Quiz-06

- Due Feb 23 at 11:59pm
- Points 10
- Questions 10
- Available Feb 21 at 6pm - Feb 23 at 11:59pm
- Time Limit None
- Allowed Attempts 3

Take the Quiz Again

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	147 minutes	7 out of 10

Correct answers are hidden.

Score for this attempt: 7 out of 10
Submitted Feb 23 at 5am
This attempt took 147 minutes.

Question 1
1 / 1 pts

A convolution layer of a 1D CNN (a TDNN) operates on the following input:

$$Y = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

with the following two convolutional filters

$$W_1 = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

The filters operate on input Y to compute the output Z. The convolution uses a stride of 2.

What is the second value of the first channel of Z (i.e. $Z(1,2)$ where the first index represents channel)? The indexing is 1-based (so indices start at 1).

Hint: Lecture 10, Slides 40-64

2

Explanations: In order to find the value of the 2nd value of the first channel, we want to apply the first filter (W1) to the input matrix. With a stride of 2, the filter W1 is applied from left to right and the convolution operation involves element-wise multiplication of the filter followed by a summation of the results.

IncorrectQuestion 2
0 / 1 pts

A convolution layer of a 2D CNN operates on the following input (the input is two channels of 4x4, represented by the two 4x4 matrices, where the left matrix represents the first channel and the right matrix represents the second channel):

$$Y = \begin{bmatrix} \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix} \end{bmatrix}$$

with the following two convolutional filters:

$$W_1 = \begin{bmatrix} \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} \end{bmatrix}$$

$$W_2 = \begin{bmatrix} \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \end{bmatrix}$$

The filters operate on input Y to compute the output Z. The convolution uses a stride of 2. No zero padding is employed in the forward pass.

During the backward pass you compute dZ (the derivative of the divergence with respect to Z) as

$$dZ = \begin{bmatrix} \begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix} \end{bmatrix}$$

During the backward pass you compute the derivative for the filters dW. What is the (2,2) element of the derivative for the first channel of the first filter (i.e. $dW_1(1,2,2)$, where the first index is the channel index)? The indexing is 1-based (so indices start at 1).

Hint: Lec 11, 166-198, but you will have to adapt the equations to 1-D convolution.

1

IncorrectQuestion 3

0 / 1 pts

A convolution layer of a 2D CNN operates on the following input (the input is two channels of 4x4, represented by the two 4x4 matrices, where the left matrix represents the first channel and the right matrix represents the second channel):

$$Y = \begin{bmatrix} \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix} \end{bmatrix}$$

with the following two convolutional filters:

$$W_1 = \begin{bmatrix} \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} \end{bmatrix}$$

$$W_2 = \begin{bmatrix} \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \end{bmatrix}$$

The filters operate on input Y to compute the output Z. The convolution uses a stride of 1. No zero padding is employed in the forward pass.

During the backward pass you compute dZ (the derivative of the divergence with respect to Z) as

$$dZ = \begin{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 2 \\ 1 & 2 & 1 \end{bmatrix} \begin{bmatrix} -1 & 1 & -1 \\ 1 & -1 & 1 \\ -1 & 1 & -1 \end{bmatrix} \end{bmatrix}$$

During the backward pass you compute the derivative for the input, dY. What is the (2,2) element of the derivative for the second channel of Y (i.e. $dY(2,2,2)$ where the first index represents channel)? The indexing is 1-based (so indices start at 1).

Hint: Lec 11, 57-160. Drawing the data flow diagram may be useful.

0

Question 4

1 / 1 pts

A convolution layer of a 1D CNN (a TDNN) operates on the following input:

$$Y = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

with the following two convolutional filters:

$$W_1 = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

The filters operate on input Y to compute the output Z. The convolution uses a stride of 0.5 (i.e. an upsampling “transpose convolution” that results in an output twice as long as the input). Assume the symmetric padding of input channels used in the lecture to compute this answer.

What is the second value of the first channel of Z (i.e. $Z(1, 2)$ where the first index represents channel)? The indexing is 1-based (so indices start at 1).

