

Due: Skeleton Code (ungraded - checks class, method names, return types, formal parameters etc.)
Completed Code – Monday, October 3, 2016 by 11:59 PM

Deliverables

Your project files should be submitted to Web-CAT by the due date and time specified above (see the Lab Guidelines for information on submitting project files). You may submit your skeleton code files until the project due date but should try to do this by Friday (there is no late penalty since this is ungraded for this project). You must submit your completed code files to Web-CAT no later than 11:59 PM on the due date for the completed code to avoid a late penalty for the project. You may submit your completed code up to 24 hours after the due date, but there is a late penalty of 15 points. No projects will be accepted after the one day late period. If you are unable to submit via Web-CAT, you should e-mail your project Java files in a zip file to your lab instructor before the deadline.

Files to submit to Web-CAT:

- Cone.java
- ConeList.java
- ConeListApp.java

Specifications

Overview: You will write a program this week that is composed of three classes: the first class defines Cone objects, the second class defines ConeList objects, and the third, ConeListApp, reads in a file name entered by the user then reads the list name and cone data from the file, creates Cone objects and stores them in an ArrayList, creates a ConeList object with the list name and ArrayList, prints the ConeList object, and then prints summary information about the ConeList object.

- **Cone.java** (assuming that you successfully created this class in Project 4, just copy the file to your new Project 5 folder and go on to ConeList.java on page 4. Otherwise, you will need to create Cone.java as part of this project.)

Requirements: Create a Cone class that stores the label, height, and radius (height and radius each must be greater than zero). The Cone class also includes methods to set and get each of these fields, as well as methods to calculate the base perimeter, base area, slant height, side area, surface area, and volume of a Cone object, and a method to provide a String value of a Cone object (i.e., a class instance).

Design: The Cone class has fields, a constructor, and methods as outlined below.

- (1) **Fields** (instance variables): label of type String, height of type double, and radius of type double. These instance variables should be private so that they are not directly accessible from outside of the Cone class, and these should be the only instance variables in the class.
- (2) **Constructor:** Your Cone class must contain a constructor that accepts three parameters (see types of above) representing the label, height, and radius. Instead of assigning the parameters directly to the fields, the respective set method for each field (described below) should be called. For example, instead of the statement `label = labelIn;` use the statement

`setLabel(labelIn);` Below are examples of how the constructor could be used to create Cone objects. Note that although String and numeric literals are used for the actual parameters (or arguments) in these examples, variables of the required type could have been used instead of the literals.

```
Cone example1 = new Cone("Short Example", 3.0, 4.0);
```

```
Cone example2 = new Cone(" Wide Example ", 10.6, 22.1);
```

```
Cone example3 = new Cone("Tall Example", 100, 20);
```

- (3) **Methods:** Usually a class provides methods to access and modify each of its instance variables (known as get and set methods) along with any other required methods. The methods for Cone are described below. See formulas in Code and Test below.
- `getLabel`: Accepts no parameters and returns a String representing the label field.
 - `setLabel`: Takes a String parameter and returns a boolean. If the string parameter is not null, then the “trimmed” String is set to the label field and the method returns true. Otherwise, the method returns false and the label is not set.
 - `getHeight`: Accepts no parameters and returns a double representing the height field.
 - `setHeight`: Accepts a double parameter and returns a boolean. If the height is greater than zero, sets height field and returns true. Otherwise, the method returns false and the height is not set.
 - `getRadius`: Accepts no parameters and returns a double representing the radius field.
 - `setRadius`: Accepts a double parameter and returns a boolean. If the radius is greater than zero, sets radius field and returns true. Otherwise, the method returns false and the radius is not set.
 - `basePerimeter`: Accepts no parameters and returns the double value for the perimeter of the base circle of the cone calculated using radius.
 - `baseArea`: Accepts no parameters and returns the double value for the base area calculated using radius.
 - `slantHeight`: Accepts no parameters and returns the double value for the slant height calculated using height and radius.
 - `sideArea`: Accepts no parameters and returns the double value for the side area calculated using radius and slant height.
 - `surfaceArea`: Accepts no parameters and returns the double value for the total surface area calculated using the base area and side area.
 - `volume`: Accepts no parameters and returns the double value for the volume calculated using height and radius.
 - `toString`: Returns a String containing the information about the Cone object formatted as shown below, including decimal formatting (“###0.0###”) for the double values. Newline escape sequences should be used to achieve the proper layout. In addition to the field values (or corresponding “get” methods), the following methods should be used to compute appropriate values in the `toString` method: `basePerimeter()`, `baseArea()`, `slantHeight()`, `sideArea()`, `surfaceArea()`, and `volume()`. Each line should

