Filter

Name	Nathan Varghese
Identity Key	nava3000

	Level	Completed
	Beginner	3
	Intermediate	0
	Advanced	0
	Expert	0

Goal
3

Total Completed
3

Filter

CSCI 5722: Computer Vision

Fall 2024

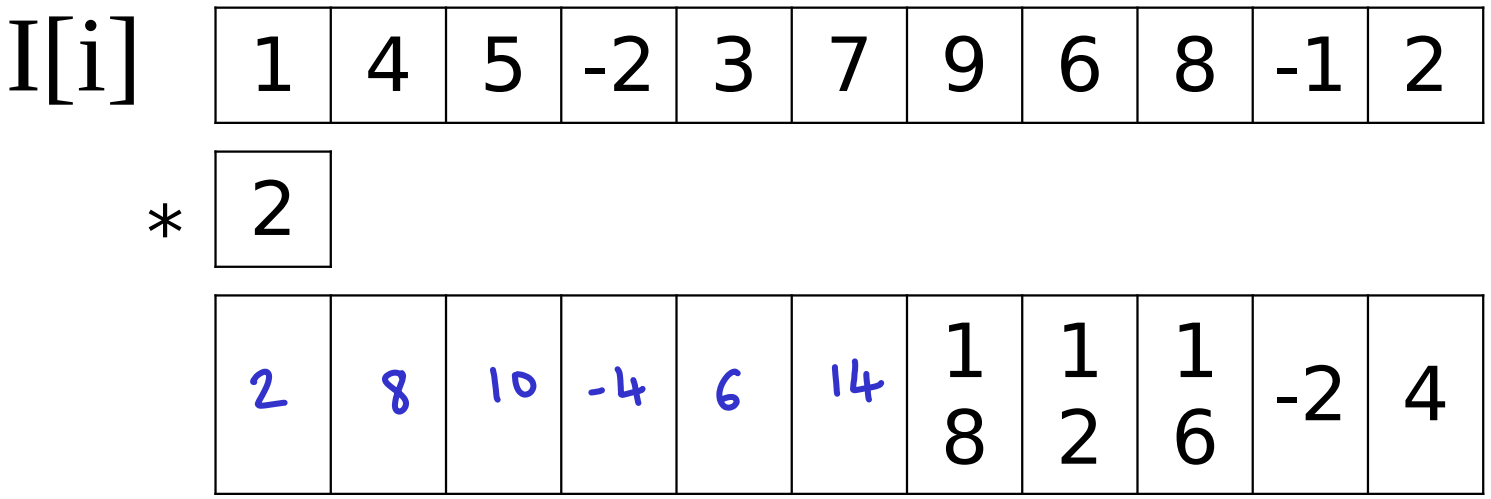
Dr. Tom Yeh

1D Filters

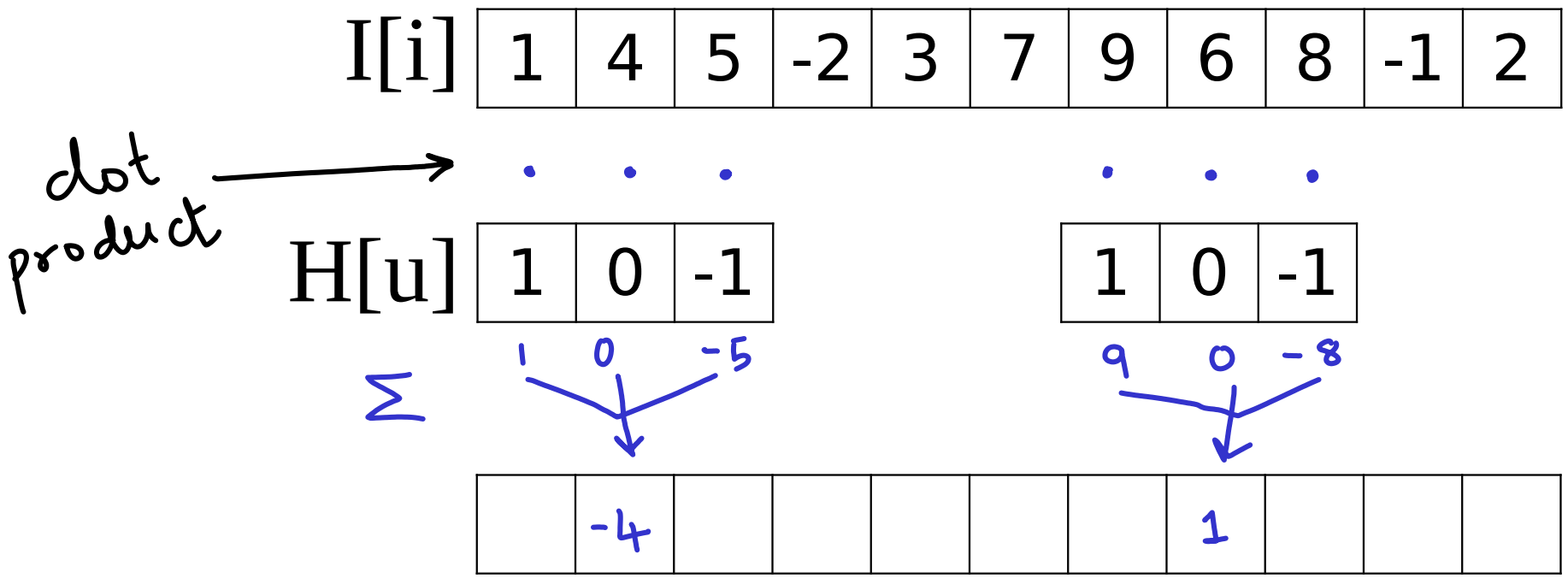
1D Signal

I[i]	1	4	5	-2	3	7	9	6	8	-1	2

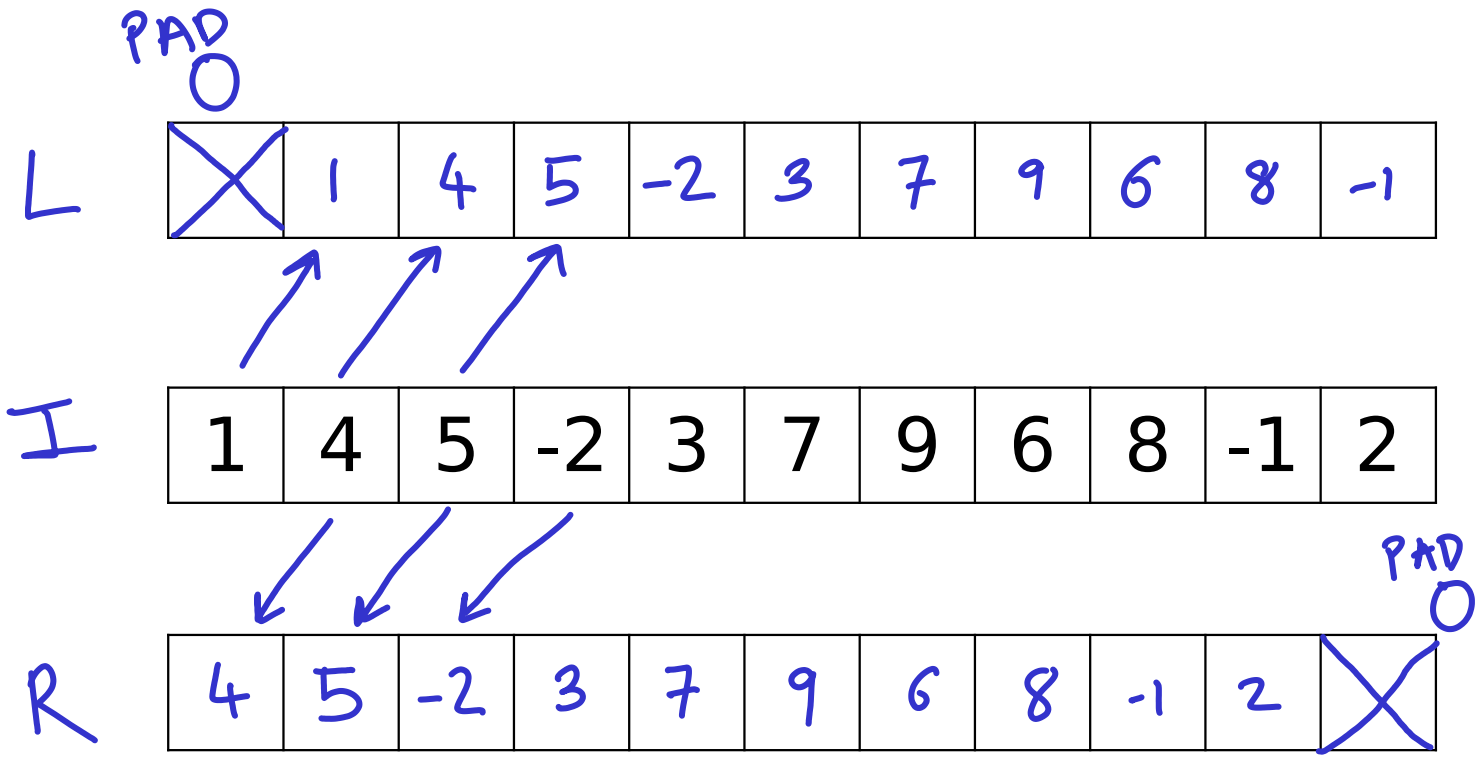
