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Machine Learning with Python-From Linear Models to Deep Learning

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4. Pegasos Algorithm

Now you will implement the Pegasos algorithm. For more information, refer to the original paper at [original paper](#).

The following pseudo-code describes the Pegasos update rule.

Pegasos update rule $(x^{(i)}, y^{(i)}, \lambda, \eta, \theta)$:

if $y^{(i)} (\theta \cdot x^{(i)}) \leq 1$ then

 update $\theta = (1 - \eta\lambda) \theta + \eta y^{(i)} x^{(i)}$

else:

 update $\theta = (1 - \eta\lambda) \theta$

The η parameter is a decaying factor that will decrease over time. The λ parameter is a regularizing parameter.

In this problem, you will need to adapt this update rule to add a bias term (θ_0) to the hypothesis, but take care not to penalize the magnitude of θ_0 .

Pegasos Single Step Update

1/1 point (graded)

Next you will implement the single step update for the Pegasos algorithm. This function is very similar to the function that you implemented in **Perceptron Single Step Update**, except that it should utilize the Pegasos parameter update rules instead of those for perceptron. The function will also be passed a λ and η value to use for updates.

Available Functions: You have access to the NumPy python library as `np`.

```
1 def pegasos_single_step_update(
2     feature_vector,
3     label,
4     L,
```

```

5     eta,
6     current_theta,
7     current_theta_0):
8     """
9     Properly updates the classification parameter, theta and theta_0, on a
10    single step of the Pegasos algorithm
11
12    Args:
13        feature_vector - A numpy array describing a single data point.
14        label - The correct classification of the feature vector.
15        L - The lambda value being used to update the parameters.
16        eta - Learning rate to update parameters

```

Press ESC then TAB or click outside of the code editor to exit

Correct

Test results

CORRECT

[See full output](#)

[See full output](#)

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You have used 1 of 20 attempts

✓ Correct (1/1 point)

Full Pegasos Algorithm

1/1 point (graded)

Finally you will implement the full Pegasos algorithm. You will be given the same feature matrix and labels array as you were given in **Full Perceptron Algorithm**. You will also be given T , the maximum number of times that you should iterate through the feature matrix before terminating the algorithm. Initialize θ and θ_0 to zero. For each update, set $\eta = \frac{1}{\sqrt{t}}$ where t is a counter for the number of updates performed so far (between 1 and nT inclusive). This function should return a tuple in which the first element is the final value of θ and the second element is the value of θ_0 .

Note: Please call `get_order(feature_matrix.shape[0])`, and use the ordering to iterate the feature matrix in each iteration. The ordering is specified due to grading purpose. In practice, people typically just randomly shuffle indices to do stochastic optimization.

Available Functions: You have access to the NumPy python library as `np` and `pegasos_single_step_update` which you have already implemented.

```
1 def pegasos(feature_matrix, labels, T, L):
2     """
3     Runs the Pegasos algorithm on a given set of data. Runs T
4     iterations through the data set, there is no need to worry about
5     stopping early.
6
7     For each update, set learning rate = 1/sqrt(t),
8     where t is a counter for the number of updates performed so far (between 1
9     and nT inclusive).
10
11     NOTE: Please use the previously implemented functions when applicable.
12     Do not copy paste code from previous parts.
13
14     Args:
15         feature_matrix - A numpy matrix describing the given data. Each row
```

Press ESC then TAB or click outside of the code editor to exit

Correct

Test results

CORRECT

[See full output](#)

[See full output](#)

Submit

You have used 1 of 20 attempts

✓ Correct (1/1 point)

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[STAFF] Full Pegasos Algorithm

6

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Inconsistency in type of theta_0 between tests (in test.py)

3

Update: The same code that's not passing `test.py` is OK to the online grader, so I suspect it's an issue with `test.py`. ----- For the `pegasos single update` test, we have...

? Pegasos Single Step Update Can someone explain?	2
> In this problem, you will need to adapt this update rule to add a bias > term (θ_0) to the hypothesis, but take care not to penalize the > magnitude of θ_0 What does that ...	
? Full Pegasos Algorithm [Staff]	2
Hi, I think there is a problem with the grader. Could you, please, check it ?	
💬 NameError: name 'sqrt' is not defined	1
Hi all. Probably my hint will be useful for someone (as I used 4 attempts to resolve the issue). Don't forget to use `import` clause in order to play with `sqrt`. Otherwise y...	
? the link for original paper not working	4
💬 Pegasos Single Step Update - Test for prediction * label > 1	3
💬 Single Step Pegasos w/ Label * Prediction > 1	5
Hi all! For some reason, I can't seem to get a correct answer on the first of the five tests for Part One. Is it correct to implement that theta 0 does not update when Label*...	
💬 The word "update" in the specification for the full Pegasos algorithm means every pass	2
Just a little note in case anyone else was all set to gripe about this... In the past, we've used "update" to refer only to the cases where the feature vector is misclassified, an...	
👤 Community TA	
? [Staff] Link doesn't work	11
I tried to open the link for the original paper and I got the message "Requested page not found". Do you have another link to download the paper? Thank you.	
💬 [STAFF] Can you raise the submit capacity of all coding problems?	3
As title said, I would prefer to have higher submit capacity or even unlimited submit. This can make us focus on debugging and implementing algorithm, not at the same ti...	
? pegasus single step correctness	2
Is it possible that pegasos singe step is wrong even though it passed all the grader tests? I'm trying to find the problem in full pegasos, and thought about this question	
💬 Full Pegasos High dimension/ High data number and Linearly separable Fail	5
Hi, my code passed the local test.py but failed 3 of the 5 tests here on the website: high dimension, high date number and linearly separable. I couldn't figure out what we...	

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