

Assignment 3

Group Members:

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Gradient Descent:

Learning Rate:

- Taking learning rate 0.001 or 0.002 or greater , then cost goes to infinity under 200 or 300 iteration

```
91 if __name__ == "__main__":  
92     # Define and initialize train_x, train_y, test_x, test_y  
93     obj = GradientDescent(500, 0.001, train_x, train_y, test_x, test_y)  
94     obj.gradient_descent()  
95
```

Iteration: 100, Cost: 1.6704778943616347e+108

Iteration: 200, Cost: 8.483928294481599e+216

Iteration: 300, Cost: inf

Iteration: 400, Cost: inf

Iteration: 500, Cost: inf

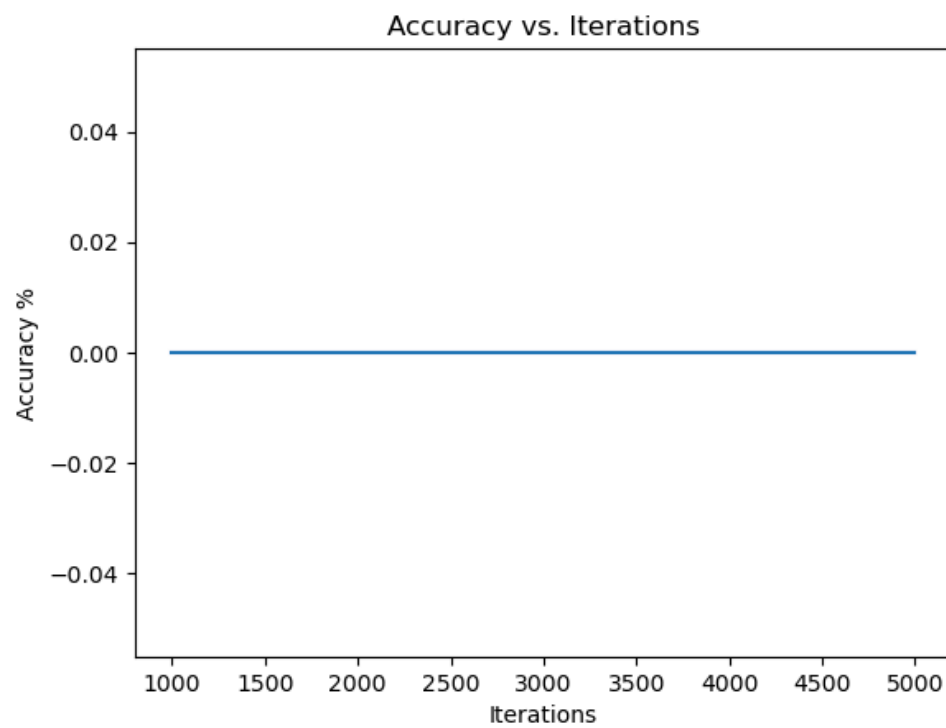
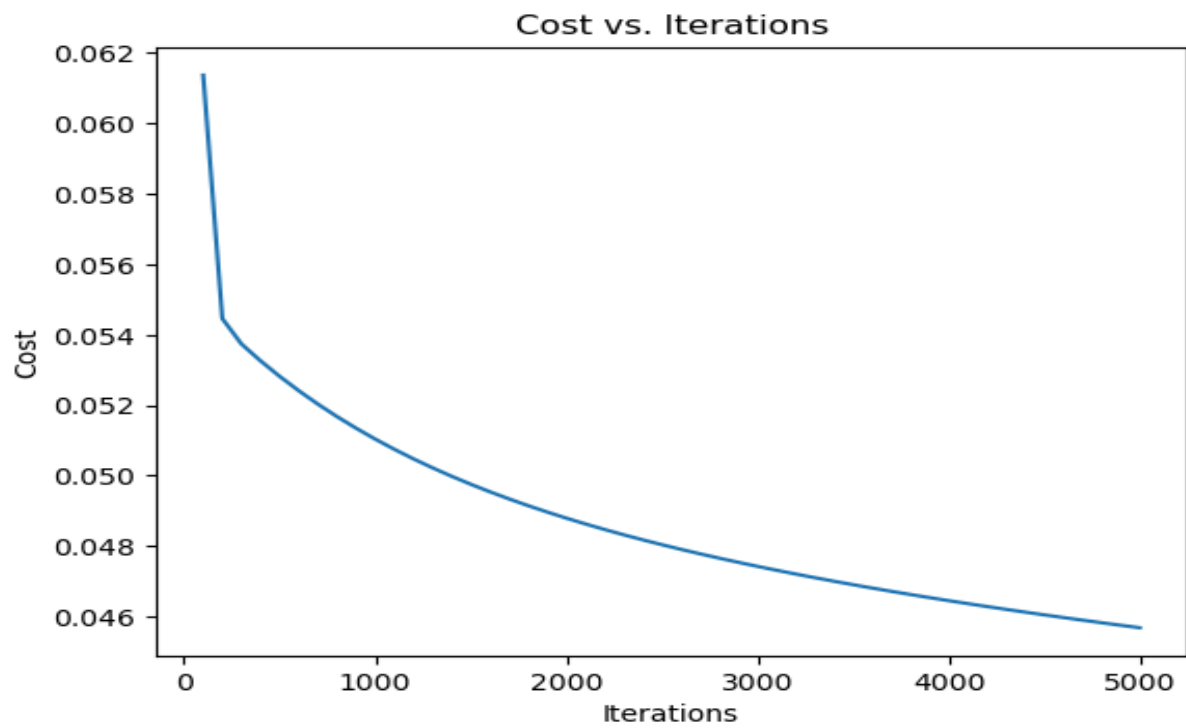
- Taking the Learning rate 0.0001 then it will give good accuracy and run smoothly.

