**Lab Report: Graph Smoother and Salter**

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This research discusses the three methods (Java, MathLab, and Apace and JFreeChart) used to find the salted and smooth values of Y (F(x) = x^2 + x).

**Java:**

I will discuss the programming involved first, then the result. Lets start from beginning to end, First I created two classes a Tester(T) and ValueGenerator(VG) and added global variables of ArrayList to store specific values (x, y, salt, and smooth respectively). Second, I created the quadratic formula method that returns the Y value and then created a writer class that writes the values (x,y,salted values) to the CSV file. Third, I created salter method that adds and subtracts Y-value with random numbers, which returns a salted Y value and stores it in the salt ArrayList and write the salted values to the CSV file. Fourth, I created the graph smoother method and to create this method it required a lot of steps; Step 1, store Y-Values into the graph smoother, to do that I created a reader method that reads a specific column from the csv file, then I use that method to read the Y-values and store it in the smoother list; Step 2, created a temp list (which temporarily stores the graph smoother values within the window value range), smooth value variable (which gets the mean from the temporary list), start window value variable (store smoother list values within the window range in temp value list during the start case, when index < windowValue), and end window value variable (store smoother list values within the window range in temp value list during the end case, when Index > size – window value); Step 3, realized my method was messy for graph smoother, so I decided to create a class graph smoother and created methods for the start case, middle case, end case, and to get the mean; Step 4, created a nested loop to smooth the Y values multiply times. Fifth, created another writer class to write over the Y-Values with the smoothed Y-Values.

**Result:**

**Smoothed Graph (Not Fixed):**

Graphical user interface, text, application

Description automatically generated

**Smooth Graph Fixed:**

**Chart, line chart

Description automatically generated**

**Salt Graph:**

**Chart, line chart

Description automatically generated**

I found an error where if I smooth the graph a certain amount of time I would get a index out of bounds error, for example if I have a window range of 3 and 100 values, I can only smooth run the graph smoother 33 times (of course if I change the window range and amount values, it will effect how many times I can run the graph smoother method).

Update: after doing the Apache and JFreeChart method I realized my mistakes and how ugly my graph smoother method looked. I will keep my mistakes to show the progression story and add a fixed smooth graph.

**MatLab**

I followed a tutorial on YouTube (I will link the playlist at the bottom) on how to use MatLab and it wasn’t as bad as I thought it was. After following the tutorial, I learned that MatLab is basically a calculator that can do almost any math. The first thing the tutorial taught me was how to make a matrix, which was useful for my case since I needed to create a matrix for my X and Y values and I realized that you can just create a matrix with just one line of command, which was a life saver. The second thing I learned from the tutorial was on how to create a graph, which again was just a one line command called plot(x,y). The third and the most important skill I learned was the browse function, by clicking on the “fx” left side of the command prompt or by typing “shift+f1” you will be met with a directory with bunch of methods and with cherry on top it also has a search bar. After I learned the third skill it took me no time to find methods such as, “randi”, and “movmean” to create a graph smoother and salter. Fourth skill I learned was to create a script file, its basically used to create more complicated methods with multi parts functionality. I created two script files, one that creates a Salter graph and the other that creates a smoother graph and this is the result I got.

**Graph Salter:**

**Graphical user interface, chart

Description automatically generated**

**Graph Smoother:**

**Chart, line chart

Description automatically generated**

After comparing the MatLab and the Java result, I realized I made a error in one of them. After punching in the mean of the MatLab and Java, the result in java did not match my calculator thus the error was in my Java program.

**Apache Math and JFreeChart:**

The first thing I immediately did was download the zip file for Apache Common Math 4- 4.0, but I didn’t know how to import it into Java. After looking around I found an answer on how to import the files, I had to go to the build path of my Java Project and in the build path I had to click on the “Libraries” tab and click on the “Classpath” and add JAR files to the “Classpath”. Then, I opened the Apache Common Math 4-4.0 API and conveniently it had a search bar for me to search for specific methods. The first I immediately searched for was the “mean” (for the graph smoother) and it had two different methods in the StatUtils class one which it gets the mean of a whole array and other which asks for an index and length of the array, I used the latter. After knowing that the mean method needed an array parameter and not an array list, I had to take a different approach compared to my Java method in which I used an array list. After I created a method for value generator X and Y arrays I made it to the salt generator and I realized that Apache Common Math 4.0 didn’t have a random number generator method, I searched for a random number generator in Apache and found that the Apache Common Lang3-3.12 library had random number generator in the RandomUtils class, guess what I downloaded and JAR files and imported that into the Classpath. I got my salt generator and eventually got my smooth generator(I figure out my errors, that I had in my Java method) ready. Now I had to import the JFreeChart and used the same process as the Apache library. I searched up how to create a line chart and found a tutorial on tutorialpoint.com (I will link the refences) and created a line chart. Here are the results:

**Salted:**

Chart

Description automatically generated

**Smoothed:**

**Chart, line chart

Description automatically generated**

I immediately saw the similarities between the MatLab and figured out that I made a grave error in my graph smoother generator in my Java method. Update Java method fixed.

**References:**

**MatLab:**

Tutorial I followed: <https://www.youtube.com/watch?v=w1cnxqBaljA&list=PLnVYEpTNGNtX6FcQm90I0WXdvhoEJPp3p>

**JFreeChart:**

How to create a Line Chart: <https://www.tutorialspoint.com/jfreechart/jfreechart_line_chart.htm>