PnS 2018

Deep Learing with Raspberry Pi

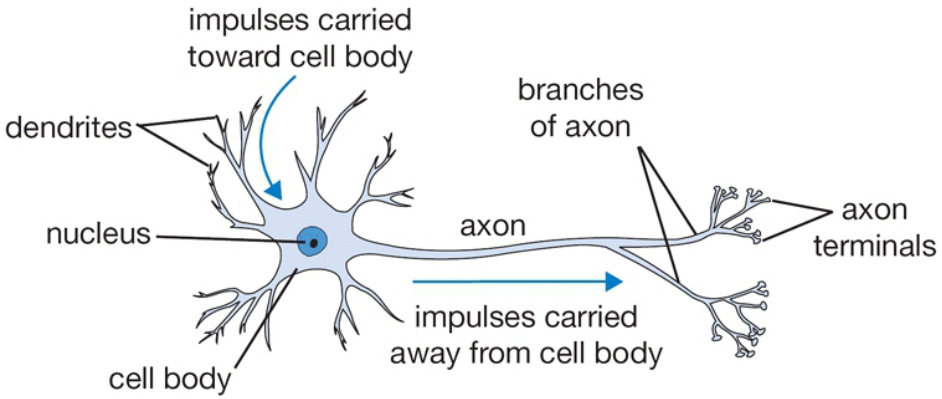
Session 3

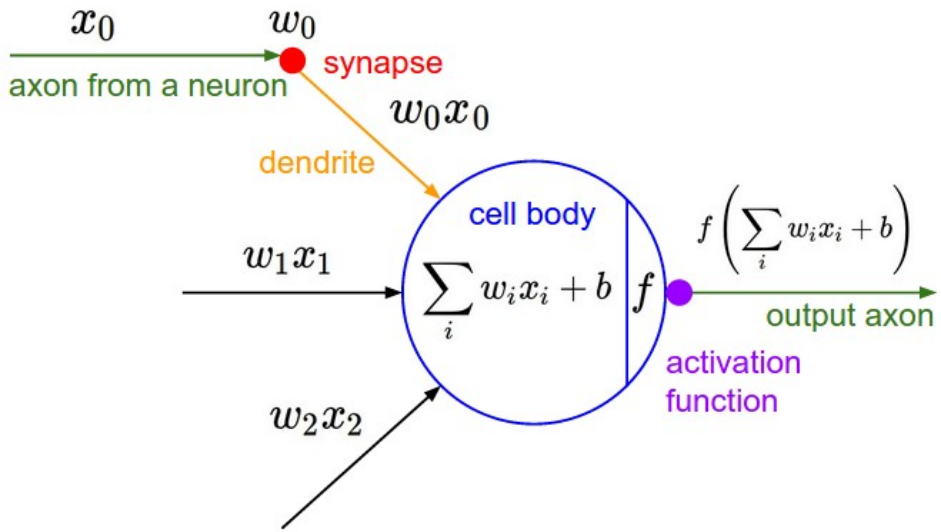
PnS 2018 Team

Institute of Neuroinformatics
University of Zürich and ETH Zürich

Outline

Artifical Neuron: Overview

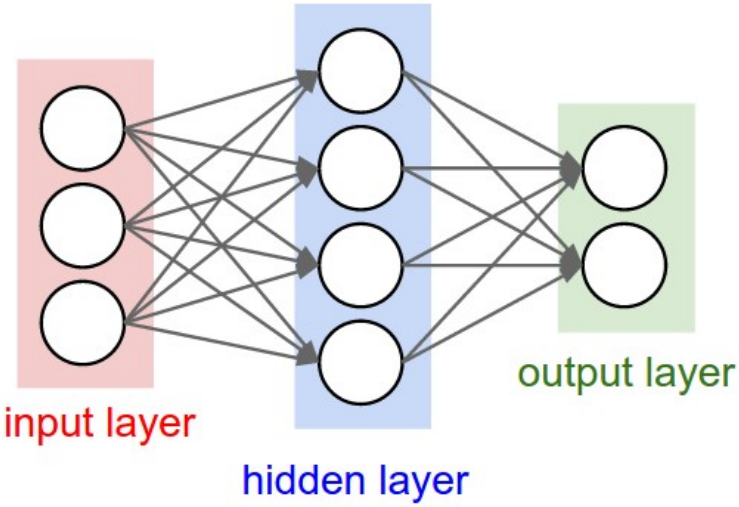


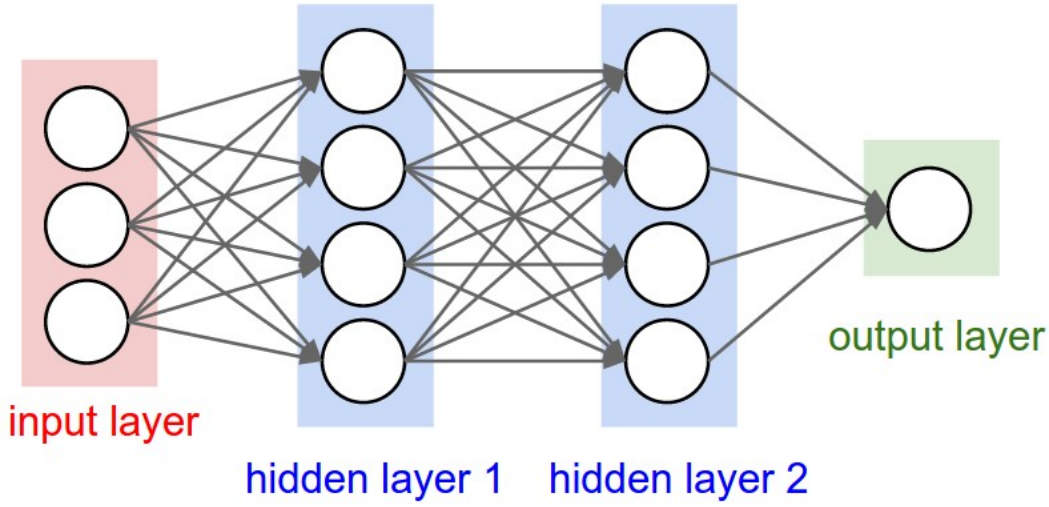


- A basic computational model of the biological model
- Single neuron as linear/logistic regression

