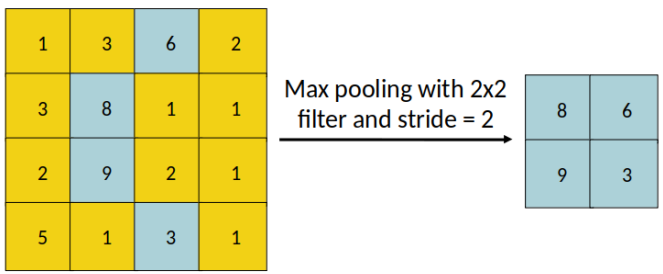
Deep Learning

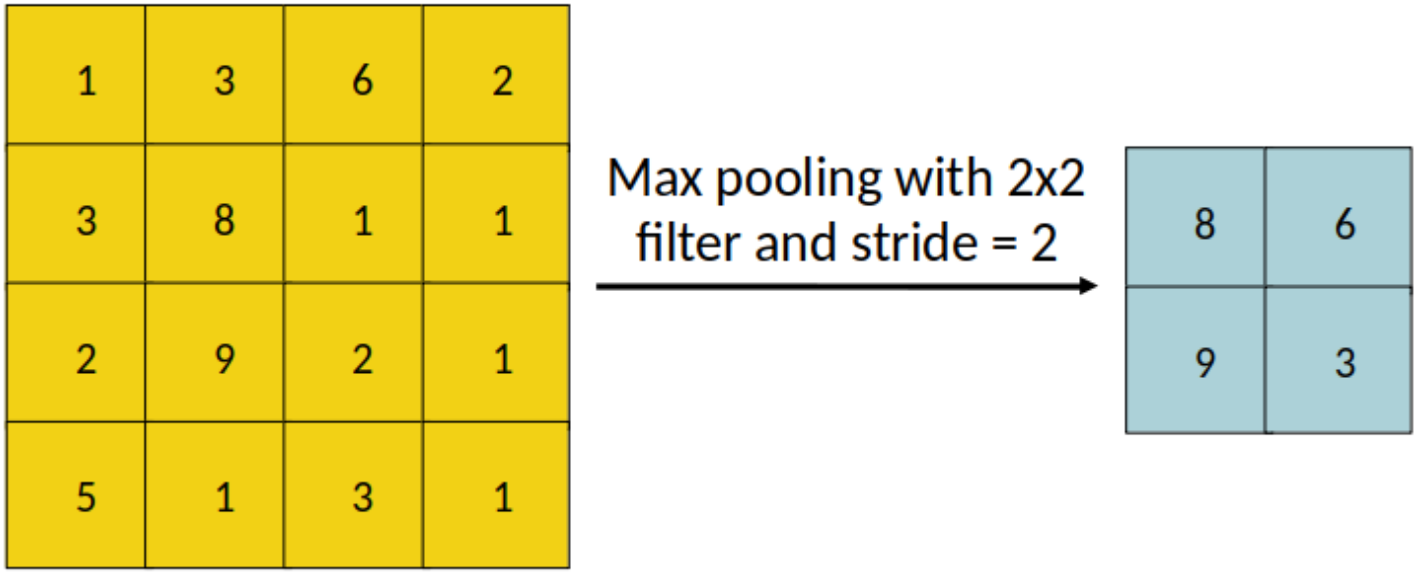
CNN: Pooling



Learning goals

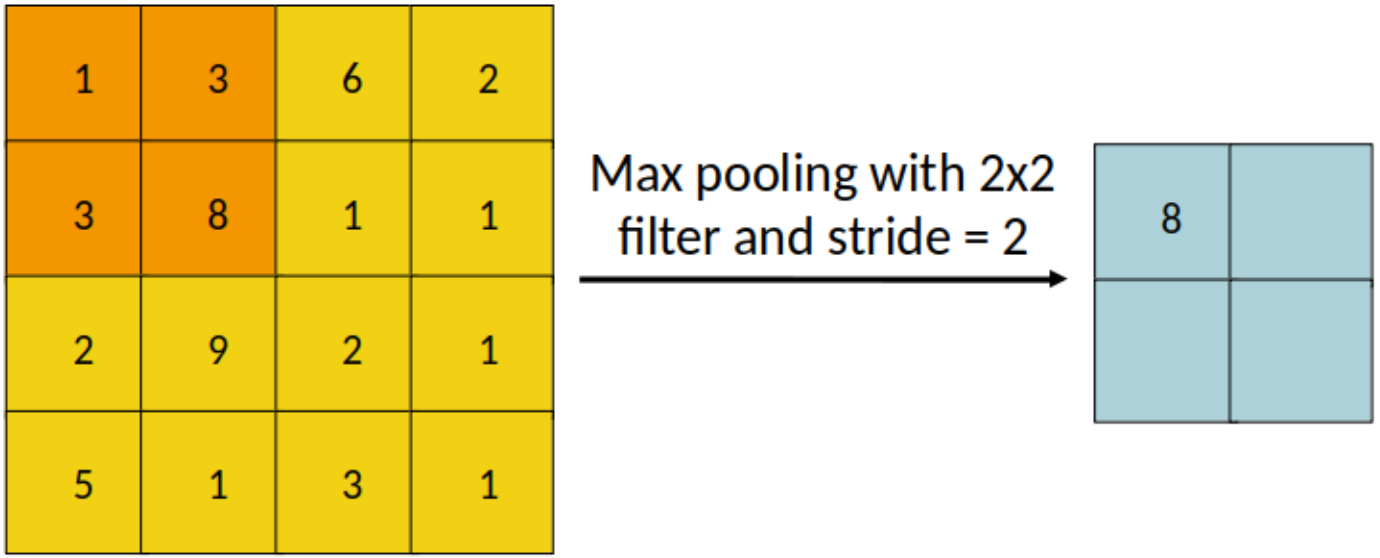
- Max Pooling
- Average Pooling
- Comparison of Max and Average Pooling

