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Optimization Algorithms
Graded Assignment • 50 min

English ∨   **Due** Dec 29, 11:59 PM IST

Your grade: 80%

Your latest: **80%** • Your highest: **80%** • To pass you need at least 80%. We keep your highest score.

Next item →

1. Using the notation for mini-batch gradient descent. To what of the following does $a^{[2]\{4\}(3)}$ correspond?

0 / 1 point

● The activation of the second layer when the input is the fourth example of the third mini-batch.

○ The activation of the third layer when the input is the fourth example of the second mini-batch.

○ The activation of the second layer when the input is the third example of the fourth mini-batch.

○ The activation of the fourth layer when the input is the second example of the third mini-batch.

⊗ **Incorrect**
No. In general $a^{[l]\{t\}(k)}$ denotes the activation of the layer l when the input is the example k from the mini-batch t.

2. Which of these statements about mini-batch gradient descent do you agree with?

1 / 1 point

○ You should implement mini-batch gradient descent without an explicit for-loop over different mini-batches so that the algorithm processes all mini-batches at the same time (vectorization).

● When the mini-batch size is the same as the training size, mini-batch gradient descent is equivalent to batch gradient descent.

○ Training one epoch (one pass through the training set) using mini-batch gradient descent is faster than training one epoch using batch gradient descent.

✓ **Correct**
Correct. Batch gradient descent uses all the examples at each iteration, this is equivalent to having only one mini-batch of the size of the complete training set in mini-batch gradient descent.

3. Which of the following is true about batch gradient descent?

1 / 1 point

○ It has as many mini-batches as examples in the training set.

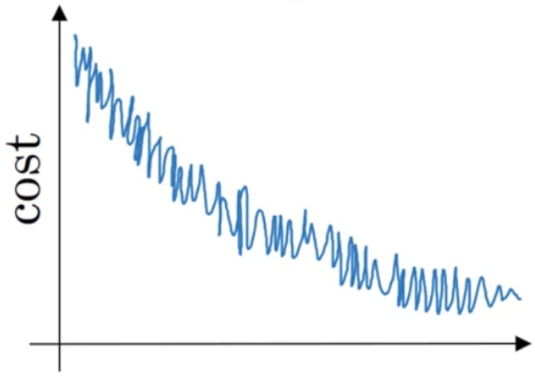
● It is the same as the mini-batch gradient descent when the mini-batch size is the same as the size of the training set.

○ It is the same as stochastic gradient descent, but we don't use random elements.

✓ **Correct**
Correct. When using batch gradient descent there is only one mini-batch thus it is equivalent to batch gradient descent.

4. While using mini-batch gradient descent with a batch size larger than 1 but less than m, the plot of the cost function J looks like this:

1 / 1 point



You notice that the value of J is not always decreasing. Which of the following is the most likely reason for that?

● In mini-batch gradient descent we calculate $J(\hat{y}^{\{t\}}, y^{\{t\}})$ thus with each batch we compute over a new set of data.

○ A bad implementation of the backpropagation process, we should use gradient check to debug our implementation.

○ You are not implementing the moving averages correctly. Using moving averages will smooth the graph.

○ The algorithm is on a local minimum thus the noisy behavior.

✓ **Correct**

Yes. Since at each iteration we work with a different set of data or batch the loss function doesn't have to be decreasing at each iteration.

5. Suppose the temperature in Casablanca over the first two days of March are the following:

1 / 1 point

March 1st: $\theta_1 = 10^\circ\ \mathrm{C}$

March 2nd: $\theta_2 = 25^\circ\ \mathrm{C}$

Say you use an exponentially weighted average with $\beta = 0.5$ to track the temperature: $v_0 = 0$, $v_t = \beta v_{t-1} + (1-\beta)\,\theta_t$. If v_2 is the value computed after day 2 without bias correction, and $v_2^{\text{corrected}}$ is the value you compute with bias correction. What are these values?

