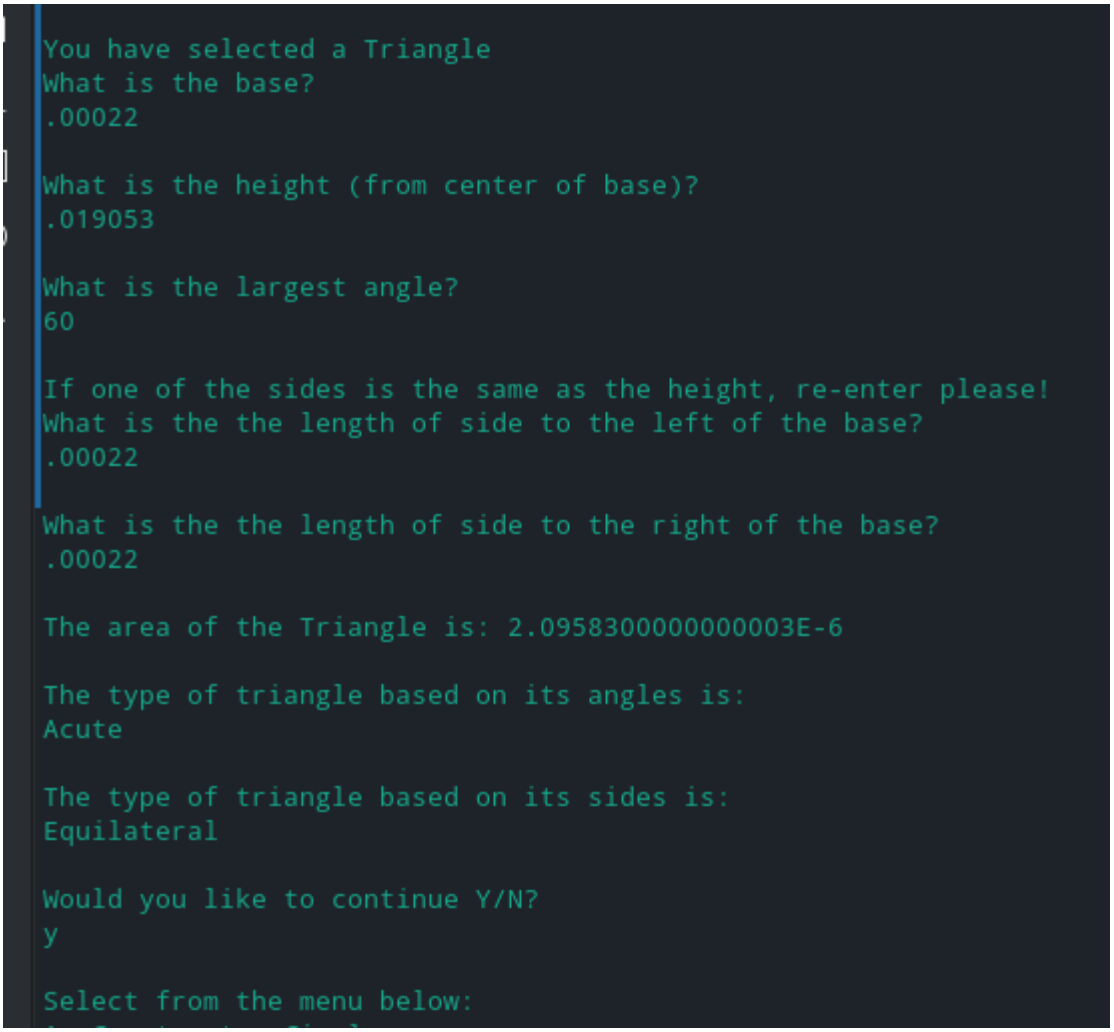
Run 2.2:


You have selected a Rectangle
What is the length?
800
What is the width?
800
The area of the Rectangle is: 640000.0
This rectangle is also is a square.
Would you like to continue Y/N?

