

Ex7 - Deep Learning Questions - Computer Vision

1. Explain each of these terms in a sentence or two:
 1. Cross entropy
 2. Residual connections
 3. Adam optimizer
 4. Cyclic learning rate
 5. Dropout
 6. Bottleneck layer
 7. 1x1 convolution
 8. DenseNet
2. Explain the pros and cons of using small and large batch sizes.
3. How many 3x3 filters are needed to replace a 7x7 kernel? Compare the number of parameters in each option.
4. You are training a neural network for classifying images on a custom dataset and it doesn't seem to learn anything. Describe your approach to solving the issue.
5. Mention the problems imbalanced datasets can cause to Deep Learning problems, and suggest a few ways to avoid them.
6. Given two networks: SRCNN (<https://arxiv.org/pdf/1501.00092.pdf>) and Unet (<https://arxiv.org/pdf/1505.04597.pdf>). What is the receptive field of a pixel in each network? You should consider one pixel (let's say the center pixel of the output) and go back to see what neighbors at the input image influence this pixel.
7. Given a standard CNN consists of convolutional layers and then fully-connected layers. Explain what layer in CNN can reach a lot of parameters? How can we avoid it?
8. What is the result of convolving an image X with a filter $h = [-1 \ -1 \ -1; 0 \ 0 \ 0; 1 \ 1 \ 1]$.
9. (a) What if all the weights are initialized with the same value?
(b) What happens if we set all the biases to be zero (ignoring the biases)?
10. Write down two NN models (it can also be convolutional networks) that have (more or less) the same number of parameters, but with different power of computational. Explain your answer.

The two questions below are open questions. We would like to see the way you develop algorithms using deep learning. Your answers should be written (not code). You can use pseudo code if it is more convenient for you.

11. You moved into a new apartment and you would like to make your front door smarter. Write an algorithm that alerts every time there is someone outside your door who is not a part of your family (you decide who is considered to be family).

12. These days, most of the parking lots have a system that recognizes the license plate number of an entering car. This helps to automatically open the gate in case that the driver paid before arriving at the exit gate. For this purpose, two cameras are needed - one at the entrance and one at the exit. Both capture the license plate number and translate it into a series of numbers.

Write an algorithm that for a given image containing a car with a license plate number, recognizes all the numbers in this plate. Pay attention that the angle and the location of the license plate can vary between images.

For simplicity: all the license plates have the same size (in the real world, not in the image), have 7 digits and have the same font. The plate is yellow with black digits. Some pictures are attached.

Moreover, no trucks or motorcycles can enter the parking lot.

If you have more assumptions, please write them down.

