Berkay Dur
220834005
Assignment 1.1
ECS708P

Q5.

Weight values:

- AGE weight: 1.9400, the higher the age, the more likely to have higher blood sugar levels,
- SEX weight: -11.4488, Female encoded as 2. Male encoded as 1. This means that being a female means you'll likely have lower blood sugar levels,
- BMI weight: 26.3047, the higher the BMI, the more likely to have higher blood sugar levels,
- BP weight: 16.6306, the higher the BP, the more likely to have higher blood sugar levels,
- S1 weight: -9.8810, the higher the S1, the less likely to have higher blood sugar levels,
- S2 weights: -2.3179, the higher the S2, the less likely to have higher blood sugar levels,
- S3 weights: -7.6995, the higher the S3 the less likely to have higher blood sugar levels,
- S4 weights: 8.2121, the higher the S4, the more likely to have higher blood sugar levels,
- S5 weights: 21.9769, the higher the S5, the more likely to have higher blood sugar levels,
- S6 weights: 2.6065, the higher the S6, the more likely to have higher blood sugar levels,
- Bias: 153.7365

Some of these weight values are difficult to interpret without an underlying knowledge of input features.

The weight corresponding to sex is given by -11.4488. We have encoded females as 2 and males as 1. This means that Women are more likely to have lower blood sugar levels than men according to the model.

The weight corresponding to BMI is 26.3047. This means that the higher the person's BMI, the more likely they are to have high blood sugar levels according to the model.

The blood sugar levels corresponding to the input, [25,F(2),18,79,130,64.8,61,2,4.1897,68], is:
43.52943420410156.

The blood sugar levels corresponding to the input,
[50,M(1),28,103,229,162.2,60,4.5,6.107,124], is: 232.23094177246094.

The error on the test set is 2885.619384765625 which is less than that of the training set, 2890.32568359375. So they are very similar and comparable.

We know that it is not overfitting the training set because when a model overfits, the training error is much lower than the test error. But in this case the test error is lower than the training error. We can't really tell if the model is underfitting because if the model underfits the training data, then the error on the training and test data is very high. But we don't have enough information about the data to draw any conclusions, we can only say that the model doesn't overfit the training data.

If we were to compute the error of the closed form solution, we get: 2868.5498046875. So, based on this, we see that the training error and test error are very close to the error of the closed form solution. This means that the model is not underfitting. This means that based on the error of the closed form solution, we can say that the model is not underfitting or overfitting. But I would not advise computing the error of the closed form solution in practice.

A model overfits when the error on the test set is much higher than the error on the training set.

A model underfits when the error on the test set and the training set is very high.

Q6: Change the learning rate. What do you observe on the training error? What about the error on the test set?

Referring to Figure 1, we see that if the learning rate is too low, then both the training set error and test set error are very high. This is due to the fact that converge to the minima takes a long time. As we increase the learning rate, we see that the error on the training set reaches a minimum at a learning rate of 0.2. And the error on the test set is minimised when we have a learning rate of 0.05. But as we keep increasing the learning rate, we see that the Error on the training and test set both diverge. This is also evident from looking at both Figure 2 and Figure 3. In Figure 3, we see that the error on the training and test set are both higher when the learning rate is too low, due to slow converges. We can also see that the error on the test and training set diverges when the learning rate is too high.

	0.0001	0.0010	0.0100	0.0500	0.1000	0.2000	0.2500	0.2600	0.2700	0.2800	0.3000
Training Set Error	28455.931641	19967.255859	3338.776855	2894.751465	2890.325684	2883.599365	2906.409668	144033920.0	2.662856e+14	1.863596e+20	7.909563e+30
Test Set Error	25530.228516	18534.308594	3431.068604	2884.922363	2885.619385	2886.526123	2907.635010	151480432.0	2.800796e+14	1.960134e+20	8.319293e+30

Figure 1.

