

Name: \_\_\_\_\_ Lab Section: 03

## CS161 Fall 2015 Programming Exam

Write your name above and return this paper to your lab instructor when you submit your exam. You must finish and submit your work using Check-In by the end of this lab.

Do your own work. Only look at your own computer screen. Do not browse, email, or use cell phones and other digital technology other than the computers in the lab.

During the exam you may use your Java text book (or ebook version if you let your instructor know), the Java API documentation website and the course website, but no other web pages.

Your grade will be based on:

- Correctness of each method
- Clarity of code and comments. Your code should be easy to read, and if there are non-obvious steps, they should be explained with comments.
- Object-oriented design: Does your code capture the idea of encapsulation
- Testing: Does your main method adequately test all aspects of your code?

You will write four java classes for keeping track of plants you have found in a forest. The names of the classes are Forest, Plant, Tree, and Shrub. The classes Tree and Shrub must extend Plant, to allow an instance of Forest to use a single ArrayList to hold instances of all plants.

Your classes must implement the following methods.

**Forest:** class that is the primary application that you will run.

- [3 points] **constructor:** Creates an empty ArrayList for holding items of type Plant.
  - [3 points] **add:** Add a new Course that is either a CS, Math, or IndStudy course.
  - [3 points] **toString:** Returns a string representation of all courses that have been added.
  - [2 points] **main:** A main method that tests each method in this class.
- [3 points] **Plant:** parent class of the Tree and Shrub classes.
- [3 points] **constructor:** Has three arguments, an String for the plant common name, and two doubles for its latitude and longitude. These values are assigned to protected instance variables.
  - [3 points] **getName:** Returns the plant name.
  - [3 points] **setName:** Changes the value of name.
  - [3 points] **getLatitude:** Returns the latitude.
  - [3 points] **setLatitude:** Changes the value of latitude.
  - [3 points] **getLongitude:** Returns the longitude.
  - [3 points] **setLongitude:** Changes the value of longitude.
  - [3 points] **equals:** Returns true if two objects being compared have the same common name. This must correctly override the default equals method.
  - [3 points] **toString:** Returns a string like `Plant("Willow",42.3,-120.3)` where Willow is the common name and the two doubles are its latitude and longitude.
  - [2 points] **main:** A main method that tests each method in this class.
- [3 points] **Tree:** child class of Plant
- [3 points] **constructor:** Has four arguments, an String for the tree common name, two doubles for its latitude and longitude, and a string for the tree genus. These values are assigned to protected instance variables.

- [3 points]     **getGenus:** Returns the genus.
- [3 points]     **setGenus:** Changes the value of genus.
- [3 points]     **equals:** Returns true if two objects being compared have the same common name and genus. Implement this only if the method inherited from `Course` is not sufficient.
- [3 points]     **toString:** Returns a string like `Tree("Salix","Willow",42.3,-120.3)` where `Salix` is the genus of a willow tree.
- [2 points]     **main:** A main method that tests each method in this class.
- [3 points] **Shrub:** child class of `Plant`
- [3 points]     **constructor:** Has five arguments, an `String` for the tree common name, two doubles for its latitude and longitude, a string for the shrub genus, and a boolean that is true if the shrub produces berries. These values are assigned to protected instance variables.
- [3 points]     **getGenus:** Returns the genus.
- [3 points]     **setGenus:** Changes the value of genus.
- [3 points]     **getBerries:** Returns true if shrub contains berries.
- [3 points]     **setBerries:** Changes the value of the boolean berries variable.
- [3 points]     **equals:** Returns true if two objects being compared have the same common name and genus. Implement this only if the method inherited from `Course` is not sufficient.
- [3 points]     **toString:** Returns a string like `Shrub("Vaccinium","Blueberry",32.5,-118.2)` where `Vaccinium` is the genus of a blueberry bush.
- [2 points]     **main:** A main method that tests each method in this class.

Remember, you are required to implement a **main** method in every class that tests the methods of that class. After your tests in the main methods of each class work, change the main method in your `Forest` class to perform the following steps.

- [4 points]     Compiles.
1. Add these plants to your `Forest` in the order given.
    - a Willow tree (genus `Salix`) at latitude 42.3 and longitude -120.3
    - a Blueberry shrub (genus `Vaccinium`) at latitude 32.5 and longitude -118.2.
    - an Oak tree (genus `Quercus`) at latitude 23.3 and longitude -90.
    - Poison Ivy (genus `Toxicodendron`) at latitude 41.9 and longitude 122.5.
    - a Ponderosa Pine tree (genus `Pinus`) at latitude 21.2 and longitude -95.2.
  - [3 points] 2. Print the forest.
  - [3 points] 3. Add another Ponderosa Pine that is at the same longitude as the above Willow Tree but is at a latitude 2 degrees higher. Use a get method for `ArrayLists`, and use get methods to get the latitude and longitude of that item.
  - [1 points] 4. Print the forest again.

Here are some reminders about how to use `ArrayLists`.

- Remember to `import java.util.ArrayList;`
- Constructing an instance: `ArrayList<Type> list = new ArrayList<Type>();`
- Add an object `o` of type `Type` doing `list.add(o)`
- Get element at index `i` by doing `list.get(i)`

When you are done, combine your files into a **jar file** named `transcript.jar`

```
jar cvf transcript.jar *.java
```

and check-in your jar file using the Checkin page at CS161 web site.

And you must turn in this exam form with your name on it to your instructor before you leave recitation.