

Deliverables

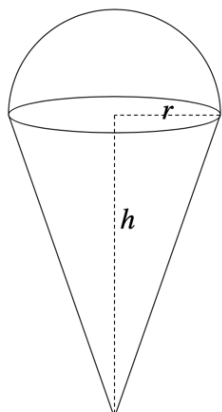
Your project files should be submitted to Web-CAT by the due date and time specified. You may submit your files to the skeleton code assignment until the project due date but should try to do this much earlier. The skeleton code assignment is ungraded, but it checks that your classes and methods are named correctly and that methods and parameters are correctly typed. The files you submit to skeleton code assignment may be incomplete in the sense that method bodies have at least a return statement if applicable or they may be essentially completed files. In order to avoid a late penalty for the 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. If you are unable to submit via Web-CAT, you should e-mail your files in a zip file to your TA before the deadline.

Files to submit to Web-CAT (all three files must be submitted together):

- IceCreamCone.java
- IceCreamConeList.java
- IceCreamConeListApp.java

Specifications

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

<p>An ice cream cone is a cone with a hemisphere on top as depicted below with cone height h and cone radius r, where r is also the radius of the hemisphere. The formulas are provided to assist you in computing return values for the respective methods in the IceCreamCone class described in this project.</p>		
	radius (r) height (h)	$cA = \pi r \sqrt{h^2 + r^2}$ $hA = 2 \pi r^2$ $A = cA + hA$
	Cone Side Area (cA) Hemisphere Area (hA) Surface Area (A) Cone Volume (cV) Hemisphere Volume (hV) Volume (V)	$cV = h\pi r^2 / 3$ $hV = 2\pi r^3 / 3$ $V = cV + hV$

- **IceCreamCone.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 IceCreamConeList.java on page 4. Otherwise, you will need to create IceCreamCone.java as part of this project.)

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

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

(1) **Fields** (instance variables): label of type String, radius of type double, and height of type double. Initialize the String to "" and the double to 0 in their respective declarations. These instance variables should be private so that they are not directly accessible from outside of the IceCreamCone class, and these should be the only instance variables in the class.

(2) **Constructor:** Your IceCreamCone class must contain a public constructor that accepts three parameters (see types of above) representing the label, radius, and height. 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 IceCreamCone 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.

```
IceCreamCone ex1 = new IceCreamCone("Ex 1", 1, 2);
```

```
IceCreamCone ex2 = new IceCreamCone(" Ex 2 ", 12.3, 25.5);
```

```
IceCreamCone ex3 = new IceCreamCone("Ex 3", 123.4, 900);
```

(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 IceCreamCone, which should each be public, 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 label field is set to the "trimmed" String and the method returns true. Otherwise, the method returns false and the label field is not set.
- `getRadius`: Accepts no parameters and returns a double representing the radius field.
- `setRadius`: Accepts a double parameter and returns a boolean as follows. If the double is greater than zero, sets the radius field to the double passed in and returns true. Otherwise, the method returns false and does not set the radius field.
- `getHeight`: Accepts no parameters and returns a double representing the height field.

- `setHeight`: Accepts a double parameter and returns a boolean as follows. If the double is greater than zero, sets the height field to the double passed in and returns true. Otherwise, the method returns false and does not set the height field.
- `surfaceArea`: Accepts no parameters and returns the double value for the total surface area calculated using formula above and the values of the radius and height fields.
- `volume`: Accepts no parameters and returns the double value for the volume calculated using formula above and the values of the radius and height fields.
- `toString`: Returns a String containing the information about the `IceCreamCone` object formatted as shown below, including decimal formatting ("`#,##0.0#####`") for the double values. Newline and tab 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: `surfaceArea()` and `volume()`. Each line should have no trailing spaces (e.g., there should be no spaces before a newline (`\n`) character). The `toString` value for `ex1`, `ex2`, and `ex3` respectively are shown below (the blank lines are not part of the `toString` values).

```
IceCreamCone "Ex 1" with radius = 1.0 and height = 2.0 units has:
  surface area = 13.308 square units
  volume = 4.1887902 cubic units
```

```
IceCreamCone "Ex 2" with radius = 12.3 and height = 25.5 units has:
  surface area = 2,044.5837657 square units
  volume = 7,937.3689278 cubic units
```

```
IceCreamCone "Ex 3" with radius = 123.4 and height = 900.0 units has:
  surface area = 447,847.2056927 square units
  volume = 18,287,175.0307675 cubic units
```

