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COMPE510 - Fall 2025
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Programming Assignment 3 - Logistic Regression

A) Results

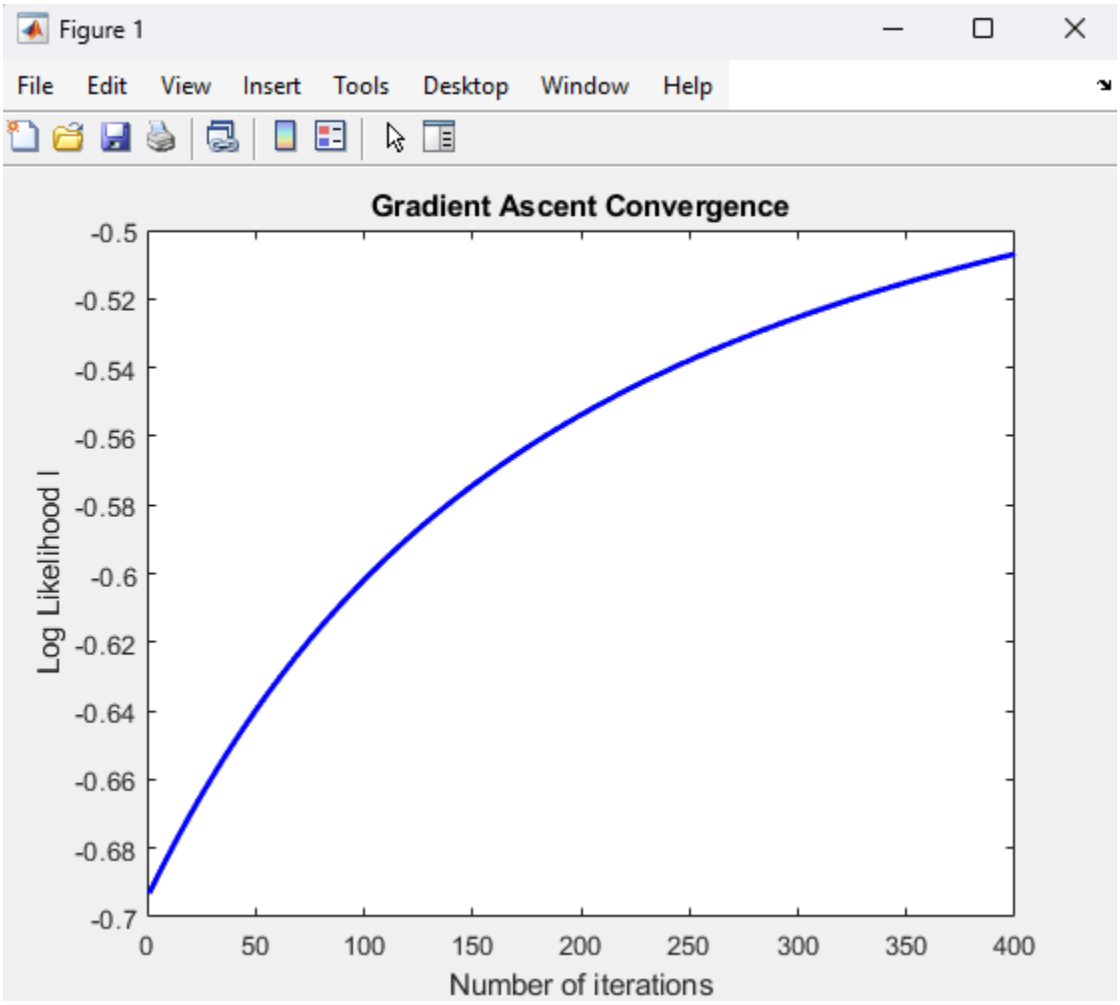
- **Data Processing**

Command Window

```
===== Part 1: Data Preprocessing =====
Loading data ...
First 10 examples from the training dataset:
 x = [0 152 82 39 272 42 0 27], y = 0
 x = [2 134 70 0 0 29 1 23], y = 1
 x = [2 107 74 30 100 34 0 23], y = 0
 x = [0 95 80 45 92 36 0 26], y = 0
 x = [6 93 50 30 64 29 0 23], y = 0
 x = [12 100 84 33 105 30 0 46], y = 0
 x = [1 79 60 42 48 44 1 23], y = 0
 x = [1 180 0 0 0 43 0 41], y = 1
 x = [10 92 62 0 0 26 0 31], y = 0
 x = [7 124 70 33 215 26 0 37], y = 0

Normalizing Features ...
First 10 examples from the training dataset after normalization:
 x = [-1 1 1 1 2 1 -1 -1], y = 0
 x = [-1 0 0 -1 -1 -0 0 -1], y = 1
