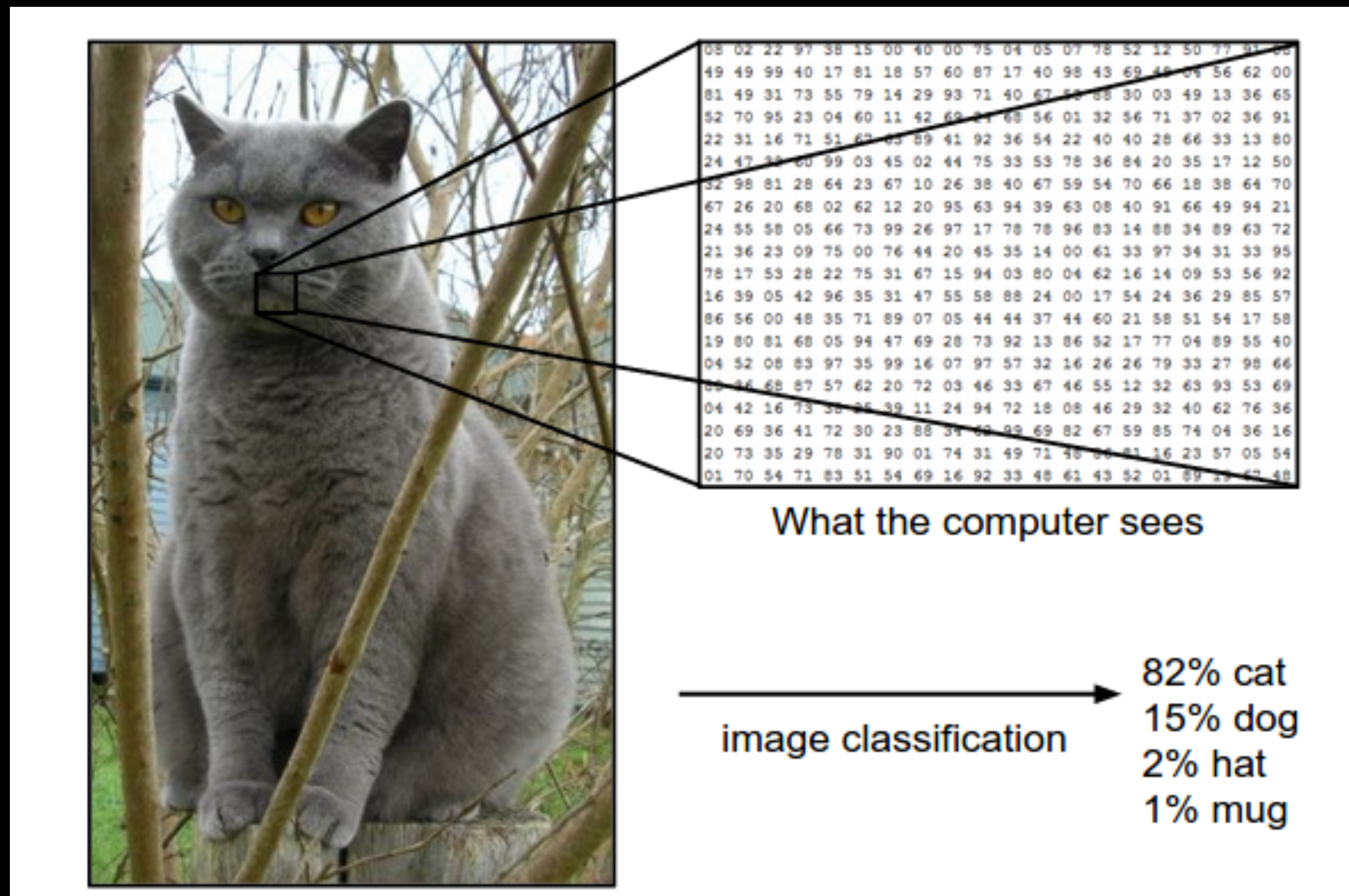
Image Classification

Agenda

- What is Image Classification?
- What are Convolutional Neural Networks?
- Outline
    - PyTorch
    - Automatic Differentiation
    - Dog breed dataset
    - Binary classification
    - Multi class classification

