Computer Vision and Deep Learning

Final exam: open book, open-notes

Date 25.01.2020
Name
Time allowed 2 hours

1. Draw the computational graph for the following expression:
   f(x, y, z) = ln(x) + ln(y) +2*z

   Show how the forward pass and backward pass are computed for the input values:

   $x = e, y = e, z = 7.$

   Reminder:

   $\frac{\partial \ln x}{\partial x} = \frac{1}{x}$

2. You have an activation map of size (5, 6, 2) as depicted in the image below (the first channel in the activation map is C0 and the second channel in the activation map is C1). Show the result after applying a max-pooling layer with a size of 2x2 with a stride of 2.
   How many learnable parameters does this layer has?
   C0

10	30	20	15	10
5	15	10	40	50
50	50	20	10	0
0	0	0	15	9
5	7	5	5	50
50	30	20	20	10

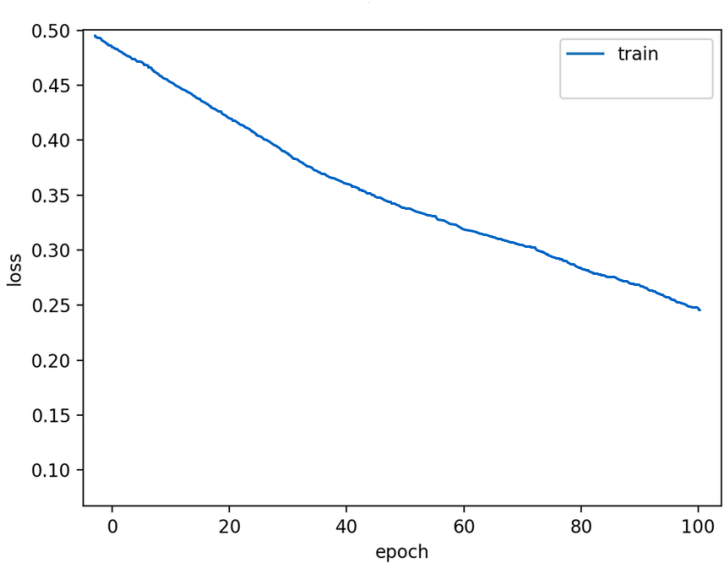
   C1

14	2	34	1	10
4	8	10	5	50
20	50	20	6	10
0	10	0	15	9
7	7	15	15	0
23	17	20	250	310

3. How many **parameters** (including the biases) does a dense (fully connected) layer with 50 neurons have, if its previous layer has 100 neurons?

4. What is the difference between L1 and L2 regularization? How do they enforce regularization?

5. During training you observe the following behaviour for the training and evaluation loss curves. What is the problem? Briefly describe the steps you will try to fix this issue.



6. What is stochastic gradient descent? What are its drawbacks?

7. You want to develop a face image manipulation application and for this you first need a CV algorithm that determines the following regions of the face: the hair, the eyebrows, the left and the right eye, the nose, the teeth and the upper and lower lip (just like in the image below).
    - How would you pre-process the input images?
    - What layers would your network use and how would these layers be connected?
    - What would be the output and output size of the network (specify both the spatial size and the depth)?
    - What would be the activation of the last layer in the network?
    - What loss function would you use?
    - What metrics would you use to evaluate your model?
    - Can you run your network on images of different sizes?

8. **Project related question:** What metric could you use to evaluate a GAN? Briefly describe how it works and what is the ideal value for this metric?