Element-wise Operation



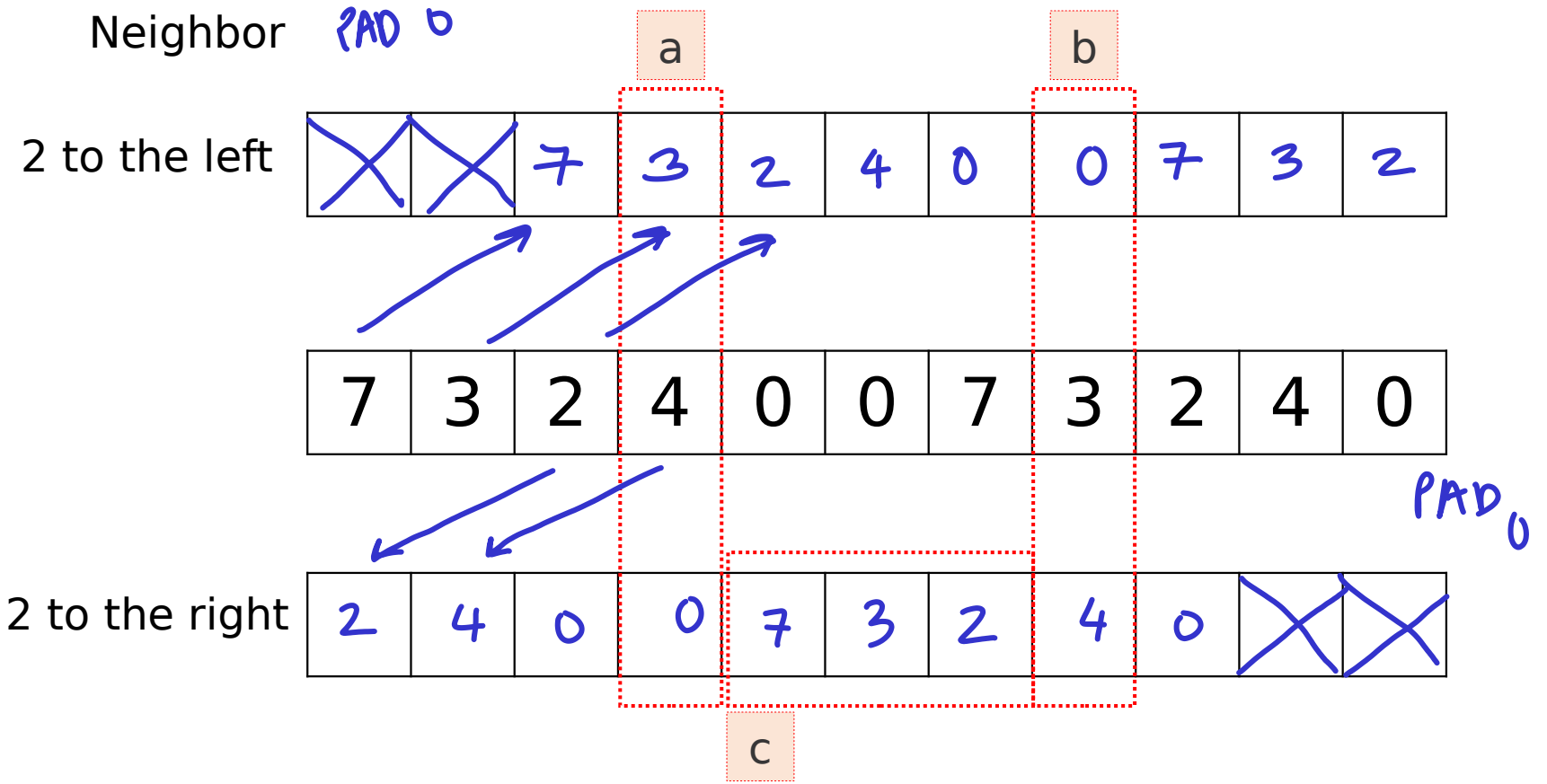
Cross Correlation



Neighborhood

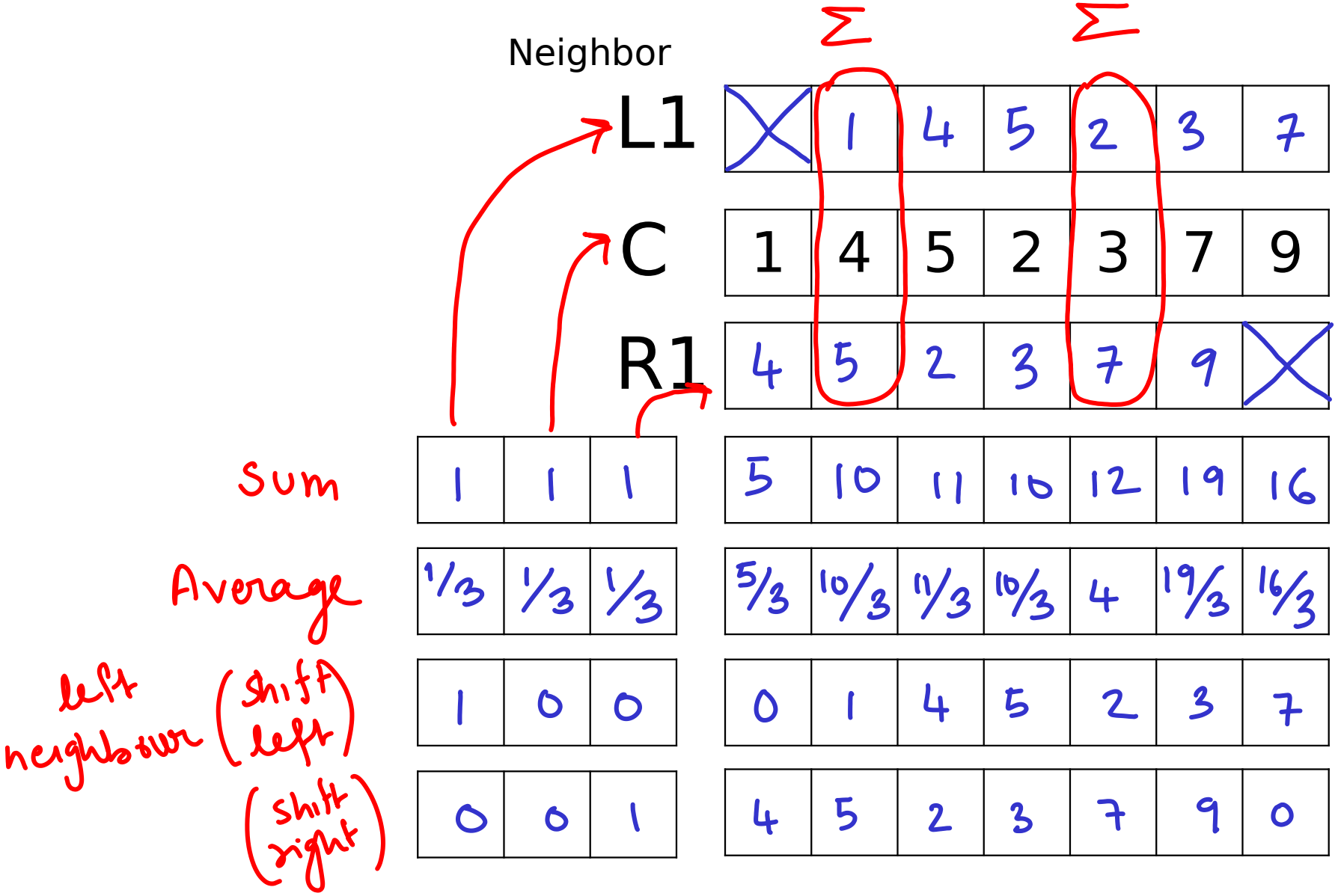


Neighborhood



Σa = 7; Σb = 7; Σc = 12

Cross Correlation as Matrix Multiplication



Box filter

pad with -1

Neighbor

L1	-1	2				3	1
C	2	1	0	2	3	1	0
R2	0	2				-1	-1
	0	3				53/9	2*

a: 14/9, 7/9, -4/9

b

c

*Doesn't add up!