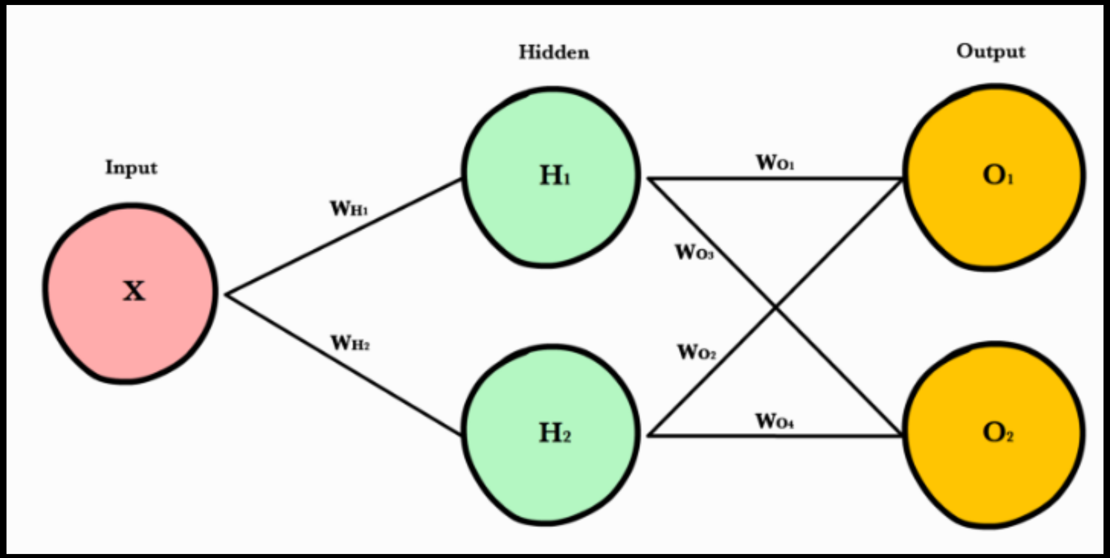
Image Classification

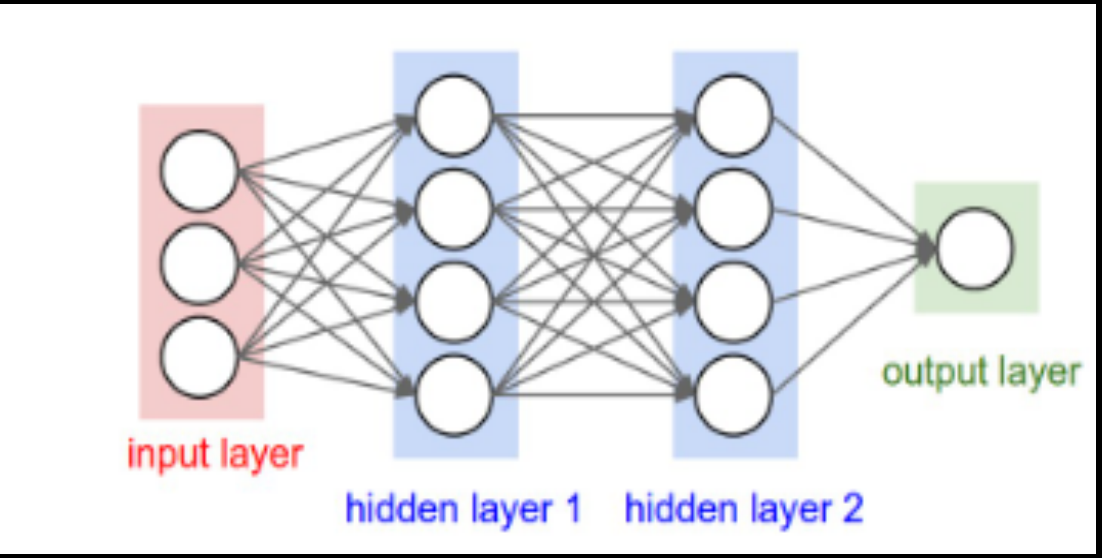


- Simplest problem: Assign a label to an image
- Several variants of image classification problems - let us focus on the simplest!

