—Assignment #7—

Make sure to review the submission requirements on pg. 4 of the Lab #1 document.

Follow the Style Guide as given in the Resources section of our conneX course page.

Learning Outcomes

When you have completed this assignment, you should understand:

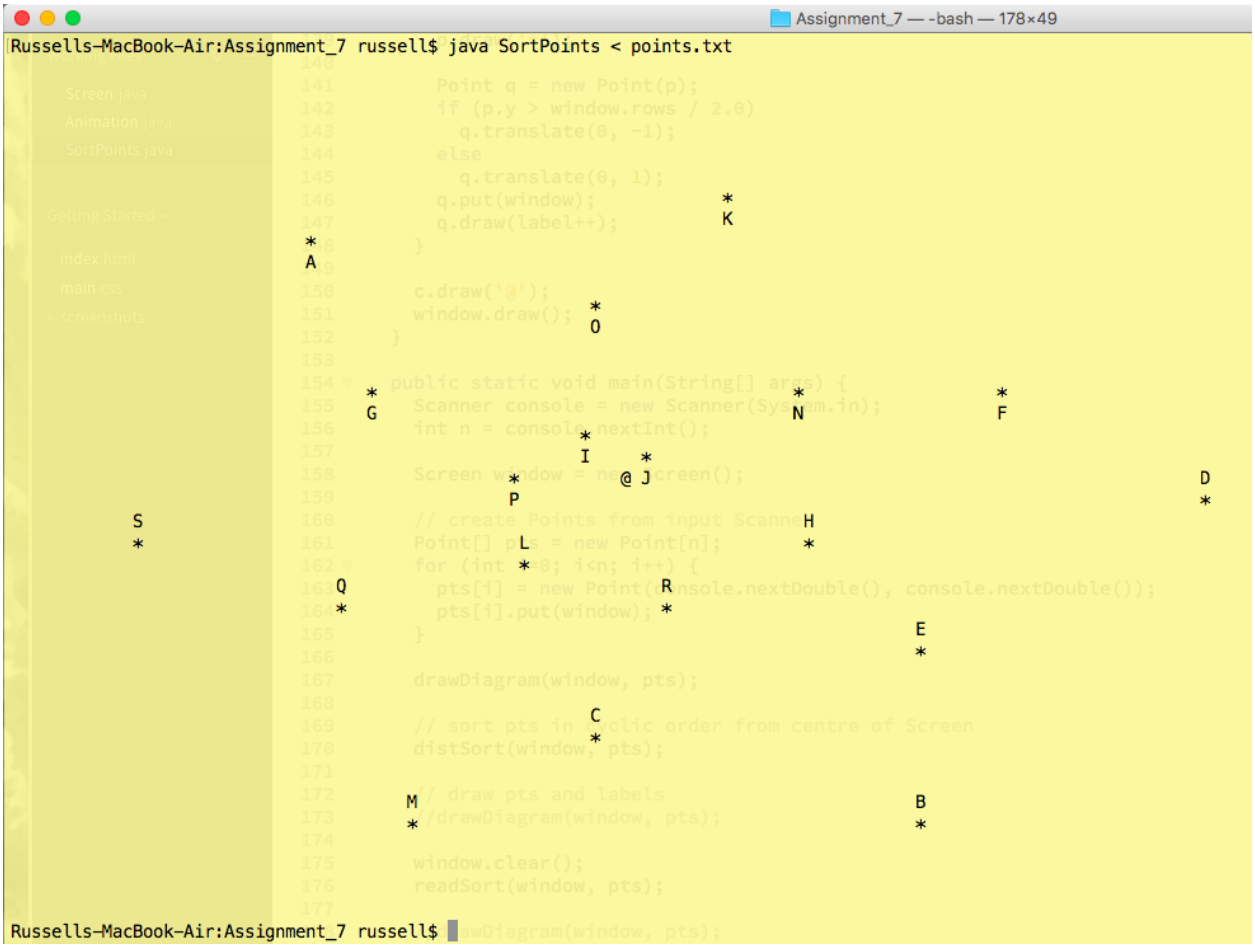
- How to use custom Classes in a client program.
- How to read a file in to a program from the command line.
- How to write Selection Sort code.
- How to write Bubble Sort code.
- How to change a sorting of elements based on your own comparisons.
- How to create a voronoi diagram.
- (That you can use different measures of distance from Euclidean distance.)