*A added

sum(a) = 3; sum(b) = 7;
sum(c) = 7

Mean filter

pad with 0

L1	0	4	8	0	4	0	0
C	4	8	0	4	0	0	4
R1	8	0	4	0	0	4	0
R2	0	4	0	0	4	0	0

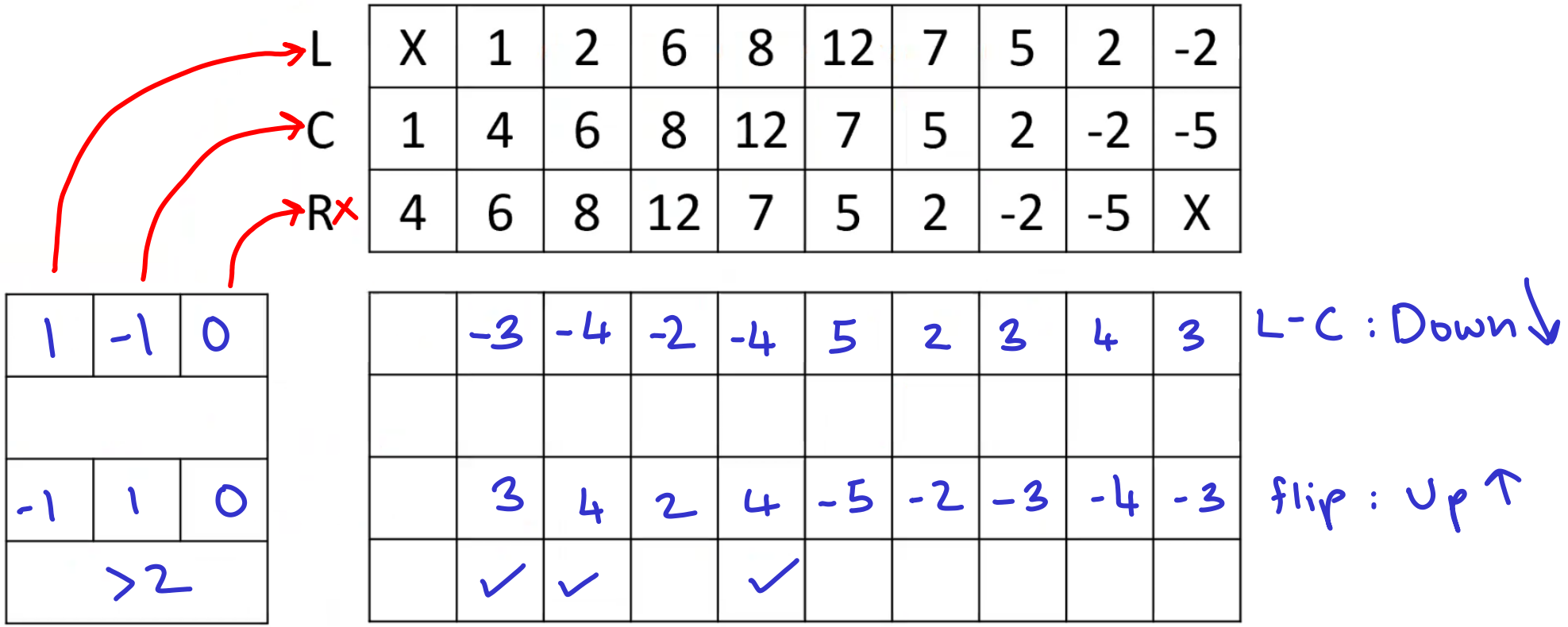
a

1/4	1/4	1/4	1/4			
3	4	3	1	2	1	1

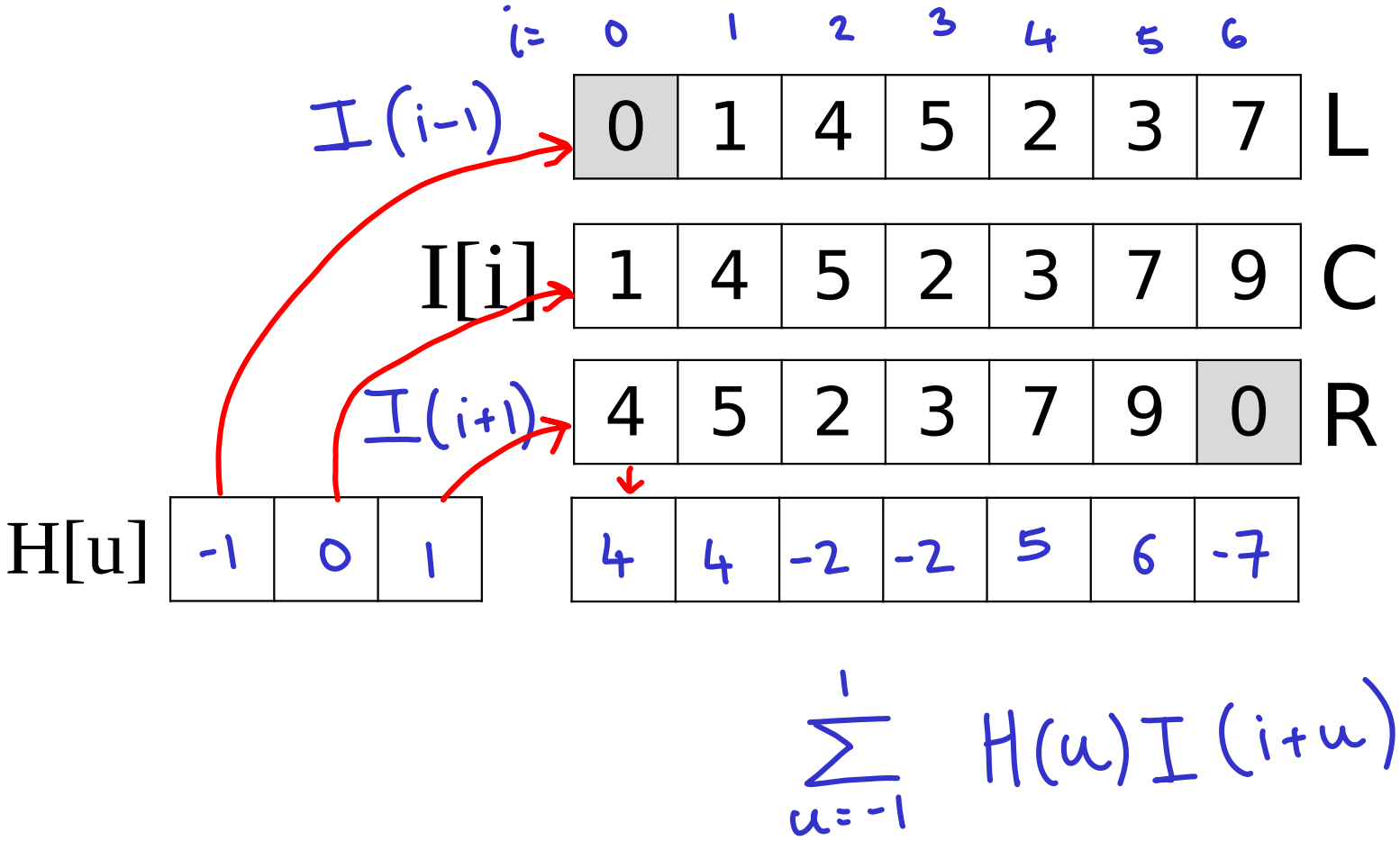