MAX POOLING



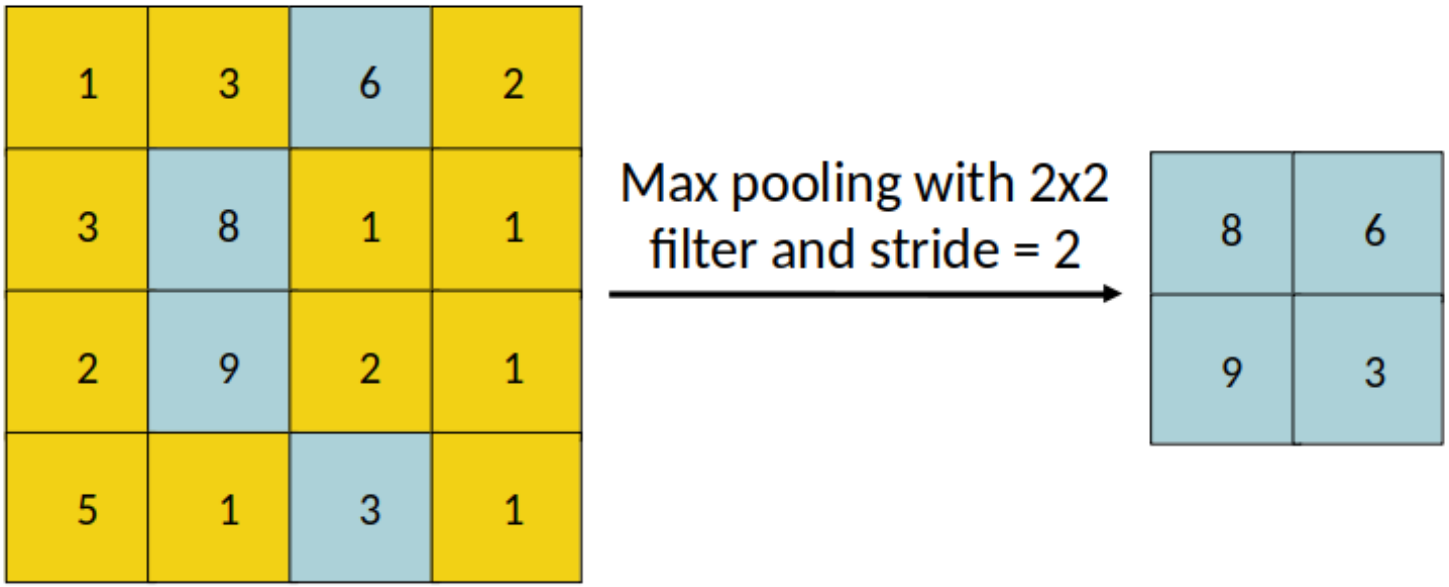
- We've seen how convolutions work, but there is one other operation we need to understand.
- We want to downsample the feature map but in the best case also lose no information.

