Backprop (2/2)
CNNs

CSE 493G1, Section 4

January 26, 2024

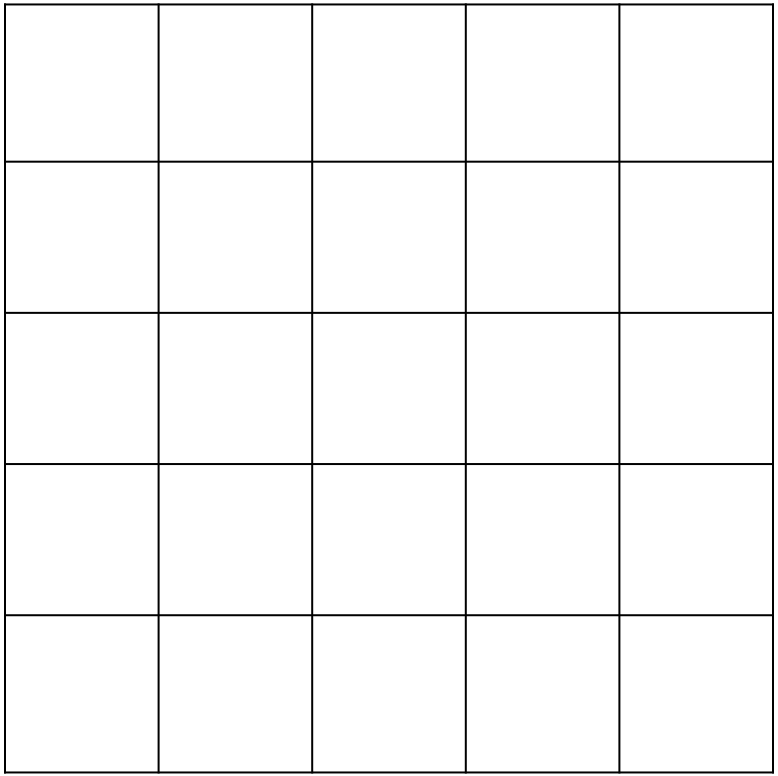
Materials prepared by Tanush Yadav

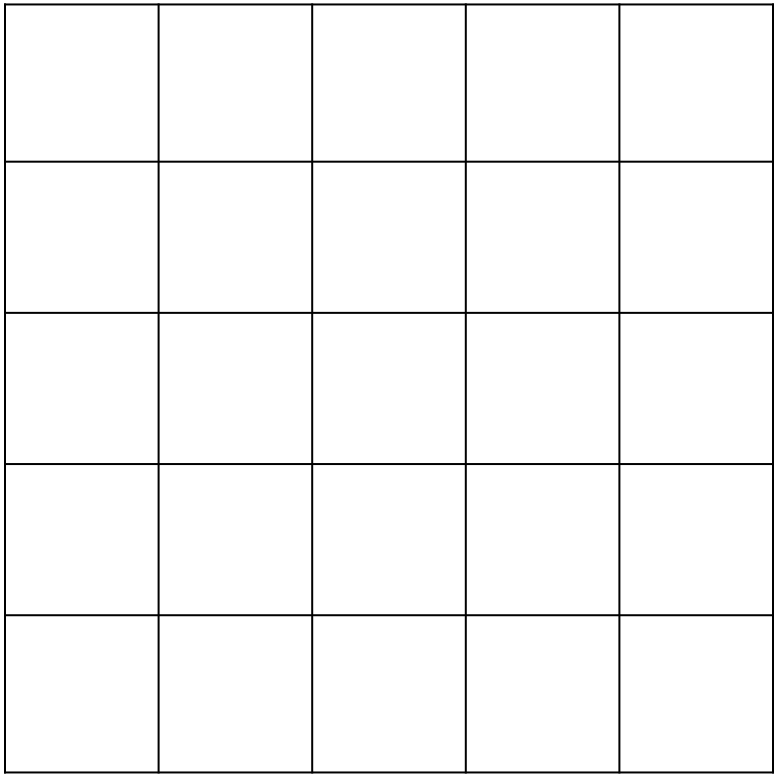
Course Logistics

Assignment 2 due **Tuesday, 1/30**.

Next week's section: Quiz 2 and Project Design Tips.

Remember to be ideating for course projects! Come to office hours for feedback.





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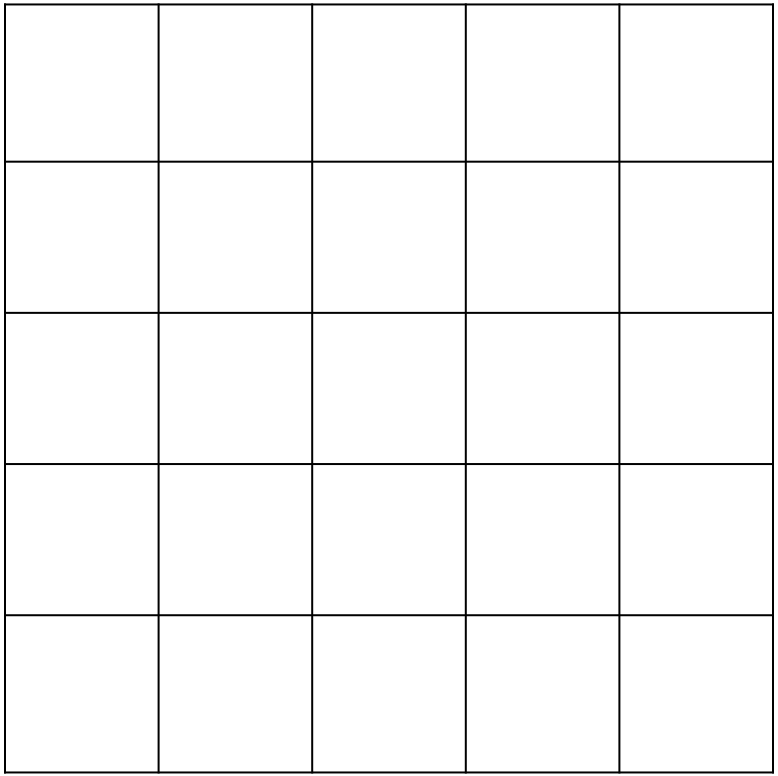

