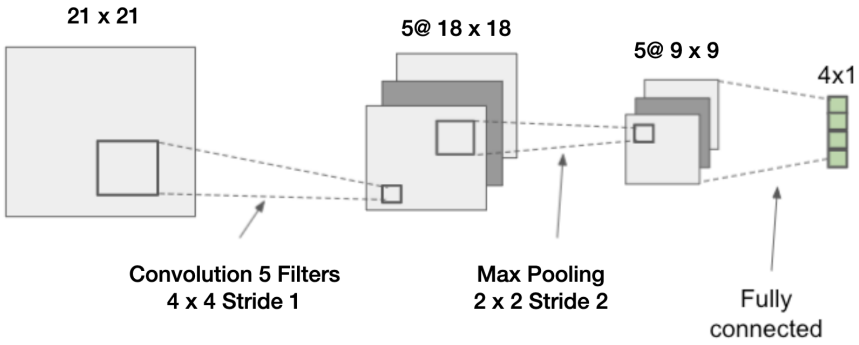
CS760 Final Exam Practice Question Set 2

May 2023

Instructions Answer the following questions. Read all the questions first. Even if you cannot obtain a final answer, make sure to write your setup and explain how you would obtain the answer. Partial credit will be considered. Do not spend too much time on any single problem—some problems are harder than others.

1 Convolutional Neural Network



This is the diagram of a small convolutional neural network. It converts a 21 x 21 image into 4 output values. The network has the following layers/operations from input to output: convolution with 5 filters (no activation function), max pooling, ReLU, and finally a fully-connected layer.

1. How many weights in the convolutional layer do we need to learn? (2pts)

   $4 \times 4 \times 5$ (filters) $= 80$ weights in total

2. How many ReLu operations are performed on the forward pass?

   405 ReLu operations. ReLu is performed after the pooling step. ReLu is performed on each pixel of the 5 (9 x 9) feature images.

2 Grapical Models

Refer to the figure in slide 29 of the Graphical models lecture: https://pages.cs.wisc.edu/~kandasamy/courses/23spring-cs760/slides/lecture17-graphical-models-2.pdf#page=29

We will assume that all 7 variables, $B, E, A_1, A_2, A_3, J, M$ are binary random variables.

1. List the conditional probability tables that need to be stored to fully specify the joint probability distribution $P(E, B, A_1, A_2, A_3, J, M)$ using as few parameters as possible.

   Ans: $P(E), P(B), P(A_1|E, B), P(A_2|B), P(A_3|B), P(J|A_1, A_2), P(M|A_3)$.

2. Work through the expectation-maximization example on slides 35–39.