Basic & Application of Machine Learning

Homework 1 – Linear Regression



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* Program Description

The main purpose of this assignment is to write a program that performs linear regression on the given dataset with different models and approaches to give students better understanding of linear regression.

Task 1 model (y = ax + b) with gradient descent approach.

The most important code lines for this are the gradient descent function, where we pass the x and y data values, slope variable, y-intercept variable, and learning rate variable. Then, we build our model which is y = ax + b, where a is the slope and b is the y-intercept. Next, compute the partial derivatives for ‘a’ and ‘b’ for the cost function, where cost = 1/m \* sum(y - y\_guess)\*\*2. Then, we update the parameters ‘a’ and ‘b’. Finally, we make iterations of updates according to the length of the data. Note that we use batch gradient descent because we iterate according to length of ‘x’ (M = m), and we got the approximation value for ‘a’ and ‘b’.

Task 2 model (y = ax^2 + bx + c) with normal equation approach.

The most important code lines for this are the normal equation function that follows Ax = b. We make the A matrix from 1D matrix of one’s values and append it to ‘x’ values and append it again to ‘x^2’ values that forms nx3 matrix, where n is the amount of data. By following the formula of normal equation which is x = (ATA)-1 ATb, we find the ‘x’ or the ‘constants’ in which we will use it to find the optimization line.

* How to Run

I use Google Colabs on a web browser to run the program. First, open Google Colabs, when prompted to open files, you can first upload the files to google drive then open it from google drive section, or you can upload it from local drive immediately.

Graphical user interface, application

Description automatically generated

After that, you need to upload the data files too, which is the “data\_hw1.csv” file, by using the upload button just like in the picture.

Graphical user interface, application

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Finally, you can run the program by pressing “Ctrl + f9” or just click run on each bar from top to bottom in orderly.

* Snapshots of Progress

This is task 1 with gradient descent approach.

Graphical user interface, text, application

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This is task 2 with normal equation approach.

Graphical user interface

Description automatically generated

* Results

1. Table of parameters

|  |  |  |  |
| --- | --- | --- | --- |
|  | x^2 | x | c |
| Task1 | 0 | 12.23 | 10.39 |
| Task2 | -5.82 | 1.06 | 12.70 |

1. Plots of the models

Task 1

Graphical user interface, application

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Task 2

Graphical user interface, application

Description automatically generated

* Conclusion

In summary, model y = ax+ b is too underfitting the data, however model y = ax^2 + bx + c fits very well with the data, and it could be used to predict the next values or new inputs.