MAX POOLING



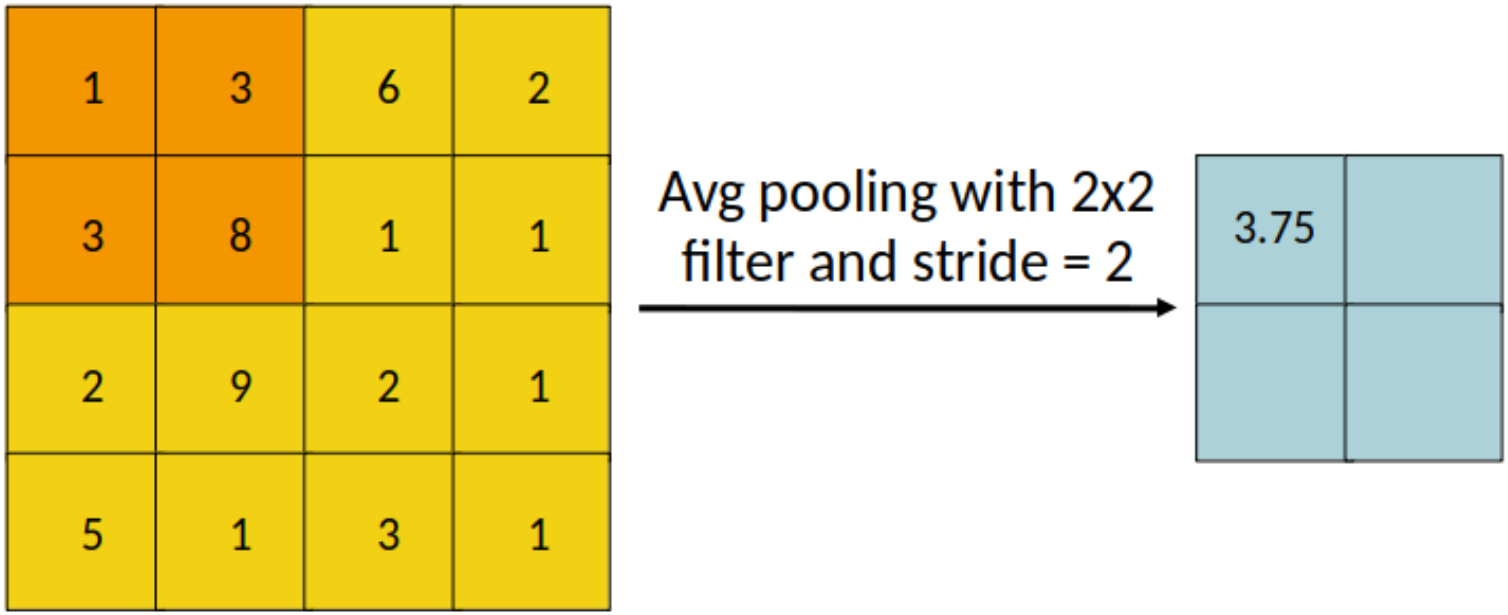
- Applying the max pooling operation, we simply look for the maximum value at each spatial location.
- This is 8 for the first location.
- Due to the filter of size 2 and no padding, we obtain a downsampled result.