Run 3:

```
You have selected a Square
What is the length of one edge?
.0000453

The area of the Square is: 2.0520900000000005E-9

Would you like to continue Y/N?
y

Select 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
10. Exit the program
3

You have selected a Square
What is the length of one edge?
98987968799

The area of the Square is: 9.79861796695179 7E21

Would you like to continue Y/N?
y

Select 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
10. Exit the program
3

You have selected a Square
What is the length of one edge?
4758344.0000432

The area of the Square is: 2.2641837622747125E13
```

Run 4.1:


You have selected a Triangle
What is the base?
.00022
What is the height (from center of base)?
.019053
What is the largest angle?
60
If one of the sides is the same as the height, re-enter please!
What is the the length of side to the left of the base?
.00022
What is the the length of side to the right of the base?
.00022
The area of the Triangle is: 2.0958300000000003E-6
The type of triangle based on its angles is:
Acute
The type of triangle based on its sides is:
Equilateral
Would you like to continue Y/N?
y
Select from the menu below:

Run 4.2:

```
10. Exit the program
4

You have selected a Triangle
What is the base?
50

What is the height (from center of base)?
69.64912

What is the largest angle?
95.739

If one of the sides is the same as the height, re-enter please!
What is the the length of side to the left of the base?
70

What is the the length of side to the right of the base?
90

The area of the Triangle is: 1741.2279999999998

The type of triangle based on its angles is:
Obtuse

The type of triangle based on its sides is:
Scalene

Would you like to continue Y/N?
```

Run 5:

```
You have selected a Sphere
What is the radius?
.00000923

The volume of the Sphere is: 3.2937733578947078E-15

Would you like to continue Y/N?
y

Select 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
10. Exit the program
5

You have selected a Sphere
What is the radius?
9980940499

The volume of the Sphere is: 4.164884949628862E30

Would you like to continue Y/N?
y

Select 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
10. Exit the program
5

You have selected a Sphere
What is the radius?
323445.668579

The volume of the Sphere is: 1.41740065230077312E17

Would you like to continue Y/N?
```

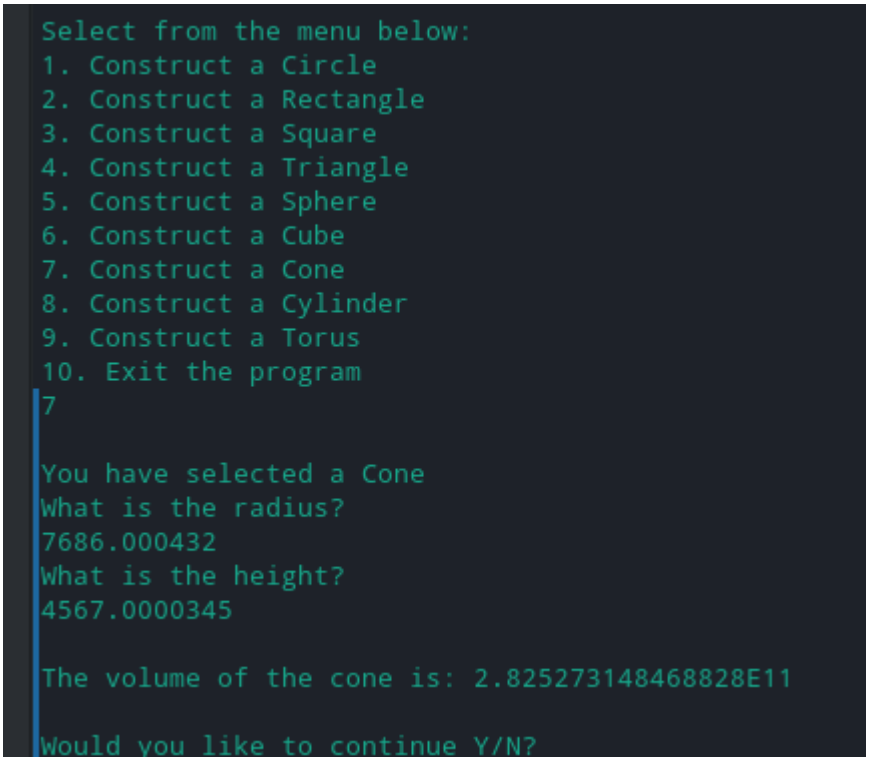
Run 6:

```
You have selected a Cube
What is the length of one edge?
.00000345

The volume of the Cube is: 4.1063625E-17

Would you like to continue Y/N?
y

Select 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
10. Exit the program
6

You have selected a Cube
What is the length of one edge?
97896879869

The volume of the Cube is: 9.382240280149298E32

Would you like to continue Y/N?
y

Select 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
10. Exit the program
6

You have selected a Cube
What is the length of one edge?
47983.00043455

The volume of the Cube is: 1.1047454061256944E14
```

