Congratulations! You passed!

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1. What do you think applying this filter to a grayscale image will do?

$$\begin{bmatrix} 0 & 1 & -1 & 0 \\ 1 & 3 & -3 & -1 \\ 1 & 3 & -3 & -1 \\ 0 & 1 & -1 & 0 \end{bmatrix}$$

1 / 1 point

- (•) Detect vertical edges
- ( ) Detect horizontal edges
- ( ) Detect image contrast
- ( ) Detect 45 degree edges

Expand

Correct
Correct! As you can see the difference between values from the left part and values from the right of this filter is high. When convolving this filter on a grayscale image, the vertical edges will be detected.

2. Suppose your input is a 128 by 128 color (RGB) image, and you are not using a convolutional network. If the first hidden layer has 64 neurons, each one fully connected to the input, how many parameters does this hidden layer have (including the bias parameters)?

1 / 1 point

- ( ) 1048640
- ( ) 3145728
- ( ) 1048576
- (•) 3145792

Expand

Correct
Correct, the number of inputs for each unit is $128 \times 128 \times 3$ since the input image is RGB, so we need $128 \times 128 \times 3 \times 64$ parameters for the weights and 64 parameters for the bias parameters, thus $128 \times 128 \times 3 \times 64 + 64 = 3145792$.

3. Suppose your input is a 256 by 256 color (RGB) image, and you use a convolutional layer with 128 filters that are each 7×7. How many parameters does this hidden layer have (including the bias parameters)?

1 / 1 point

- ( ) 6400
- (•) 18944
- ( ) 1233125504
- ( ) 18816

Expand

Correct
Yes, you have $7 \times 7 \times 3 + 1$ weights per filter with the bias. Given that you have 128 filters, you get $(7 \times 7 \times 3 + 1) \times 128 = 18944$.

4. You have an input volume that is 63x63x16, and convolve it with 32 filters that are each 7x7, using a stride of 2 and no padding. What is the output volume?

1 / 1 point

- (•) 29x29x32
- ( ) 29x29x16
- ( ) 16x16x16
- ( ) 16x16x32

Expand

Correct
Yes, $\frac{63-7+0\times2}{2}+1=29$ and the number of channels should match the number of filters.

5. You have an input volume that is 61x61x32, and pad it using "pad=3". What is the dimension of the resulting volume (after padding)?

1 / 1 point

- ( ) 64x64x35
- (•) 67x67x32
- ( ) 61x61x35
- ( ) 64x64x32

Expand

Correct
Yes, if the padding is 3 you add 6 to the height dimension and 6 to the width dimension.

6. You have a volume that is $64 \times 64 \times 32$, and convolve it with 40 filters of 9×9, and stride 1. You want to use a "same" convolution. What is the padding?

1 / 1 point

- ( ) 8
- ( ) 6
- (•) 4
- ( ) 0

Expand

Correct
Yes, when using a padding of 4 the output volume has $n_H = \frac{121-9+2\times4}{1}+1$.

7. You have an input volume that is 32x32x16, and apply max pooling with a stride of 2 and a filter size of 2. What is the output volume?

1 / 1 point

- ( ) 16x16x8
- (•) 16x16x16
- ( ) 32x32x8
- ( ) 15x15x16

Expand

Correct
Correct, using the following formula: $n_H^{[l]} = \frac{n_H^{[l-1]} \times 2 \times p - f}{s} + 1$

8. Because pooling layers do not have parameters, they do not affect the backpropagation (derivatives) calculation.

1 / 1 point

- ( ) True
- (•) False

Expand

Correct
Everything that influences the loss should appear in the backpropagation because we are computing derivatives. In fact, pooling layers modify the input by choosing one value out of several values in their input volume. Also, to compute derivatives for the layers that have parameters (Convolutions, Fully-Connected), we still need to backpropagate the gradient through the Pooling layers.

9. Which of the following are the benefits of using convolutional layers? (Check all that apply)

1 / 1 point

- [x] Convolutional layers are good at capturing translation invariance.
  - ✓ **Correct** Yes, this is due in part to applying the same filter all over the image.
- [ ] It allows parameters learned for one task to be shared even for a different task (transfer learning).
- [x] It reduces the total number of parameters, thus reducing overfitting through parameter sharing.
  - ✓ **Correct** Yes, a convolutional layer uses parameters sharing and has usually a lot fewer parameters than a fully-connected layer.
- [ ] It reduces the computations in backpropagation since we omit the convolutional layers in the process.

Expand

Correct
Great, you got all the right answers.

10. In lecture we talked about "sparsity of connections" as a benefit of using convolutional layers. What does this mean?

1 / 1 point

- (•) Each activation in the next layer depends on only a small number of activations from the previous layer.
- ( ) Regularization causes gradient descent to set many of the parameters to zero.
- ( ) Each layer in a convolutional network is connected only to two other layers
- ( ) Each filter is connected to every channel in the previous layer.

Expand

Correct
Yes, each activation of the output volume is computed by multiplying the parameters from **only one filter** with a volumic slice of the input volume and then summing all these together.