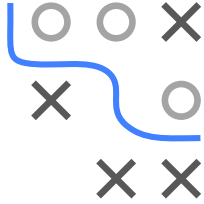
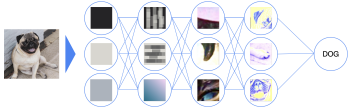
Introduction to Machine Learning



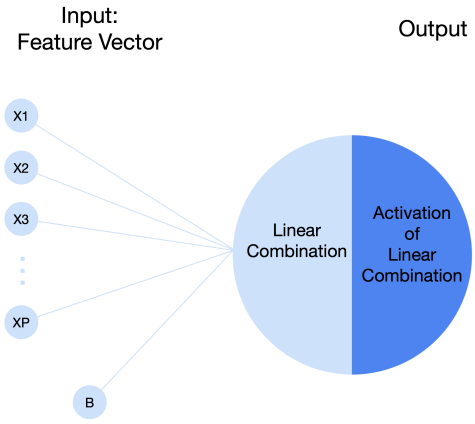
Neural Networks
In a Nutshell



Learning goals

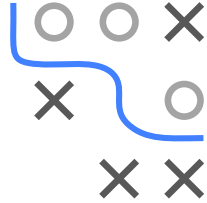
- Know basic computational unit
- Know basic architecture
- Understand Learning in NNs

BASIC COMPUTATIONAL UNIT: PERCEPTRON



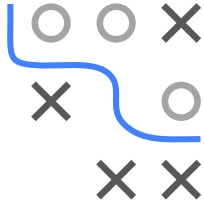
Output differs depending on activation function:

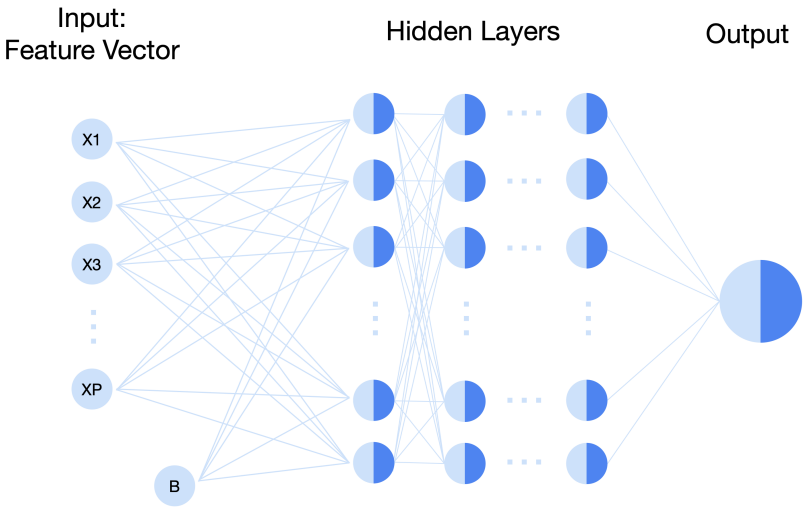
- **Identity function**: Perceptron represents linear regression
- **Logistic function**: Perceptron represents logistic regression
- Other activation functions possible



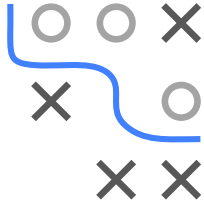
BASIC ARCHITECTURE OF NN

A neural network is built by combination of multiple perceptrons:





BASIC ARCHITECTURE OF NN



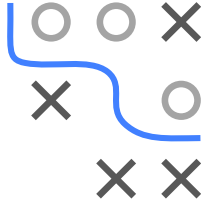
Hidden Layers:

- Output of hidden units serves as input for units in next layer
- Too many hidden layers or too many units per layer can lead to overfitting

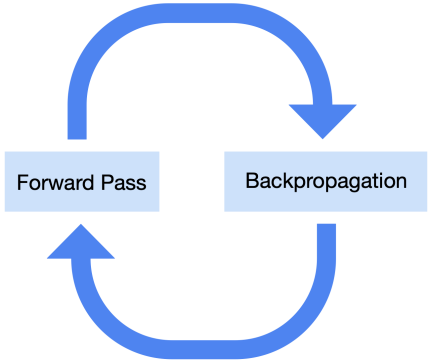
Output Layer:

- Number of output units depend on task
- Different activation functions for output layer and hidden layers possible

