

DEEP LEARNING IN MEDICINE

CONVOLUTIONAL

*NEURAL NETWORKS*

2/13/2025

LAB 4

## BEFORE WE START



# USING HPC

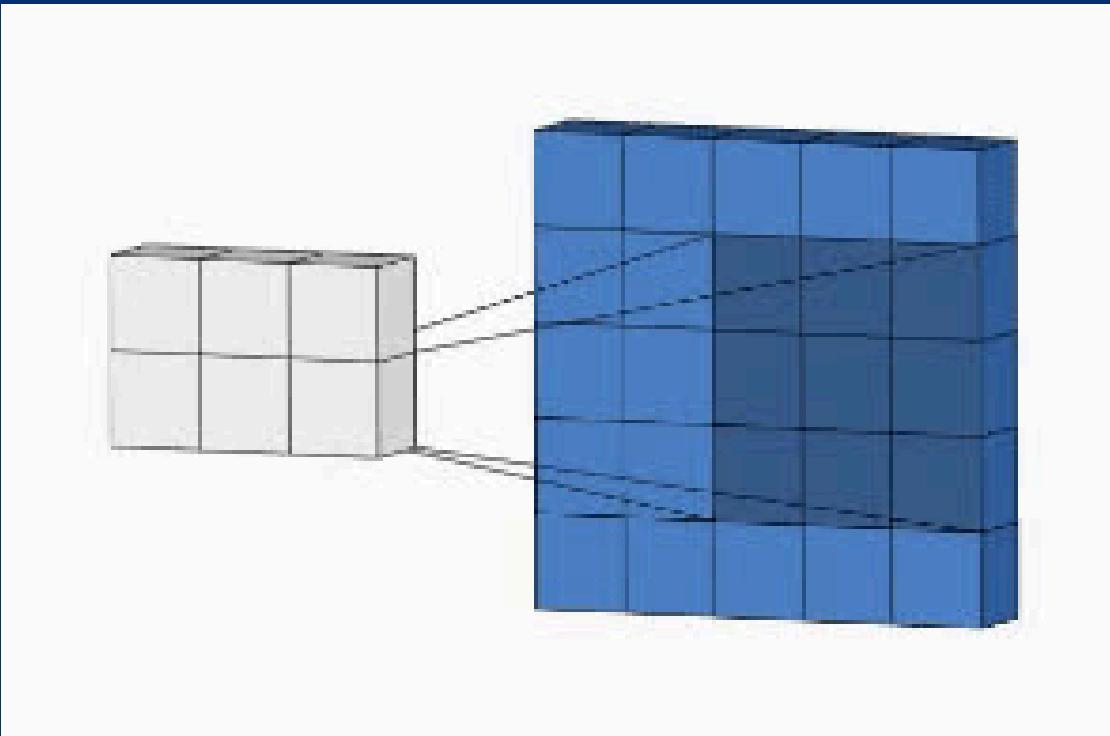
① SSH into Greene

② Start a job for a jupyter notebook



# CONVOLUTION

- Application of a filter that results in a feature value
- The filter moves over the image and produces a feature map
- The size of the feature map is dependent on the size of the input, filter size, padding, and stride