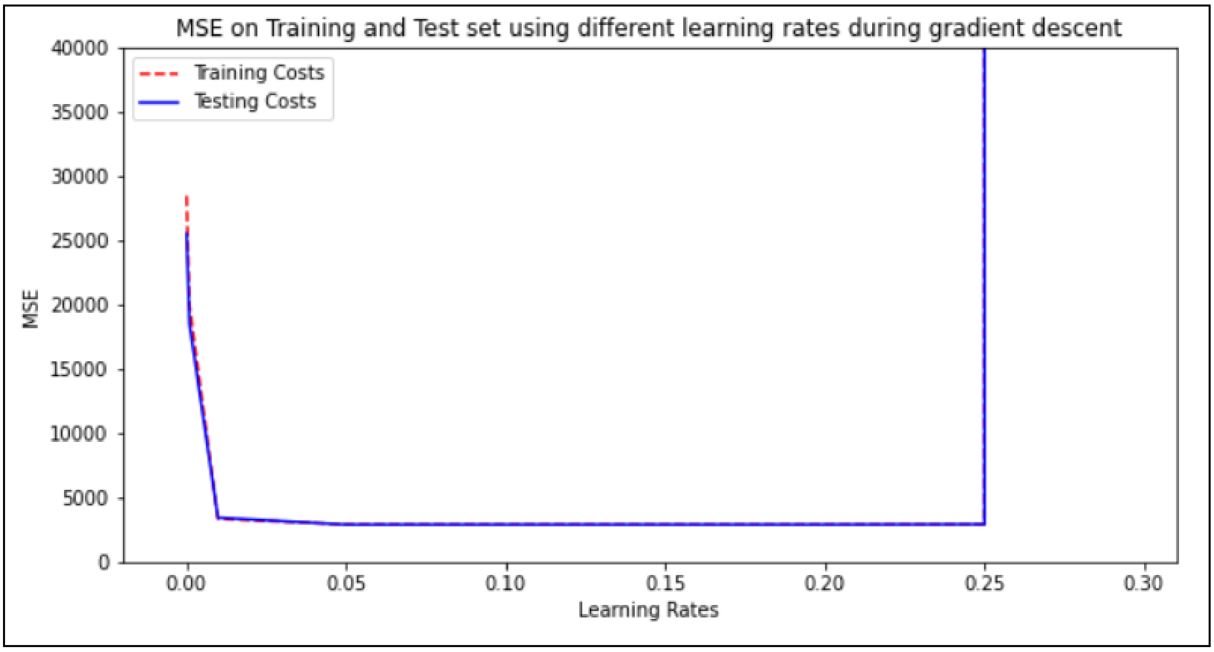

Figure 2.

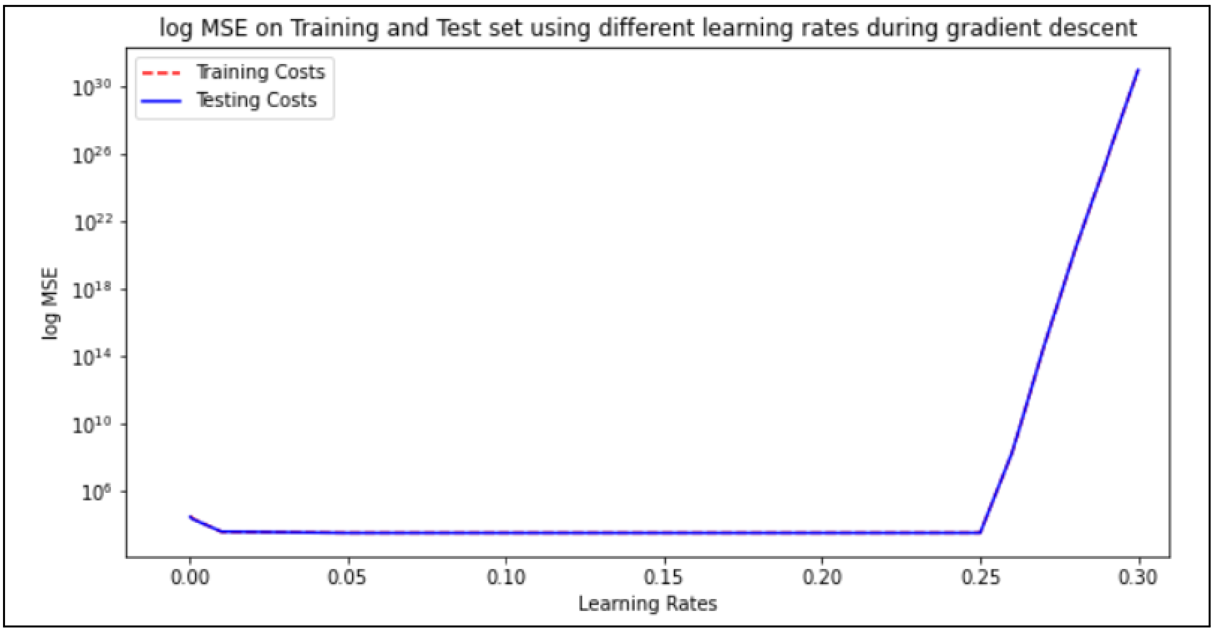

Figure 3.

Q8.

I have set the value of lamda to 0 for this task. By testing over several different learning rates, I have arrived at the conclusion that the best learning rate, alpha, is: 1.42, to 2 decimal places of accuracy.

I have used the best learning rate from the previous question. Just from observation of, we see that from Figure 4 to Figure 7, we see that the prediction deviates further away from the Ground truth as we increase the value of lambda. This is due to the fact that increasing lambda will increase the error.