MAX POOLING



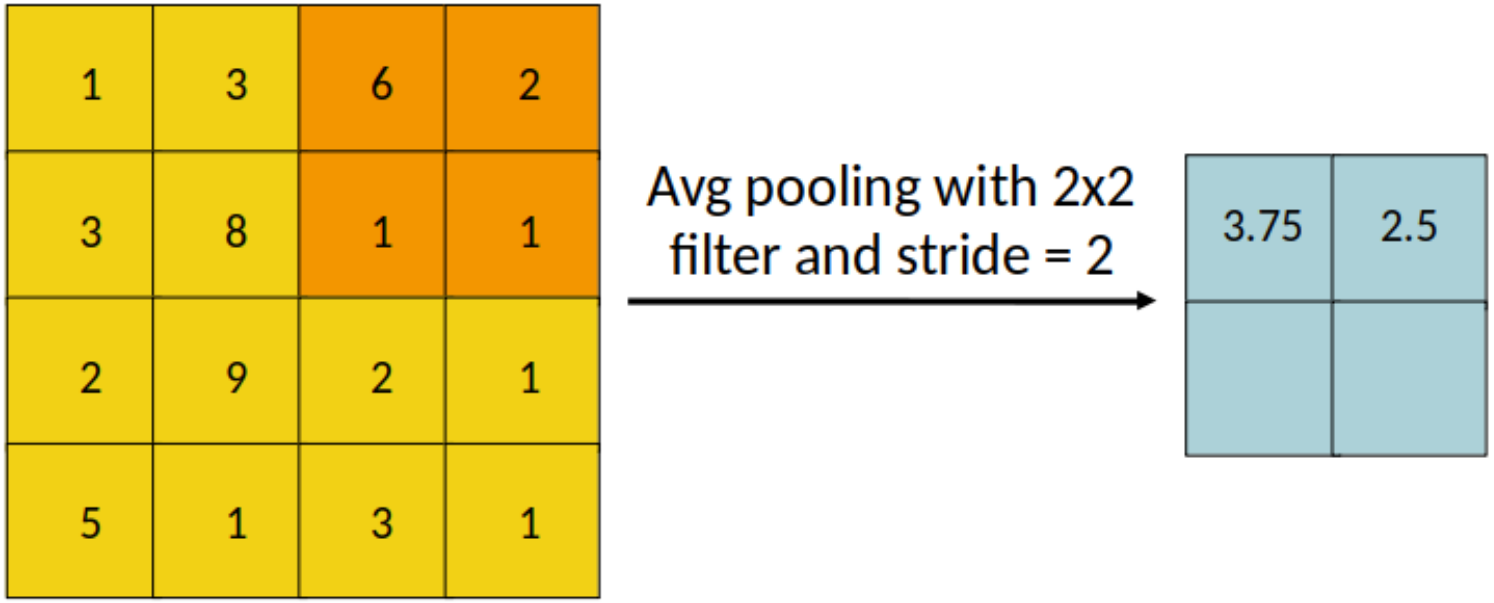
- The final pooled feature map has entries 8, 6, 9 and 3.
- Max pooling brings us 2 properties: 1) dimention reduction and 2) spatial invariance.
- Popular pooling functions: max and (weighted) average.