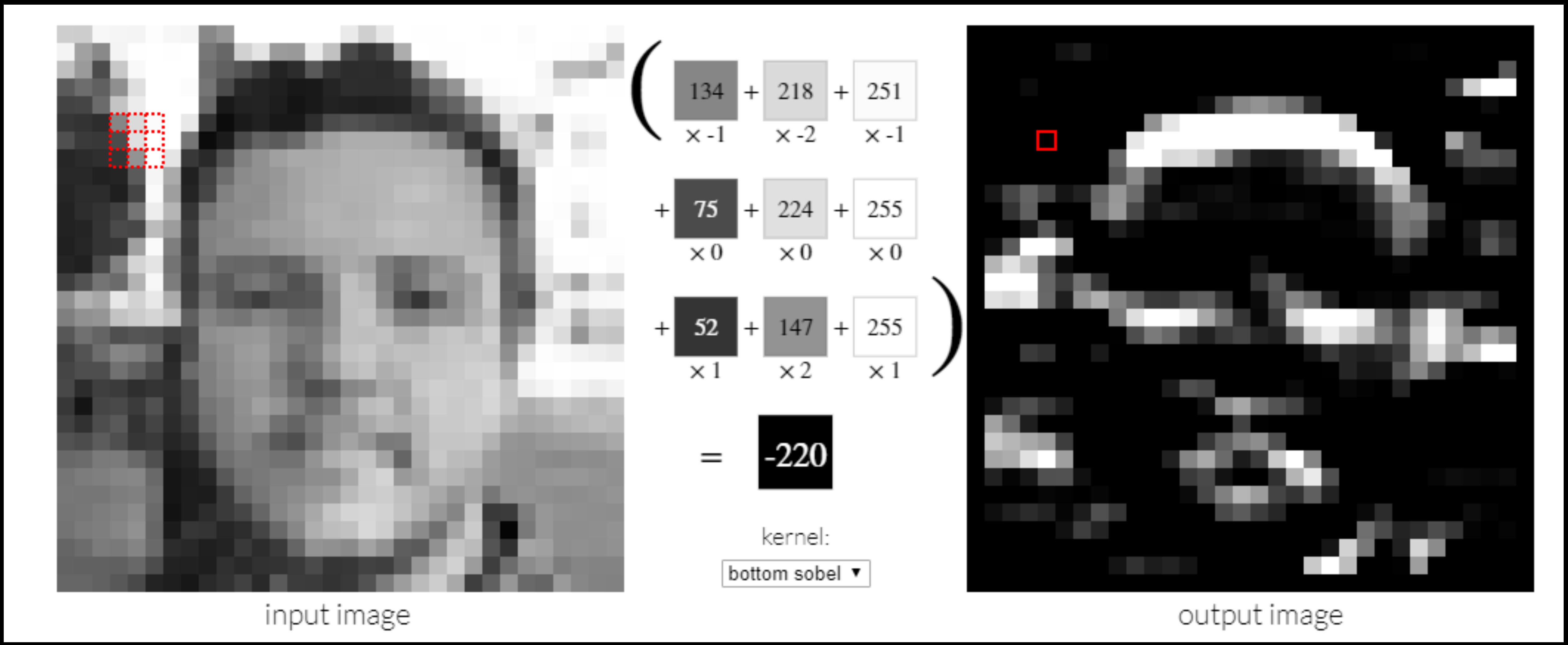
Source: CS231n, Stanford

Neural networks



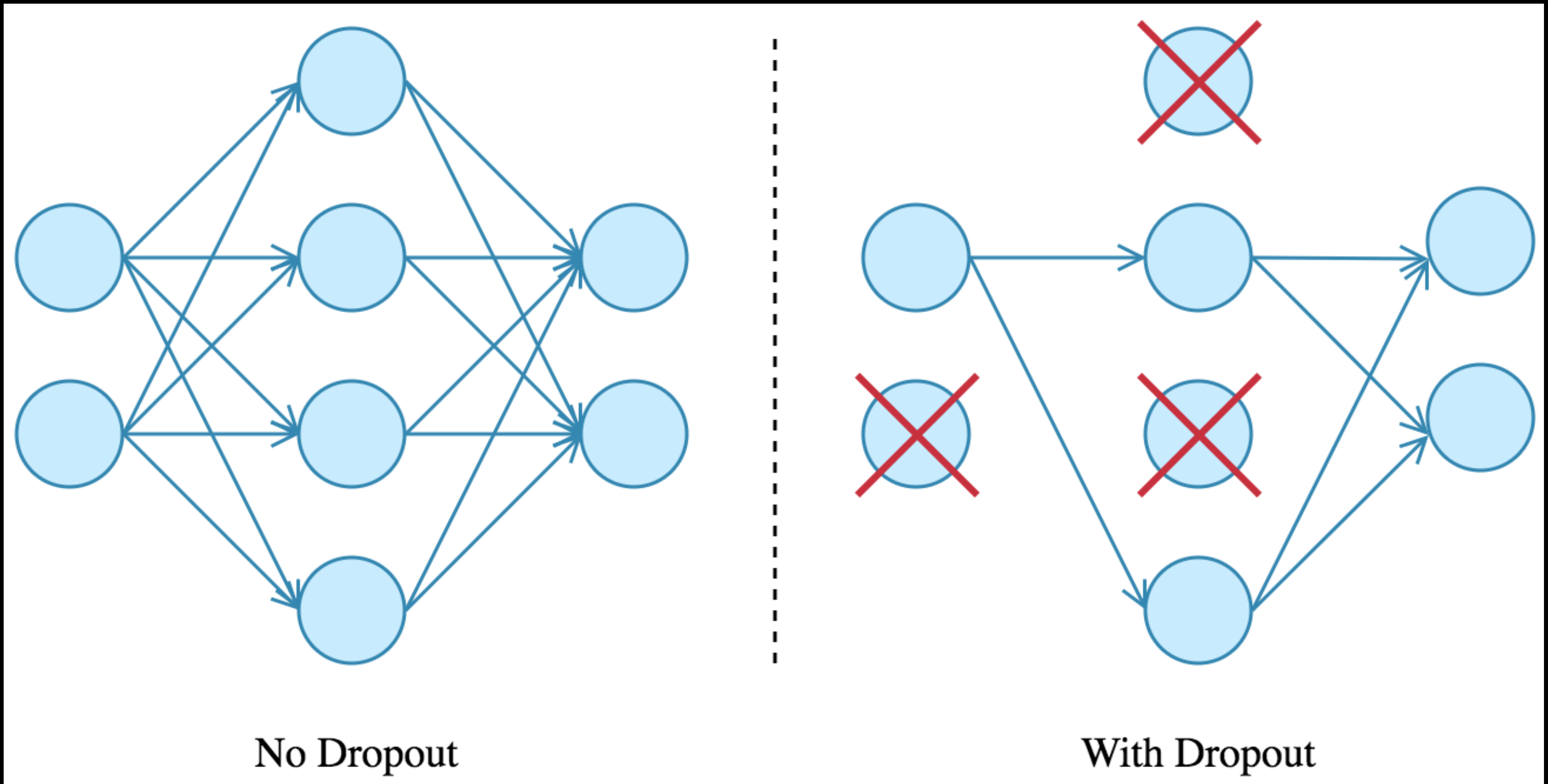


- Dense neural network - every node is connected to every other node
