

Intro to ML
PS2 Report

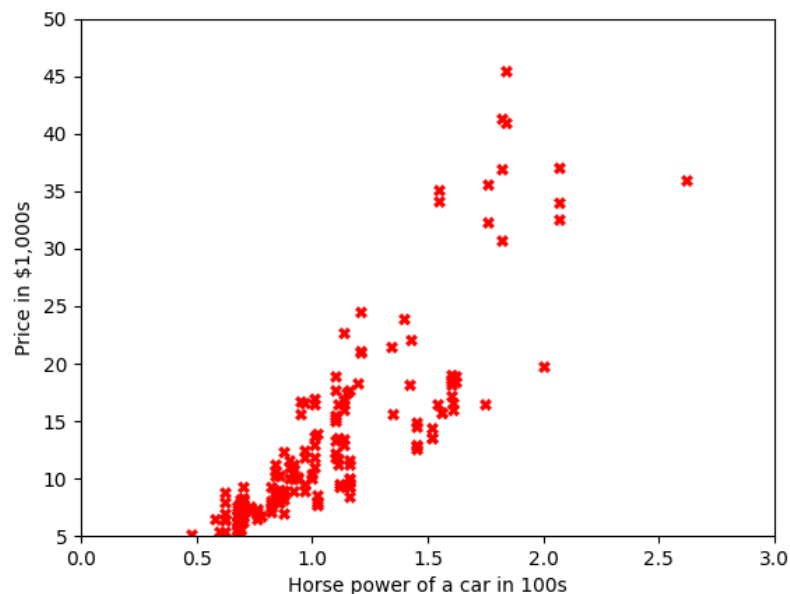
Name: Timothy Horrell
ID: 4475990

Questions:

- 1) Cost of case i: 29.66
Cost of case ii: 14.875
- 2) Theta estimates: *theta begins at a random number between -1 and 1*
 $\Theta_0 = 1.02$
 $\Theta_1 = 0.509$
Cost after 15 iterations:
22.48
- 3) Theta estimates:
 $\Theta_0 = 4$
 $\Theta_1 = 2$

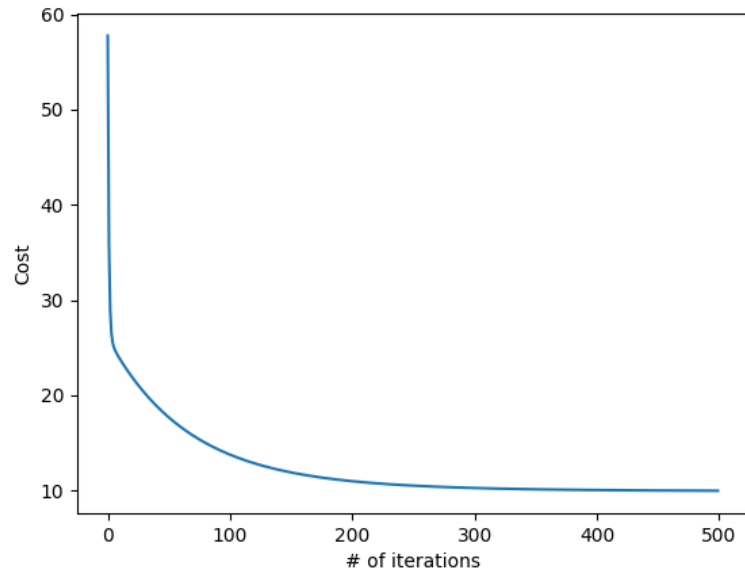
There is a significant difference between the estimates from gradient descent and the normal equation. That difference is because gradient descent only iterated 15 times with a learning rate low enough that it didn't get to fully descend to the minimum cost. I would need to run the gradient descent algorithm more times to get the functions to give the same result.