AVERAGE POOLING



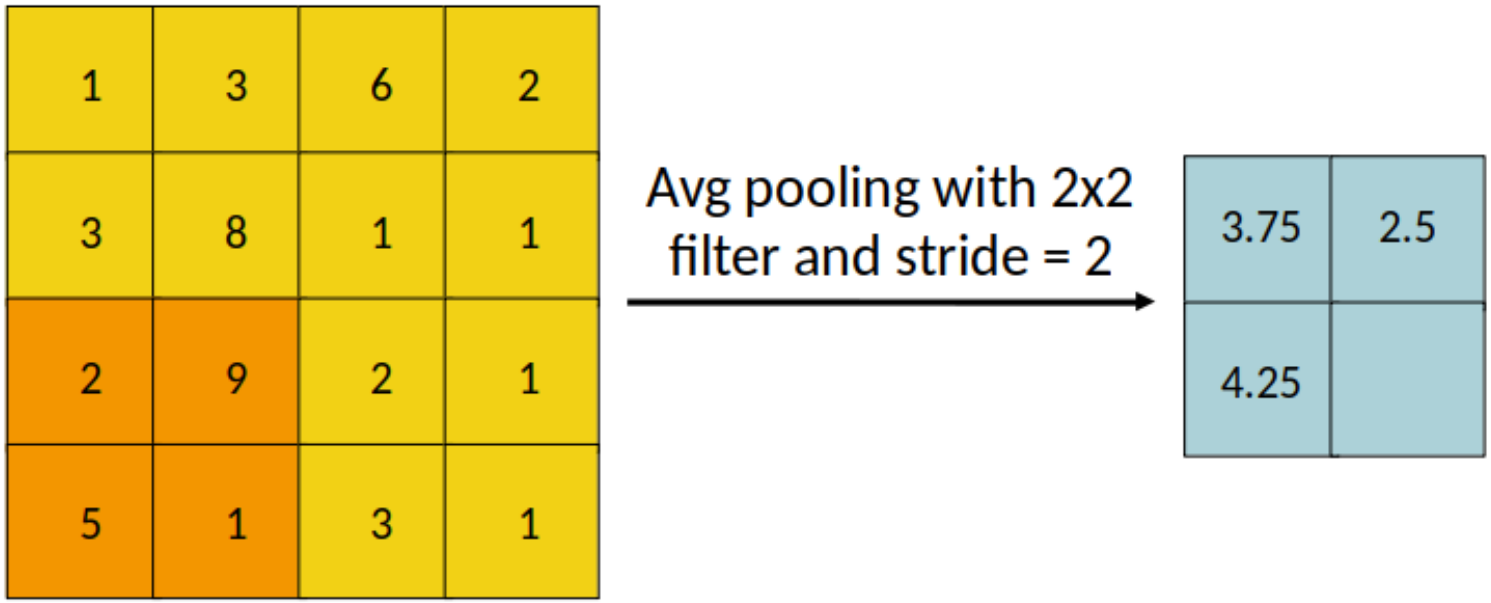
- We've seen how max pooling works. There also exist other pooling operations such as Avg Pooling, Fractional Pooling, LP Pooling, Wavelet Pooling, Softmax Pooling, Stochastic Pooling, Blur Pooling, Orderable Pooling, Global Average Pooling, and etc.
- Similar to max pooling, we downsample the feature map but maybe preserve more information.