Code and Test: As you implement your `IceCreamCone` 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 `IceCreamCone` in interactions (e.g., copy/paste 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 an `IceCreamCone` 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 `IceCreamCone` then prints it out. This would be similar to the `IceCreamConeApp` class you will create below, except that in the `IceCreamConeApp` class you will read in the values and then create and print the object.

- **IceCreamConeList.java**

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

Design: The IceCreamConeList 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 IceCreamCone objects. These are the only fields (or instance variables) that this class should have, and both should be private.
- (2) **Constructor:** Your IceCreamConeList class must contain a constructor that accepts a parameter of type String representing the name of the list and a parameter of type ArrayList<IceCreamCone> representing the list of IceCreamCone objects. These parameters should be used to assign the fields described above (i.e., the instance variables).
- (3) **Methods:** The methods for IceCreamConeList are described below.
 - **getName:** Returns a String representing the name of the list.
 - **numberOfIceCreamCones:** Returns an int representing the number of IceCreamCone objects in the IceCreamConeList. If there are zero IceCreamCone objects in the list, zero should be returned.
 - **totalSurfaceArea:** Returns a double representing the total surface area for all IceCreamCone objects in the list. If there are zero IceCreamCone objects in the list, zero should be returned.
 - **totalVolume:** Returns a double representing the total volume for all IceCreamCone objects in the list. If there are zero IceCreamCone objects in the list, zero should be returned.
 - **averageSurfaceArea:** Returns a double representing the average surface area for all IceCreamCone objects in the list. If there are zero IceCreamCone objects in the list, zero should be returned.
 - **averageVolume:** Returns a double representing the average volume for all IceCreamCone objects in the list. If there are zero IceCreamCone objects in the list, zero should be returned.
 - **toString:** Returns a String (does not begin with \n) containing the name of the list followed by each IceCreamCone 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 IceCreamCone object in the list (adding a \n before and after each). Be sure to include appropriate newline escape sequences. For an example, see [lines 3 through 16](#) in the output below from IceCreamConeListApp for the *IceCreamCone_data_1.txt* input file. [Note that the toString result should **not** include the summary items in lines 18

through 24 of the example. These lines represent the return value of the summaryInfo method below.]

- `summaryInfo`: Returns a String (does not begin with `\n`) containing the name of the list (which can change depending of the value read from the file) followed by various summary items: number of `IceCreamCone` objects, total surface area, total volume, average surface area, and average volume. Use `"#,##0.0##"` as the pattern to format the double values. For an example, see lines 18 through 24 in the output below from `IceCreamConeListApp` for the *IceCreamCone_data_1.txt* input file. The second example below shows the output from `IceCreamConeListApp` for the *IceCreamCone_data_0.txt* input file which contains a list name but no `IceCreamCone` data.