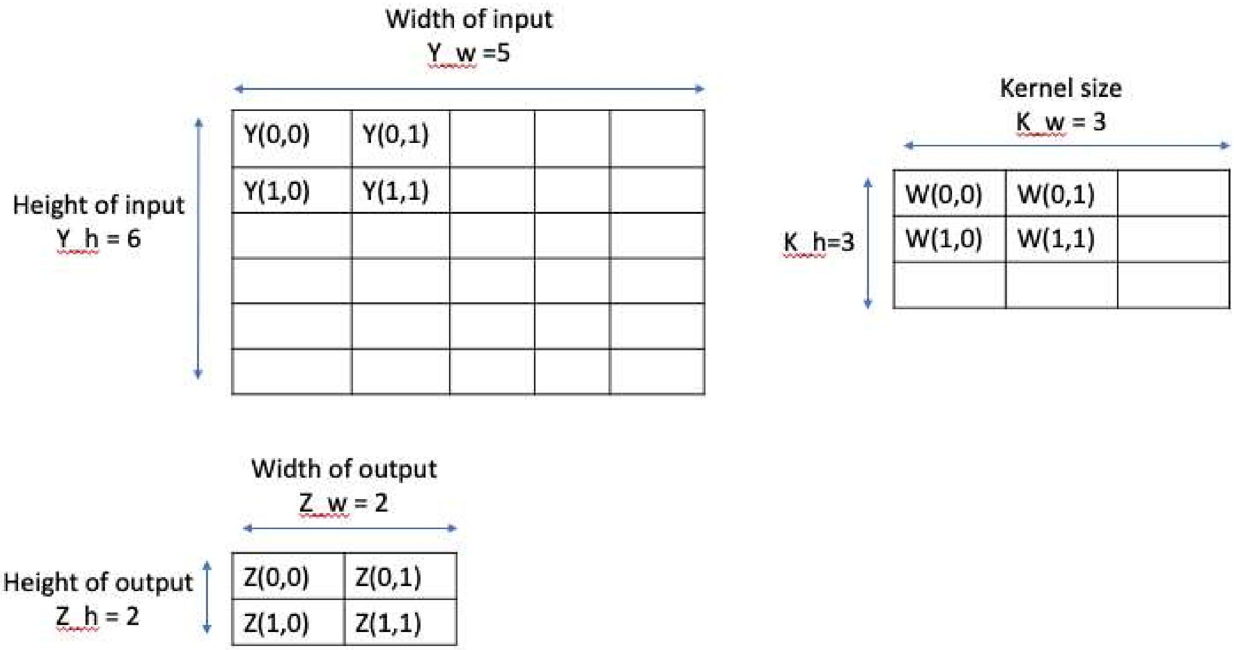
Hint: A transpose convolution is an upsampling followed by convolution. The question is asking about the output of the convolution layer at a single position.

1

Question 5

1 / 1 pts

Consider a 2-D convolution setup. Let the input be Y with height (h) = 6, width (w) =5 and in-channels (m_i) = 1. Let there be only 1 filter W with height (K_h) = 3 and width = K_w = 3. Let the stride along the width (s_w) = 2 and stride along height (s_h) = 3. Let the output of this convolution operation be Z.



You are given the gradient of the loss wrt Z i.e dL/dZ. Construct a new filter F which when convolved with the input Y (stride 1) produces an output A of shape same as filter W and has A(i,j) = dL/dW(i,j)

NOTE: Height is the first dimension and width is the second dimension. We are using 0-based indexing.

The notation is used below is as follows:

Y(i,j) refers to the pixel at ith row and jth column. Similar convention for Z, W, A and F

- [x] Shape of proposed filter F is (4,3)
- [x] $\frac{dL}{dW(1,1)} = \frac{dL}{dZ(0,0)}Y(1,1) + \frac{dL}{dZ(1,0)}Y(4,1) + \frac{dL}{dZ(0,1)}Y(1,3) + \frac{dL}{dZ(1,1)}Y(4,3)$
- [x] $Z(i,j) = \sum_{i'=0}^{K_h-1}\sum_{j'=0}^{K_w-1} W(i',j')Y(s_h * i + i', s_w * j + j')$

Question 6

1 / 1 pts

The input to a 2D convolutional layer is size 28x28, with 32 input channels. We wish to perform a convolution using kernels of size 5x5 on it to obtain 32 output channels. No bias is employed.