b c

sum(a) = 1; sum(b) = 7; sum(c) = 4

Up or Down?

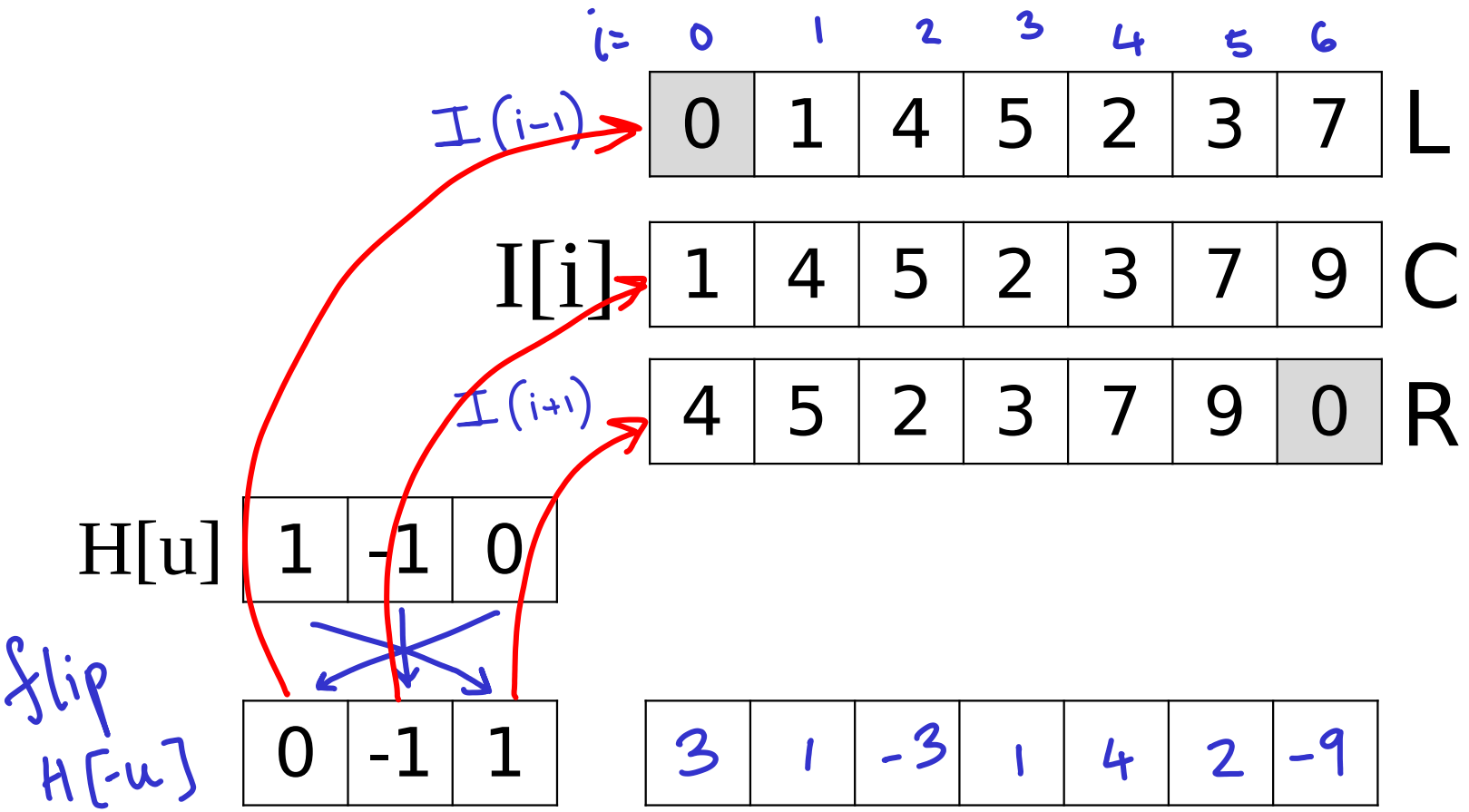

L
C
R
X 1 2 6 8 12 7 5 2 -2
1 4 6 8 12 7 5 2 -2 -5
4 6 8 12 7 5 2 -2 -5 X
1 -1 0
-1 1 0
>2
-3 -4 -2 -4 5 2 3 4 3
3 4 2 4 -5 -2 -3 -4 -3
L-C : Down
flip : Up