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

- **IceCreamConeListApp.java**

Requirements: Create an `IceCreamConeListApp` class with a main method that reads in the name of the data file entered by the user and then reads list name and `IceCreamCone` data from the file, creates `IceCreamCone` objects, stores them in a local `ArrayList` of `IceCreamCone` objects, creates an `IceCreamConeList` object with the name of the list and the `ArrayList` of `IceCreamCone` objects, and then prints the `IceCreamConeList` object followed summary information about the `IceCreamConeList` object. **All input and output for this project must 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 data file. The first record (or line) in the file contains the name of the list. This is followed by the data for the `IceCreamCone` objects. After each set of `IceCreamCone` data (i.e., label, radius, and height) is read in, an `IceCreamCone` object should be created and added to the local `ArrayList` of `IceCreamCone` objects. After the file has been read in and the `ArrayList` has been populated, the main method should create an `IceCreamConeList` object with the name of the list and the `ArrayList` of `IceCreamCone` objects as parameters in the constructor. It should then print the `IceCreamConeList` object, then print the summary information about the `IceCreamConeList` (i.e., print the value returned by the `summaryInfo` method for the `IceCreamConeList`). The output from two runs of the main method in `IceCreamConeListApp` is shown below. The first is produced after reading in the *IceCreamCone_data_1.txt* file, and the second is produced after reading in the *IceCreamCone_data_0.txt* file. Your program output should be formatted exactly as shown.

Line #	Program output
1	----jGRASP exec: java IceCreamConeListApp
2	Enter file name: IceCreamCone_data_1.txt
3	
4	IceCreamCone Test List
5	IceCreamCone "Ex1" with radius = 1.0 and height = 2.0 units has:
6	surface area = 13.308 square units
7	volume = 4.1887902 cubic units
8	
9	IceCreamCone "Ex 2" with radius = 12.3 and height = 25.5 units has:
10	surface area = 2,044.5837657 square units
11	volume = 7,937.3689278 cubic units
12	
13	IceCreamCone "Ex 3" with radius = 123.4 and height = 900.0 units has:
14	surface area = 447,847.2056927 square units
15	volume = 18,287,175.0307675 cubic units
16	
17	
18	----- Summary for IceCreamCone Test List -----
19	Number of IceCreamCone Objects: 3
20	Total Surface Area: 449,905.097
21	Total Volume: 18,295,116.588
22	Average Surface Area: 149,968.366
23	Average Volume: 6,098,372.196
24	
	----jGRASP: operation complete.

Line #	Program output
1	----jGRASP exec: java IceCreamConeListApp
2	Enter file name: IceCreamCone_data_0.txt
3	
4	IceCreamCone Empty Test List
5	
6	----- Summary for IceCreamCone Empty Test List -----
7	Number of IceCreamCone Objects: 0
8	Total Surface Area: 0.0
9	Total Volume: 0.0
10	Average Surface Area: 0.0
11	Average Volume: 0.0
12	
	----jGRASP: operation complete.

Code: Remember to import java.util.ArrayList, java.util.Scanner, and java.io.File, and java.io.FileNotFoundException prior to the class declaration. Your main method declaration should indicate that main throws FileNotFoundException. After your program reads in the file name from the keyboard, it should read in the data 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 data file is the name of the list, and then each set of three lines contains the data from which an IceCreamCone 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 IceCreamCone 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 IceCreamCone data items (label, radius, and height) should be assigned, after which the IceCreamCone object should be created and added to a local ArrayList of IceCreamCone objects. The next iteration of the loop should then read the next set of three lines then create the next IceCreamCone object and add it to the local ArrayList of IceCreamCone objects, 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 of IceCreamCone objects should be used to create an IceCreamConeList object. The list should be printed by printing a leading \n and the IceCreamConeList object. Finally, the summary information is printed by printing a leading \n and the value returned by the summaryInfo method invoked on the IceCreamConeList object.

Test: You should test your program minimally (1) by reading in the *IceCreamCone_data_1.txt* input file, which should produce the first output above, and (2) by reading in the *IceCreamCone_data_0.txt* input file, which should produce the second output above. Although your program may not use all of the methods in IceCreamConeList and IceCreamCone, 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 IceCreamCone class should do any input/output (I/O).
2. Be sure to download the test data files (*IceCreamCone_data_1.txt* and *IceCreamCone_data_0.txt*) and store them in the 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.