



CS60010: Deep Learning

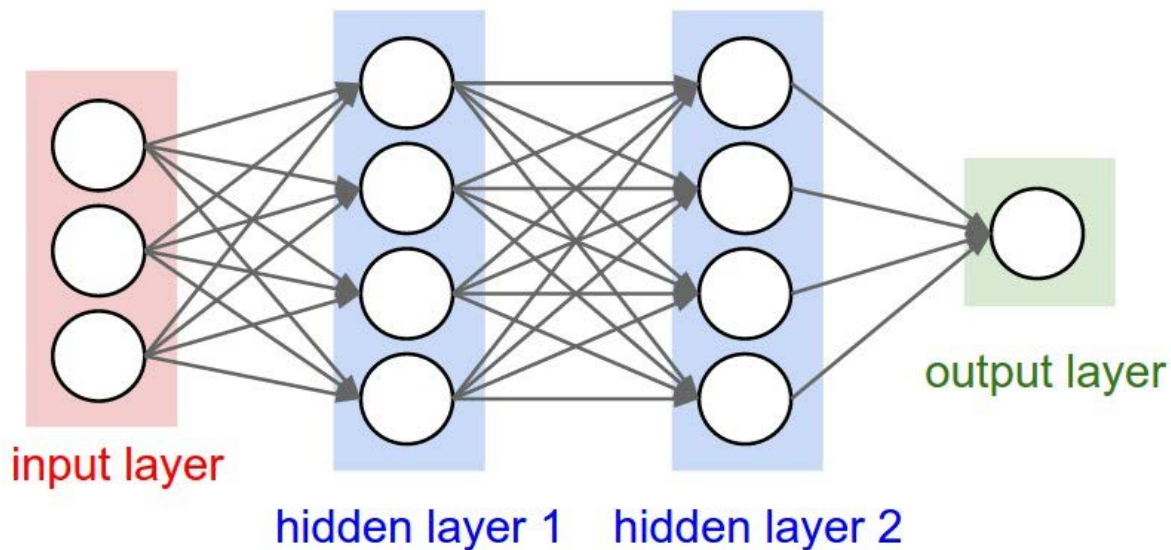
Spring 2023

Sudeshna Sarkar

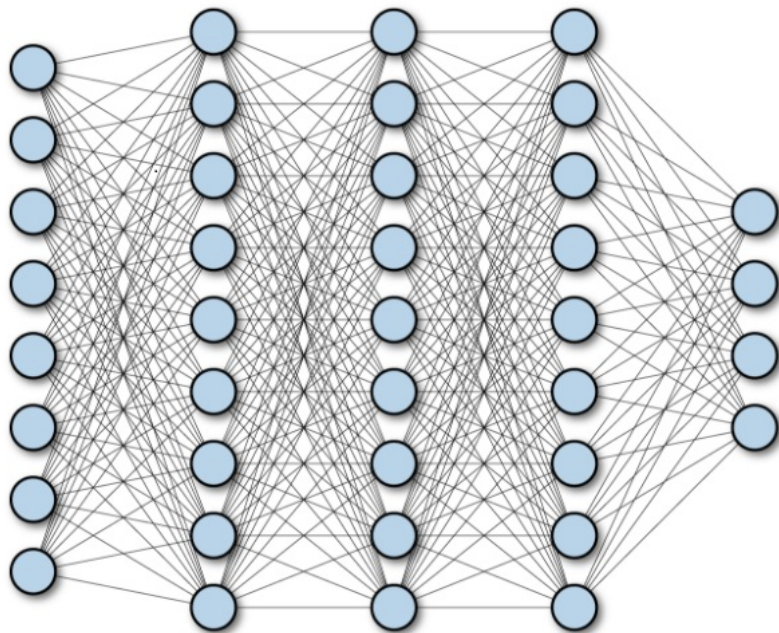
CNN part 1

3 Feb 2023

Neural Networks for Visual Data



Fully Connected MLPs

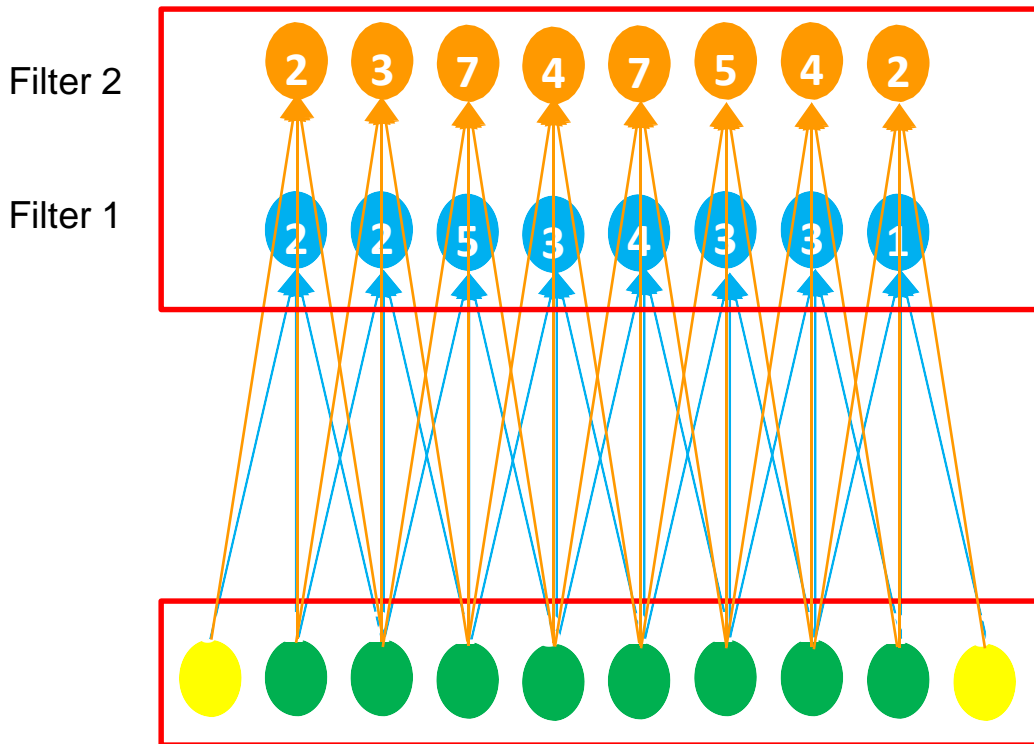


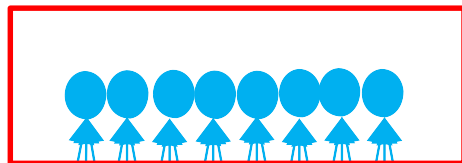
- Number of parameters required could be very high