Run 7.1

```
You have selected a Cone
What is the radius?
.0000021234
What is the height?
.00002221

The volume of the cone is: 1.0486747291891002E-16

Would you like to continue Y/N?
y

Select 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
10. Exit the program
7

You have selected a Cone
What is the radius?
978978999
What is the height?
97979797999

The volume of the cone is: 9.8335857359846O4E28

Would you like to continue Y/N?
```

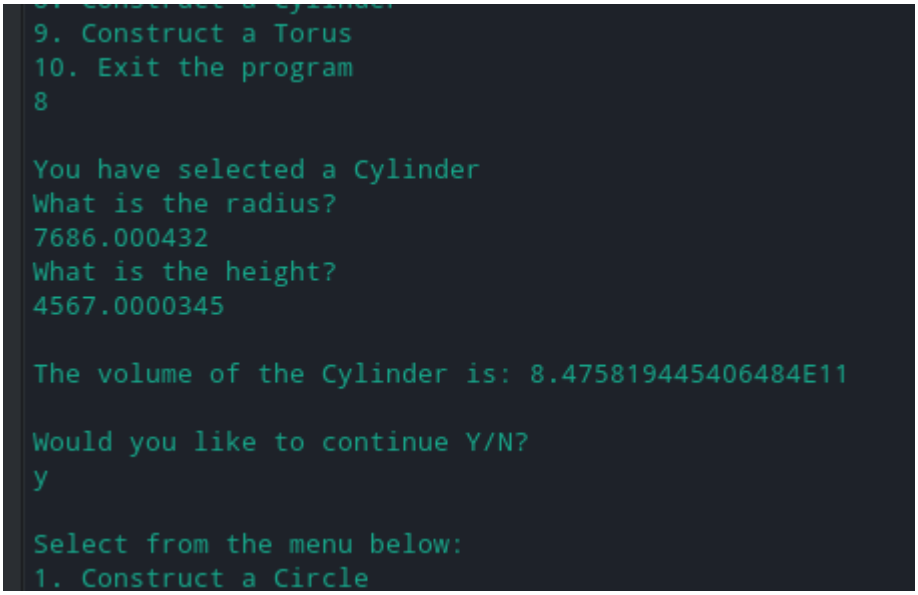
Run 7.2


Select 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
10. Exit the program
7
You have selected a Cone
What is the radius?
7686.000432
What is the height?
4567.0000345
The volume of the cone is: 2.825273148468828E11
Would you like to continue Y/N?

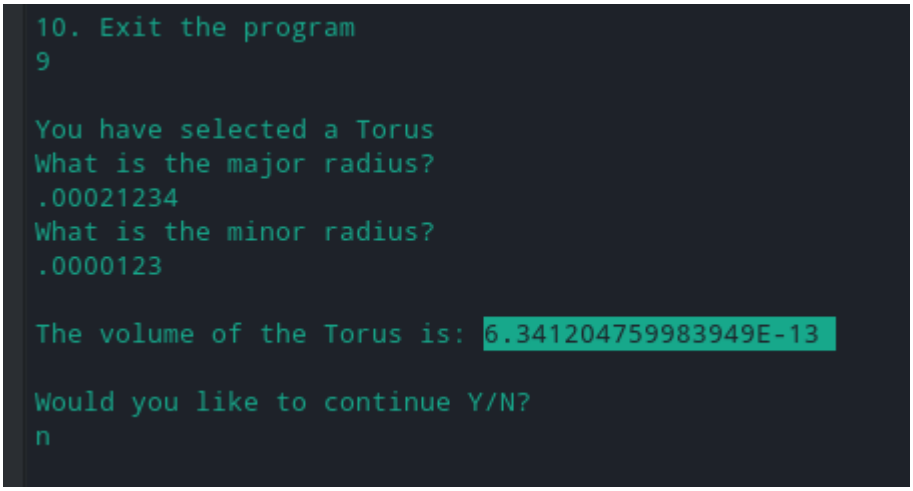
Run 8.1

```
You have selected a Cylinder
What is the radius?
.0000021234
What is the height?
.00002221

The volume of the Cylinder is: 3.1460241875673005E-16

Would you like to continue Y/N?
y

Select 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
10. Exit the program
8

You have selected a Cylinder
What is the radius?
978978999
What is the height?
97979797999

The volume of the Cylinder is: 2.9500757207953814E29
```

Run 8.2:


9. Construct a Torus
10. Exit the program
8
You have selected a Cylinder
What is the radius?
7686.000432
What is the height?
4567.0000345
The volume of the Cylinder is: 8.475819445406484E11
Would you like to continue Y/N?
y
Select from the menu below:
1. Construct a Circle