Training 75 sample:

Without Activation function:

Iteration & error	Accuracy
Iteration: 1000, Cost: 0.025519430662945406	0.0
Iteration: 2000, Cost: 0.024397375751156514	0.0
Iteration: 3000, Cost: 0.02371292283648035	0.0
Iteration: 4000, Cost: 0.02322637115420771	0.0
Iteration: 5000, Cost: 0.022841558931382143	0.0

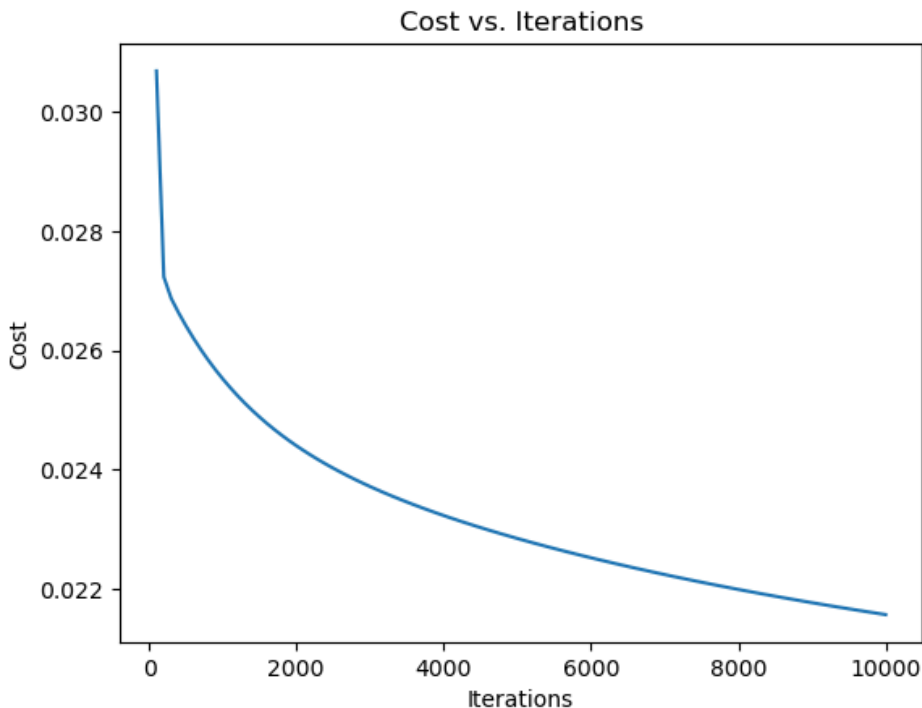
Iteration: 10000, Cost: 0.021564210814602875	0.0
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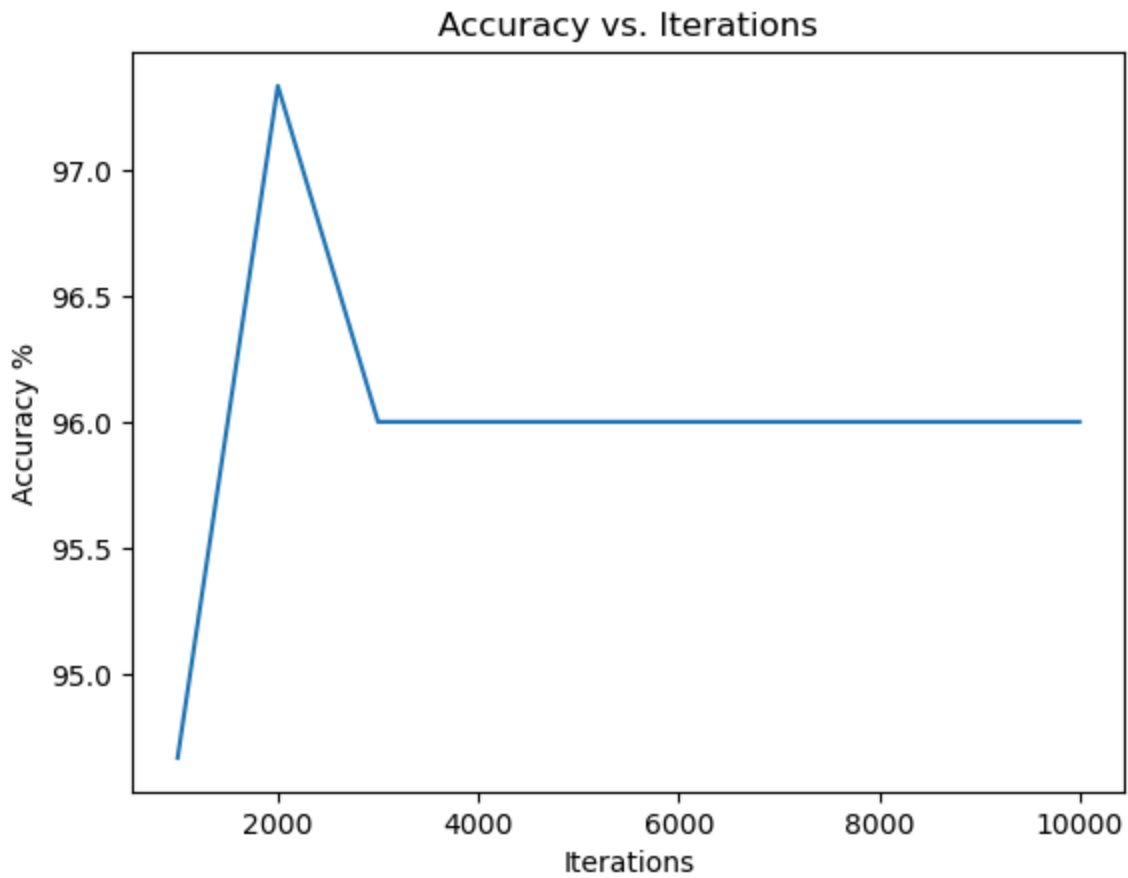


Accuracy is 0 because during testing y_{pred} values are continuous and y_{actual} value is integer. It can't match that's why accuracy remain 0

With Activation function:

Iteration & error	Accuracy
Iteration: 1000, Cost: 0.025519430662945406	Accuracy After 1000 Iteration Accuracy : 94.66666666666667
Iteration: 2000, Cost: 0.024397375751156514	Accuracy After 2000 Iteration Accuracy : 97.33333333333334
Iteration: 3000, Cost: 0.02371292283648035	Accuracy After 3000 Iteration Accuracy : 96.0
Iteration: 4000, Cost: 0.02322637115420771	Accuracy After 4000 Iteration Accuracy : 96.0
Iteration: 5000, Cost: 0.022841558931382143	Accuracy After 5000 Iteration Accuracy : 96.0
Iteration: 10000, Cost: 0.021564210814602875	Accuracy After 10000 Iteration Accuracy : 96.0

