Assignment 1 Part 1 (Regression)

Q5. What conclusion if any can be drawn from the weight values? How does sex and BMI affect diabetes disease progression?**

What are the estimated disease progression values for the below examples? [2 marks]

AGE	Sex	BMI	BP	S1	S2	S3	S4	S5	S6
25	F	18	79	130	64.8	61	2	4.1897	68
50	M	28	103	229	162.2	60	4.5	6.107	124

In order to predict the disease progression in diabetes and examine the influence of sex and BMI I used a linear regression model utrained on a diabetes dataset.

The two examples in the figure above were normalized using the training sets mean and standard deviation.

The predicted progression values for the two examples are :

Disease Progression for Example 1: 48.12

Disease Progression for Example 2: 232.61

Sex could be a significant factor as a female has a much lower prediction at 48.12 compared to a males disease prediction at 232.61. This could be interpreted as females are less likely to have get this disease but further research must be done before that statement can be made. BMI is a the other major factor as the female in example 1 has BMI of 18 compared to the larger Male BMI of 28 . Example 2 with a higher BMI also had a much higher disease progression.Higher BMI is associated with greater risk factors in diabetes, as it can eventually lead to type 2 diabetes so we can assume the higher BMI for example 2 is the major factor in the large disease progression prediction.

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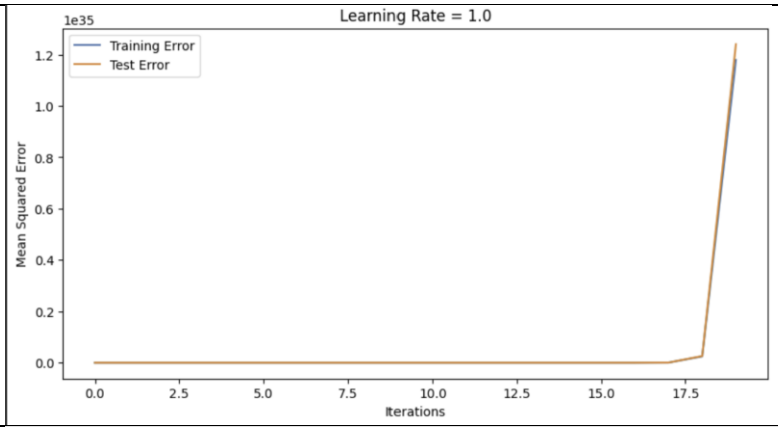
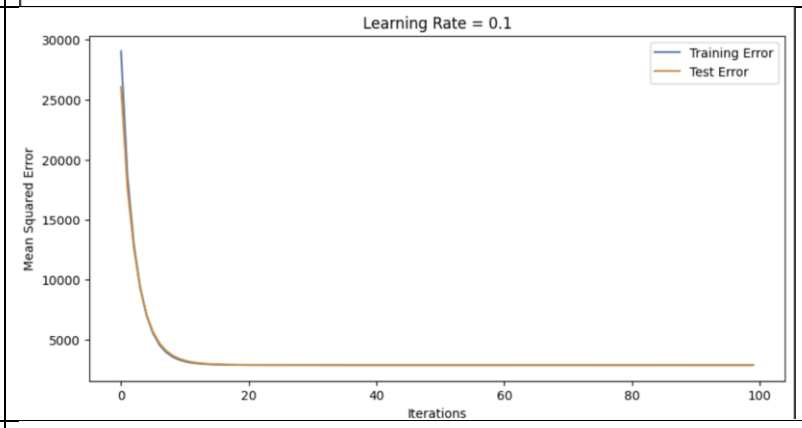
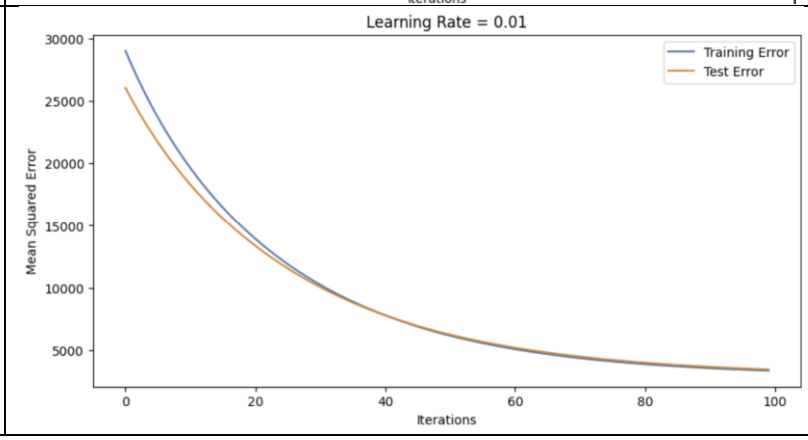
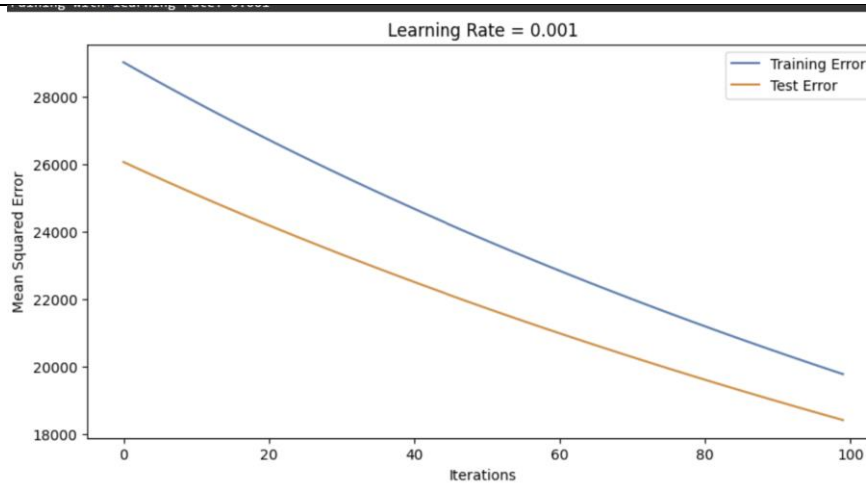
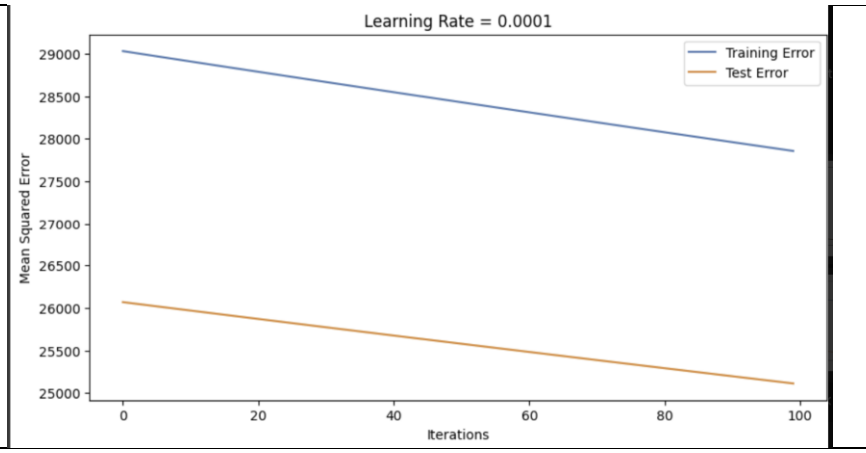
Q6. **Try the code with several learning rates that differ by orders of magnitude, and record the training and test set errors. Describe the theory of how changing the learning rate affects learning. What do you observe in the training error? How about the error on the test set? [3 marks] s**