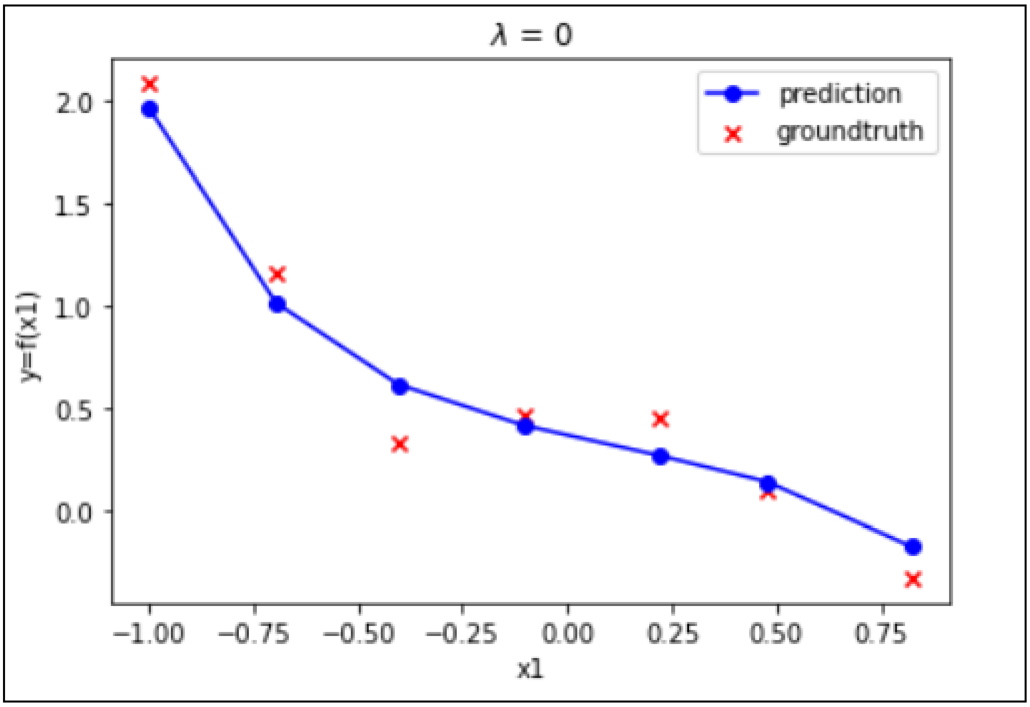

Figure 4.

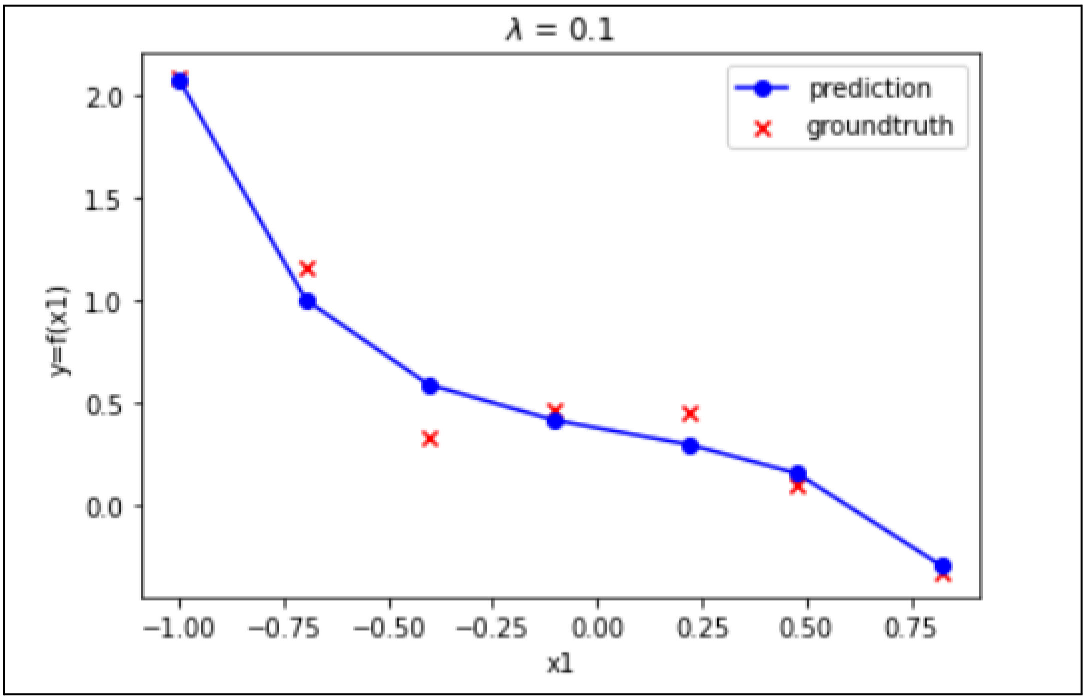

Figure 5.