http://cs231n.github.io/neural-networks-1/

Multi-Layer Perceptron

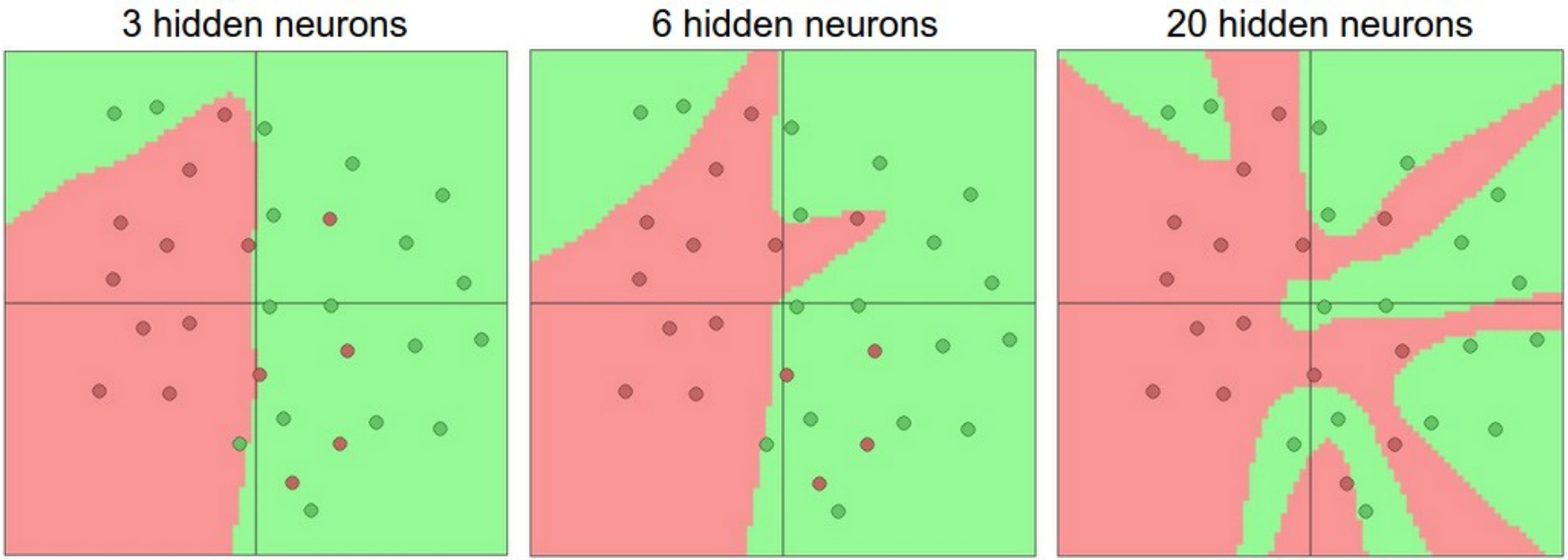




- Neurons in an acyclic feed-forward graph
- Fully connected layers
- Each fully connected layer computation is a matrix multiplication, matrix addition and an activation function

http://cs231n.github.io/neural-networks-1/

What can an MLP learn?



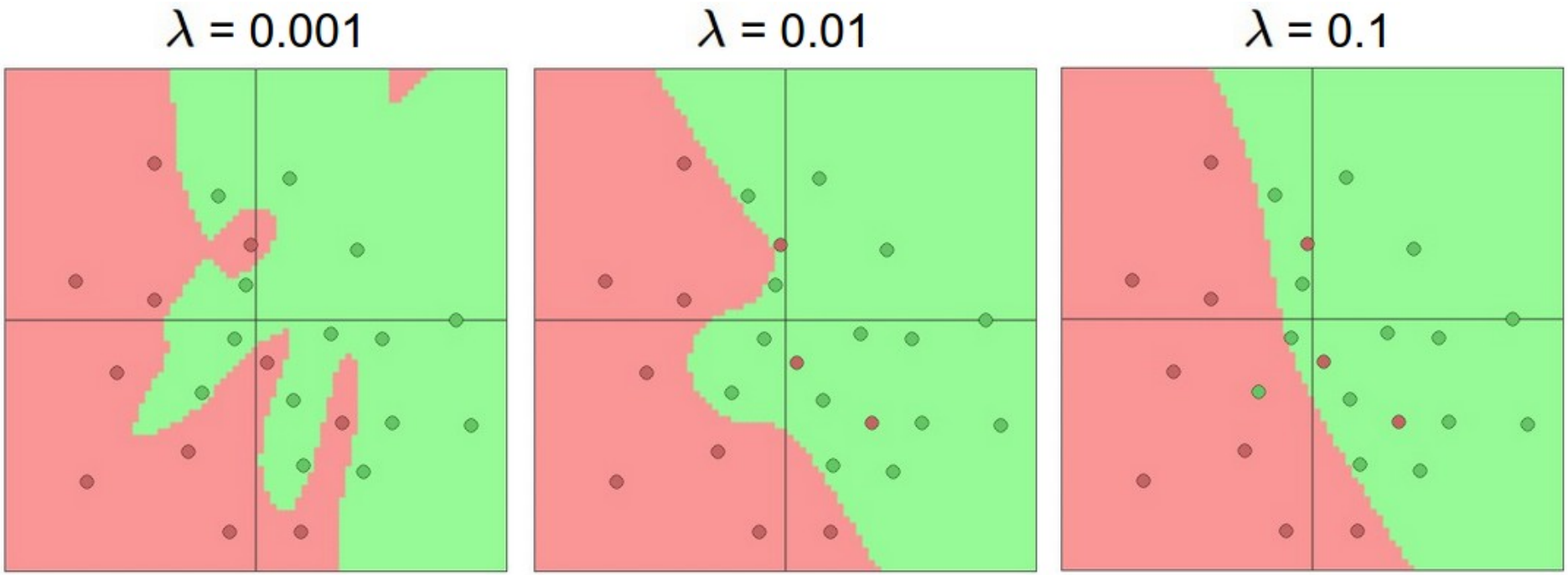
- Neural Networks with at least one hidden layer are universal approximators[1]
- More neurons are expected to approximate better

[1] Approximation by superpositions of a sigmoidal function, by Cybenko G. http://cs231n.github.io/neural-networks-1/

Regularization

- Overfitting more probable with larger models
- Could be prevented by using a regularization term in the loss function