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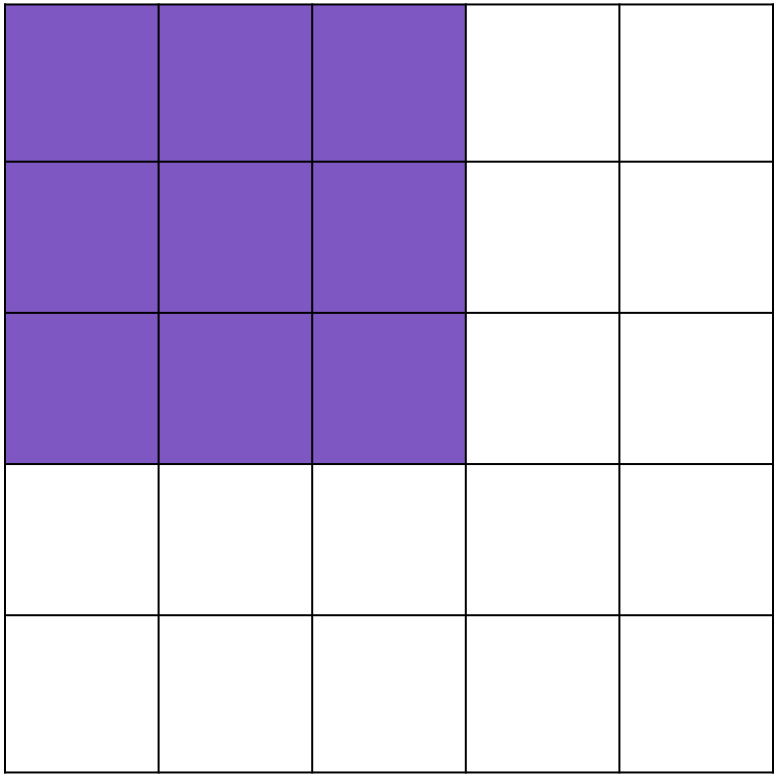
F = 3



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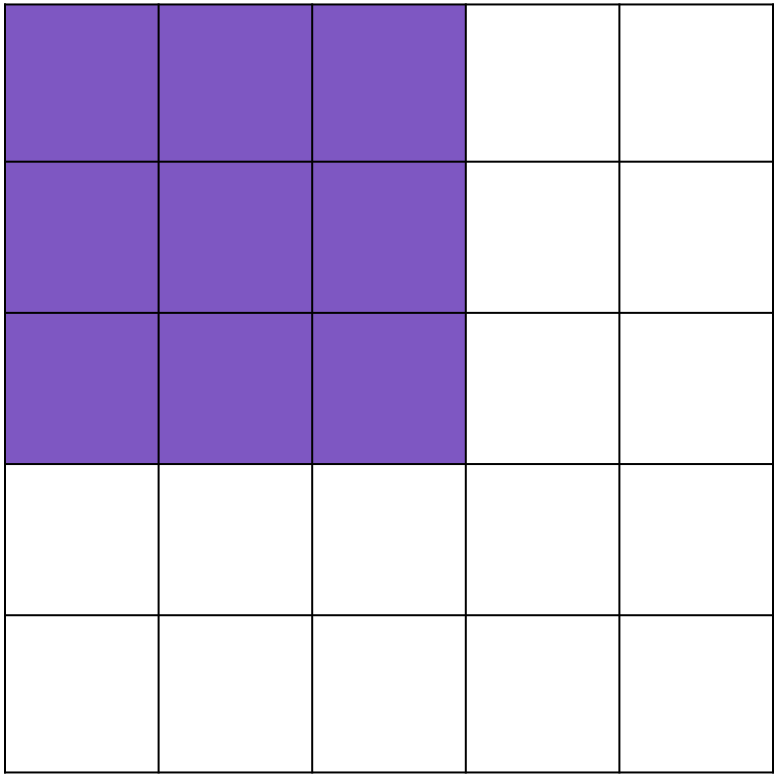
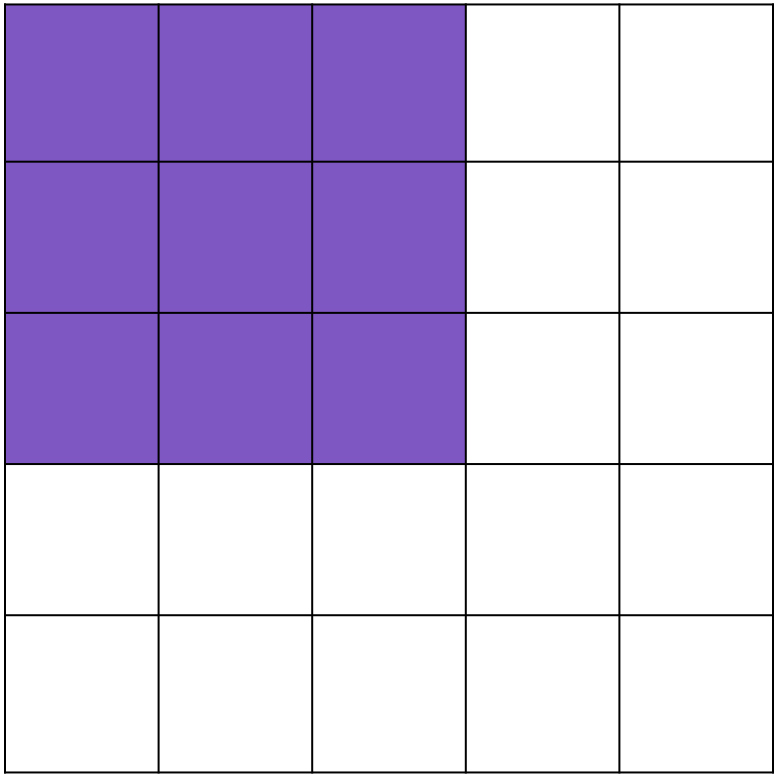