Math: Cross-Correlation

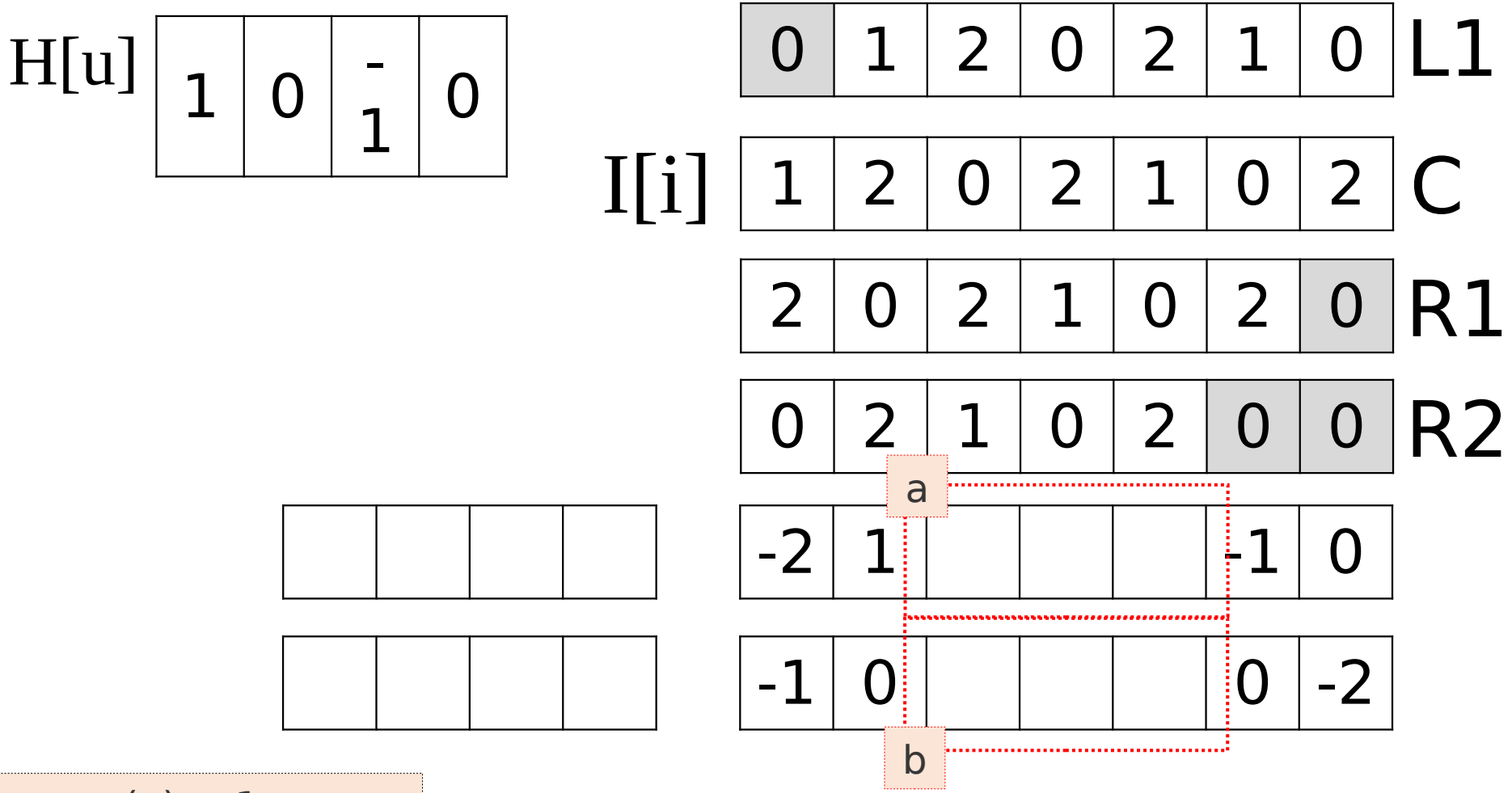


$$\sum_{u=-1}^{1} H(u)I(i+u)$$

Math: Convolution



Cross Correlation vs. Convolution



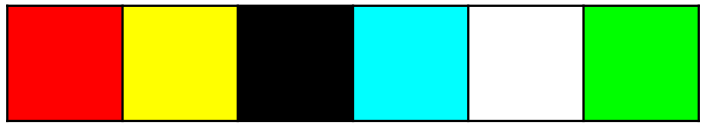
sum(a) = 1;
sum(b) = 0

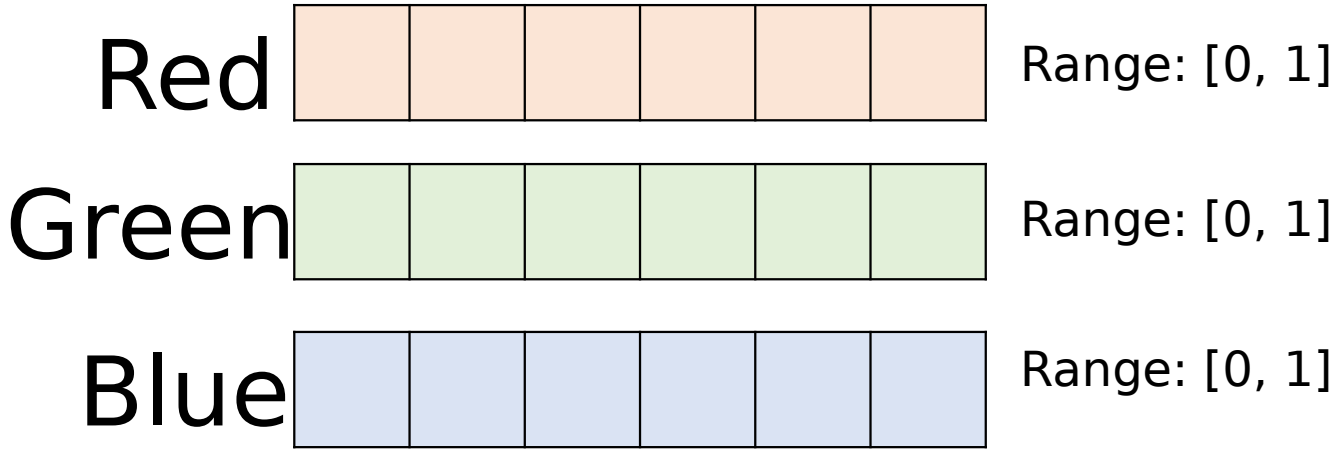
Properties

$$H \otimes F = F \otimes H \qquad H * F = F * H$$

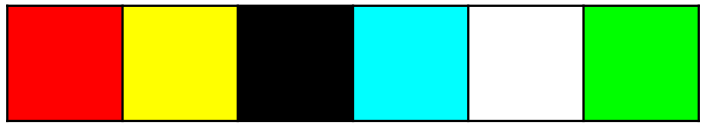
Multiple Channels

Color: floating value representation



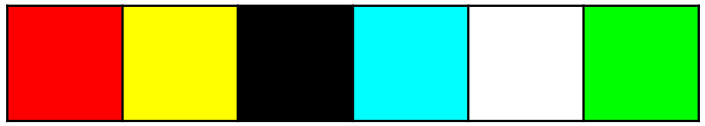


RGB → Grayscale



Red	1	1	0	0	1	0	Range: [0, 1]
Green	0	1	0	1	1	1	Range: [0, 1]
Blue	0	0	0	1	1	0	Range: [0, 1]

RGB: Float Integer



Red	1	1	0	0	1	0	Range: [0, 1]
Green	0	1	0	1	1	1	
Blue	0	0	0	1	1	0	
.*							

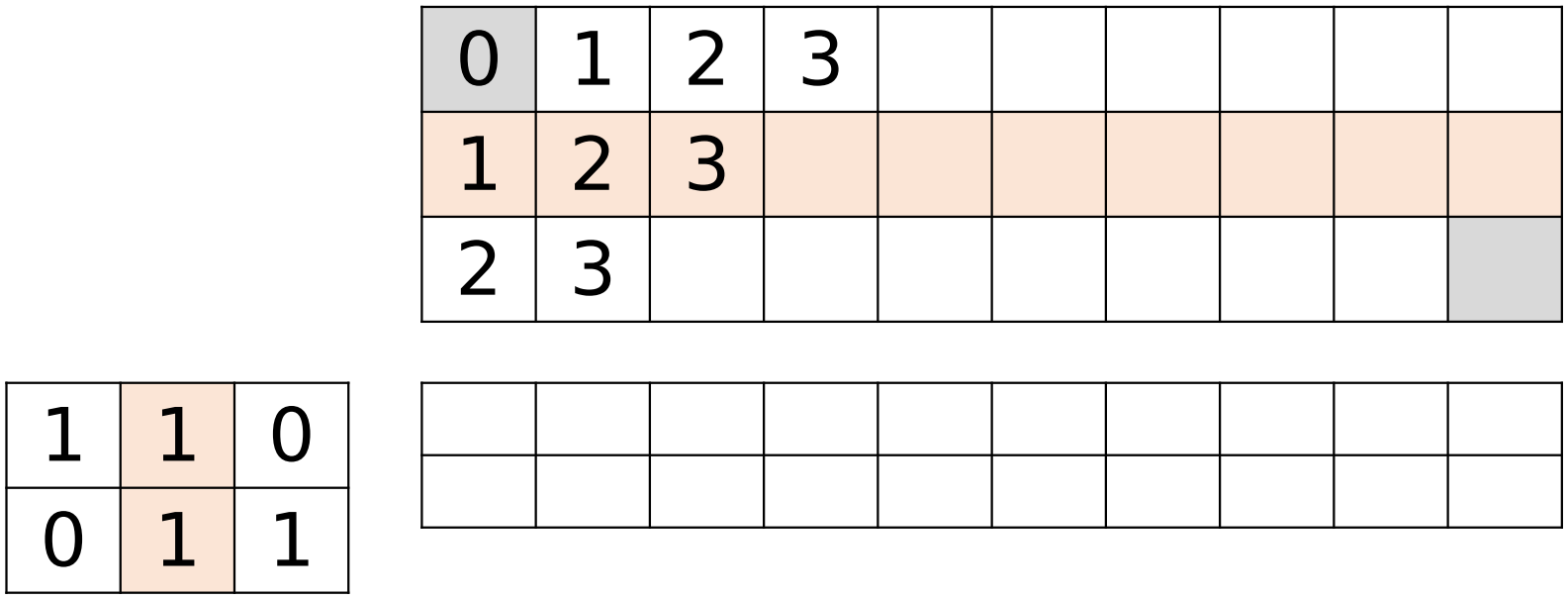
Red							Range: [0, 255]
Green							
Blue							