have no leading and no trailing spaces (e.g., there should be no spaces before a newline (\n) character). The toString value for example1, example2, and example3 respectively are shown below (the blank lines are not part of the toString values).

"Short Example" is a cone with height = 3.0 units and radius = 4.0 units, which has base perimeter = 25.133 units, base area = 50.265 square units, slant height = 5.0 units, side area = 62.832 square units, surface area = 113.097 square units, and volume = 50.265 cubic units.

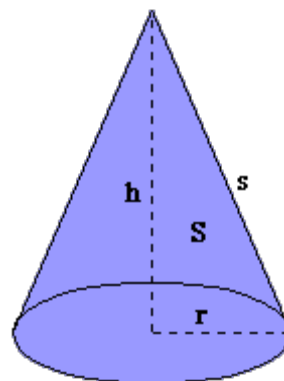
"Wide Example" is a cone with height = 10.6 units and radius = 22.1 units, which has base perimeter = 138.858 units, base area = 1,534.385 square units, slant height = 24.511 units, side area = 1,701.752 square units, surface area = 3,236.137 square units, and volume = 5,421.495 cubic units.

"Tall Example" is a cone with height = 100.0 units and radius = 20.0 units, which has base perimeter = 125.664 units, base area = 1,256.637 square units, slant height = 101.98 units, side area = 6,407.617 square units, surface area = 7,664.254 square units, and volume = 41,887.902 cubic units.

Code and Test: As you implement your Cone class, you should compile it and then test it using interactions. For example, as soon you have implemented and successfully compiled the constructor, you should create instances of Cone in interactions (see the examples above). Remember that when you have an instance on the workbench, you can unfold it to see its values. You can also open a viewer canvas window and drag the instance from the Workbench tab to the canvas window. After you have implemented and compiled one or more methods, create a Cone object in interactions and invoke each of your methods on the object to make sure the methods are working as intended. You may find it useful to create a separate class with a main method that creates an instance of Cone then prints its out. This would be similar to the class you will create in Part 2, except that in Part 2 you will read in the values and then create the object. The formulas below are provided to assist you in computing return values for the respective cone methods described above. `Math.PI` should be used for Pi. (adapted from <http://mathforum.org/dr.math/faq/formulas/faq.cone.html>).

height: h
radius of base: r
perimeter of base: P
base area: B
slant height: s
side area: S
total surface area: T
Volume: V

$$\begin{aligned} P &= \text{Pi } 2r \\ B &= \text{Pi } r^2 \\ s &= \sqrt{r^2 + h^2} \\ S &= \text{Pi } rs \\ T &= \text{Pi } r(r+s) \\ V &= \text{Pi } r^2 h / 3 \end{aligned}$$



- **ConeList.java**

Requirements: Create a ConeList class that stores the name of the list and an ArrayList of Cone objects. It also includes methods that return the name of the list, number of Cone objects in the ConeList, total surface area, total volume, total base perimeter, total base area, average surface area, and average volume for all Cone objects in the ConeList. The toString method returns a String containing the name of the list followed by each Cone in the ArrayList, and a summaryInfo method returns summary information about the list (see below).

Design: The ConeList class has two fields, a constructor, and methods as outlined below.