A note on terminology.

- filter
- neuron’s receptive field



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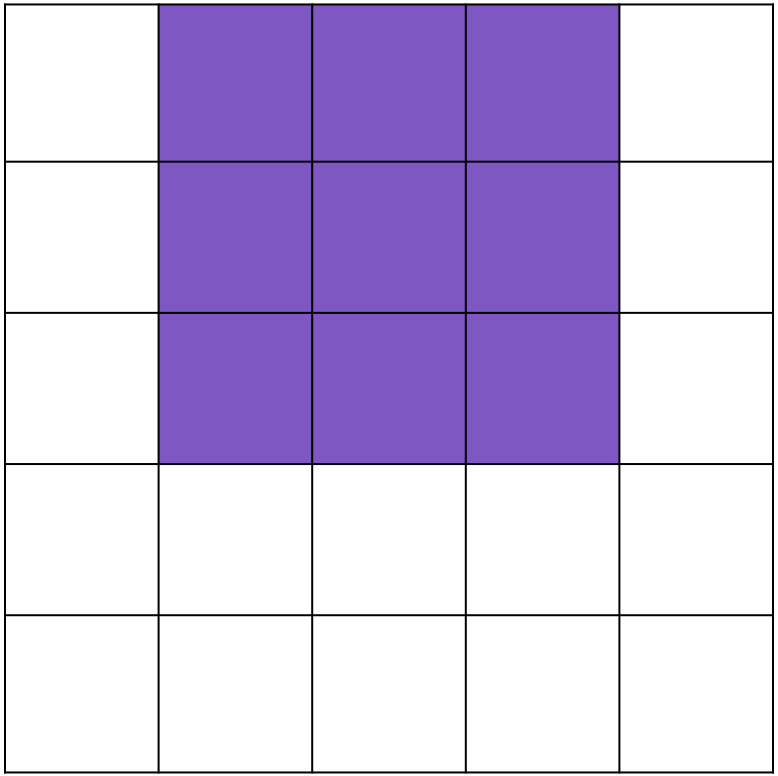

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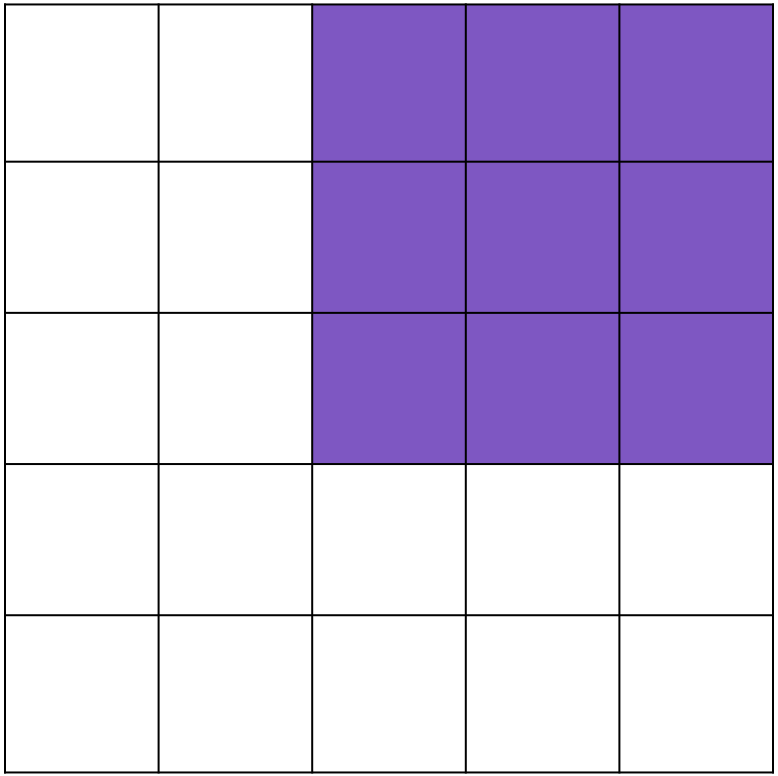