Regularization



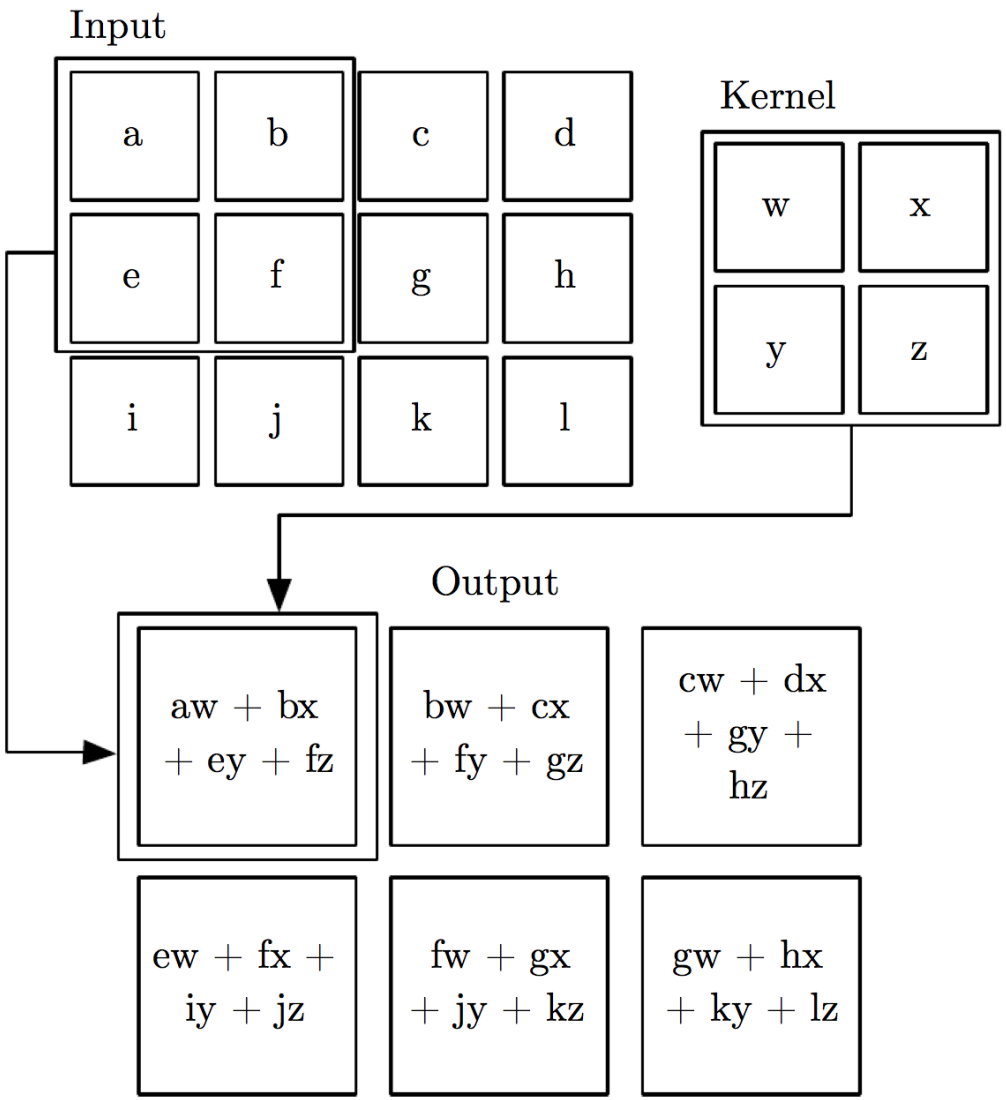
- Use bigger networks but take measures to prevent overfitting