AVERAGE POOLING



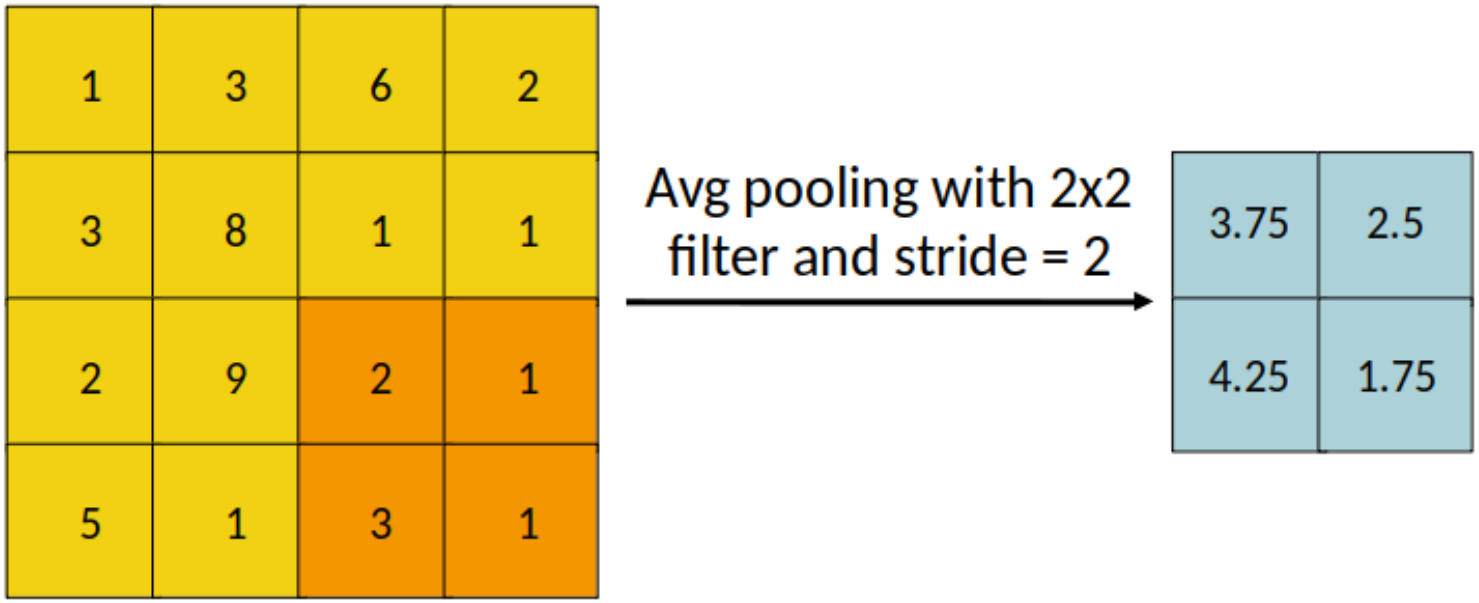
- Applying the average pooling operation, we simply look for the mean/average value at each spatial location.

AVERAGE POOLING



- We use all information by due to the sum and backpropagated to all responses.
- Due to the average, this pooling is not robust to noise.

AVERAGE POOLING



- The final pooled feature map has entries 3.75, 2.5, 4.25 and 1.75.

COMPARISON OF MAX AND AVERAGE POOLING

- Avg pooling uses the information of all inputs while Max pooling uses only the largest value.
- In Max-pooling operation details are removed, therefore it is suitable for sparse information (typically in image classification) and Avg pooling is suitable for dense information (typically in NLP)

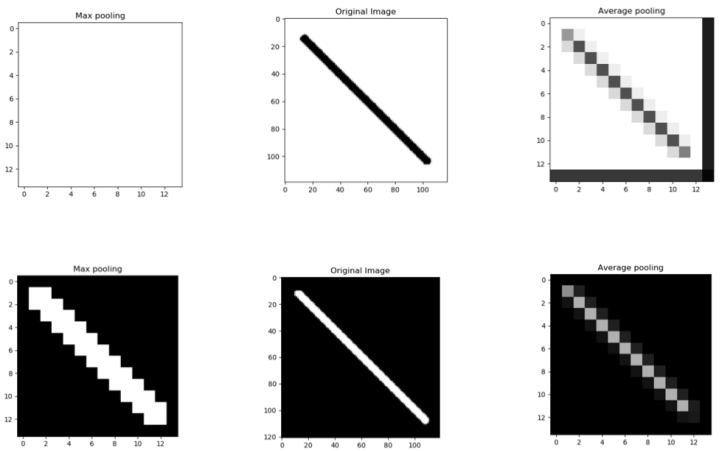


Figure: Shortcomings of Max and Average Pooling using a toy image (photo source: https://iq.opengenus.org/maxpool-vs-avgpool/)