CS640 Homework 4: Convolutional Neural Networks

In this assignment, you will be asked about some questions related to Convolutional Neural Networks (CNN).

For all questions, **provide calculation steps and/or some reasoning**.

Collaboration

You must answer written questions independently.

Instructions

General Instructions

In an ipython notebook, to run code in a cell or to render Markdown+LaTeX press `Ctrl+Enter` or `[>|]` (like "play") button above. To edit any code or text cell (double) click on its content. To change cell type, choose "Markdown" or "Code" in the drop-down menu above.

Most of the written questions are followed up a cell for you enter your answers. Please enter your answers in a new line below the **Answer** mark. If you do not see such cell, please insert one by yourself. Your answers and the questions should **not** be in the same cell.

Instructions on Math

Some questions require you to enter math expressions. To enter your solutions, put down your derivations into the corresponding cells below using LaTeX. Show all steps when proving statements. If you are not familiar with LaTeX, you should look at some tutorials and at the examples listed below between $..$. The OEIS website can also be helpful.

Alternatively, you can scan your work from paper and insert the image(s) in a text cell.

Submission

Once you are ready, save the note book as PDF file (File -> Print -> Save as PDF) and submit via Gradescope.

Please select pages to match the questions on Gradescope. **You may be subject to a 5% penalty if you do not do so**.

Q1

Consider a 1D convolution of a vector $[6, 3, 6]$ and filter $[2, 2, 1]$ with stride 1. Additionally, a ReLU activation is applied after the convolution. Calculate the final result.

Answer

Q2

Consider a 1D convolution of a vector of size 16 and a filter of size 3 with stride 2. Calculate the size of the convolution output with padding size 1 (per side).

Answer

Q3

Consider passing an image of size 2048×1024 to a max pooling layer with a kernel of size 3×3 with stride 2, and padding of 7 pixel per side. How many weights are there in this pooling layer?

Answer

Q4

Consider a convolution of an image of size 256×256 and a filter of size 32×32 and stride 2. How many pixels of padding per side are needed to obtain a result of size 128×128?

Answer

Q5

Consider a 1D convolution layer with input dimension 1280, 12 filters of size 3 and stride 3, and no padding. Calculate the number of parameters. Assume that there is no bias.

Answer

Q6

Consider a convolution of an image of size 48×48 and a filter of size 5×5 with 0 padding and stride 2. What is the size of the output?

Answer

Q7

Consider a convolution of an image of size 42×42 and a filter of size 7×7 and stride 2. How many pixels of padding per side are needed to obtain a result of size 28×28?

Answer

Q8

Let L be a pooling layer in a CNN, and let x and y be the input and output of L respectively. Is it possible that size(x) < size(y)? Briefly explain.

Answer