http://cs231n.github.io/neural-networks-1/

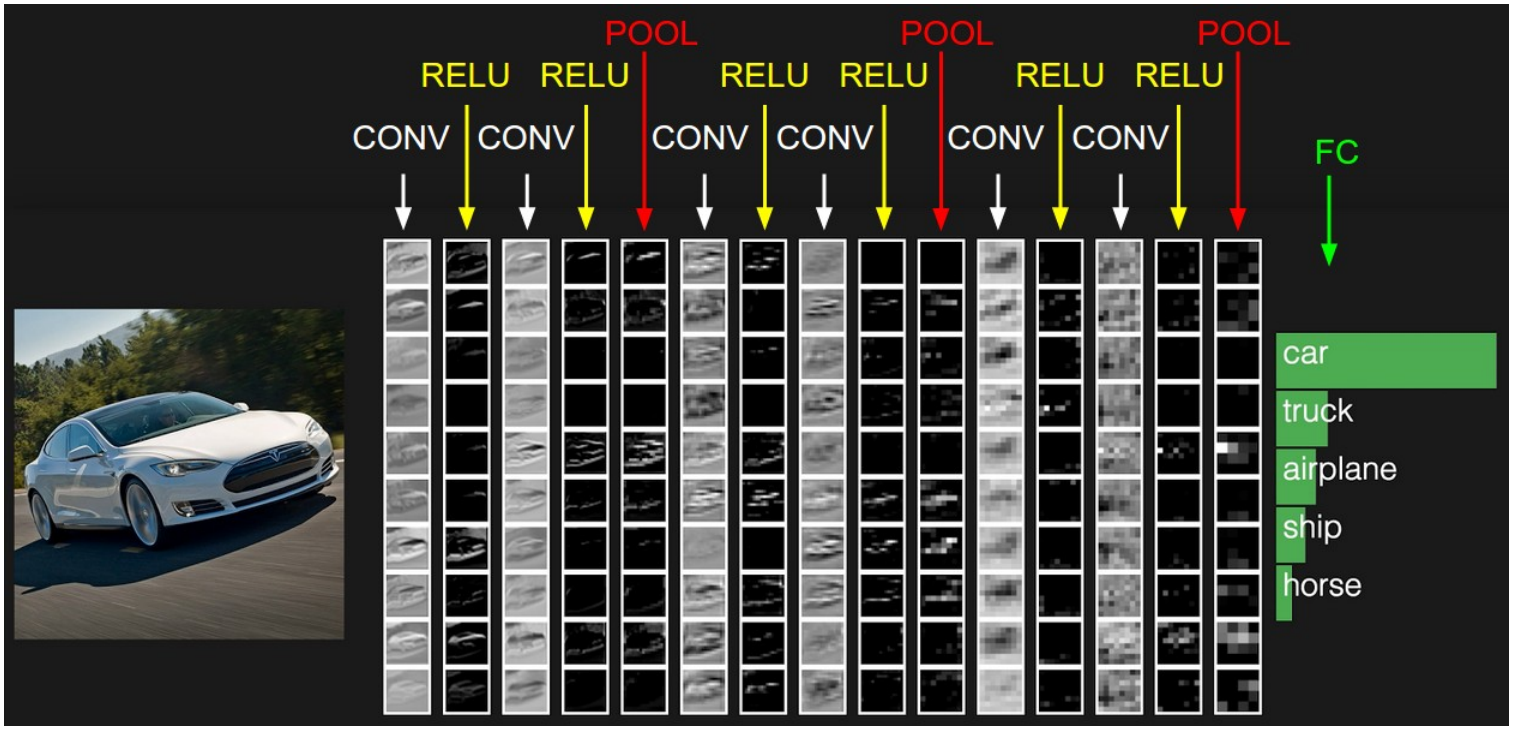
Working with images

- MLPs do not work well with images
- Hierarchy of local spatial features
- Extract these local spatial features through filters