 x = [-1 -0 0 1 0 0 -0 -1], y = 0
 x = [-1 -1 1 2 0 1 -0 -1], y = 0
 x = [1 -1 -1 1 -0 -0 -0 -1], y = 0
 x = [2 -1 1 1 0 -0 0 1], y = 0
 x = [-1 -1 -0 1 -0 1 1 -1], y = 0
 x = [-1 2 -3 -1 -1 1 -1 1], y = 1
 x = [2 -1 -0 -1 -1 -1 -1 -0], y = 0
 x = [1 0 0 1 1 -1 -1 0], y = 0

Program paused. Press enter to continue.
```

- **Maximum Likelihood & Gradient Ascent (Next Page)**

```
Program paused. Press enter to continue.
===== Part 2: Maximum Likelihood & Gradient Ascent =====
beta computed from gradient ascent:
 -0.457268
  0.191763
  0.528154
 -0.065925
  0.029734
  0.061329
  0.288776
  0.156031
  0.162130

Program paused. Press enter to continue.
```



- **Evaluate Performance**

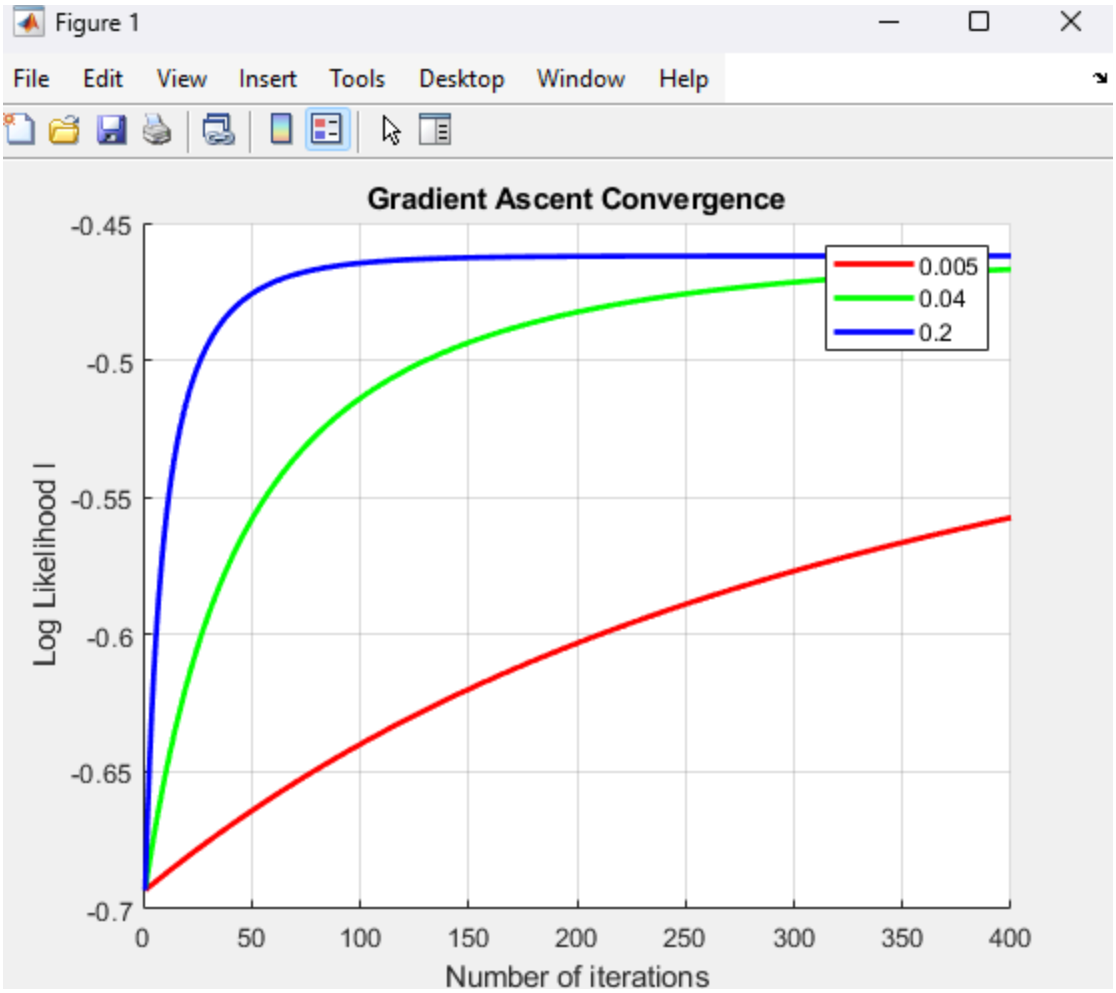
```
Program paused. Press enter to continue.
===== Part 3: Evaluate Performance =====
Accuracy:
 74.458874

Predicted output:
 0
>>
```