Learning Rate	Training Cost	Test Cost	Graph
1.0	Nan	Nan	
0.1	2890.0229	2886.1457	
0.01	3351.2712	3444.731	

0.001	**19769.7031**	**18406.6016**	
0.0001	**27855.7227**	**25111.6152**	

The first graph for learning rate 1.0 we can see the function cannot converge and our graphs of test and training errors overlap as they increase,this is a very unstable function and the learning rate should not be used.

Following this, the cost functions for learning rate of 0.1 are much better and again we can see they overlap but this time are decreasing and coverging as intended. The errors are being minimised aswell as the cost.

Moving on to the lower learing rates of 0.01,0.001 and 0.0001 we can see that we get a muchs slower convergance and this rates are too small. The slow convergance is evident when the curve becomes flatter and more like a line.

To conclude the optimum learning rate is 0.1 due to it minimising both the error and the cost effectively.

Q8. First of all, find the best value of alpha to use in order to optimize best. Next, experiment with different values of λ and see how this affects the shape of the hypothesis. [3 marks]

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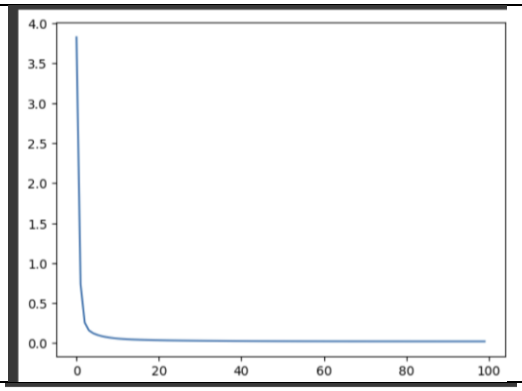
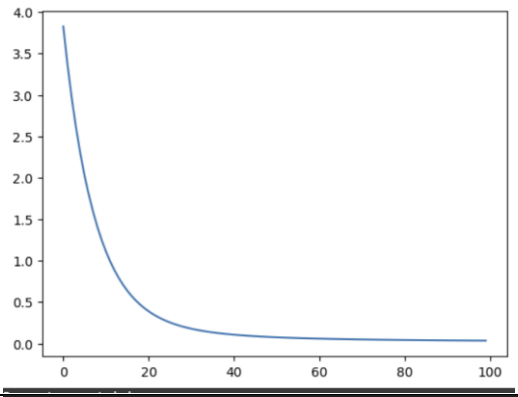
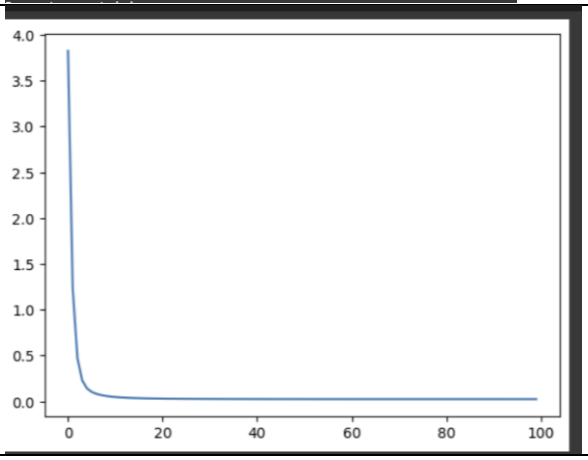
Learning Rate (α)	Regularization (λ)	Iterations	Minimum Cost	Final Weights	Graph
1.0	0	100	**0.0164**	[0.3954, -0.3166, -0.0795, -0.8243, 0.3729, -0.3048]	
0.1	0.5	100	0.0370	[0.2954, -0.5681, 0.2401, -0.3319, 0.4130, -0.1451]]	
0.7	0.5	100	0.0241	[0.3836, -0.4311, 0.1254, -0.4632, 0.1858, -0.3864]	

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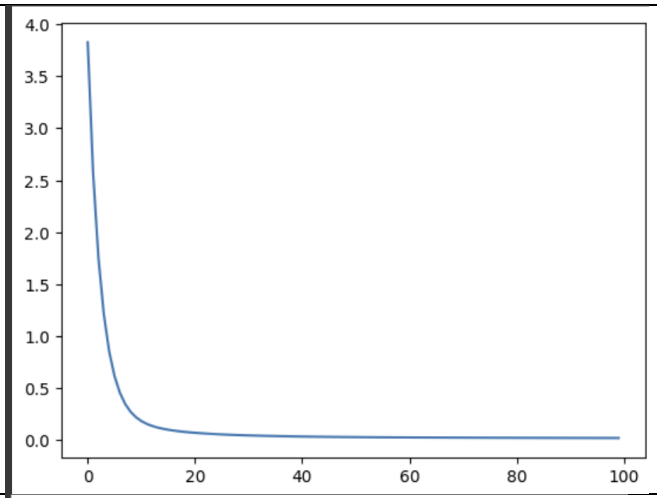
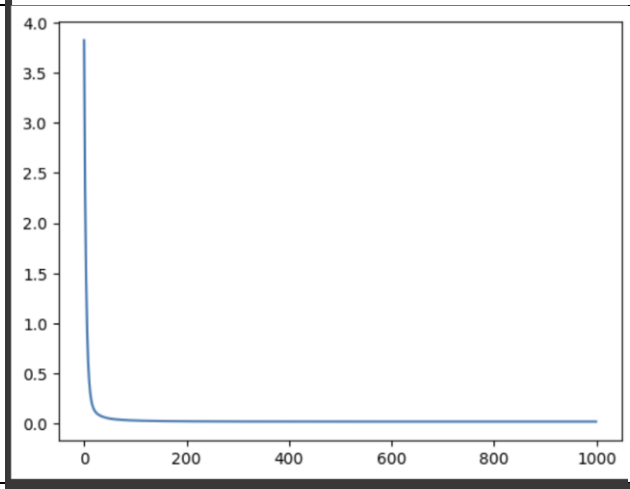
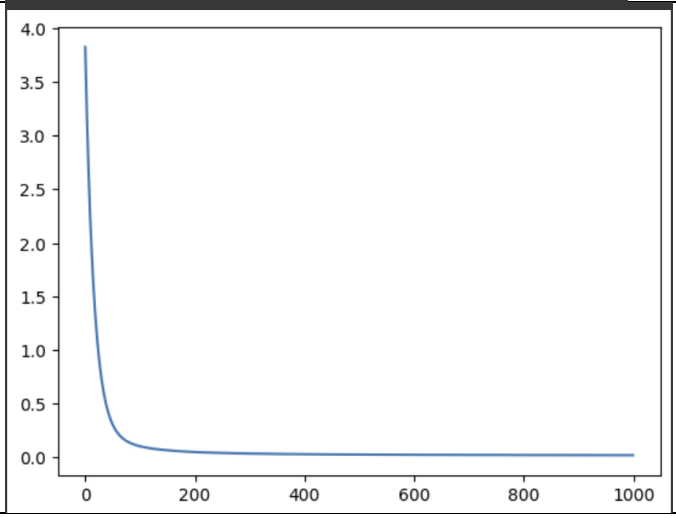
0.3	0.2	100	0.0223	[0.3659, -0.5036, 0.0926, -0.4894, 0.3013, -0.2925]	
0.2	0.1	1000	0.0176	[0.3797, -0.3600, 0.0920, -0.6531, 0.1827, -0.4277]	
0.05	0.1	1000	0.0191	[0.3769, -0.4396, 0.0422, -0.5830, 0.3005, -0.3423]])	