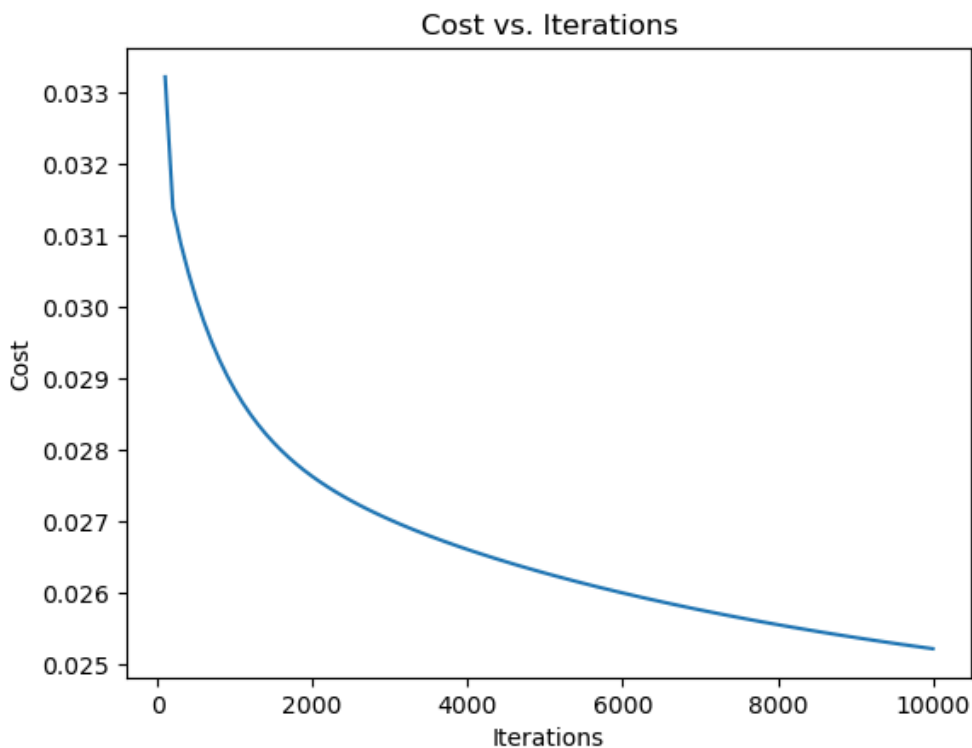


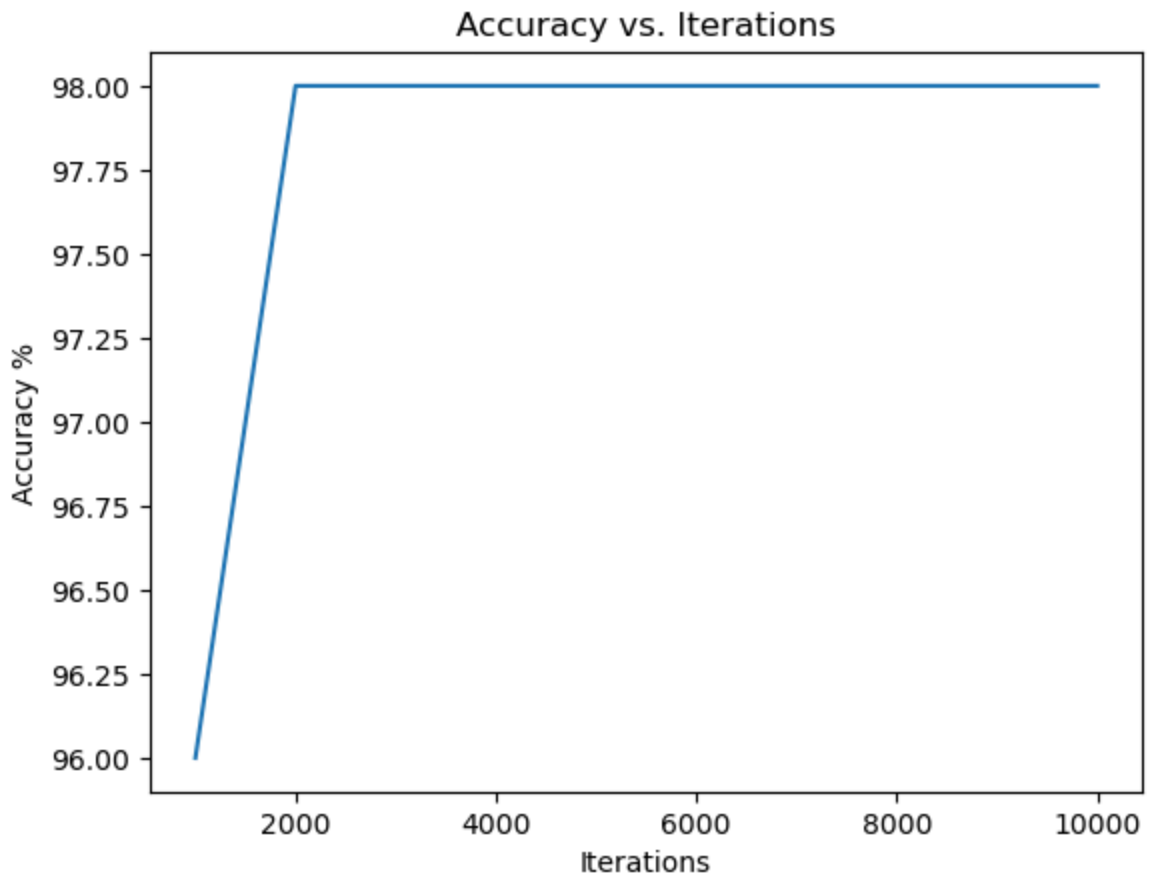


As compared to 75 samples without activation function , with activation function after 2000 iterations achieve 97.33% accuracy. That happens because we round off values of y_{pred} according to the step function that is defined in question.

Training 100 sample with activation function:

Error & Iterations	Accuracy
Iteration: 1000, Cost: 0.02884291878472591	Accuracy After 1000 Iteration Accuracy : 96.0
Iteration: 2000, Cost: 0.02763352295693714	Accuracy After 2000 Iteration Accuracy : 98.0
Iteration: 3000, Cost: 0.02702975772038599	Accuracy After 3000 Iteration Accuracy : 98.0
Iteration: 4000, Cost: 0.026614169274804422	Accuracy After 4000 Iteration Accuracy : 98.0
Iteration: 5000, Cost: 0.026283684811494158	Accuracy After 5000 Iteration Accuracy : 98.0
Iteration: 10000, Cost: 0.02522666494778617	Accuracy After 10000 Iteration Accuracy : 98.0





After 2000 iterations no improvement in accuracy.

Comparison of 75 sample and 100 sample error

Iteration & error of 75 samples	Error & Iterations of 100 samples
Iteration: 1000, Cost: 0.025519430662945406	Iteration: 1000, Cost: 0.02884291878472591
Iteration: 2000, Cost: 0.024397375751156514	Iteration: 2000, Cost: 0.02763352295693714
Iteration: 3000, Cost: 0.02371292283648035	Iteration: 3000, Cost: 0.02702975772038599
