Deep Learning

4.2 Pooling

Dr. Konda Reddy Mopuri
kmopuri@iittp.ac.in
Dept. of CSE, IIT Tirupati

Pooling

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2. Reduces the dimensionality of the signal → considers non-overlapping stride

Max Pooling

1. Standard in CNNs

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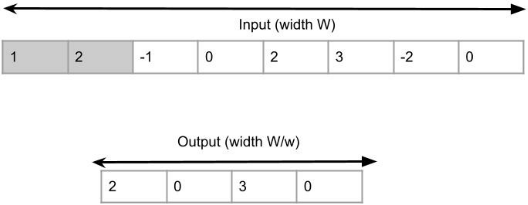
2. Computes maximum value over a non-overlapping blocks in the input



Input (width W)

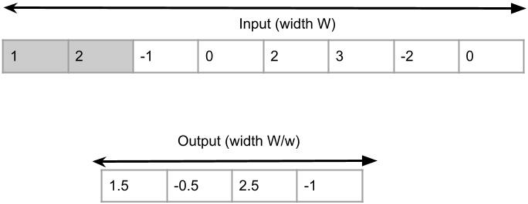
1	2	-1	0	2	3	-2	0

Output (width W/w)

2	0	3	0

Average Pooling

1. Computes the average of the receptive field

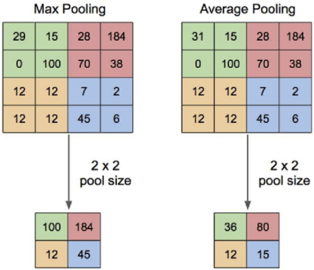


1	2	-1	0	2	3	-2	0

1.5	-0.5	2.5	-1

Pooling in 2D

1. Same as 1D, but the receptive field is 2D and non-overlapping



Max Pooling

29	15	28	184
0	100	70	38
12	12	7	2
12	12	45	6

2 x 2
pool size

100	184
12	45

Average Pooling

31	15	28	184
0	100	70	38
12	12	7	2
12	12	45	6

2 x 2
pool size

36	80
12	15

Figure credits: Preston Hoang and Quora

Pooling in 2D

1. Contrary to Convolution, Pooling applies channel wise

Pooling in 2D

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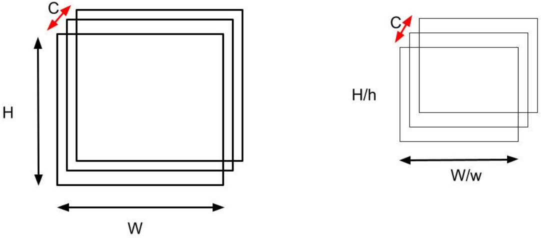
2. No reduction in number of channels, only spatial size reduction



Pooling provides weak invariance

1. Operation is invariant to any permutation within the block

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2. Withstands deformations caused by local translations

Max_Pooling PyTorch

```
F.max_pool2d(input, kernel_size, stride=None, padding=0,
dilation=1, ceil_mode=False, return_indices=False)
```

1. Applies max pooling on each of the channels separately

Max_Pooling PyTorch

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2. `input` is $N \times C \times H \times W$ tensor

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```

1. Applies max pooling on each of the channels separately
2. `input` is $N \times C \times H \times W$ tensor
3. `kernel_size` is (h, w) or k
4. Result would be a tensor of size $N \times C \times \lfloor H/h \rfloor \times \lfloor W/w \rfloor$

Pooling in PyTorch

1. Default stride is the kernel size (for convolution, it is 1)

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2. But, it can be modulated if required
3. Default padding is zero

Pooling Layer in PyTorch

```
class torch.nn.MaxPool2d(kernel_size, stride=None,
padding=0, dilation=1, return_indices=False,
ceil_mode=False)
```