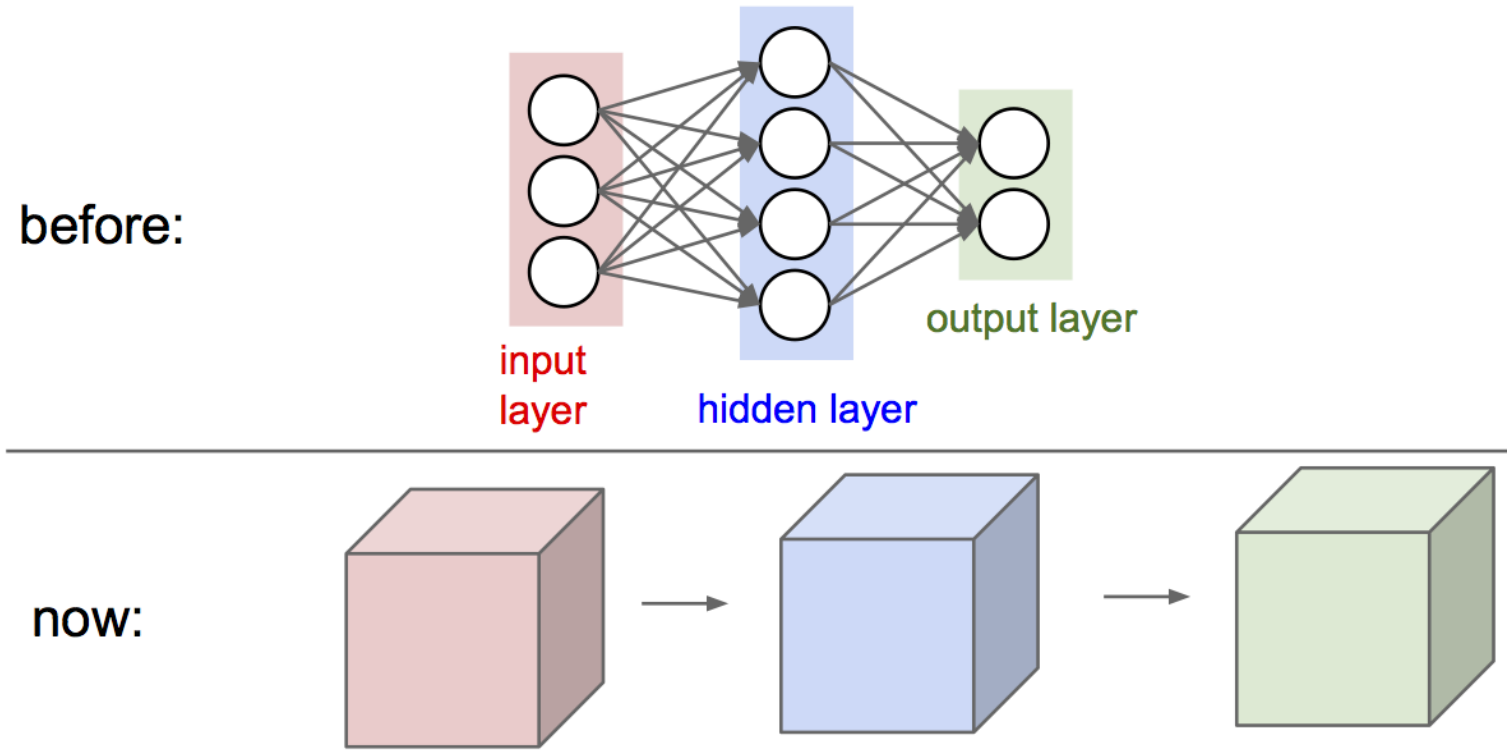
2D convolution operation



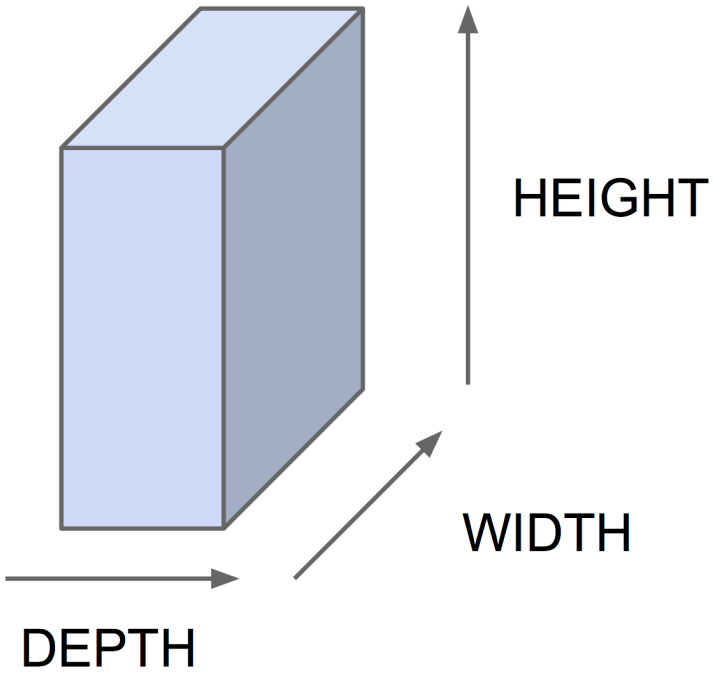
LeNet-5


POOL
POOL
POOL
RELU
RELU
RELU
RELU
RELU
RELU
CONV
CONV
CONV
CONV
CONV
CONV
FC
car
truck
airplane
ship
horse

MLP→ConvNet



Feature maps: activations of ConvNets



- Network activations in ConvNets are **feature maps**.
- All ConvNets feature maps arranged in **3 dimensions**.
- Each feature maps has size of (HEIGHT, WIDTH)
- Input image can be a special kind of feature map (*e.g.* color image is feature maps of some size with depth 3, one for each RGB channel).