B) Questions

- **Run gradient ascent with at least three different learning rates. Show how the log likelihood function behaves over iterations. Based on the results, explain how the learning rate affects convergence and model performance. What learning rate worked best for your data, and why?**

After running gradient ascent with at least three different learning rates, it is clear that the conclusion that we can draw is that smaller values converge slower and bigger values converge faster. Provided below will be the output testing gradient ascent with at least three different learning rates of 0.005, 0.04, and 0.2.

```
Program paused. Press enter to continue.
===== Part 2: Maximum Likelihood & Gradient Ascent =====
beta computed from gradient ascent (alpha = 0.005):
 -0.235206
 0.126567
 0.343527
 -0.009680
 0.017516
 0.059273
 0.190790
 0.105203
 0.140645

beta computed from gradient ascent (alpha = 0.040):
 -0.740674
 0.284203
 1.008952
 -0.216019
 -0.023964
 -0.060566
 0.560843
 0.259016
 0.221111

beta computed from gradient ascent (alpha = 0.200):
 -0.868476
 0.348531
 1.260809
 -0.303191
 0.008723
 -0.197534
 0.690765
 0.310483
 0.181141
```



- **In your own words, explain what the log-likelihood function represents in logistic regression. Why is it a more appropriate objective than minimizing squared error in this case?**

In this assignment, the log-likelihood function in correlation to logistic regression represents an error check, by checking how accurate the measurement being done in logistic regression is. It is a more appropriate objective than minimizing squared error because it is a more accurate error check.

- **Logistic regression outputs probabilities. Select a few examples where the model was either very confident but incorrect, or uncertain but correct. What might cause such cases in real-world applications? How could you improve the model to handle these situations?**

Times where the model was either confident but incorrect, or uncertain but correct can be when detecting spam emails or diagnosing patients. In real-world applications, this

would be caused by situations that require more specific handling. In order to handle these situations, the model can be improved by adding more specific features to handle unique situations that require a deeper measurement or analysis.

C) Summary

In this third programming assignment, I believe that the implementation of each of the program files went well in connection to the main program file. The things that went well regarding this third assignment include producing outputs for the instructions/requirements, and furthering our knowledge on the difference between linear regression (last assignment) and logistic regression (this assignment). On the other hand, some challenges along the way included debugging my code when it did not produce an output at all, and fixing my code at first when it was producing the wrong output from what was expected. Overall, this third assignment was efficient in teaching me the difference between linear and logistic regression, and some new ways to analyze a different dataset that is loaded into Matlab.