○ $v_2 = 20, v_2^{\text{corrected}} = 15.$

○ $v_2 = 20, v_2^{\text{corrected}} = 20.$

○ $v_2 = 15, v_2^{\text{corrected}} = 15.$

● $v_2 = 15, v_2^{\text{corrected}} = 20.$

✓ **Correct**

Correct. $v_2 = \beta v_{t-1} + (1-\beta)\,\theta_t$ thus $v_1 = 5, v_2 = 15$. Using the bias correction $\frac{v_t}{1-\beta^t}$ we get $\frac{15}{1-(0.5)^2} = 20.$

6. Which of these is NOT a good learning rate decay scheme? Here, t is the epoch number.

1 / 1 point

● $\alpha = e^t \alpha_0$

○ $\alpha = 0.95^t \alpha_0$

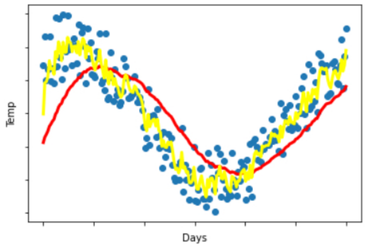
○ $\alpha = \frac{1}{1+2*t}\alpha_0$

○ $\alpha = \frac{1}{\sqrt{t}}\alpha_0$

✓ **Correct**

7. You use an exponentially weighted average on the London temperature dataset. You use the following to track the temperature: $v_t = \beta v_{t-1} + (1-\beta)\theta_t$. The yellow and red lines were computed using values $beta_1$ and $beta_2$ respectively. Which of the following are true?

0 / 1 point



○ $\beta_1 < \beta_2.$

○ $\beta_1 = \beta_2.$

○ $\beta_1 = 0, \beta_2 > 0.$

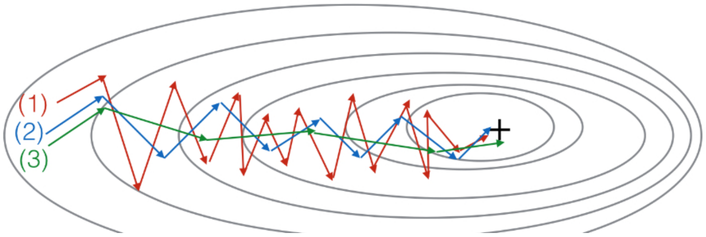
● $\beta_1 > \beta_2.$

⊗ **Incorrect**

Incorrect. $\beta_1 < \beta_2$ since the yellow curve is noisier.

8. Consider this figure:

1 / 1 point



These plots were generated with gradient descent; with gradient descent with momentum (β = 0.5); and gradient descent with momentum (β = 0.9). Which curve corresponds to which algorithm?

○ (1) is gradient descent. (2) is gradient descent with momentum (large β) . (3) is gradient descent with momentum (small β)

○ (1) is gradient descent with momentum (small β), (2) is gradient descent with momentum (small β), (3) is gradient descent

○ (1) is gradient descent with momentum (small β). (2) is gradient descent. (3) is gradient descent with momentum (large β)

● (1) is gradient descent. (2) is gradient descent with momentum (small β). (3) is gradient descent with momentum (large β)

Correct

9. Suppose batch gradient descent in a deep network is taking excessively long to find a value of the parameters that achieves a small value for the cost function $\mathcal{J}(W^{[1]}, b^{[1]}, ..., W^{[L]}, b^{[L]})$. Which of the following techniques could help find parameter values that attain a small value for $\mathcal{J}$? (Check all that apply)

1 / 1 point

□ Add more data to the training set.

☑ Try better random initialization for the weights

Correct
Yes. As seen in previous lectures this can help the gradient descent process to prevent vanishing gradients.

☑ Normalize the input data.

Correct
Yes. In some cases, if the scale of the features is very different, normalizing the input data will speed up the training process.

☑ Try using gradient descent with momentum.

Correct
Yes. The use of momentum can improve the speed of the training. Although other methods might give better results, such as Adam.

10. Which of the following statements about Adam is ***False***?

1 / 1 point

○ The learning rate hyperparameter α in Adam usually needs to be tuned.

○ We usually use “default” values for the hyperparameters β_1, β_2 and ε in Adam ($\beta_1 = 0.9$, $\beta_2 = 0.999, \varepsilon = 10^{-8}$)

○ Adam combines the advantages of RMSProp and momentum

● Adam should be used with batch gradient computations, not with mini-batches.

Correct