Deep Learning　　　　　　　HW #3　　　　　Instructor: Shusen Pu

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Question:	1	2	3	Total
Points:	10	10	20	40
Score:				

Instructions:　This homework assignment is divided into two sections:

- The first section requires you to find the padding

- The second section, labeled as problems 2 and 3, requests programming.

1. (10 points) During convolution, if we apply the filter on the input feature map (shown below):

Filter

1	0.5
1	0

1	0.5	0
0.5	0	1
1	0.5	0

Input

(a) For the above input and filter in CNN, what are the dimensions of the input and filter? i.e., find the n and f that we defined in the class.

n = 3 because input is a 3x3 matrix
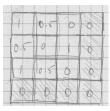f = 2 because filter is a 2x2 matrix

(b) In order to create the same padding, what is the number of padding layers ("p")?

$$p = \frac{f-1}{2} = \frac{2-1}{2} = \frac{1}{2}$$

Since p is a fraction, round up to the nearest whole number which is 1. Therefore there is 1 padding layer.

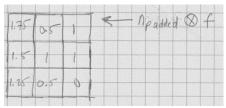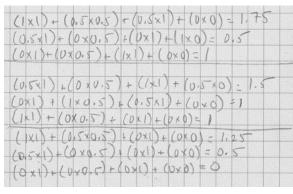(c) Draw the padding layers around the input image.

$$n + 2p - f + 1 = 3 + 2(1) - 2 + 1 = 4$$

Therefore, the padded matrix needs to be a 4x4 matrix

(d) Use the filter and input image to find the output of this convolution.

$(1\times1) + (0.5\times0.5) + (0.5\times1) + (0\times0) = 1.75$
$(0.5\times1) + (0\times0.5) + (0\times1) + (1\times0) = 0.5$
$(0\times1) + (0\times0.5) + (1\times1) + (0\times0) = 1$

$(0.5\times1) + (0\times0.5) + (1\times1) + (0.5\times0) = 1.5$
$(0\times1) + (1\times0.5) + (0.5\times1) + (0\times0) = 1$
$(1\times1) + (0\times0.5) + (0\times1) + (0\times0) = 1$

$(1\times1) + (0.5\times0.5) + (0\times1) + (0\times0) = 1.25$
$(0.5\times1) + (0\times0.5) + (0\times1) + (0\times0) = 0.5$
$(0\times1) + (0\times0.5) + (0\times1) + (0\times0) = 0$

$\leftarrow n_{padded} \otimes f$

1.75	0.5	1
1.5	1	1
1.25	0.5	0

2. (10 points) **Practice with CNN.** Download the data and code on Google Drive, and run it locally with Jupyter Notebook.

   (a) Data and code for CNN is available on Google Drive: named CNN.zip
       `https://drive.google.com/drive/folders/1IGWWU6vVvDuZ59u8bjfn48NET7t8A-4J?usp=sharing`

   (b) In the example code, we made a prediction on the dog photo (`'dataset/single_prediction/cat_or_dog_1.jpg'`). Find the prediction for another picture in the same folder `dataset/single_prediction/`.

   ### See Homework3-FM-CNN.ipynb

   (c) Find the number of pictures in the "dataset/test_set", define it as N_{test}. Randomly draw 10 numbers from 0 to N_{test}, and make predictions on pictures with those indices from the cat's folder (dataset/test_set/cats) and also the dog's folder (dataset/test_set/dogs). In other words, randomly draw ten pictures (with the same indices in the cat's folder and the dog's folder) and make predictions on those pictures. Compare your predictions with the true label.

   ### See Homework3-FM-CNN.ipynb

   (d) Upload your code for this problem on Canvas under this assignment. I will subsequently review and run your code in order to grade your assignment.

3. (20 points) Complete the coding tasks in the file titled HW3_RNN

   Instructions:

   - The code with other example codes are available in Google Drive:
     `https://drive.google.com/drive/folders/1IGWWU6vVvDuZ59u8bjfn48NET7t8A-4J?usp=sharing`
   - You can use the codes in the folder "RNN_examples" for reference. Some parts of this coding assignment require further reading of the related documentation.
   - Once you've finished, save your work and rename the file by appending your initials. For instance, if your name is Shusen Pu, you should rename the file as "Homework3-SP.ipynb".
   - Make sure all your inputs in the code are saved. Then close and reopen the renamed file (in my case, "Homework3-SP.ipynb") to confirm that all your answers have been saved properly.
   - Upload your code on Canvas under this assignment.

   I will subsequently review and run your code in order to grade your assignment.

See Homework3-FM-RNN.ipynb