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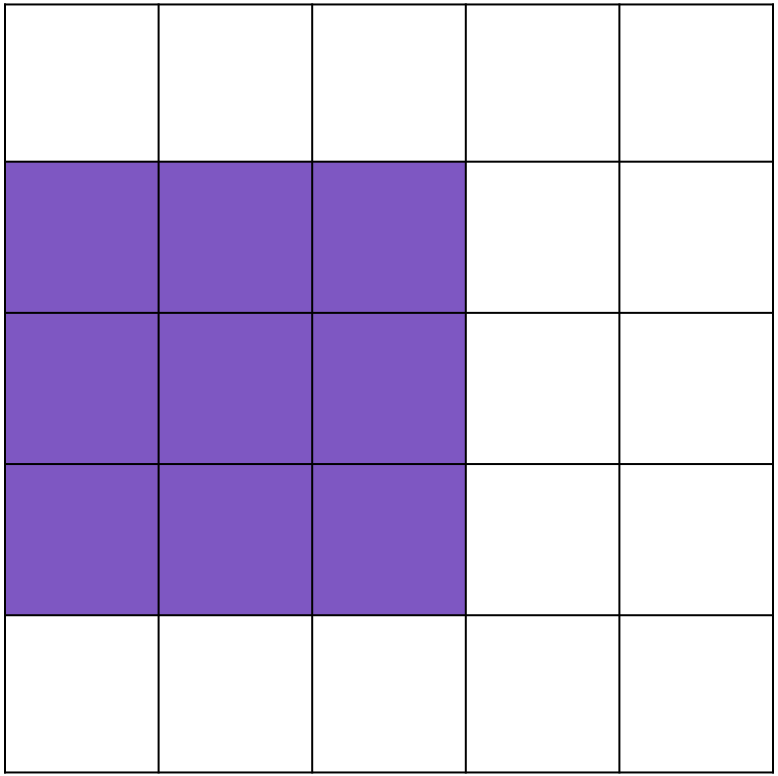

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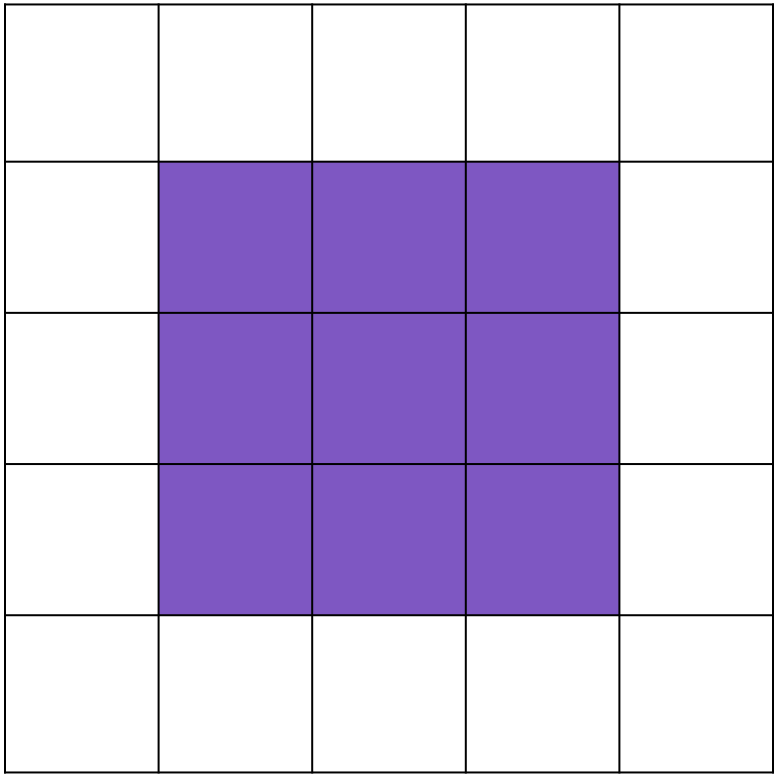

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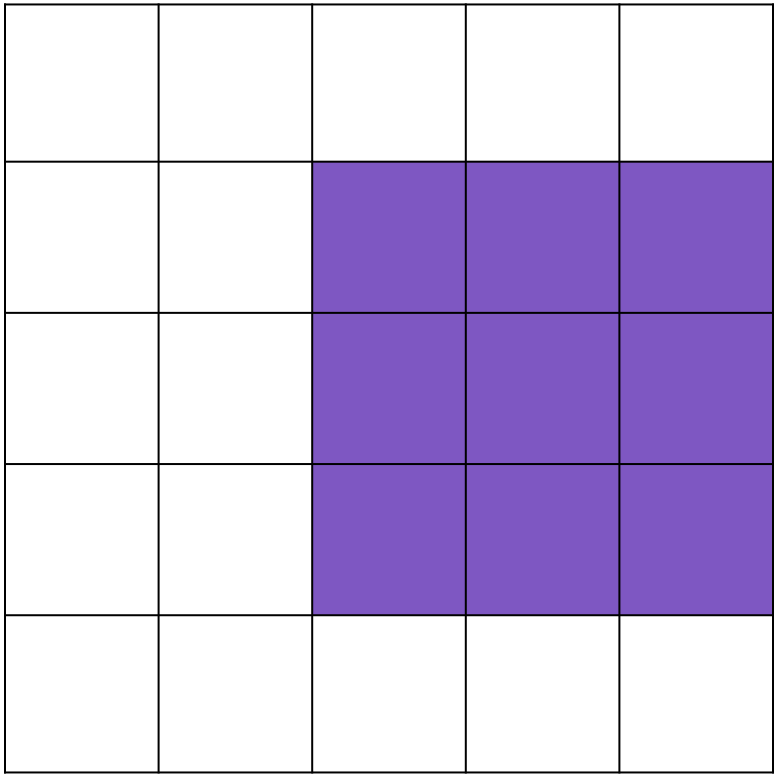

