

Tutorial 6

Question 1 (Linear Regression)

Imagine you're working on a basic sentiment analysis task. You have collected a small dataset where each data point consists of the number of positive words in a movie review and the corresponding rating given by the reviewer on a scale of 1 to 10. Now use a simple linear regression model to predict the movie rating based on the number of positive words. Your model should be defined as: $y = w \times x + b$, where x = number of positive words. Use the following data to derive

- 1) The optimal weight w and bias b using the least squares method.
- 2) Once you have the parameters, what would be the predicted rating for a review with 4 positive words?

Number of Positive Words	Movie Rating
1	3
3	6
5	8
6	9

Question 2 (Logistic Regression)

You're trying to predict the sentiment label for the following document (tokenized):

"It's hokey . There are virtually no surprises , and the writing is second-rate . So why was it so enjoyable ? For one thing , the cast is great . Another nice touch is the music . I was overcome with the urge to get off the couch and start dancing . It sucked me in , and it'll do the same to you ."

There are 6 features x_1, \dots, x_6 capturing key factors for determining sentiment as detailed in the table below.

Feature	Definition	Value
x_1	# positive lexicons	
x_2	# negative lexicons	
x_3	Is “no” in the document? 1 if yes, 0 otherwise	
x_4	# first and second pronouns	
x_5	Is “!” in the document? 1 if yes, 0 otherwise	
x_6	log(word count in total)	

Now use binary logistic regression to formalize this problem.

- 1) Fill in the value for each feature according to the given document.
- 2) Suppose $w=[2.5, -5.0, -1.2, 0.5, 2.0, 0.7]$, $b=0.1$, write the logistic regression function for the above input document.
- 3) What is the predicted probability for positive sentiment? What is the predicted label?
- 4) If we want to use this document to train the model and the ground-truth sentiment is positive, what is the loss computed for this single example?
- 5) If we change the binary prediction task to 3-class classification, involving positive, negative and neutral, what is the predicted probability for each class? What is the loss value under this setting? Suppose the weight matrix for 3-class classification is $W=[[1.3, -2.2, -1.0, 0.1, 0.7, 0.5], [-2.4, 1.9, 0.5, -0.4, -1.0, 0.2], [1.0, 0.8, -1.5, 1.3, -2.0, 0.6]]$, $b=[0.1, 0.2, 0.3]$.

Coding exercises

- Linear Regression:
<https://colab.research.google.com/drive/1KeYjOo36ABjbc-dX1pfJyVyFUQX50dff?usp=sharing>

- Logistic Regression:
[https://colab.research.google.com/drive/1C63UPtGeC21-N-TaZftFdWxwMKMLz_Md?
usp=sharing](https://colab.research.google.com/drive/1C63UPtGeC21-N-TaZftFdWxwMKMLz_Md?usp=sharing)