Scaling 1D Filtering

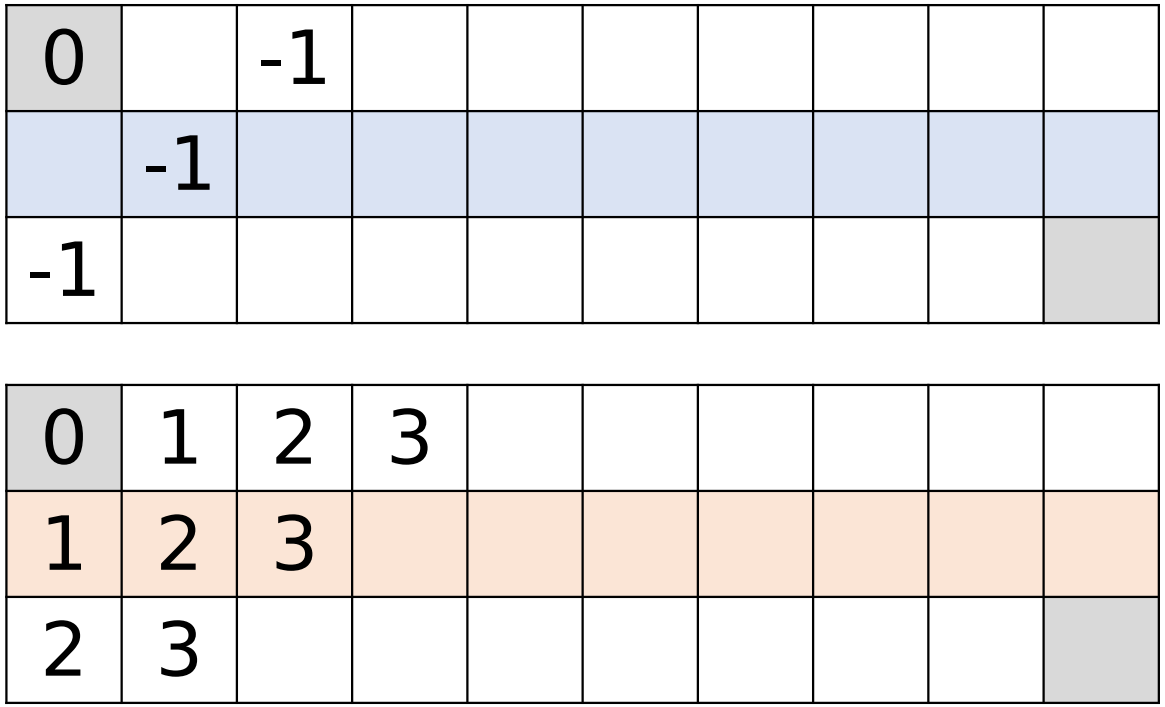
CSCI 5722/4722 Computer Vision

University of Colorado Boulder

Single Channel



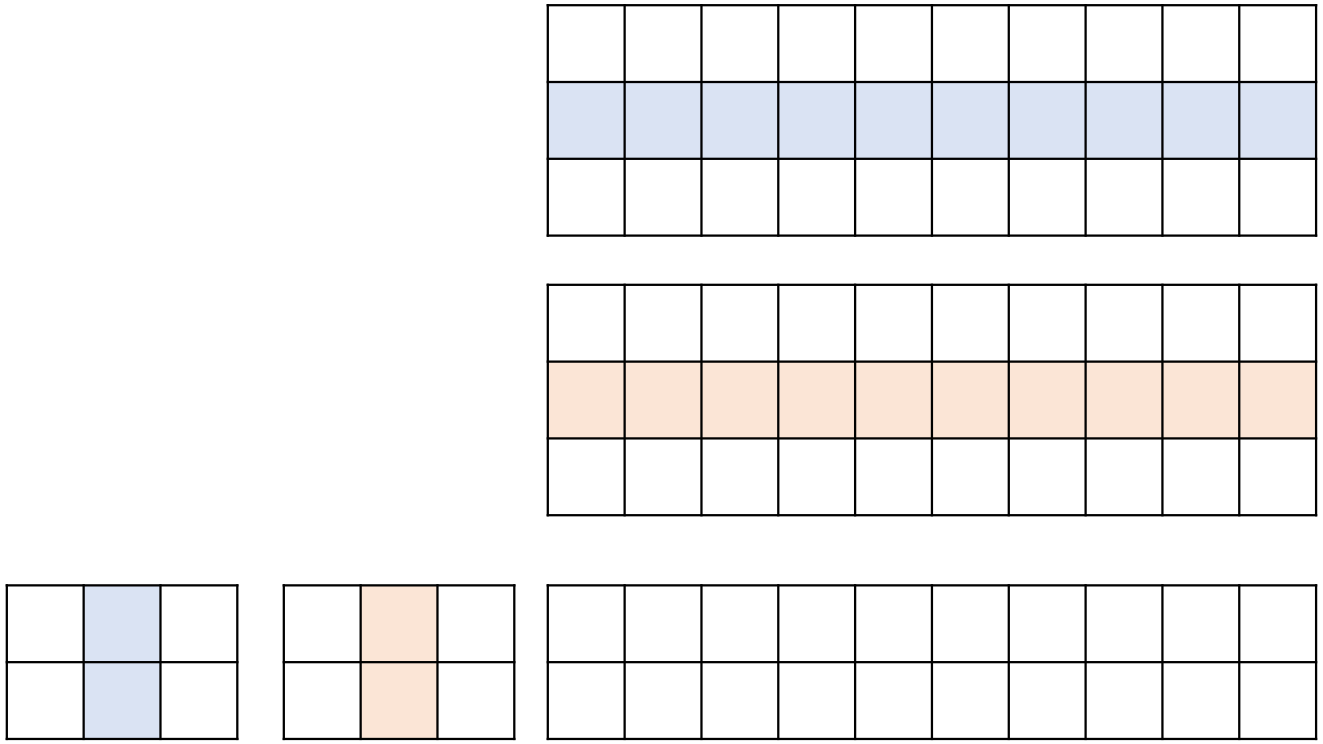
Two Channels



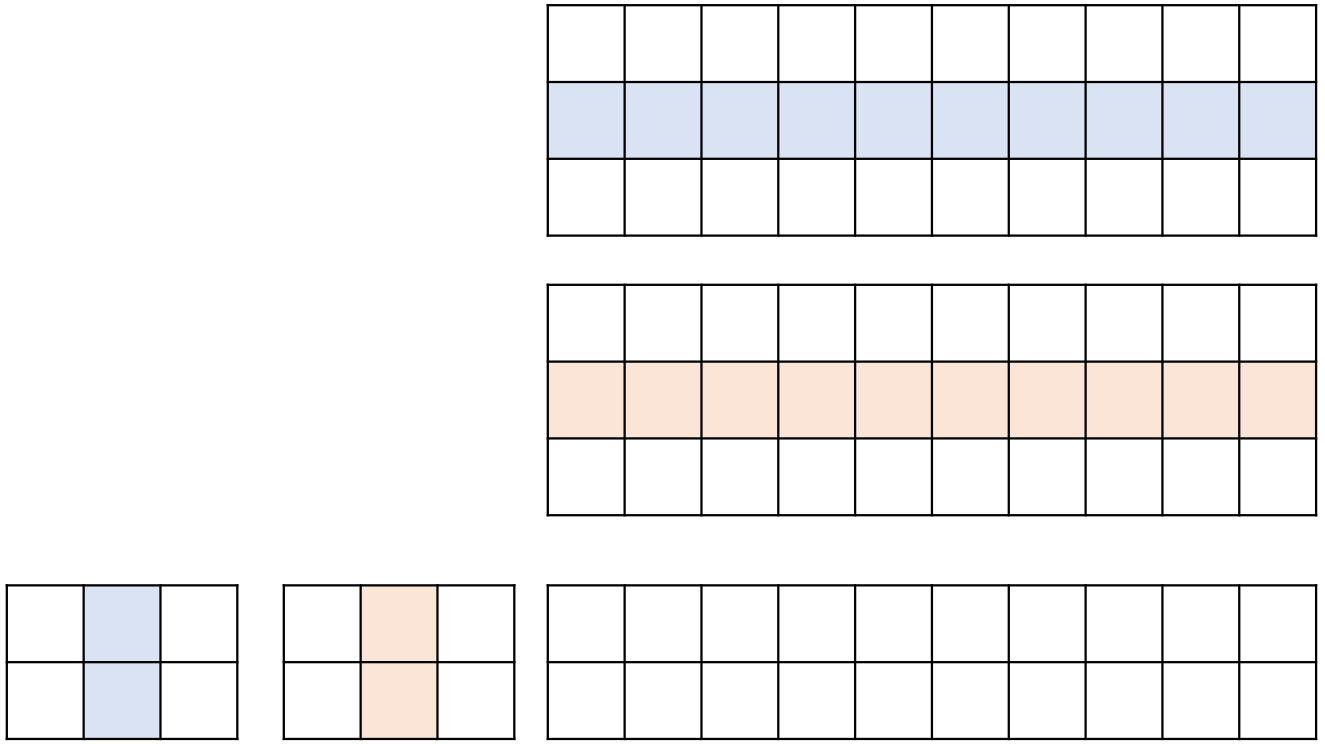
0	0	1
1	0	0

1	1	0
0	0	1

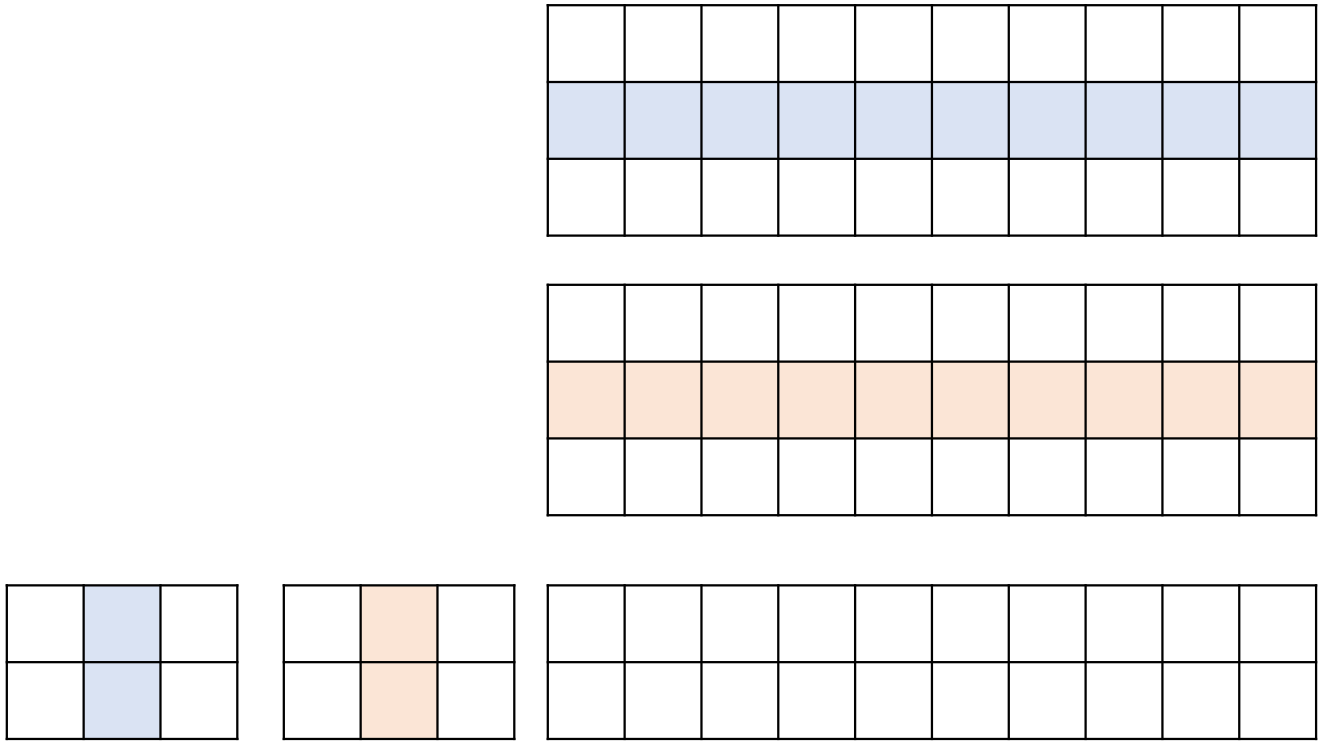
Add One Channel



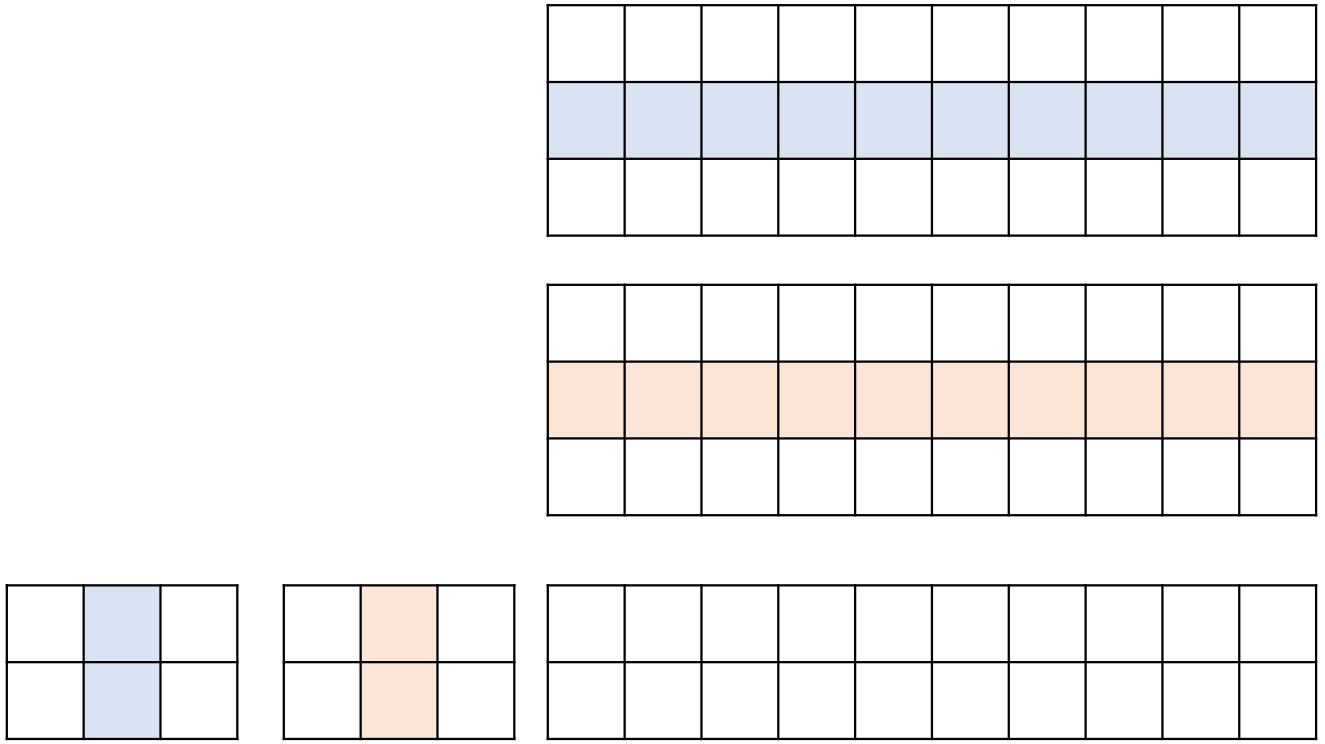
Add One Filter



Add One Neighbor

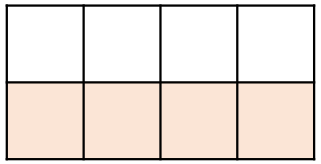


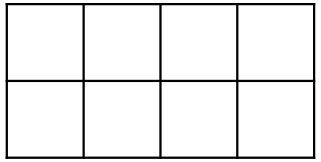
Add One Input



Add 1 Neighbor

Copy, add rows and columns
Show your work