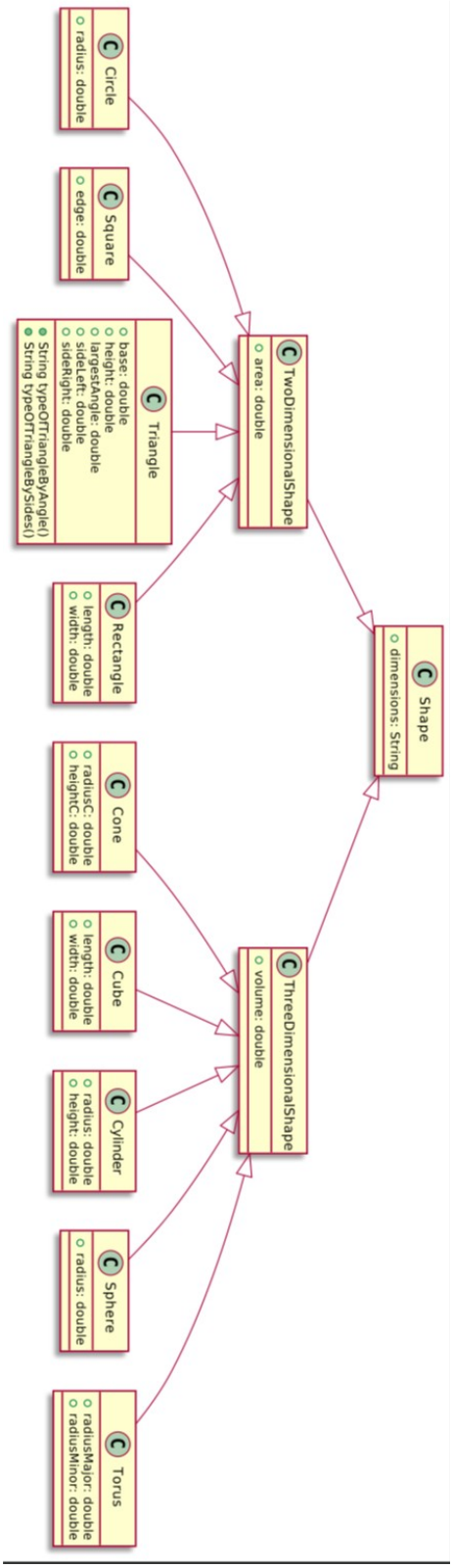
Run 9.1:


10. Exit the program
9
You have selected a Torus
What is the major radius?
.00021234
What is the minor radius?
.0000123
The volume of the Torus is: 6.341204759983949E-13
Would you like to continue Y/N?
n

Run 9.2:

```
You have selected a Torus
What is the major radius?
978978999
What is the minor radius?
923245565

The volume of the Torus is: 1.6471667869898933E28

Would you like to continue Y/N?
y

Select 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
10. Exit the program
9

You have selected a Torus
What is the major radius?
7686.000432
What is the minor radius?
500.0002342

The volume of the Torus is: 3.7928927377015 16E10
```

UML Class Diagram



Lessons Learned

I feel that every time I complete a project, I learn many small lessons along the way that I do not recall when it comes time to write them down. However, I always have a few moments that stick out as larger lessons that I have learned from a project. One of the lessons I learned from completing this project is that testing a program can be as tedious and time consuming, if not more, as writing the actual program itself. This project was very time consuming for me to test, because I tested most of it all at once when it was finished. Since I waited till the end, I ended up having to stop testing and fix things that were wrong. Thankfully, none of the issues I encountered effected the code as a whole, but I will definitely remember to test often during my coding process, which I kind of did, but only for logic that controlled the flow of the program as a whole.

Another lesson I learned, is that it is very helpful to know a programming language as a whole and its capabilities, even if you do not remember how to use all of its capabilities. This is because it is really helpful when you run into a problem to solve and then remember that some ability of the language can help solve the problem. Then it turns into a simple search on how to use that ability and then implementing it into code. For example, multiple shapes in this program take in a varying amount of arguments, and I wanted to write a method that could test if all arguments for any shape, no matter how many it took in, were greater than zero. I wanted this, because I have been taught that you can not have a shape with a side length of zero. I remembered reading in the Java Complete Reference Guide that using a vargas parameter allows a method to take in any number of arguments, so I used that in a method in main to be able to check any number of user inputs, before they were sent to the appropriate class to construct a shape.