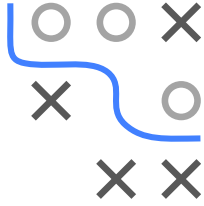
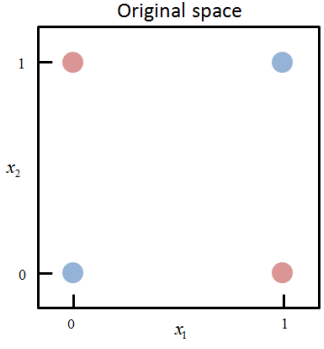
Introduction to Machine Learning



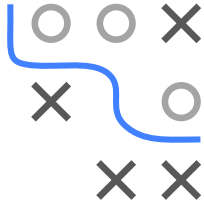
Neural Networks
XOR-Problem



Learning goals

- Example problem a single neuron can not solve but a single hidden layer net can

EXAMPLE: XOR PROBLEM



- Suppose we have four data points

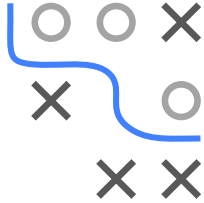
$$X = \{(0,0)^\top, (0,1)^\top, (1,0)^\top, (1,1)^\top\}$$

- The XOR gate (exclusive or) returns true, when an odd number of inputs are true:

x_1	x_2	**XOR** $= y$
0	0	0
0	1	1
1	0	1
1	1	0

- Can you learn the target function with a logistic regression model?

NEURAL NETWORKS : OPTIMIZATION



- In this simple example we actually “guessed” the values of the parameters for $\mathbf{W}$, $\mathbf{b}$, $\mathbf{u}$ and c.
- That won’t work for more sophisticated problems!
- We will learn later about iterative optimization algorithms for automatically adapting weights and biases.
- An added complication is that the loss function is no longer convex. Therefore, there might not exist a single minimum.