The need for shift invariance

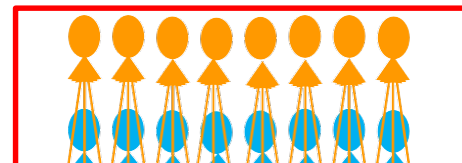
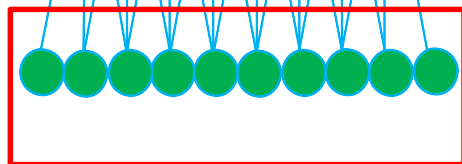


1-D CNN

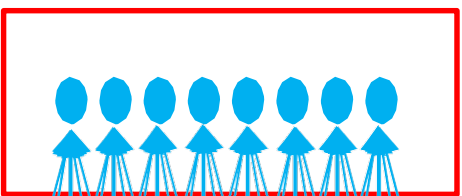
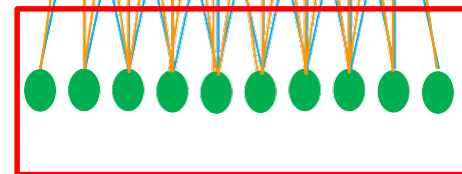




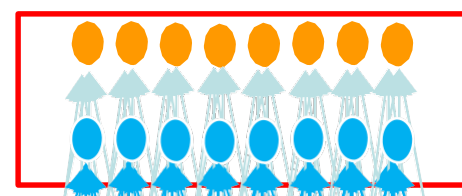
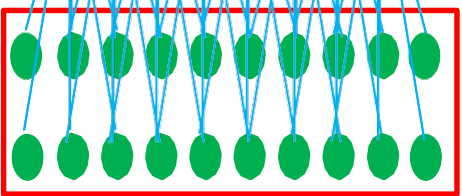
- Channels:
- I/P = 1
 - O/P = 1
 - #Parameters = 3