What is the difference in the number of parameters to be learned between a conventional convolutional layer, and a depthwise separable convolutional layer?

Hint: Lecture 12, Slides 83-92

- ○ The regular convnet needs 1024 parameters while the depthwise separable convolution needs 800 parameters
- ○ The regular convnet and the depthwise separable network both need 800 parameters, but they are distributed differently across filters and layers
- ◉ A regular convnet requires 25600 parameters while a depthwise separable convolution needs 1824
- ○ The regular convnet and the depthwise separable convolution both need 1824 parameters

Question 7

1 / 1 pts

A transform-invariant CNN has 32 filters in its lth layer. The model imposes invariance to rotation by +45 degrees, rotation by -45 degrees, and at each orientation, scaling up by a factor of 1.25 and scaling down by a factor of 0.75. How many output channels will the layer produce?

Hint: Lecture 12, Slides 73-79

- ◉ 288
- ○ 128
- ○ 32
- ○ 6

Question 8

1 / 1 pts

The innermost loop in an explicitly indexed (non-vectorized) implementation of a TDNN, is written as:

z(l,j,t) += w(l,j,i,t')Y(l-1,i,t+t'-1)

where z(l,j,t)is the value at location t of the jth affine map at the lth layer, w(l,j,i,t') is the value of the jth filter of the lth layer, that is assigned to a shift t', within the ith channel of the (l-1)th layer, and Y(l-1,i,t) is the value of the output of the ith channel of the (l-1)th layer at location t.

If we use the same loops, loop variables and loop limits as the original TDNN code, which of the following are correct backpropagation derivative updates dY(l-1,i,t+t'-1) += w(l,j,i,t')z(l,j,t)

- dw(l,j,i,t') += dz(l-1,i,t+t'-1)

dY(l-1,i,t+t'-1) = w(l,j,i,t')dz(l,j,t)

- dw(l,j,i,t) = dz(l,j,t)Y(l-1,i,t+t'-1)

dY(l-1,i,t+t'-1) += w(l,j,i,t')dz(l,j,t)

- dw(l,j,i,t') += dz(l,j,t)Y(l-1,i,t+t'-1)

dY(l-1,i,t+t'-1) += z(l,j,t)dw(l,j,i,t')

- dw(l,j,i,t') += z(l,j,t)

Question 9

1 / 1 pts

While backpropagating through a max pooling layer, the divergence derivative at the output of a max pool filter is...

(Assume all input values to the max pooling layer are unique)

Hint: Lecture 12, Slides 16-23

- randomly assigned to one of the input locations
- equally distributed over the input pool
- assigned such that more weightage is given to the location of the maximum value and the remaining locations get equal parts of the derivative
- assigned to the input location of the maximum value when there is a unique maximum value in the pool

The derivative of the mean pooling layer at any input location is (1/(K^2)) with in the same kernel, where K is the width of the square kernel

IncorrectQuestion 10

0 / 1 pts

A convolutional layer in a CNN scans the inputs with a 3x3 filter, with a stride of 2. When backpropagating gradients through this layer, what is the equivalent sequence of operations?

Hint: Lecture 12, slides 32-52

- [ ] Backprop through a convolutional layer with a 3x3 filter and stride 1, followed by backprop through an upsampling-by-2 layer
- [ ] Backprop through a downsampling-by-2 layer followed by backpropagating through a convolutional layer with 3x3 filters and stride 1
- [ ] Backprop through a convolutional layer with a 3x3 filter and stride 1, followed by backprop through a downsampling-by-2 layer
- [x] Backprop through an upsampling-by-2 layer followed by backpropagating through a convolutional layer with 3x3 filters and stride 1

Quiz Score: 7 out of 10