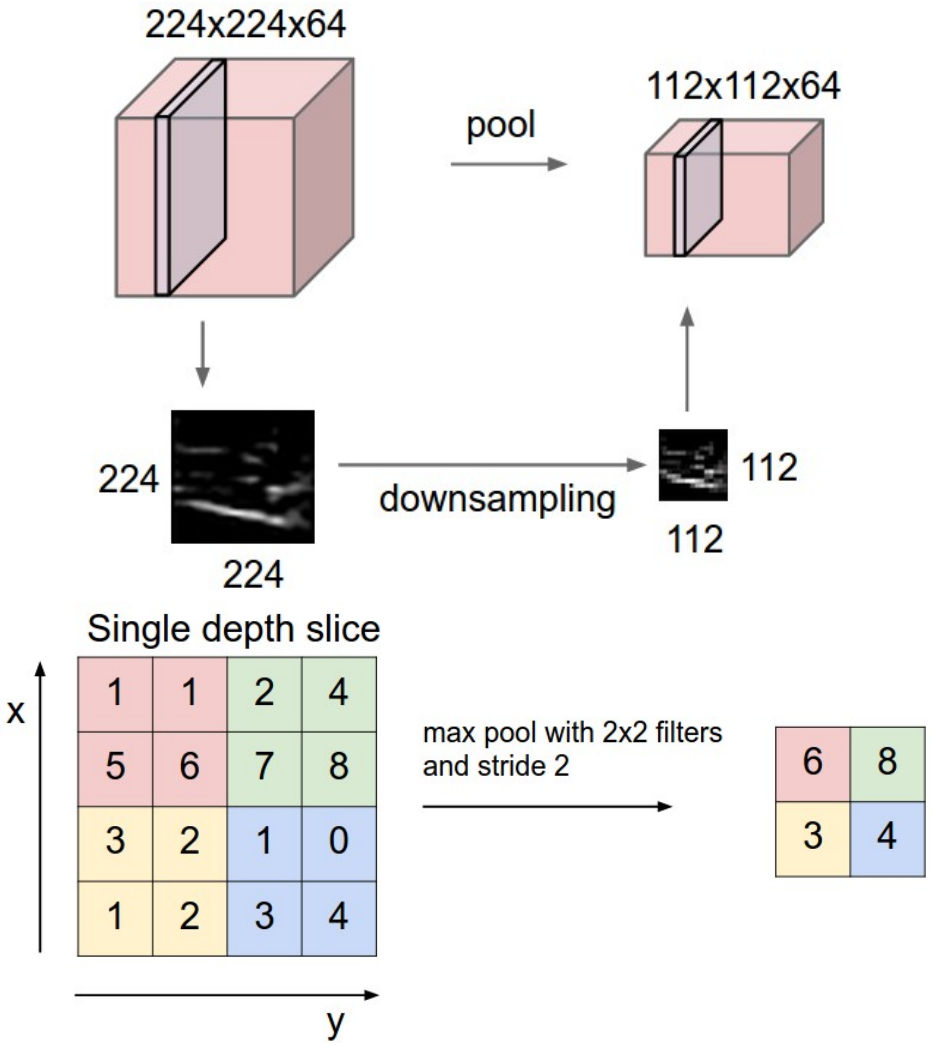
Convolution Layer: simple cell

- Accepts a volume of size $N_f \times N_h \times N_w$
- Number of filters K_m with shape $K_n \times K_h \times K_w$, stride S_h, S_v, amount of zero-padding P_h, P_v
- Produce a volume of size $\hat{N}_f \times \hat{N}_h \times \hat{N}_h$ where

$$\hat{N}_f = K_m$$
$$\hat{N}_h = (N_h - K_h + 2P_v)/S_v + 1$$
$$\hat{N}_w = (N_w - K_w + 2P_h)/S_h + 1$$

Live Demo of convolution

Pooling Layer: complex cell



Q&A