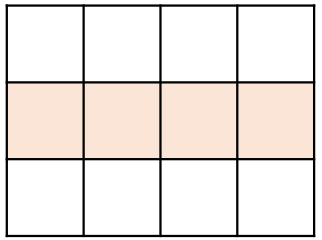


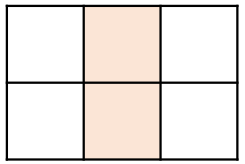


Number of new cells added = _____

Add 1 Channel

Copy, add rows and columns
Show your work





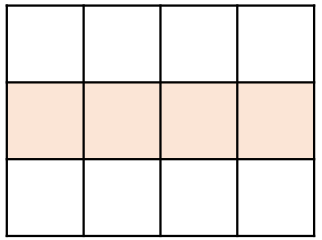
a

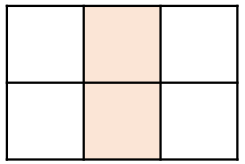
Number of new cells added = _____

a % 4
= 2

Add 1 Neighbor + 1 Filter

Copy, add rows and columns
Show your work





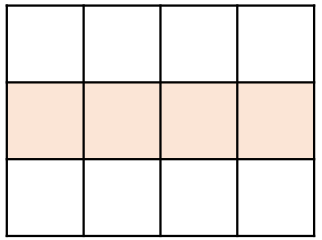
a

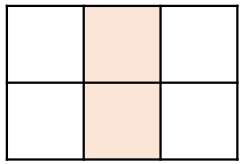
Number of new cells added = _____

a % 6 = 2

Add 2 inputs

Copy, add rows and columns
Show your work





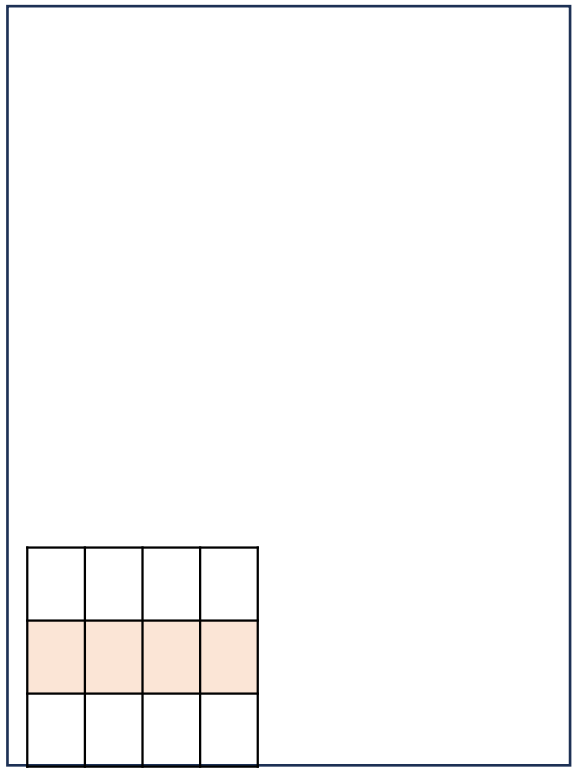
