Machine Learning

Logistic Regression

Dataset. In this programming homework, you will use student exams data set. It is a collection of exam scores and a binary value indicating whether student has passed the course (exams.csv).

Your homework is divided into:

-loading data

-visualization

-sigmoid function

-cost function

- gradient descent implementation from scratch

- testing

- Solve same problem by Logistic Regression with regularization using library and test.

You are free to use any programming language, although Python is highly recommended. Also, consider using Jupyter Notebook for your own convenience.

Description.

Loading data. For this task you need to read exams.csv file. It contains three columns. First two columns (exam_1, exam_2) are exam scores of a student and the third value indicates whether the student has passed the course or not (1 or 0). (Using pandas library is recommended)

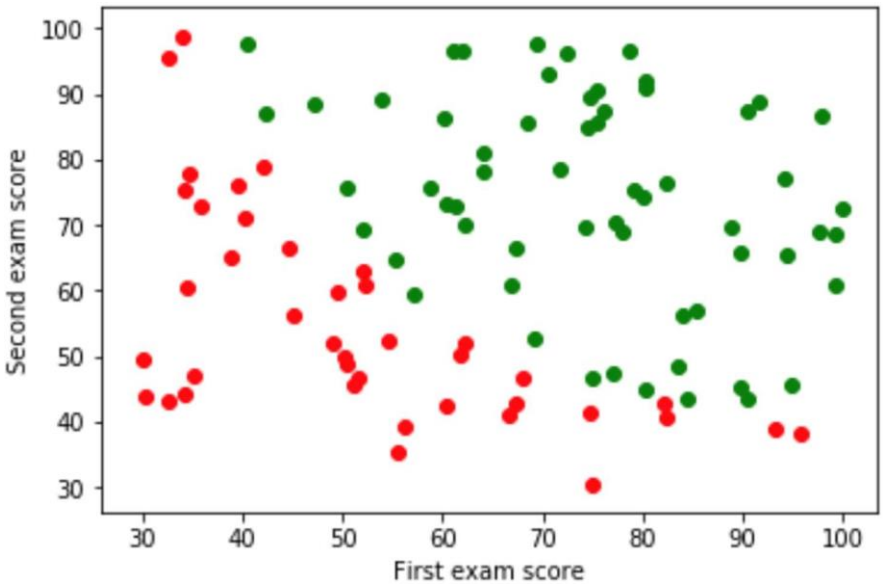
It is recommended to normalize the data at this stage. You will see that gradient descent algorithm performs much better when data is normalized. You can use min max normalization if you want.

(https://en.wikipedia.org/wiki/Feature_scaling#Rescaling_(min-max_normalization)

(https://scikit-learn.org/stable/modules/generated/sklearn.preprocessing.MinMaxScaler.html)

Visualization part 1.

Plot a graph of first exam score vs second exam score. Admitted



student points should be green and failed student points should be red. It should look similar to this one.

Sigmoid function. Implement a function which returns sigmoid of a value given the value.

(https://en.wikipedia.org/wiki/Sigmoid_function)

Cost function. Implement the following cost function.

$$J(\theta) = -\frac{1}{m}\sum_{i=1}^{m}[y^{(i)}\log(h_\theta(x^{(i)})) + (1-y^{(i)})\log(1-h_\theta(x^{(i)}))]$$

Gradient descent implementation from scratch. Implement a code which finds best fit parameters for logistic regression using gradient descent from scratch. You should be able to change training step and number of iterations through the variables (or input to the function). In addition to that, you should save cost at each iteration and plot it in the next sub-task.

Repeat $\{$

$$\theta_j := \theta_j - \alpha \sum_{i=1}^{m} (h_\theta(x^{(i)}) - y^{(i)}) x_j^{(i)}$$

(simultaneously update all θ_j)

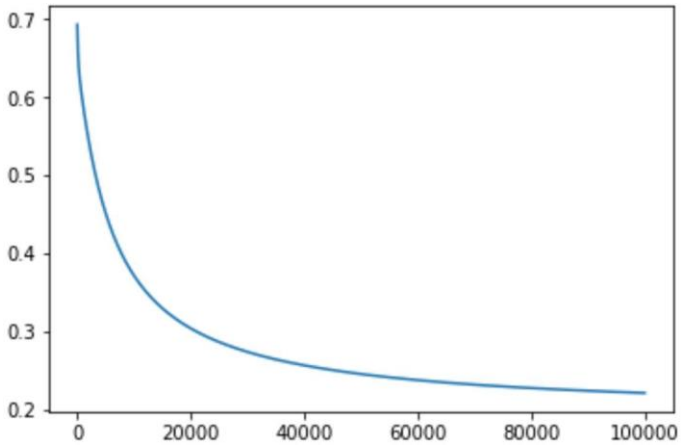
$\}$

$$h_\theta(x) = \frac{1}{1+e^{-\theta^T x}}$$

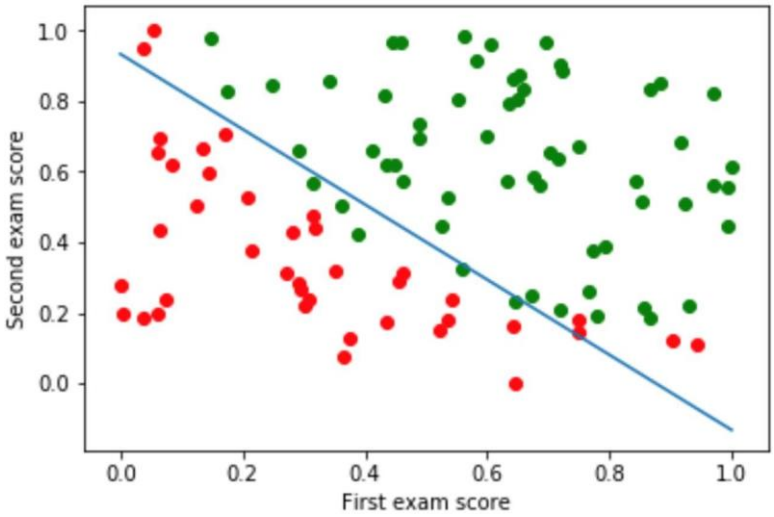
Visualization part 2.

You should plot:

1. Array of costs at each iteration (Cost vs Iteration). It should look similar to this: (cost decreases with each iteration)



2. Plot points of first exam score vs second exam score. Admitted student points should be green and failed student points should be red. (same as Visualization part 1). And plot the decision boundary using the parameters found by gradient descent on the same graph. It should look similar to this:



Test.

Make predictions of the training data using your trained model, compare predicted labels with actuals label and print the score indicating how well your model performs. You can use accuracy_score function from scikit-learn library.

After doing that, check if your model makes correct predictions for these data: {55, 70, 1} and {40, 60,0}.

Note. Submit homework solution in 2 files:

1) python file (.py or ipynb)
2) word file containing your codes (copy your codes from python file and paste in the word file).

Furthermore, please, write your full name and homework assignment number in the FILE NAME. Don't use Zip file.