- (1) **Fields** (or instance variables): (1) a String representing the name of the list and (2) an ArrayList of Cone objects. These are the only fields (or instance variables) that this class should have.
- (2) **Constructor:** Your ConeList class must contain a constructor that accepts a parameter of type String representing the name of the list and a parameter of type ArrayList< Cone> representing the list of Cone objects. These parameters should be used to assign the fields described above (i.e., the instance variables).
- (3) **Methods:** The methods for ConeList are described below.
 - `getName`: Returns a String representing the name of the list.
 - `numberOfCones`: Returns an int representing the number of Cone objects in the ConeList. If there are zero Cone objects in the list, zero should be returned.
 - `totalBasePerimeter`: Returns a double representing the total for the base perimeters for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `totalBaseArea`: Returns a double representing the total for the base areas for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `totalSlantHeight`: Returns a double representing the total for the slant heights for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `totalSideArea`: Returns a double representing the total for the side areas for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `totalSurfaceArea`: Returns a double representing the total surface areas for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `totalVolume`: Returns a double representing the total volumes for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `averageSurfaceArea`: Returns a double representing the average surface area for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `averageVolume`: Returns a double representing the average volume for all Cone objects in the list. If there are zero Cone objects in the list, zero should be returned.
 - `toString`: Returns a String containing the name of the list followed by each Cone in the ArrayList. In the process of creating the return result, this toString() method should

include a while loop that calls the `toString()` method for each `Cone` object in the list. Be sure to include appropriate newline escape sequences. For an example, see [lines 3 through 21](#) in the output below from `ConeListApp` for the `cone_1.dat` input file. [Note that the `toString` result should **not** include the summary items in lines 22 through 30 of the example. These lines represent the return value of the `summaryInfo` method below.]

- `summaryInfo`: Returns a `String` containing the name of the list (which can change depending of the value read from the file) followed by various summary items: number of cones, total base perimeter, total base area, total slant heights, total side areas, total surface area, total volume, average surface area, average volume. For an example, see [lines 22 through 30](#) in the output below from `ConeListApp` for the `cone_1.dat` input file. The second example below shows the output from `ConeListApp` for the `cone_0.dat` input file which contains a list name but no cone data.

Code and Test: Remember to import `java.util.ArrayList`. Each of the methods above requires that you use a loop (i.e., a while loop) to retrieve each object in the `ArrayList`. As you implement your `ConeList` class, you can compile it and then test it using interactions. Alternatively, you can create a class with a simple main method that creates a `ConeList` object and calls its methods.

- **ConeListApp.java**

Requirements: Create a `ConeListApp` class with a main method that reads in the name of the input file entered by the user and then reads list name and `Cone` data from the file, creates `Cone` objects, stores them in a local `ArrayList`, creates an `ConeList` object with the name of the list and the `ArrayList` of `Cone` objects, and then prints the `ConeList` object followed summary information about the `ConeList` object. **All input and output for this project should be done in the main method.**

Design: The main method should prompt the user to enter a file name, and then it should read in the file. The first record (or line) in the file contains the name of the list. This is followed by the data for the `Cone` objects. After each set of `Cone` data is read in, a `Cone` object should be created and stored in the local `ArrayList`. After the file has been read in and the `ArrayList` created, the main method should create a `ConeList` object with the name of the list and the `ArrayList` of `Cone` objects as parameters in the constructor. It should then print the `ConeList` object followed by summary information about the `ConeList` (i.e., print the value returned by the `summaryInfo` method for the `ConeList`). The output from two runs of the main method in `ConeListApp` is shown below: the first produced after reading in the `cone_1.dat` file and the second after reading in the `cone_0.dat` file. Your program output should be formatted exactly as follows).