# KERNELS

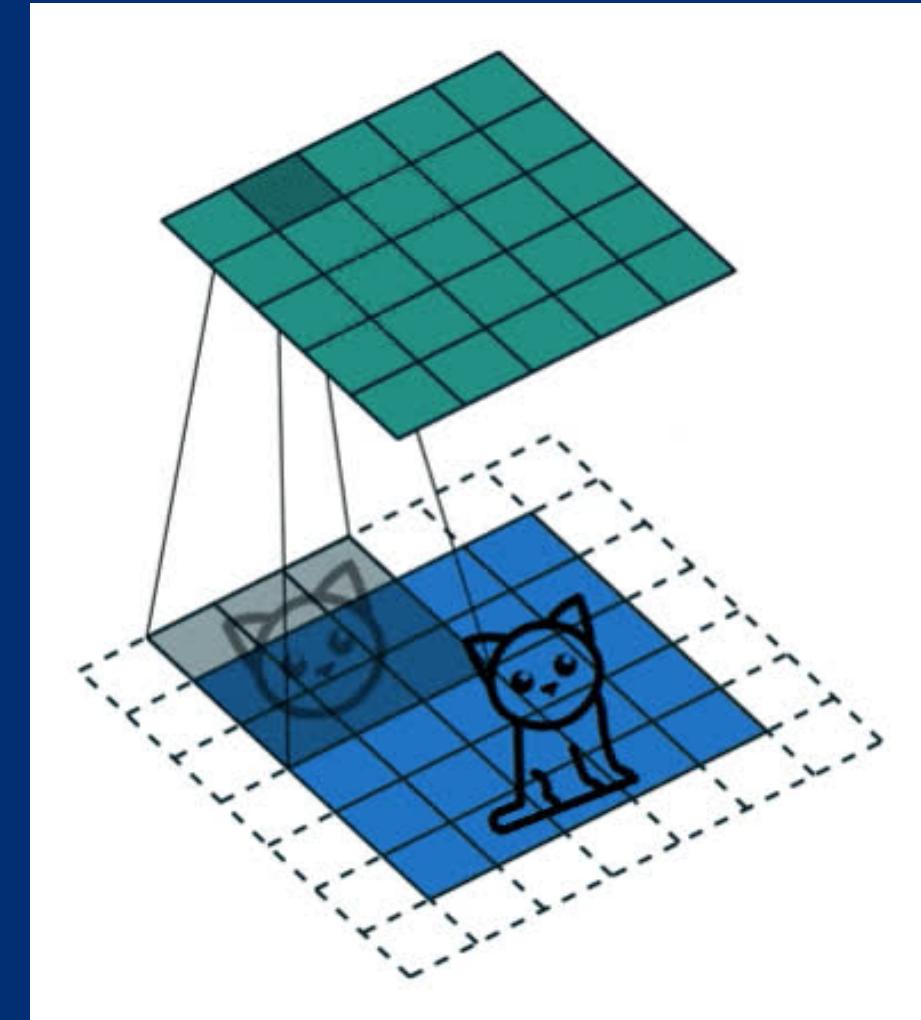
- A set of weights that are used during convolution to determine the feature value
- Learned during the training of a CNN
- If the kernel is  $3 \times 3$  then the filter is # input channels  $\times 3 \times 3$