LEARNING - IMAGE CLASSIFICATION TASK



For each Training Iteration:



LEARNING - IMAGE CLASSIFICATION TASK

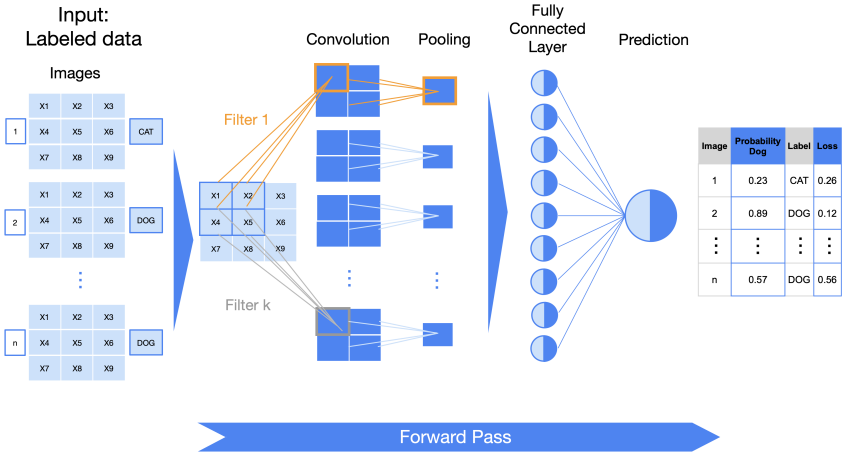
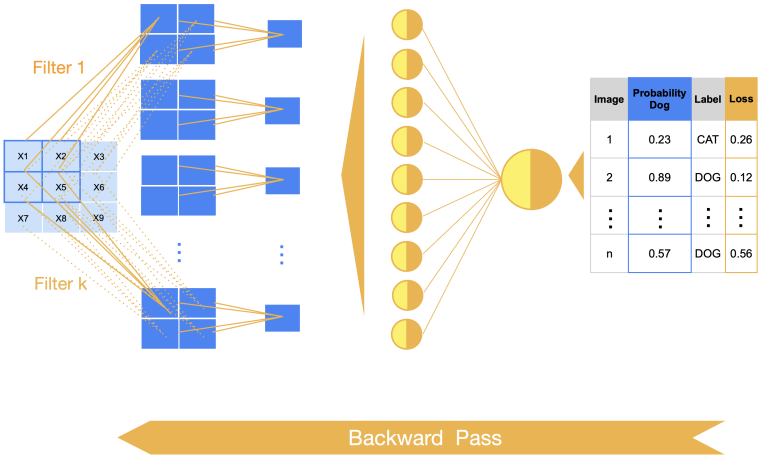
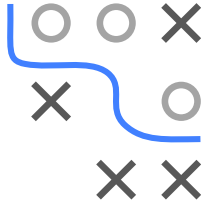


Image	Probability Dog	Label	Loss
1	0.23	CAT	0.26
2	0.89	DOG	0.12
⋮	⋮	⋮	⋮
n	0.57	DOG	0.56

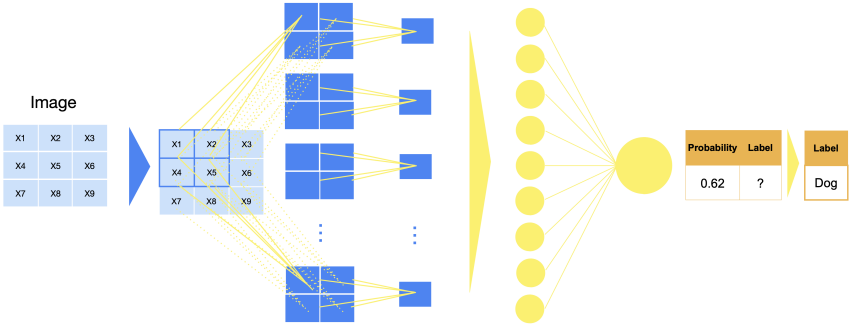
LEARNING - IMAGE CLASSIFICATION TASK

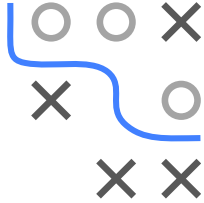
Compute update of each weight by backpropagation





PREDICTION - IMAGE CLASSIFICATION TASK





EFFECT OF HIDDEN LAYERS

- Learn more and more abstract representations
- Each layer adds degree of non-linearity