Math 105B Lab Report 2

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Purpose/Objective: In this lab I will first write a function that computes the Newton forward divided differences using the inputs X list and Y list, outputting F and storing them into a matrix. Then I will interpolate the given data to estimate the value at a given point using the fourth degree Lagrange interpolating polynomial and the third degree polynomial, in order to compare these two and find the error. Lastly, I will add a point into our given data table and again interpolate at a given point using two different degrees of polynomial.

Introduction: For the Newton forward divided differences function, I used a nested for loop and followed the formula given to iterate through the matrix. After I have obtained the F matrix from the divided differences function, I wrote Pn(x) into a function handle. By this way, I was able to compute P_4(0.05) and P_3(0.05) and compare these two results. For part 3, I made new lists for X and Y and repeated the same process I did above, except that the point we want is x=1.05 and we are comparing fifth degree polynomial with fourth degree polynomial.

Procedure(Algorithm method): Firstly I initialized F to be the zero matrix of dimension n and put the list Y into the first column of the matrix. Then I carefully adjusted the indices when looping because Matlab doesn't start with index 0. For example, F(1,1) is actually F(0,0) in the problem and F(1,2) is actually F(1,1) based on how my matrix is organized. For part 2, I tried to generate Pn(x) by writing another function, but the abnormal indices in part 1 made it very nearly impossible. So instead I typed Pn(x) manually into a function handle based on the formula and the degree we want. I also changed the format to long when we are comparing two results. I

didn't suppress some of the results so I could see what matrix F looks like, what value P4_x(0.05) gives and etc.

Results:

```
F =

   -6.0000    1.0517    0.5725    0.2150    0.0630
   -5.8948    1.2234    0.7015    0.2780         0
   -5.6501    1.5742    0.9517         0         0
   -5.1779    2.2404         0         0         0
   -4.2817         0         0         0         0


y_4 =

   -5.9487


y_3 =

   -5.9487


abs_error =

    2.166170634954057e-05
```

```
F1 =

   -6.0000    1.0517    0.5725    0.2150    0.0630    0.0142
   -5.8948    1.2234    0.7015    0.2780    0.0786         0
   -5.6501    1.5742    0.9517    0.3566         0         0
   -5.1779    2.2404    1.2370         0         0         0
   -4.2817    2.8589         0         0         0         0
   -3.9958         0         0         0         0         0


y_5 =

   -4.1423


y_4_new =

   -4.1426


abs_error_new =

    2.383433948871527e-04
```

Conclusion: We get very small absolute errors for 4th degree vs. 3rd degree in part 2 and 5th degree vs. 4th degree in part 3. However, I can imagine the error being large when we compare 4th degree with 1st degree, or when we have a very large dataset.