①

Reuse the same weights

②

Help to identify features



# CALCULATION \*

input

10	6	8	10	9
7	8	5	5	8
9	0	6	1	4
7	7	8	0	1
8	9	1	3	2

kernel

0	2	1
1	3	0
1	2	0

output

60	61	57
51	56	35
60	55	21

# CALCULATION \*

input

10	6	8	10	9
7	8	5	5	8
9	0	6	1	4
7	7	8	0	1
8	9	1	3	2

kernel

0	2	1
1	3	0
1	2	0

output

60	61	57
51	56	35
60	55	21

# CALCULATION \*

input

2	3	3	2	0
3	2	2	2	1
0	2	0	1	0
3	3	0	1	3
3	3	0	2	3

kernel

0	2	1
1	3	0
1	2	0

output


# CALCULATION \*

input

2	3	3	2	0
3	2	2	2	1
0	2	0	1	0
3	3	0	1	3
3	3	0	2	3

kernel

0	2	1
1	3	0
1	2	0

output

22	18	14
21	11	10
25	7	9

# EDGE DETECTION

input

2	2	2	6	2
2	2	2	6	2
2	2	2	6	2
2	2	2	6	2
2	2	2	6	2

kernel

1	0	-1
1	0	-1
1	0	-1

output

0	-12	0
0	-12	0
0	-12	0



# MAXPOOLING

input

2	2	2	7	6
2	3	2	6	5
2	2	5	6	8
2	4	2	0	6
9	2	2	6	3

output

5	6	8
5	6	8
9	6	8



# SUMPOOLING

input

1	2	1	2	1
2	3	2	3	3
1	3	2	1	3
3	2	3	2	3
1	1	1	1	1

output

17	19	18
21	17	22
17	16	17



# AVG POOLING

input

2	2	2	6	4
2	2	2	4	1
2	2	2	5	1
0	3	3	4	5
6	0	0	8	8

output

2	3	3
2	3	3
2	3	4

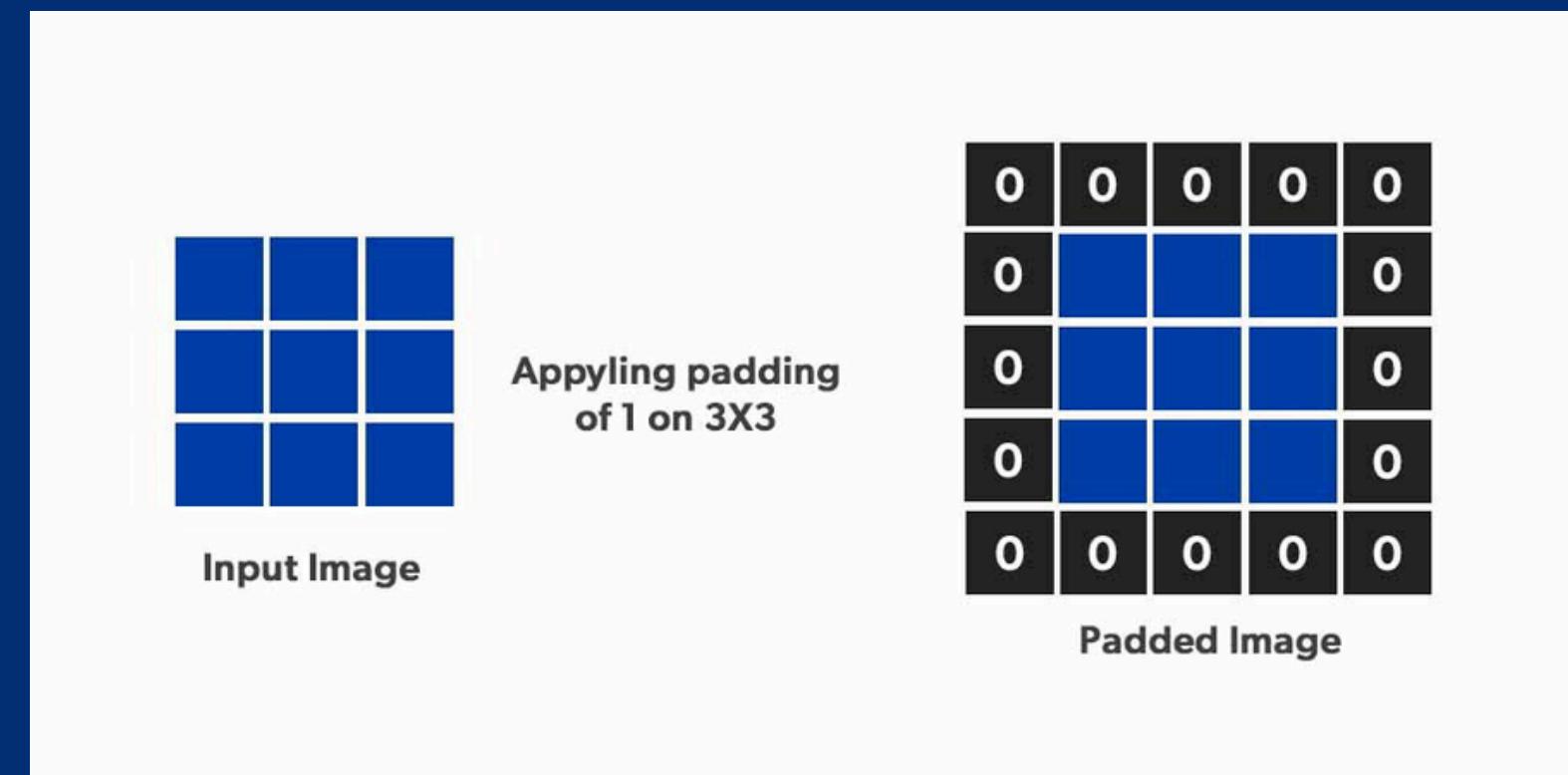


# PADDING

- Adding a buffer around your input
- Alters the output size

① Maintain dimensions

② Use edge information



# STRIDE

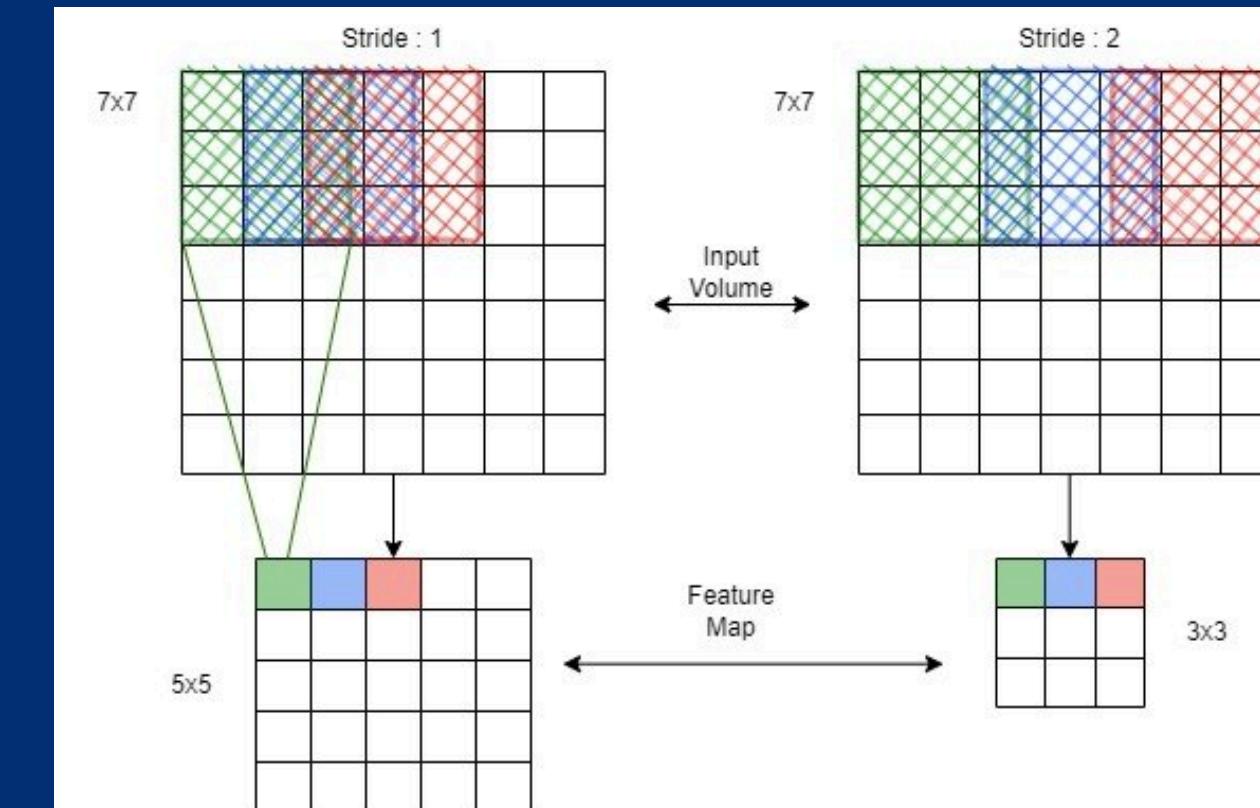
- Determining how to move and apply your filters
- Alters the output size