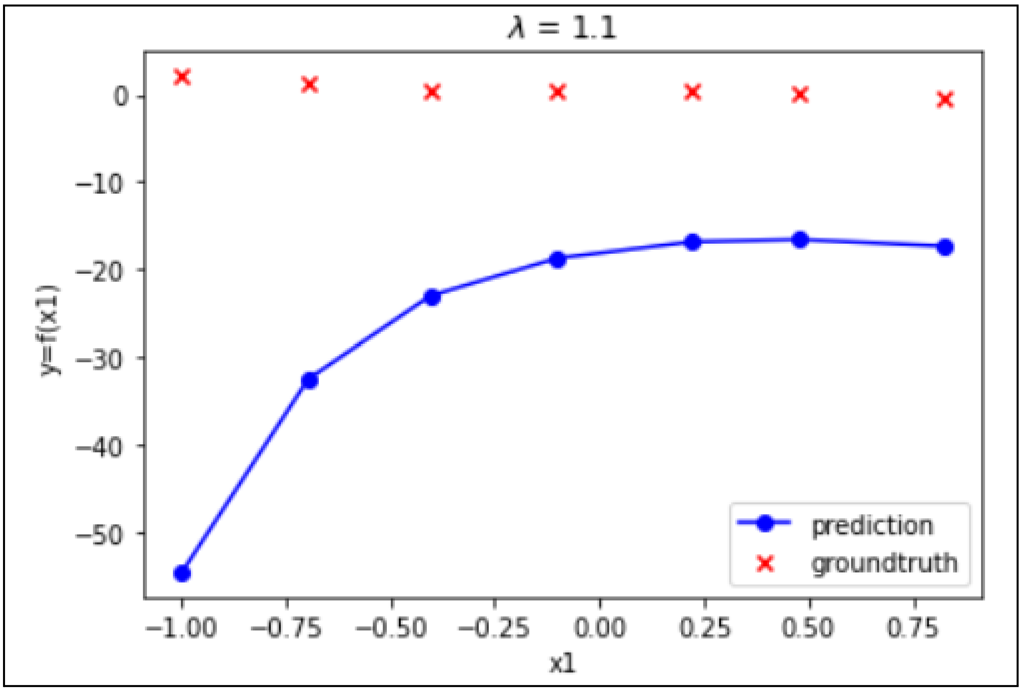

Figure 6.

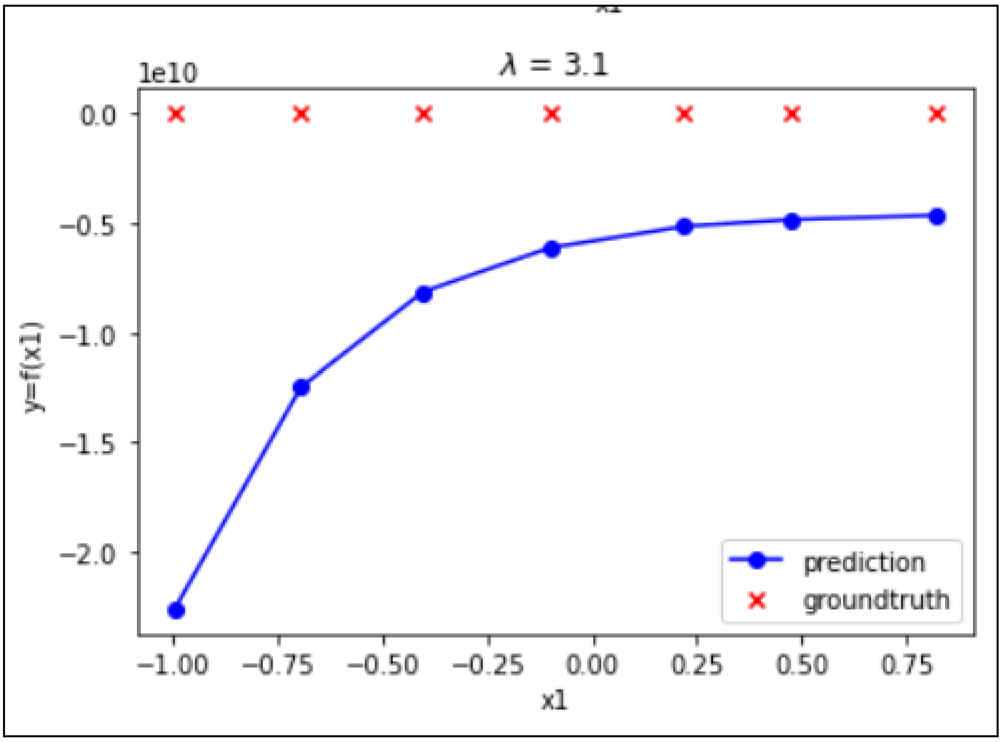

Figure 7.