Download the template program file `SortPoints.java`, along with the `Screen.java` and `Point.java` classes (they must be the ones from the Assignment 7 section on conneX). `SortPoints.java` has comments throughout that will help you complete your work. When finished the program `SortPoints.java` should read in a set of points from a file called `points.txt` (available for download on conneX) using the command line in your console. You can do this with the following command:

```
java SortPoints < points.txt
```

and you can read the values in the file using a `Scanner` connected to `System.in`. DO NOT use a `File` object. The marker will not run your program correctly if you do, and you will not receive full marks. The first value in `points.txt` is the number of (x, y) coordinates in the file, and you should save this value as an `int` in your program. Use it to create an array of `Point` objects with the appropriate number of elements, and then scan in the remaining values to create each `Point` in the array.

The (x, y) coordinates in `points.txt` are not listed in any particular order. The first code you should write will be part of the `drawDiagram` method. Make it draw the points on a `Screen` and label each `Point` in the order they are listed in your array from A to S (there are 19 of them). You can use a `char` variable and increment it as you label each `Point`. Use a copy of each `Point` to draw the label and change its (x, y) coordinates so that if the `Point` is above the centre of the `Screen` then the label draws directly below the `Point`, and otherwise the label should draw directly above the `Point`. Also, draw an @ character at the centre of the `Screen` object. Your output should look exactly like the output given below:

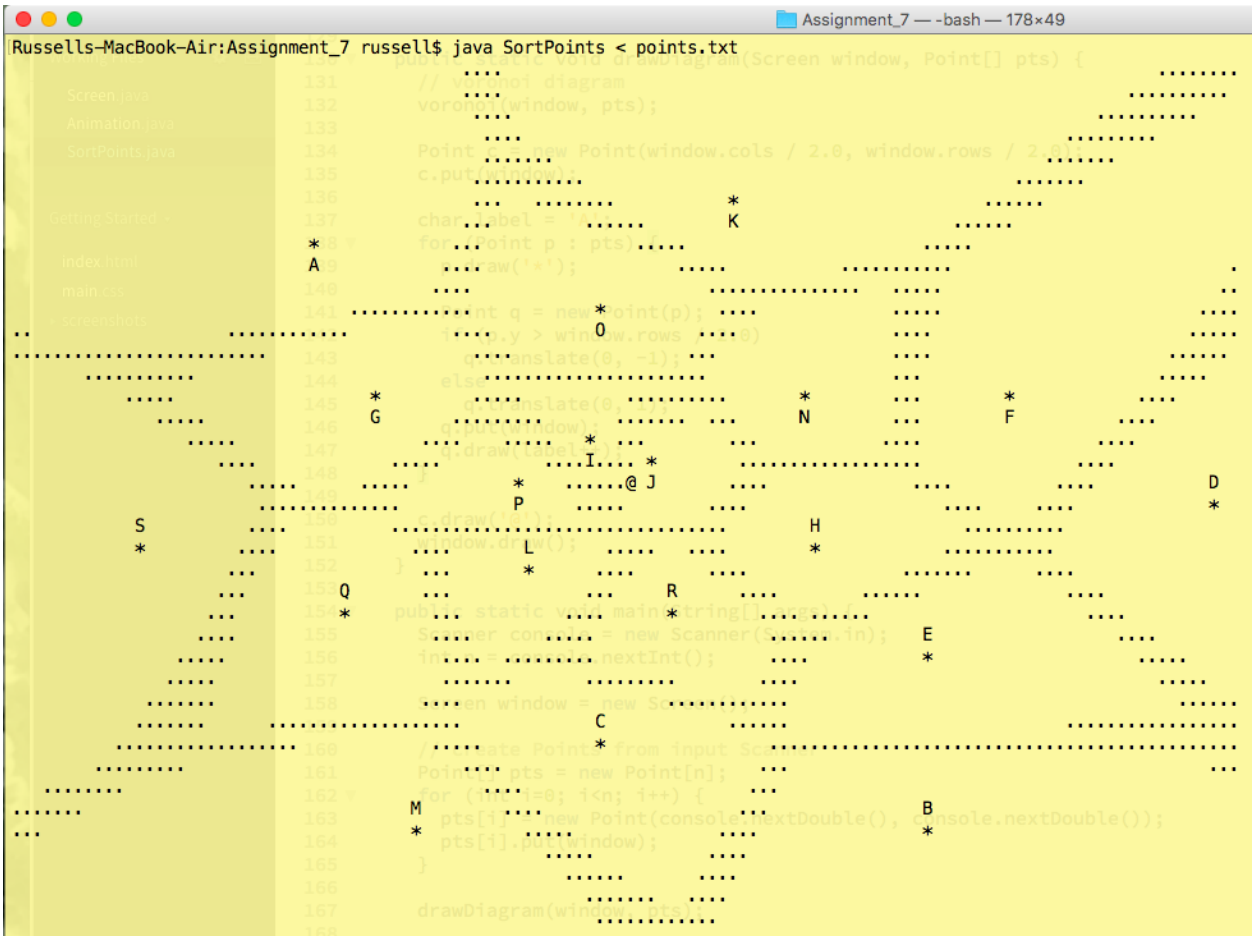


You have been given the code for the `dist` method that calculates the distance in a slightly different way than the usual Euclidean distance formula you are used to. The only difference here is that the vertical distance has been scaled to contribute 3 times as much as normal. I've done this because the `Screen` object is defined to have roughly three times as much width as there is height and the `Point` objects are arranged in an elliptical spiral to match the aspect ratio of the `Screen`. There are actually many ways to consider calculating the distance between elements in a set such as points in the 2D plane, and Metric Spaces is a topic in mathematics that studies what happens when you define distances in different ways.

