

CSci 4270 and 6270
Computational Vision,
Spring Semester, 2021
Lecture 17 Exercise — Number of Parameters
Due: Wednesday, March 31 at 11:59pm EST

Consider a convolutional neural network applied to an RGB input image of size $N \times N$ where, for simplicity of analysis, N is a power of 2. Suppose that

- the convolutions each cover $k \times k$ pixels,
- there are d different convolutions per convolution layer,
- padding is used so that convolutions do not result in image shrinkage, and
- after each convolution layer there is a max pooling layer applied over non-overlapping 2×2 pixel regions.

Suppose also that there are two convolution and max pooling layers, and these are followed by two fully-connected hidden layers with h nodes per layer before a final output layer with o output nodes. For simplicity, assume that no bias terms are used anywhere throughout the network. Derive expressions for the number of learnable convolution parameters and the number of learnable parameters in the fully-connected and output layers. In particular, answer the following:

1. How many learnable parameters are in the first convolutional layer?
2. How many learnable parameters are in the second convolutional layer?
3. How many learnable parameters are in the first hidden layer?
4. How many learnable parameters are in the second hidden layer?
5. How many learnable parameters are in the output layer?

Finally, if $N = 256$, $k = 3$, $d = 128$, $h = 256$ and $o = 10$, how many parameters are in the convolutional layers and how many are in the fully-connected layers, including the final output layers?

Please submit a formatted pdf file showing your answers.