Line #	Program output
1	----jGRASP exec: java ConeListApp
2	Enter file name: cone_1.dat
3	Cone List 1
4	
5	"Short Example" is a cone with height = 3.0 units and radius = 4.0 units,
6	which has base perimeter = 25.133 units, base area = 50.265 square units,
7	slant height = 5.0 units, side area = 62.832 square units,
8	surface area = 113.097 square units, and volume = 50.265 cubic units.
9	

10	"Wide Example" is a cone with height = 10.6 units and radius = 22.1 units,
11	which has base perimeter = 138.858 units, base area = 1,534.385 square units,
12	slant height = 24.511 units, side area = 1,701.752 square units,
13	surface area = 3,236.137 square units, and volume = 5,421.495 cubic units.
14	
15	"Tall Example" is a cone with height = 100.0 units and radius = 20.0 units,
16	which has base perimeter = 125.664 units, base area = 1,256.637 square units,
17	slant height = 101.98 units, side area = 6,407.617 square units,
18	surface area = 7,664.254 square units, and volume = 41,887.902 cubic units.
19	
20	"Really Large Example" is a cone with height = 300.0 units and radius = 400.0 units,
21	which has base perimeter = 2,513.274 units, base area = 502,654.825 square units,
22	slant height = 500.0 units, side area = 628,318.531 square units,
23	surface area = 1,130,973.355 square units, and volume = 50,265,482.457 cubic units.
24	
25	----- Summary for Cone List 1 -----
26	Number of Cones: 4
27	Total Base Perimeter: 2,802.929
28	Total Base Area: 505,496.112
29	Total Slant Height: 631.491
30	Total Side Area: 636,490.731
31	Total Surface Area: 1,141,986.844
32	Total Volume: 50,312,842.12
33	Average Surface Area: 285,496.711
34	Average Volume: 12,578,210.53
	 ----jGRASP: operation complete.

Line #	Program output
	----jGRASP exec: java ConeListApp
1	Enter file name: cone_0.dat
2	
3	Empty List of Cones
4	
5	----- Summary for Empty List of Cones -----
6	Number of Cones: 0
7	Total Base Perimeter: 0.0
8	Total Base Area: 0.0
9	Total Slant Height: 0.0
10	Total Side Area: 0.0
11	Total Surface Area: 0.0
12	Total Volume: 0.0
13	Average Surface Area: 0.0
14	Average Volume: 0.0
15	 ----jGRASP: operation complete.

Code: Remember to import `java.util.ArrayList`, `java.util.Scanner`, and `java.io.File`, and `java.io.IOException` prior to the class declaration. Your main method declaration should indicate that main throws `IOException`. After your program reads in the file name from the keyboard, it should read in the file using a `Scanner` object that was created on a file using the file name entered by the user.

```
... = new Scanner(new File(fileName));
```

You can assume that the first line in the file is the name of the list, and then each set of three lines contains the data from which a Cone object can be created. After the name of the list has been read and assigned to a local variable, a while loop should be used to read in the cone data. The boolean expression for the while loop should be (_____ .hasNext()) where the blank is the name of the Scanner you created on the file. Each iteration through the loop reads three lines. As each of the lines is read from the file, the respective local variables for the cone data items (label, side, and height) should be assigned, after which the Cone object should be created and added to a local ArrayList. The next iteration of the loop should then read the next set of three lines then create the next Cone object and add it to a local ArrayList, and so on. After the file has been processed (i.e., when the loop terminates after the hasNext method returns false), name of the list and the ArrayList should be used to create a ConeList object. The ConeList object should then be printed. Finally, the summary information is printed by printing the value returned by the summaryInfo method invoked on the ConeList object.

Test: You should test your program minimally (1) by reading in the *cone_1.dat* input file, which should produce the first output above, and (2) by reading in the *cone_0.dat* input file, which should produce the second output above. Although your program may not use all of the methods in ConeList and Cone, you should ensure that all of your methods work according to the specification. You can either use interactions in jGRASP or you can write another class and main method to exercise the methods. Web-CAT will test all methods to determine your project grade.

General Notes

1. All input from the keyboard and all output to the screen should be done in the main method. Only one Scanner object on System.in should be created and this should be done in the main method. All printing (i.e., using the System.out.print and System.out.println methods) should be in the main method. Hence, none of your methods in the Cone class should do any input/output (I/O).
2. Be sure to download the test data files (*cone_1.dat* and *cone_0.dat*) and store them in same folder as your source files. It may be useful to examine the contents of the data files. Find the data files in the jGRASP Browse tab and then open each data file in jGRASP to see the items that your program will be reading from the file. Be sure to close the data files without changing them.