The next code you should write are two methods called `voronoi` and `equidistant`. The method `equidistant` has two parameters, an array `pts` of `Point` objects and another `Point` named `p`, and this method should check the distance of each `Point` in `pts` against `p`. Then if the two closest distances have an absolute value of their difference below 3.0 it should return `true`. Otherwise, it should return `false`. This code will be very much like finding the minimum, but you have to find the second to smallest value as well. (hint: look at the if/else code block inside the `worley` method of `Animation.java` in Lecture 15 code on conneX)

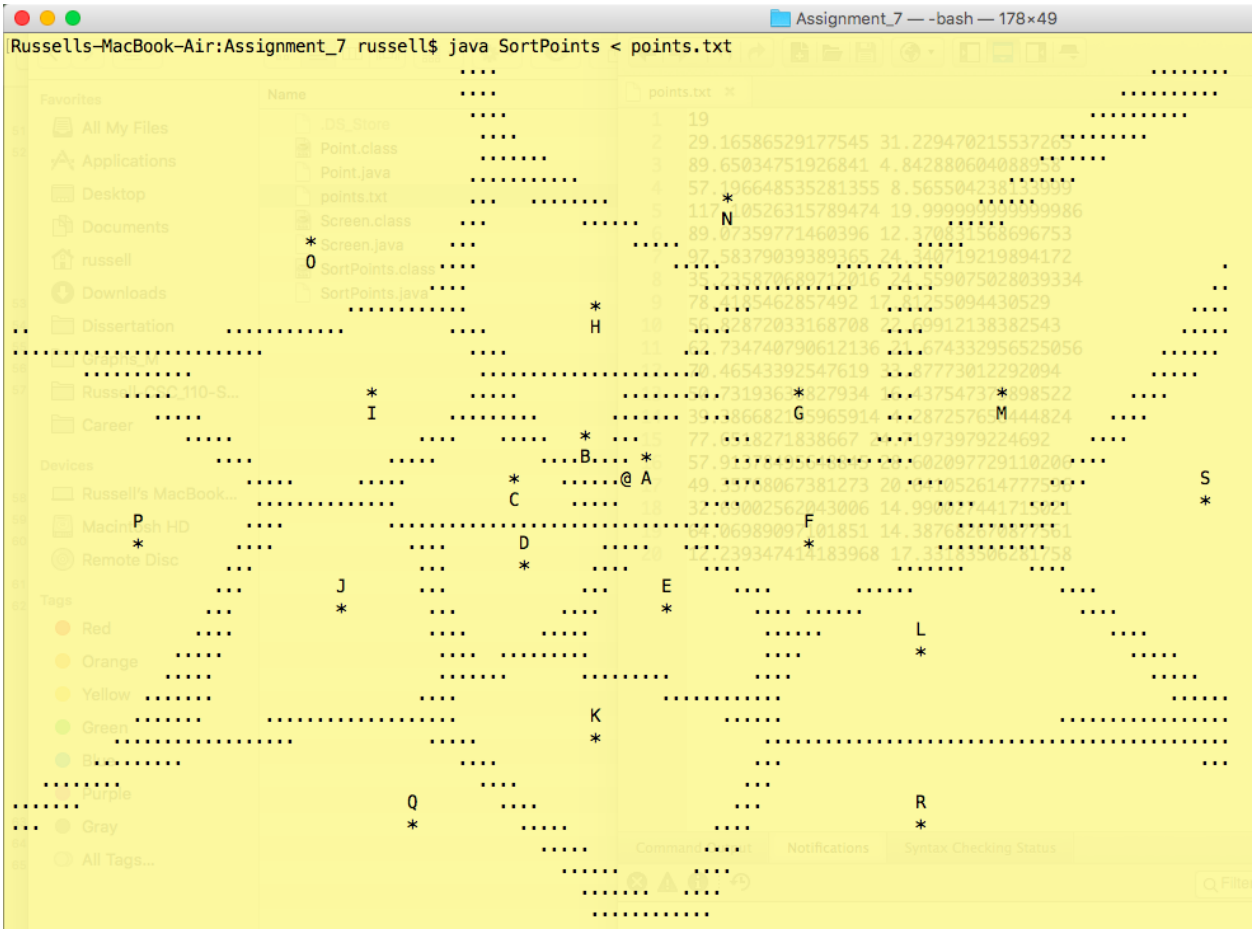
A voronoi diagram draws boundaries around a set of points, so that any position on a boundary is equidistant from its two closest points. These diagrams are useful for generating structures like cells, tiles, maps, etc.