①

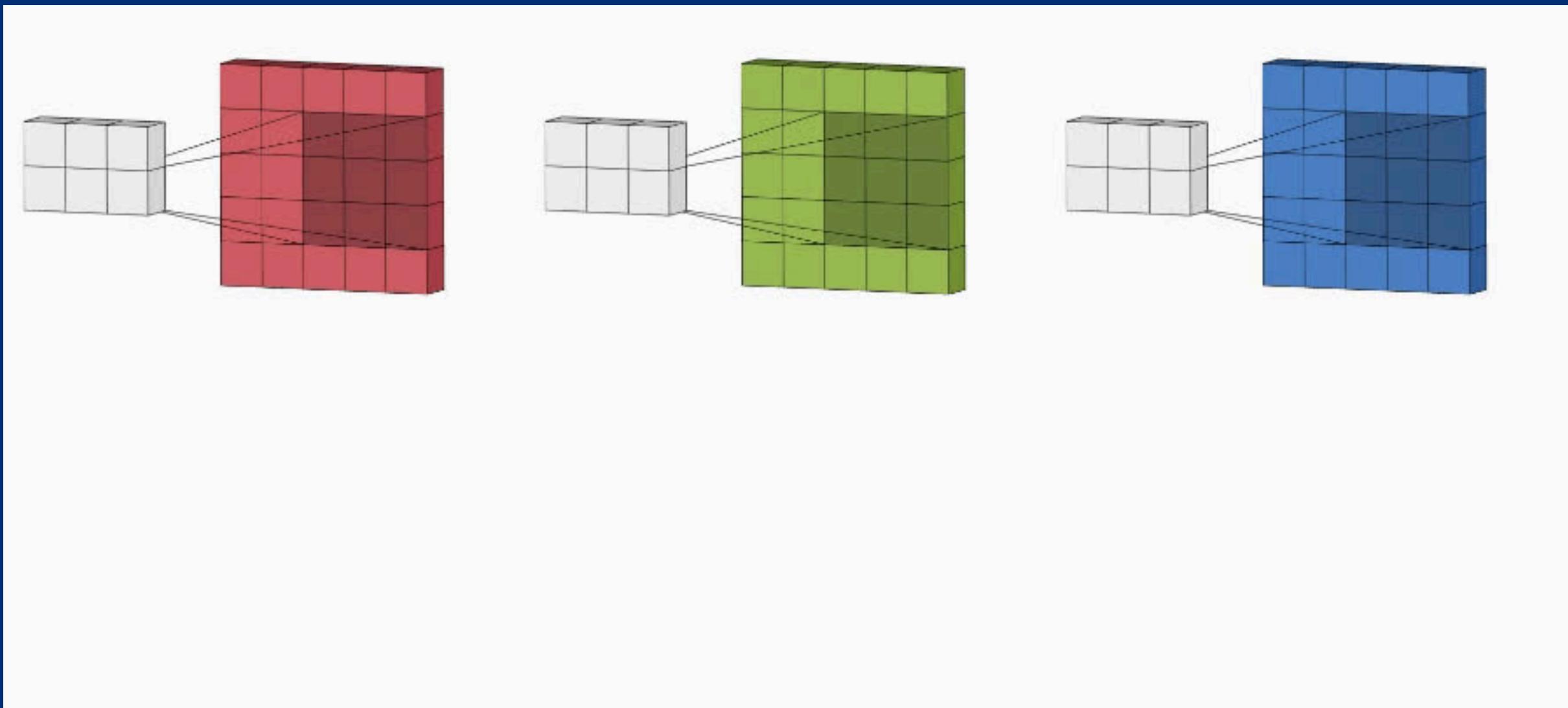
Reduce dimensions

②

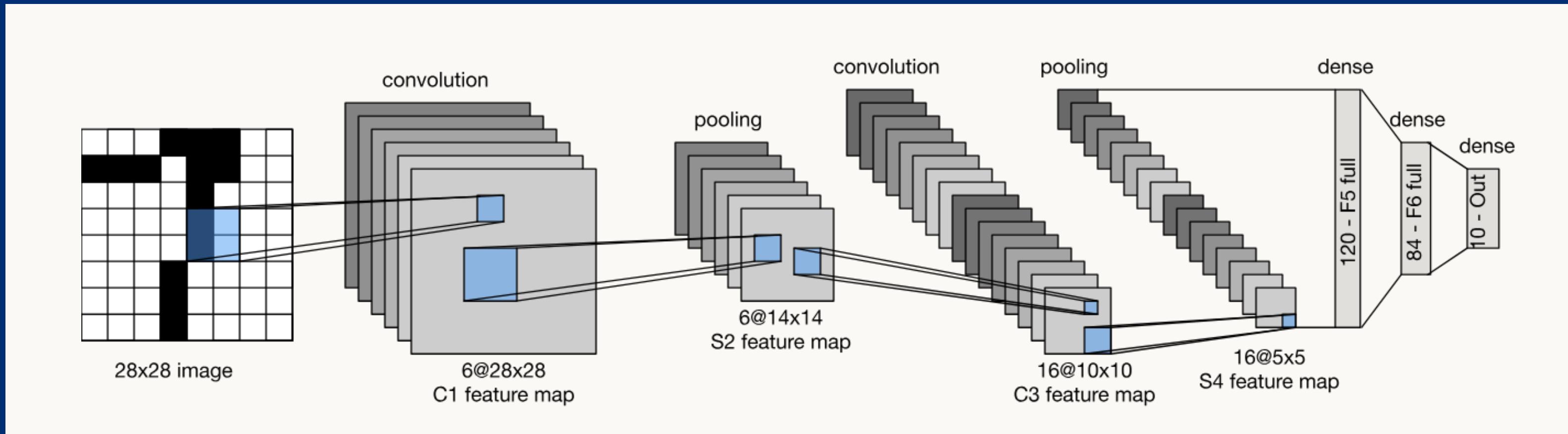
Control overlap



# 3 INPUT CHANNELS



# LENET



Originally used for written number identification

O  
AND A

AND A

# NOTEBOOK

*TIME*

