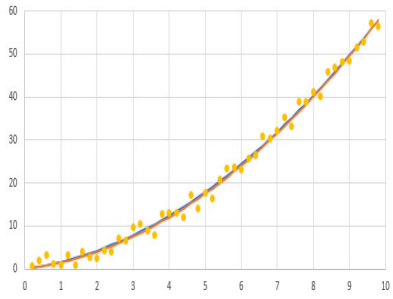


24-780 B—Engineering Computation

Assigned: Mon. Nov. 21, 2022
Due: Tues. Nov. 29, 2022, 11:59pm

Problem Set 10: Quadratic Regression

Once again, I expect this assignment to take about 3-5 hours only, so that you can keep pushing hard on the development of your team project.

In engineering, we are often required to covert experimental data to more usable mathematical expressions. For this assignment, you are asked to use the least squares approach to curve fitting (to be discussed in lecture, but you may also look it up or ask for further clarification) to find and output the coefficients a1 and a2 of a quadratic curve of the type:

$$F = a_1 x + a_2 x^2$$

Note that we are keeping a0 = zero to simplify things a bit more.

A sample set of experimental data is provided in the attached txt file (partially shown at right, and charted above, with solution a1 = 1.1607, a2 = 0.48501), but your program should be able to determine the values of a1 and a2 for any data set in the given format.

```
0.2     0.657
0.4     1.914
0.6     3.235
0.8     1.213
1       0.809
1.2     3.150
1.4     0.960
1.6     4.045
1.8     2.660
2       2.403
2.2     4.246

. . .
```

It is likely you will need to work this out "on paper" before you try to code it.

Task 1 (Create *QuadraticFit* class)

Our *Shape2D* class will once again be the foundation of our efforts since it allows us to read coordinate data from a file, write to a file, plot on the screen, etc., etc., This time, we want to inherit from *Shape2D* to create a *QuadraticFit* class that can use the coordinate pairs in the vector *thePoints* as the experimental input data to determine the quadratic coefficients a1 and a2 (assume a0 is zero).

Unlike in PS09, you are expected to create the subclass all on your own (the main purpose of the assignment).

Task 2 (Visualization)

Now that you have the number-crunching part done, adapt the user interface code you already have (from PS09 or earlier), to visualize the results of your calculations. At a minimum, your program should be able to:

- load from file and save to file,
- chart the experimental coordinate points (the input)
- chart the best fit quadratic curve from the minimum x value of the experimental data to the maximum x-value of the experimental data
- allow individual data points to be moved so the results on the best fit curve are instantly visible
- display the full quadratic formula on the screen in the form shown above (with the values of a1 and a2 substituted in, of course)

NOT REQUIRED (time constraints):

- show x-axis and y-axis
- gridlines

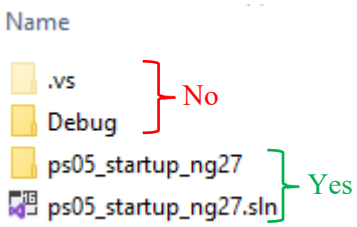
Deliverables

7 files (zipped together):

DataManager.h, DataManager.cpp
QuadraticFit.h, QuadraticFit.cpp
Shape2D.h, Shape2D.cpp -> expect very few changes from PS09 (if any)
Some cpp file containing main()

The 7 files above are the only ones that may/will require changes from you, so don't need to include all the others unless you made some changes. Upload the zip file to the class Canvas page before the deadline (Tuesday, Nov. 29, 11:59pm).

Alternatively, if you are using Visual Studio, it may be easier to submit your entire solution rather than a collection of files. To do this, create a *zip file* of the whole project (the .sln file and the associated folder), being careful NOT to include the hidden folder called ".vs". This folder is used only to manage the IDE and is typically huge (100MB). Erasing or omitting it will just force Visual Studio to rebuild it when needed. The Debug folder should be kept out of the zip file too to avoid including executable files that some firewalls may disallow. *The name of the project should include your AndrewID*



Learning Objectives

Inheritance in C++.

Numerical methods in C++.

Increasing understanding of graphical data representation.

Implementing algorithms developed by others.