The `voronoi` method should use nested for loops to iterate through every possible position in the `Screen` parameter and check whether each position is equidistant from its two closest `Point` objects in `pts`. If the position is equidistant, then it should set that position in the `Screen` to draw a period character. The `drawDiagram` method should call the `voronoi` method. Your output should look exactly like the output given below:



Now you should write code for the `distSort` to sort the array `pts` so that they are labelled in the order of the closest to the centre of the `Screen`. You must implement the Bubble Sort algorithm to do this, and make the ordering use the `distCompare` method given. If two `Point` objects are out of order, then `distCompare` will return -1 and you then need to swap their locations in the array `pts`. Your Bubble Sort implementation must use the `swap` method, which you also need to write.

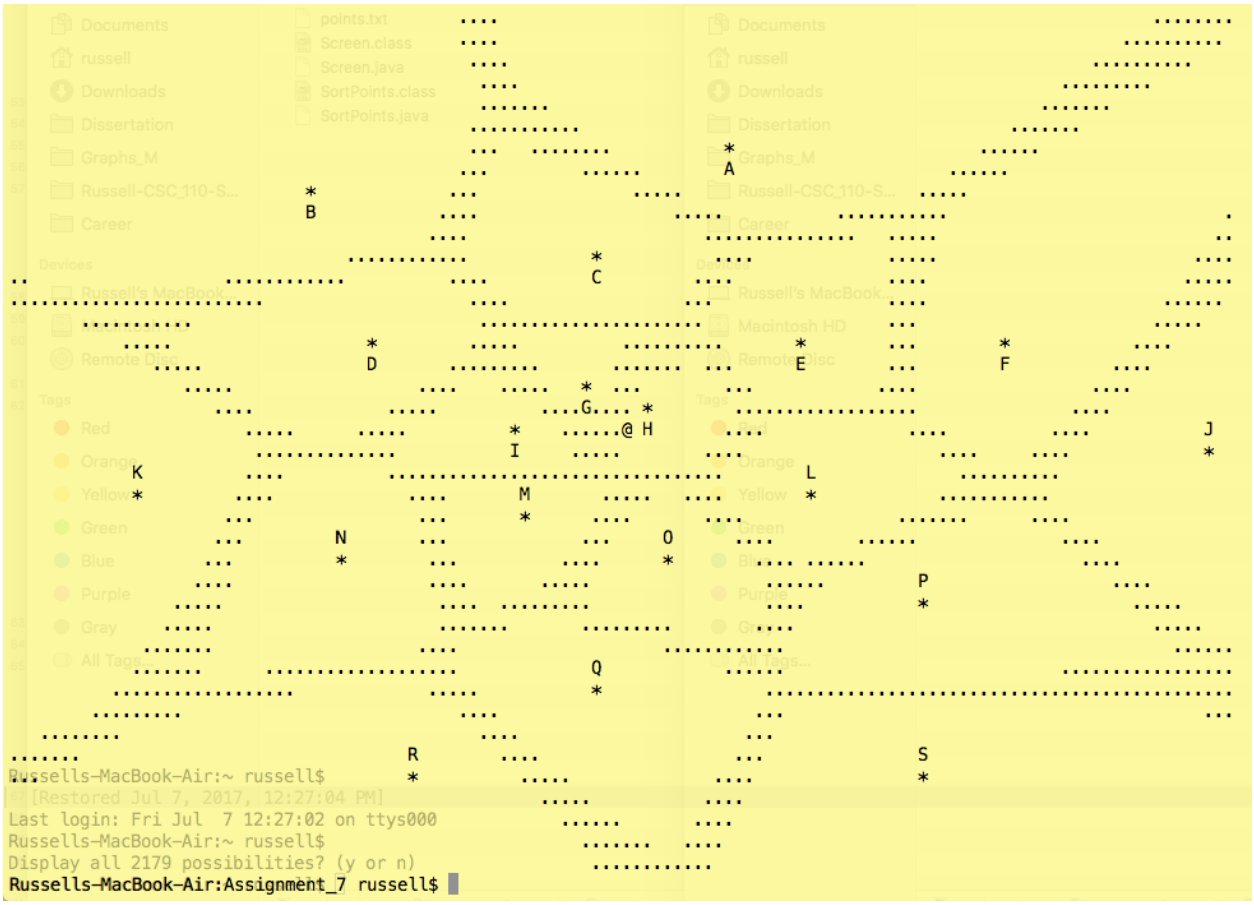
After you print the diagram in `main`, use your `distSort` method to sort the array `pts` and then print the diagram again. The additional output should look exactly like the output given below:



You can see that the `Point` objects are labelled in the order of an elliptical spiral, increasing from the centre of the printed `Screen`.

Lastly, write code for the `readSort` and `readCompare` methods to sort the array `pts` so that they are labelled in the order as that of reading from top left to bottom right. That is, any `Point` above another should be labelled with a lower value, and any two `Point` objects with the same height should be labelled from left to right. There are helpful comments in the `readCompare` method to help you write it. Your `readSort` must implement the Selection Sort algorithm, and must also make use of the `swap` and `readCompare` methods.

After you print the previous two diagrams in `main`, use your `readSort` method to sort the array `pts` and then print the diagram a third time. The additional output should look exactly like the output given below:



Make sure your program prints the above described three diagrams. Please submit your finished `SortPoints.java` file to conneX.

Grading

Marks will be allocated out of 30 points:

- (0 points) You do not submit any program file.
- (5 points) Your program does not compile. The marker cannot fix the complier error easily, or if they can, the output is severely mismatched with the assignment requirements.
- (10 points) Your program does not compile, but the marker can fix the error easily.
- (15 points) Your program compiles, but only outputs a few of the assignment requirements.
- (20 points) Your program compiles, outputs most of the assignment requirements, and is missing documentation comments or has formatting issues.
- (25 points) Your program compiles, outputs everything required, but is missing documentation comments or has formatting issues.
- (30 points) Your program compiles, outputs everything required, and has proper documentation and formatting.

This assignment gives you the basic ideas behind manipulating two-dimensional data in different ways. If you wanted to have some fun with it, when you are done, you could change the `dist` method to calculate the distance between points in a different way, say, using something simple like the Manhattan Metric, and see how it changes the voronoi diagram. Note that changing the way you calculate distance will also most likely change the way `distSort` arranges the `Point` objects in `pts`, and therefore will change the order of the labelling.