a

Number of new cells added = _____

a % 3
= 1

Scale to 2 channels, 3 filters

Copy, add rows and columns
Show your work



shape(K) = (_____, _____)

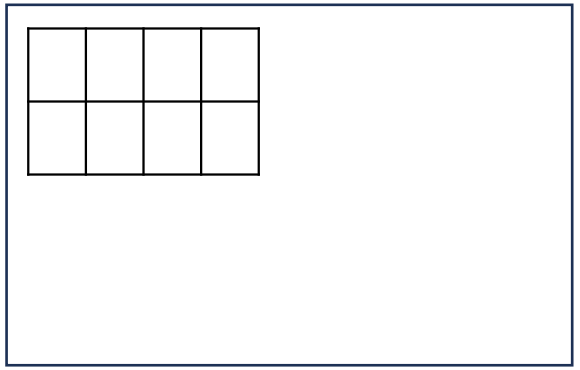
shape(X) = (_____, _____)

shape(Z) = (_____, _____)

a

b

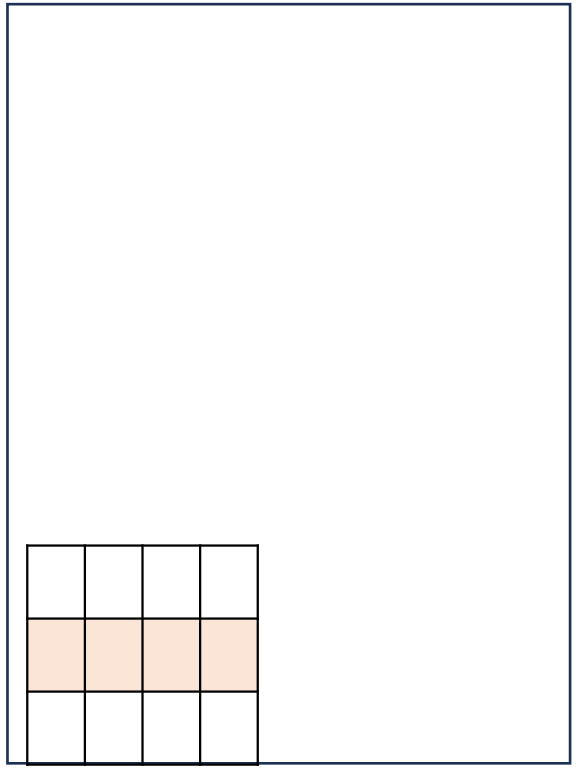
K



sum(a)=12;
sum(b)=14

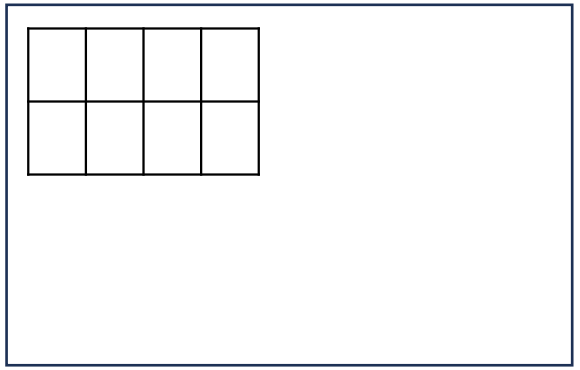
Scale to 4 channels, 5 filters, 6 inputs

Copy, add rows and columns
Show your work



X

K



Z

b

a

shape(K) = (_____, _____)

shape(X) = (_____, _____)

shape(Z) = (_____, _____)

sum(a)=22;
sum(b)=24