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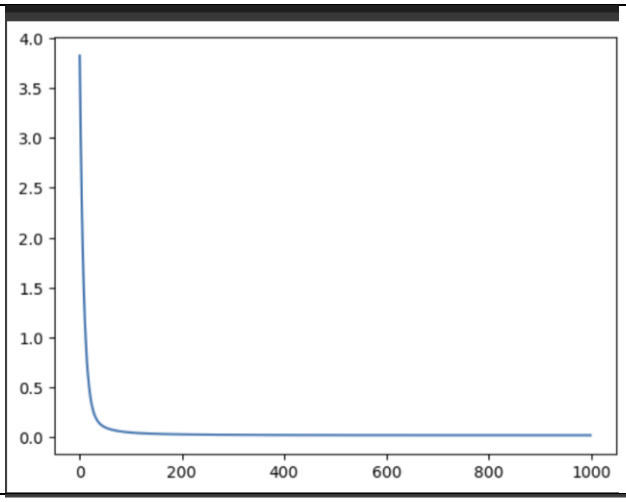
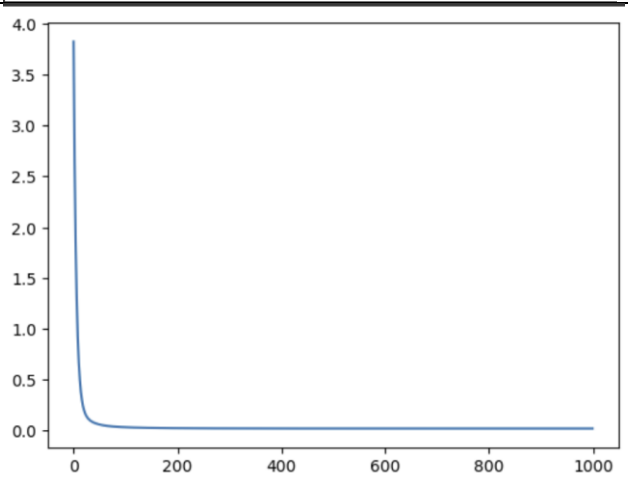
0.1	0.15	1000	: 0.0185	[0.3801, -0.3899, 0.0862, -0.5930, 0.2045, -0.4236]])	
0.15	0.2	1000	0.0192	[0.3787, -0.4006, 0.1081, -0.5596, 0.1845, -0.4294]]	

The Best alpha is 0.1 as it offers the best balance of learning rate for optimal convergance .When alpha was 0.1 along with lambda being 0.5 the cost was 0.0370.When lambda was 0.15 and alpha was 0.1 we got a cost of 0.0185. From the table and graph we can see values close to 0.1 such as 0.2 yielded low costs too.

Effect of lambda on the models, higher lambda values such as 0.5 allow for smoother and regularized hypothesis.this reduces overfitting. Lower lambda vlaues may cause overfitting and we can see from the sharper descent on the graphs.