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
KEPT	Attempt 1	147 minutes	7 out of 10
LATEST	Attempt 2	649 minutes	6 out of 10
	Attempt 1	147 minutes	7 out of 10

Correct answers are hidden.

Score for this attempt: 6 out of 10
Submitted Feb 23 at 3:50pm
This attempt took 649 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

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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):

$$Y = \left[\begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}\right]$$

with the following two convolutional filters:

$$W_1 = \left[\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}\right]$$

$$W_2 = \left[\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\right]$$

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 filters dW. What is the (2,2) element of the derivative for the second channel of the second filter (i.e. $dW_2(2,2,2)$ where the first index is the channel index)? The indexing is 1-based (so indices start at 1).

Hint: Lec 11, 166-199. For code refer to slides 202-207. Drawing the data flow diagram may be useful. Also, feel free to use Python for calculations.

0

Question 3

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 three convolutional filters

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

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

$$W_3 = \begin{bmatrix} 3 & 2 \\ 1 & 0 \end{bmatrix}$$

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

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

During the backward pass you compute the derivative for the input, dY. What is the first element of the derivative for the second channel of Y (i.e. $dY(2,1)$, 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.

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IncorrectQuestion 4
0 / 1 pts

A convolution layer of a 2D CNN operates on the following input (the input is two channels of 3x3, represented by the two 3x3 matrices, where the left matrix represents the first channel and the right matrix represents the second channel):

$$Y = \left[\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}\right]$$

with the following two convolutional filters:

$$W_1 = \left[\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}\right]$$

$$W_2 = \left[\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\right]$$

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 the width and twice the height of the input). Assume the symmetric padding of input channels used in the lecture to compute this answer.

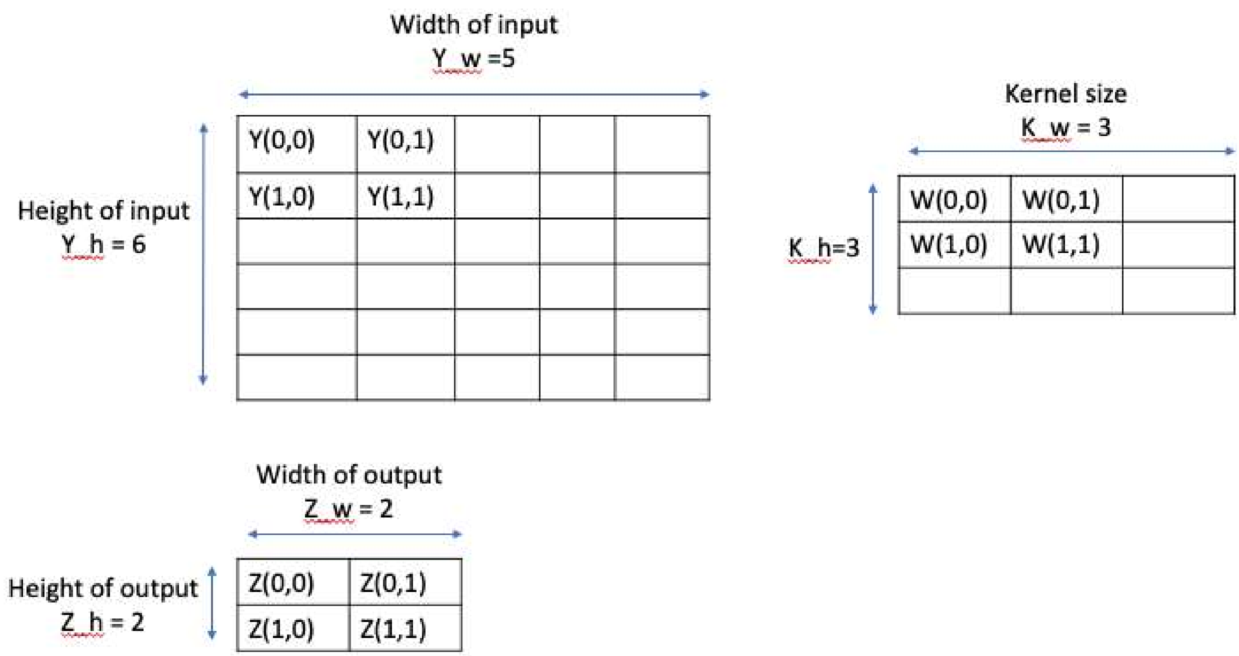
What is the value at position (2,2) of the second channel of Z (i.e. $Z(2,2,2)$ where the first index represents channel)? The indexing is 1-based (so indices start at 1).

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

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

IncorrectQuestion 6

0 / 1 pts

Please read the following paper for answering the question below.

https://arxiv.org/pdf/1707.01083.pdf (https://arxiv.org/pdf/1707.01083.pdf)

Which of the following are true about ShuffleNet model architecture?

- [x] In a ShuffleNet Unit, a pointwise group convolution is followed by a channel shuffle operation.
- [x] For all scales s of ShuffleNet, the larger the number of groups g, the lesser the complexity of the ShuffleNet.
- [x] Channel shuffle operation can take place across convolution layers even if they only have the same number of groups.
- [x] For a given complexity constraint, the group convolution allows more feature map channels, which result in encoding more information.

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
- ( ) 6
- ( ) 32
- ( ) 128

Question 8

1 / 1 pts

The innermost loop in an explicitly indexed (non-vectorized) implementation of a 2D CNN, is written as:

z(l,j,x,y) += w(l,j,i,x',y')Y(l-1,i,x+x'-1,y+y'-1)

where z(l,j,x,y)is the value at location x, y of the jth affine map at the lth layer,
w(l,j,i,x',y') is the value of the jth filter of the lth layer, that is assigned to a shift x', y' within the ith channel of the (l-1)th layer, and Y(l-1,i,x, y) is the value of the output of the ith channel of the (l-1)th layer at location x, y.

If we use the same loops, loop variables and loop limits as the original CNN code, which of the following are correct backpropagation derivative updates

- dY(l-1,i,x+x'-1,y+y'-1) += w(l,j,i,x',y')dz(l,j,x,y)
  dw(l,j,i,x',y') += dz(l,j,x,y)Y(l-1,i,x+x'-1,y+y'-1)
- dY(l-1,i,x+x'-1,y+y'-1) += z(l,j,x,y)dw(l,j,i,x',y')
  dw(l,j,i,x',y') += z(l,j,x,y)
- dY(l-1,i,x+x'-1,y+y'-1) = w(l,j,i,x',y')dz(l,j,x,y)
  dw(l,j,i,x',y') = dz(l,j,x,y)Y(l-1,i,x+x'-1,y+y'-1)
- dY(l-1,i,x+x'-1,y+y'-1) += w(l,j,i,x',y')z(l,j,x,y)
  dw(l,j,i,x',y') += dz(l-1,i,x+x'-1,y+y'-1)

IncorrectQuestion 9

0 / 1 pts

While backpropagating through a mean pooling layer, the divergence derivative at the input location of the non maximum values is

Hint: Lecture 12, Slides 24-28

- -1
- 0
- Identical to the derivative at the input location of the maximum value
- Proportional to the value of the input at that location

Question 10

1 / 1 pts

A convolutional layer in a CNN scans the inputs with a 3x3 filter, with a fractional stride of 0.5. When backpropagating gradients through this layer, what is the equivalent sequence of operations?

Hint: Lecture 12, slides 32-52

- Backprop through an upsampling-by-2 layer followed by backpropagating through a convolutional layer with 3x3 filters and stride 1

- [x] 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

Quiz Score: 6 out of 10