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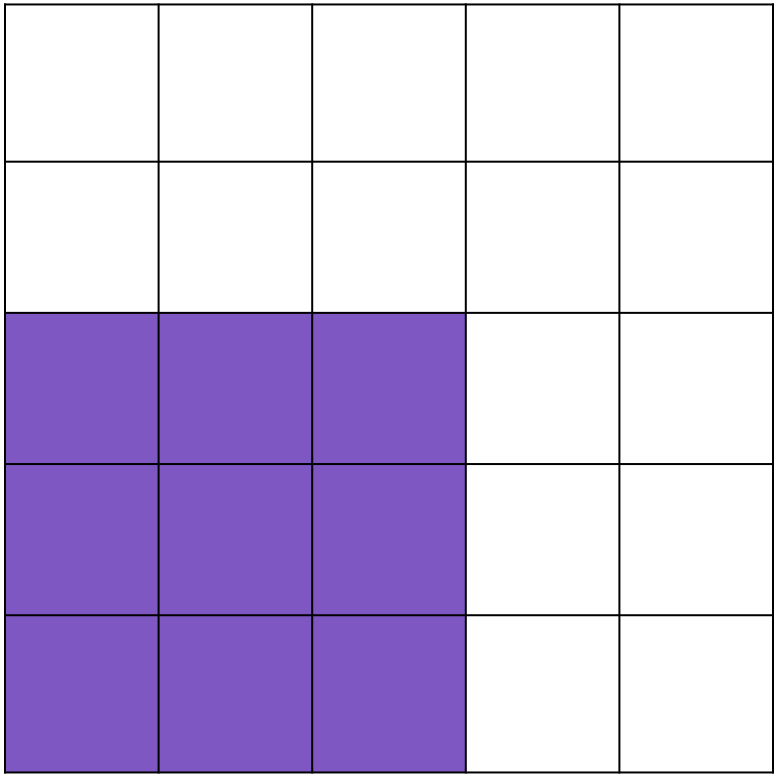

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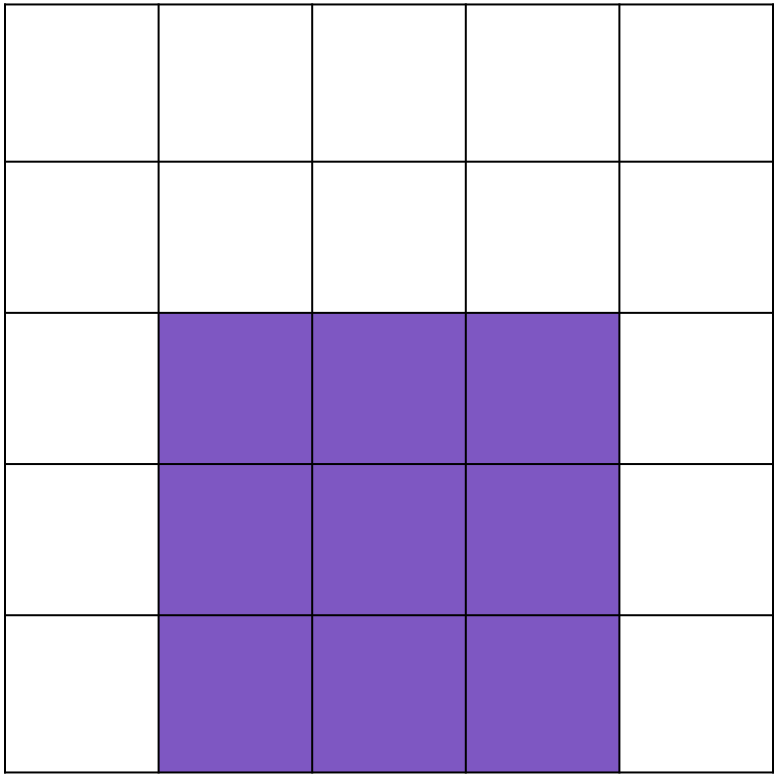

