Homework

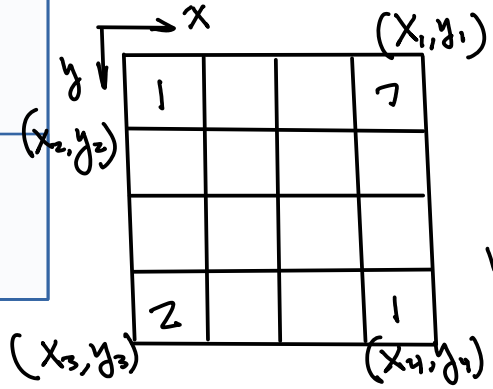
Up-Sampling and Composite Convolution

CMPE 258

1. Given a feature layer below, use bi-linear technique to perform up-sampling.

Sol. Step 1. Map the Anchor Points to 4x4 feature map. Step 2. Apply Linear Interpolation Eqn (pp.55, Lecture Notes)

1	7
2	1



$$y = \underbrace{\frac{y_2 - y_1}{x_2 - x_1}}_{a} x - \underbrace{\frac{y_2 - y_1}{x_2 - x_1} x_1 + y_1}_{b} \quad \ldots(1)$$

where

$$a = \frac{y_2 - y_1}{x_2 - x_1} \quad \ldots(2)$$

, Pick $(x_1, y_1) = (3, 7)$

$(x_2, y_2) = (0, 1)$, so $a = \frac{1-7}{0-3} = 2$ and $b = -\frac{y_2 - y_1}{x_2 - x_1} x_1 + y_1$ ...(3)

$b = -\frac{1-7}{0-3} \cdot 3 + 7 = -\frac{-6}{-3} \cdot 3 + 7 = 1$, Here, the 1st interpolation $y = ax + b = 2x + 1$ ...(4) Then for point (1,0), the feature value $y = 2x + 1 = 2 \cdot 1 + 1 = 3$. Similarly, you can feature values at (2,0) on the 1st Row; for (1,3), (2,3) on the Last Row, use the Same process to find New a and b for the interpolation Equation $y = ax + b$. Step 3. for the 1st Column, use Eqn (1)–(3), with x replaced by y Coordinate find:

$$a = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{feature@}(0,3) - \text{feature@}(0,0)}{\text{Indp.Variable } y@(0,3) - \text{Indp.Variable } y@(0,0)} = \frac{2-1}{3-0} = 1/3$$

$$b = -\frac{y_2 - y_1}{x_2 - x_1} x_1 + y_1 = -\frac{2-1}{3-0} \cdot 0 + \text{feature@}(0,0) = 1$$

2. Given a feature layer below

(2.1) compute max pooling;

(2.1) then, using the result in (2.1) to compute max-unpooling.

1	7	1	7
3	7	1	4
1	9	1	7
2	7	1	9

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So, after Replacing independant variable x by y, we have feature value

$$y' = ay + b = \frac{1}{3}\cdot y + 1 \quad \ldots(5)$$

For the feature value at (0,1) on the Left Column (1st Col from the Left), we have

$$y' = \frac{1}{3}y + 1 \Big|_{y=1} = \frac{1}{3} + \frac{3}{3} = 4/3 = 1.333$$

Similarly, for the feature value at (0,2) on the Left Col.

$$y' = \frac{1}{3}y + 1 \Big|_{y=2} = \frac{2}{3} + \frac{3}{3} = 5/3 = 1.667$$

Step 4. Use the Same Process as in Step 3, find the Interpolation Equation with New a and b for the Last col. (Right Col.)

$$a = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{feature@(3,3)} - \text{feature@(3,0)}}{\underset{y@(3,3)}{\text{Indp.Variable}} - \underset{y@(3,0)}{\text{Indp.Variable}}} = \frac{1-7}{3-0} = -2$$

$$b = -\frac{y_2 - y_1}{x_2 - x_1}x_1 + y_1 =$$

$$= -\frac{\text{feature@(3,3)} - \text{feature@(3,0)}}{\underset{y@(3,3)}{\text{Indp.Variable}} - \underset{y@(3,0)}{\text{Indp.Variable}}}\left(\underset{y@(3,0)}{\text{Indp.Variable}}\right) + \text{feature@(3,0)}$$

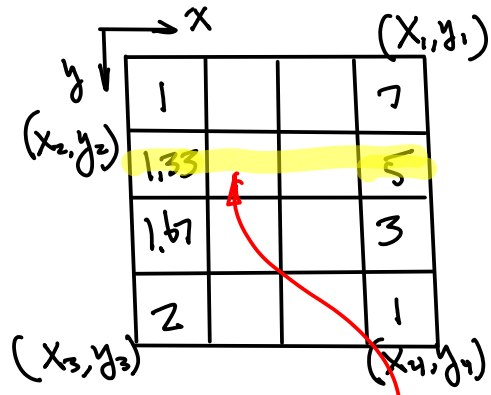
$$= -2\cdot 0 + 7 = 7$$

So, Feature Value@(3,1): $y' = -2y + 7\Big|_{y=1} = 5$

Now, we have all feature values on the Boundary, e.g., The First and the Last Row, And the first and the Last col. Counting from the Left.

Step 5. Find the Interior feature values By using the Interpolation either from the one along each row or the one along each col.

For Example using the one along the rows



Feature Value@(1,1)

Pick the 2nd Row, so

$$a = \frac{\text{feature@(3,1)} - \text{feature@(0,1)}}{\underset{x@(3,1)}{\text{Indp.Variable}} - \underset{x@(0,1)}{\text{Indp.Variable}}}$$

$$= \frac{5 - 1.33}{0 - 3} = 3.67/3 = 1.223$$

$b = -1.223\cdot 0 + 1.33 = 0.107$

$\therefore$ Feature Value@(1,1):

$y' = 1.223\times 1 + 0.107 = 2.3$ // END

And Feature Value@(3,2):

$$y' = -2y + 7\Big|_{y=2} = -4 + 7 = 3$$

3. Convert your answer sheet to pdf file using any online tool; then use the similar naming convention used before in this class, and submit your work to CANVAS.

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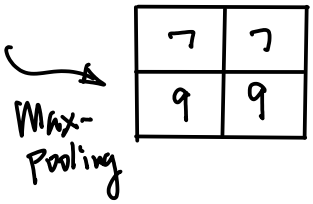
(END)

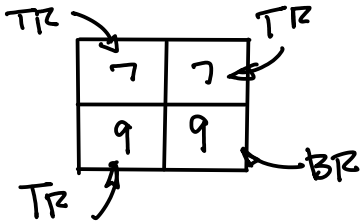
Q2.1: Sol: Max Pooling. Note. Register Location for the Next Step

1	7	1	7
3	7	1	4
1	9	1	7
2	7	1	9

Max-Unpooling.



Max-Pooling With Location Info



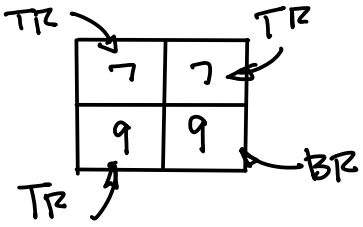
(TR: Top Right
BR: Bottom Right,
TL: Top Left,
BL: Bottom Left).

Note: For This Pattern, You Can Pick Any one of the Two 7's. As Long as You are Consistent.

7	7
9	9

Q2.2. Sol: Compute Max-Unpooling.

Given the Feature Map (Computed from Q2.1). Below (left), we have the Result Below (Right).



	7		7
	9		
			9

END.