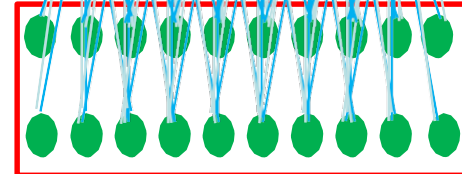
- Channels:
- I/P = 1
 - O/P = 2
 - #Parameters = 6

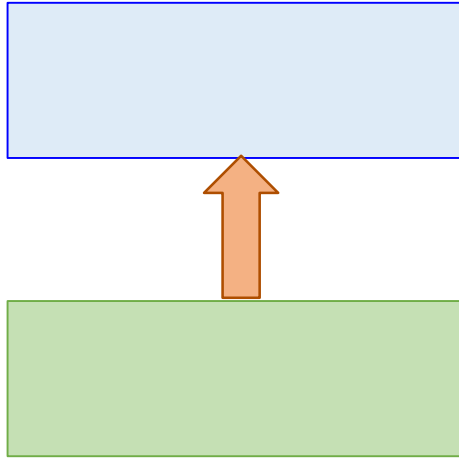


- Channels:
- I/P = 2
 - O/P = 1
 - #Parameters = 6



- Channels:
- I/P = 2
 - O/P = 2
 - #Parameters = 12





Channels:

- $I/P = m$
- $O/P = n$
- Filter size: k
- $\#Parameters = m * n * k$

- # Input Channels
- # Output channels
- Feature Maps/Channels
- Filters/Weights
- Filter Size/Window Size
- Stride
- Padding

Convolution



These are the network parameters to be learned.

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

-1	1	-1
-1	1	-1
-1	1	-1

Filter 2

Each filter detects a small pattern (3 x 3).

Convolution



stride=1

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

Dot product



3

-1

1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

Convolution



stride=2

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

Dot product



3

-3

1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

Convolution



stride=1

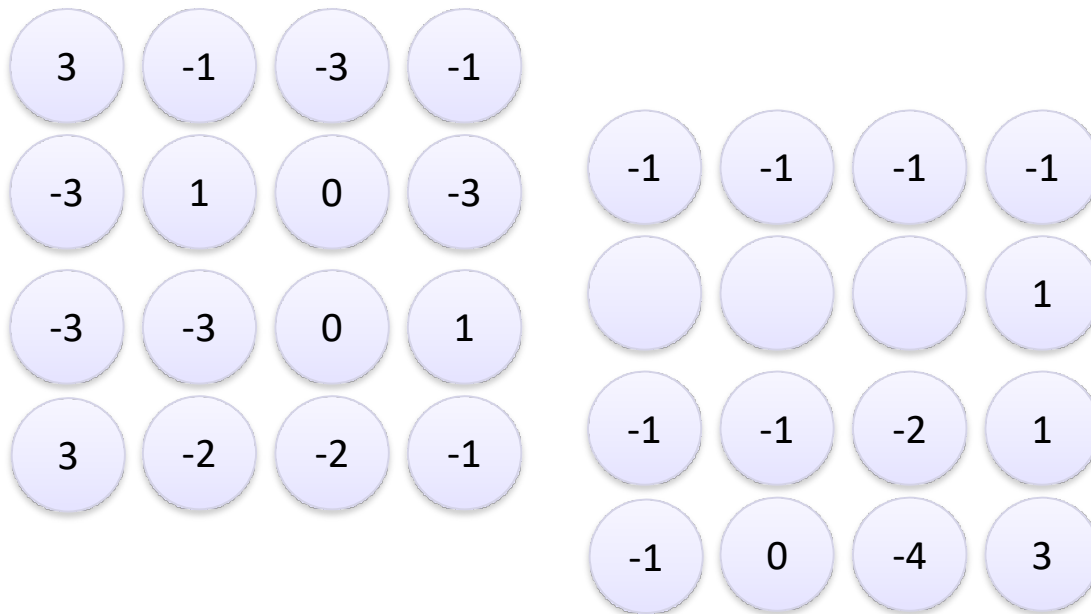
1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

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

Repeat for each filter



Feature Map