Iteration: 4000, Cost: 0.02322637115420771	Iteration: 4000, Cost: 0.026614169274804422
Iteration: 5000, Cost: 0.022841558931382143	Iteration: 5000, Cost: 0.026283684811494158
Iteration: 10000, Cost: 0.021564210814602875	Iteration: 10000, Cost: 0.02522666494778617

There seems not too much difference in cost between 75 and 100 samples.

Comparison of 75 sample and 100 sample accuracy

75 sample Accuracy	100 sample Accuracy
Accuracy After 1000 Iteration Accuracy : 94.66666666666667	Accuracy After 1000 Iteration Accuracy : 96.0
Accuracy After 2000 Iteration Accuracy : 97.33333333333334	Accuracy After 2000 Iteration Accuracy : 98.0
Accuracy After 3000 Iteration Accuracy : 96.0	Accuracy After 3000 Iteration Accuracy : 98.0
Accuracy After 4000 Iteration Accuracy : 96.0	Accuracy After 4000 Iteration Accuracy : 98.0
Accuracy After 5000 Iteration Accuracy : 96.0	Accuracy After 5000 Iteration Accuracy : 98.0
Accuracy After 10000 Iteration Accuracy : 96.0	Accuracy After 10000 Iteration Accuracy : 98.0

- **75 Sample Accuracy:** The accuracy decreases after 2000 iterations, indicating potential overfitting or convergence to a suboptimal solution.
- **100 Sample Accuracy:** While initially higher than the 75-sample accuracy, it shows no improvement after 2000 iterations, suggesting that the additional samples may not have contributed positively to the model's performance.