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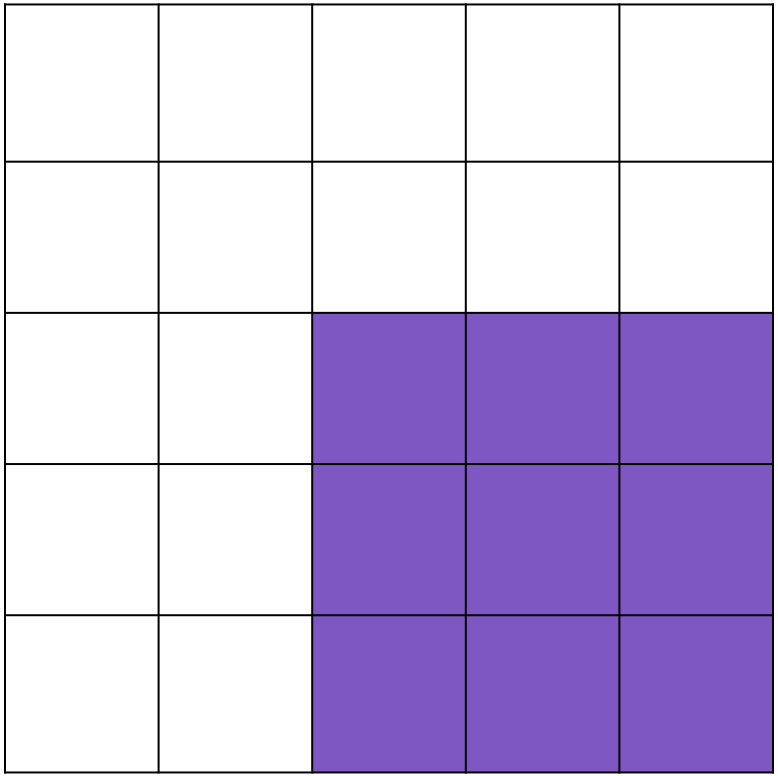
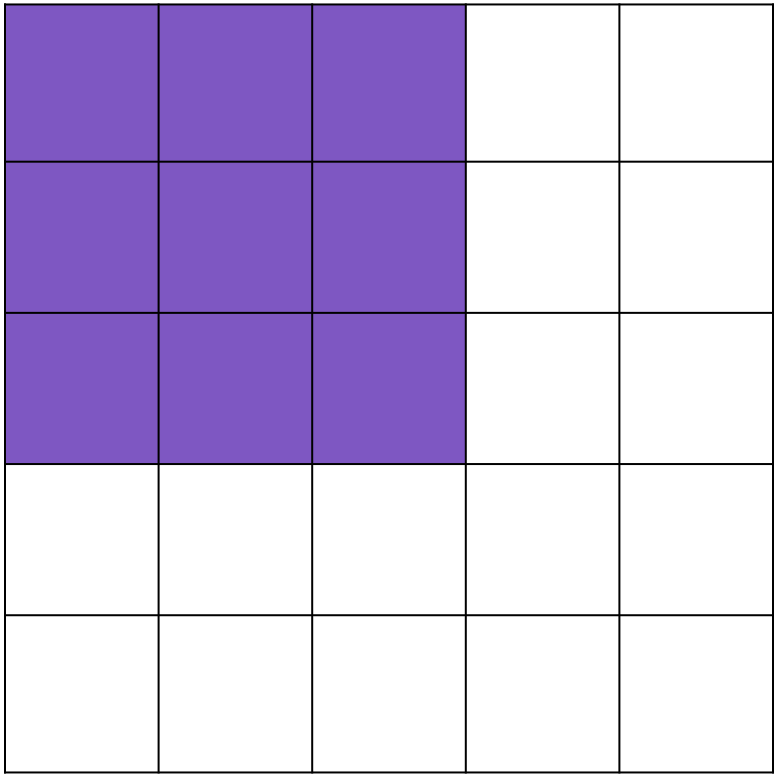


Input: 5x5x1
Filter: 3x3x1

W = 5
F = 3

Shift horizontally and vertically is the same.

Let’s focus on studying one.



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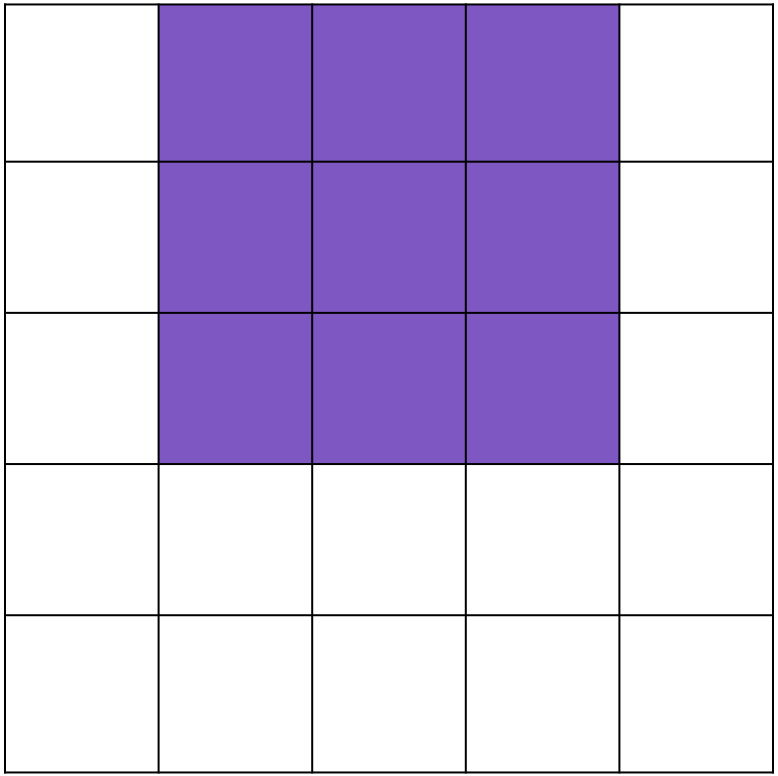