- 4) .
 - a. .
 - b. Image output

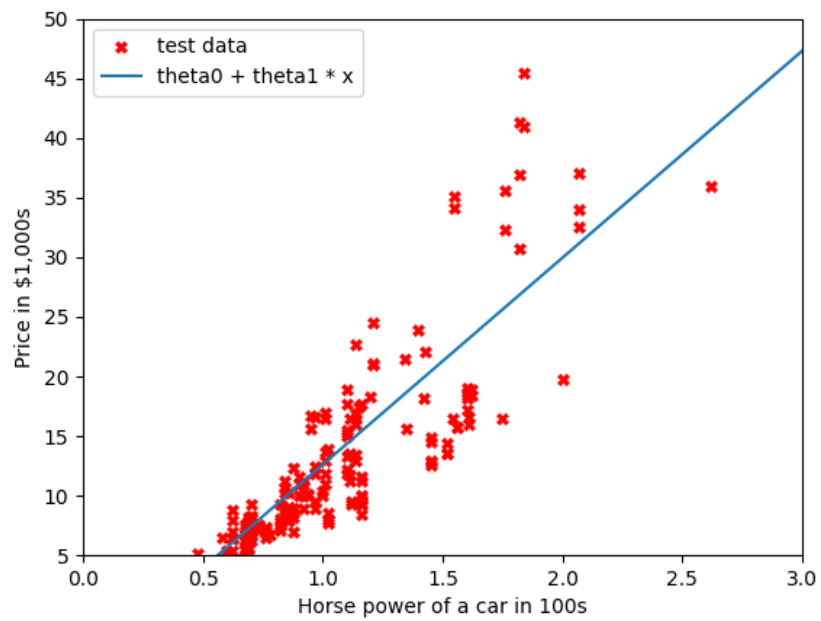


ps2-4-b.png

- c. Feature matrix X : (179,2) Label vector y : (179,)
- d. .
- e. Image Output



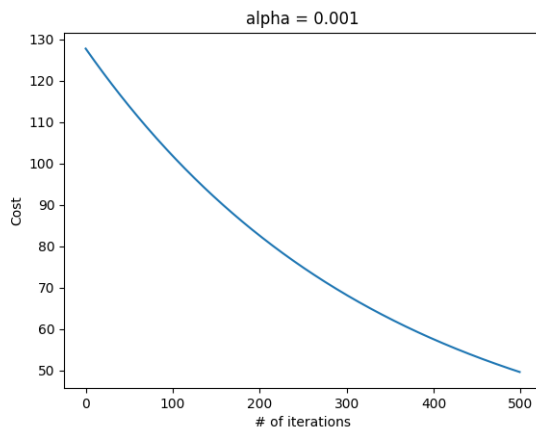
ps2-4-e-1.png



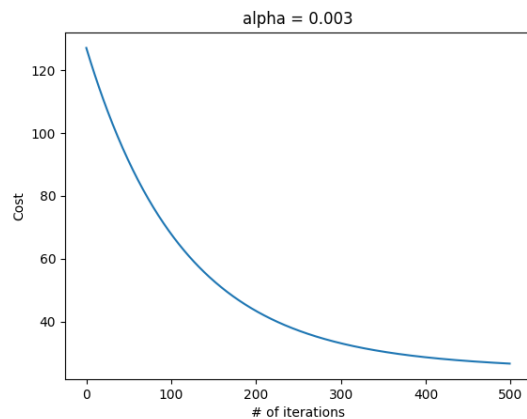
ps2-4-e-2.png

- f. Mean Square Prediction Error: 28.9

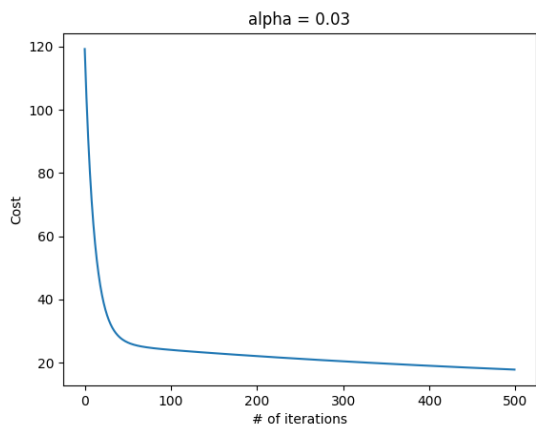
- g. Normal Mean Square Error Prediction: 26.7. The error for this method of linear regression is slightly lower than gradient descent, because this method provides the exact solution for the optimal line of best fit. That in combination with limited iterations on gradient descent make the normal equation solution a stronger fit.
- h. The larger the value of alpha, the cost minimizes quickly. The smallest learning rate ($\alpha = 0.001$) is too slow and never reaches a low cost after 500 iterations. The learning rate ($\alpha = 0.003$) also suffers from being too slow. The learning rate ($\alpha = 0.3$) achieves the lowest cost without diverging and is a sufficient selection as a learning rate.



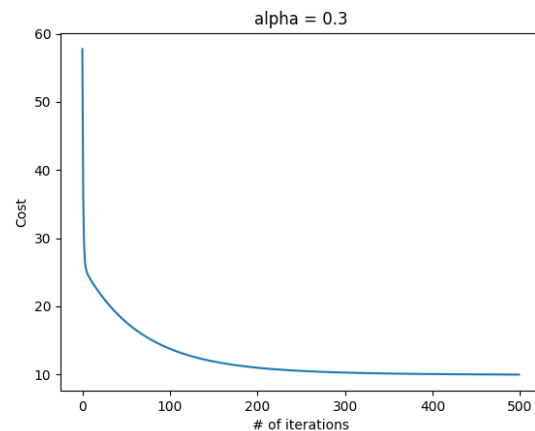
ps2-4-h-1.png



ps2-4-h-2.png



ps2-4-h-3.png



ps2-4-h-4.png

5) .

- a. House size mean: 2000 square feet
House size std: 786.2
House bedrooms mean: 3.17 bedrooms
House bedrooms std: 0.75

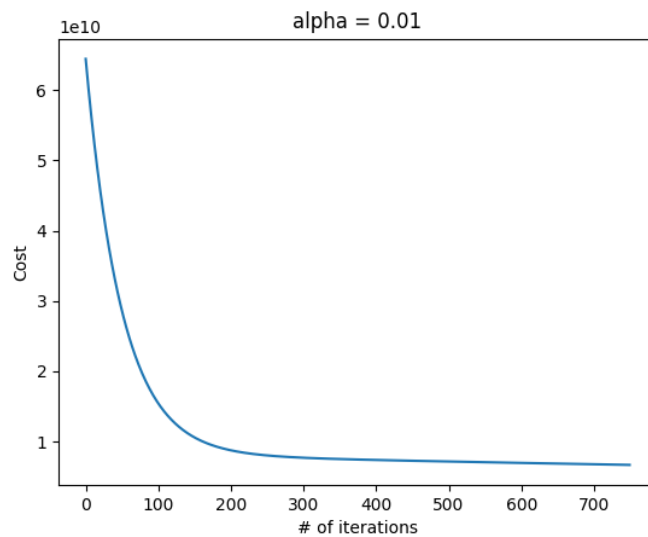
Feature matrix size: (47, 3)

Label vector size: (47, 1)

b. $\Theta_0 = 340,231$

$\Theta_1 = 14,249$

$\Theta_2 = -8,398$



ps2-5-b.png

c. Normalized data:

Sq. feet = $(1080 - 2000) / 786.2 = -1.17$

Bedrooms = $(2 - 3.17) / 0.75 = -1.56$

Cost Prediction = $340,231 + 14,249(-1.17) + (-8,398)(-1.56)$

Cost Prediction = \$336,660