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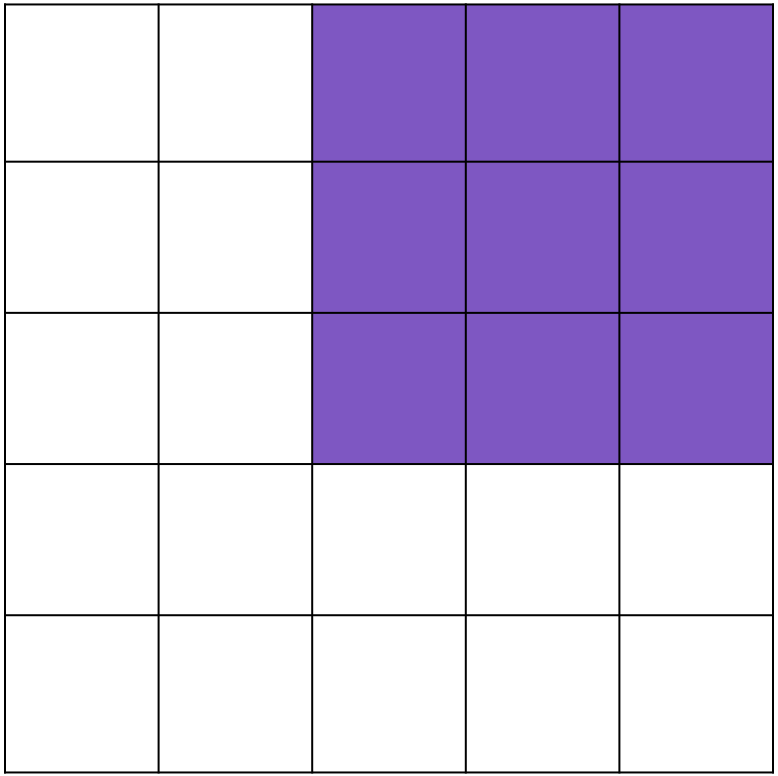
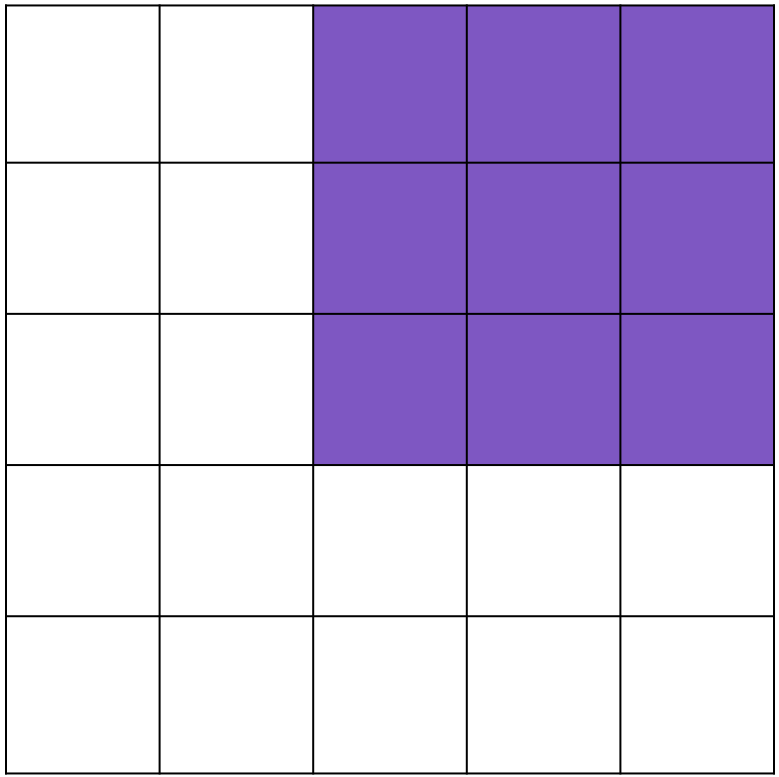


Input: 5x5x1
Filter: 3x3x1

W = 5
F = 3

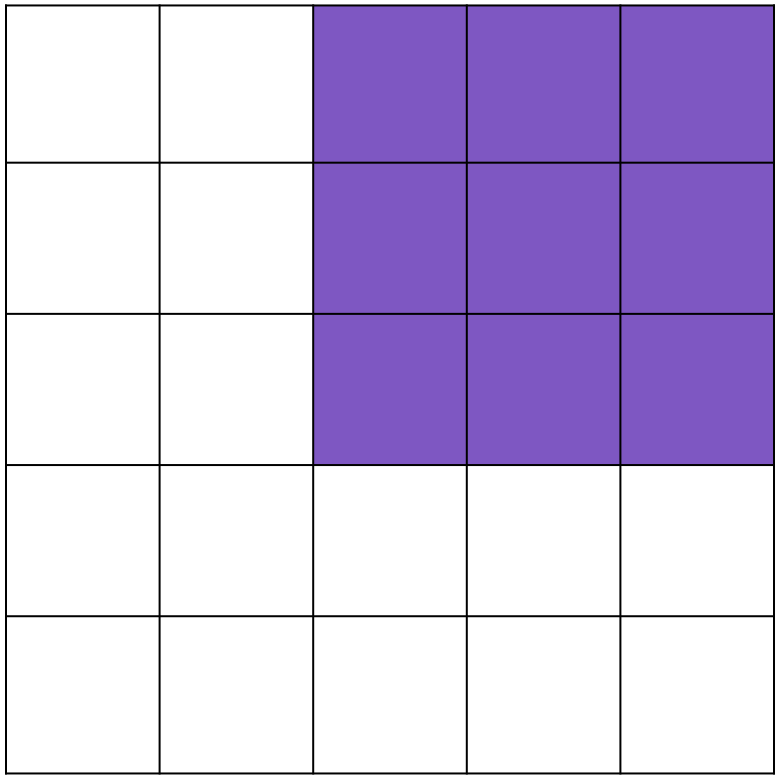
What could a good equation be?



Input: 5x5x1
Filter: 3x3x1

W = 5
F = 3

$$W - F + 1$$

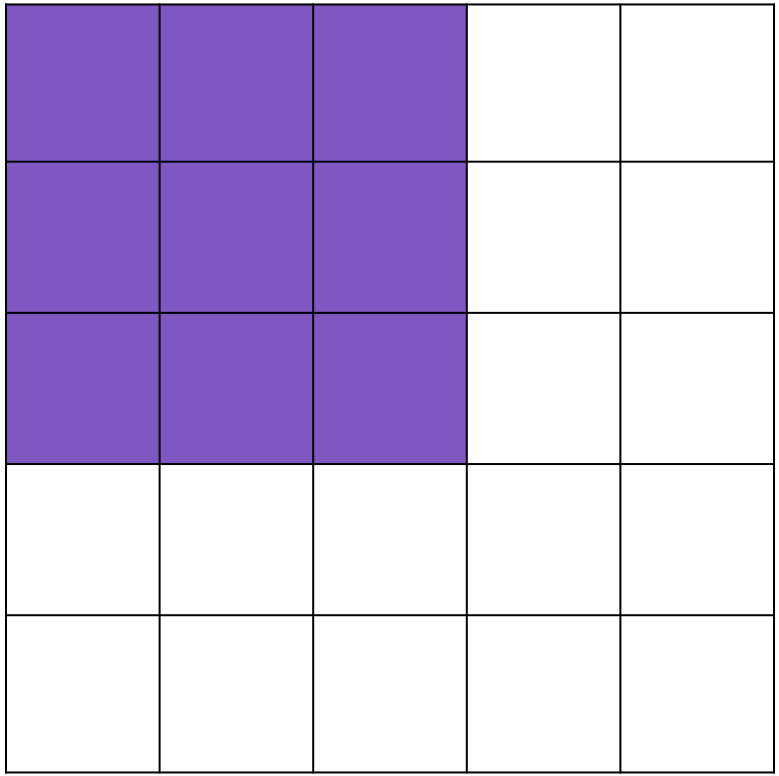


Input: 5x5x1
Filter: 3x3x1

W = 5
F = 3

$$\frac{W - F}{1} + 1$$

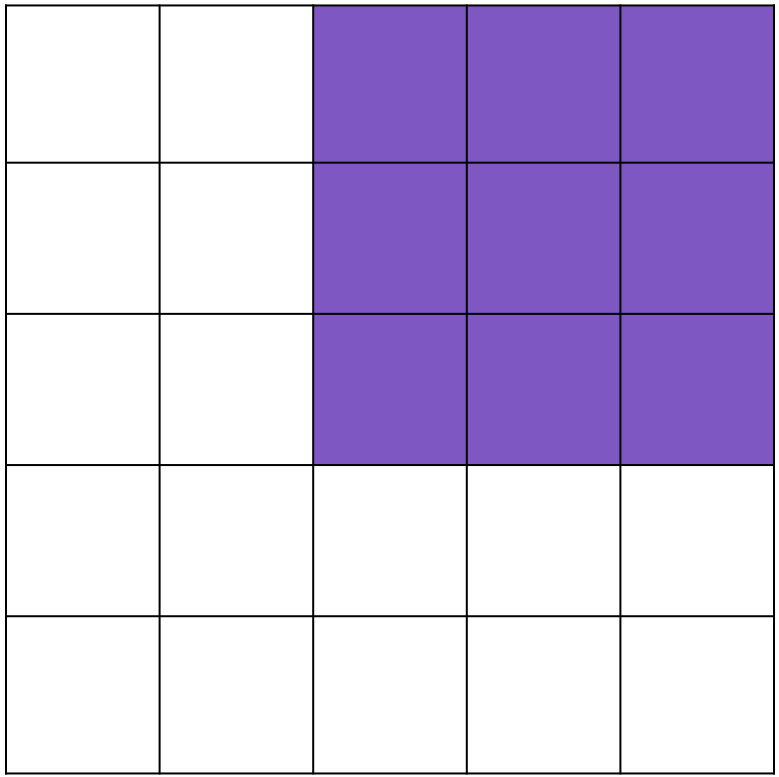
Let’s now consider stride.



Input: 5x5x1
Filter: 3x3x1

W = 5
F = 3
S = 2

$$\frac{W - F}{1} + 1$$



Input: 5x5x1
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W = 5
F = 3
S = 2

$$\frac{W - F}{1} + 1$$

The math ain't mathing.

Input: 5x5x1
Filter: 3x3x1

This equation gives us 3.

But we just saw that our output will have width 2!

W = 5
F = 3
S = 2

$$\frac{W - F}{1} + 1$$

Here's one way to make the math work.

W = 5
F = 3
S = 2

$$\frac{5-3}{2}+1=1+1=2$$

What changed?

W = 5
F = 3
S = 2

$$\frac{5-3}{1}+1=2+1=3$$

$$\frac{5-3}{2}+1=1+1=2$$

What changed?

W = 5
F = 3
S = 2

$$\frac{5-3}{2}+1$$

$$\frac{W-F}{2}+1$$

2 is our stride!! Let's adjust our equation.

$$\frac{W - F}{2} + 1$$

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$$\frac{W - F}{S} + 1$$

Alright great, now what about padding?

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Let P represent our padding.

If set P = 1, then we're adding a zero value on the left and right of our image.

In other words … we're increasing the width of our image by 2.

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Adding 2*P to our value for W should do the trick!

Taking padding into account...

$$\frac{W - F}{S} + 1$$

Taking padding into account...

$$\frac{W - F}{S} + 1$$

$$\frac{W + 2P - F}{S} + 1$$

Almost there!

$$\frac{W + 2P - F}{S} + 1$$

Our final equation 🙂

$$\frac{W - F + 2P}{S} + 1$$

Remember that conv layers operate along the *entire* depth.

Our final equation 🙂

$$\frac{W - F + 2P}{S} + 1$$

“The connections are local in 2D space (along width and height), but always full along the entire depth of the input volume” ~ cs231n notes