- For deep networks, very expensive!

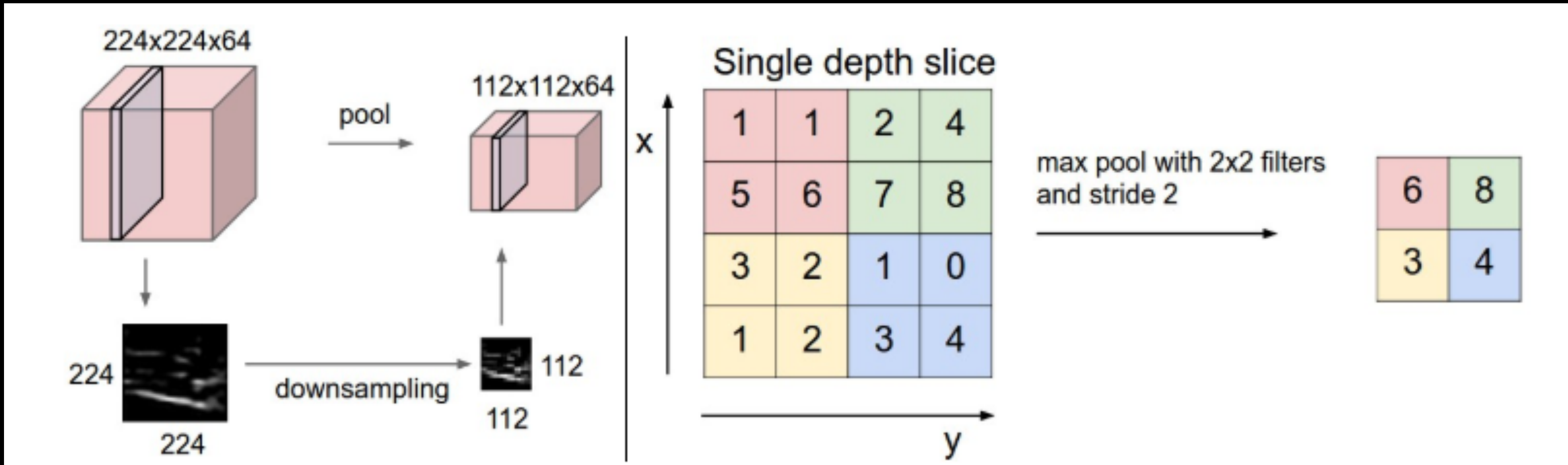


Convolutional Layer

- Link: http://setosa.io/ev/image-kernels/
- Link: http://cs231n.github.io/convolutional-networks/

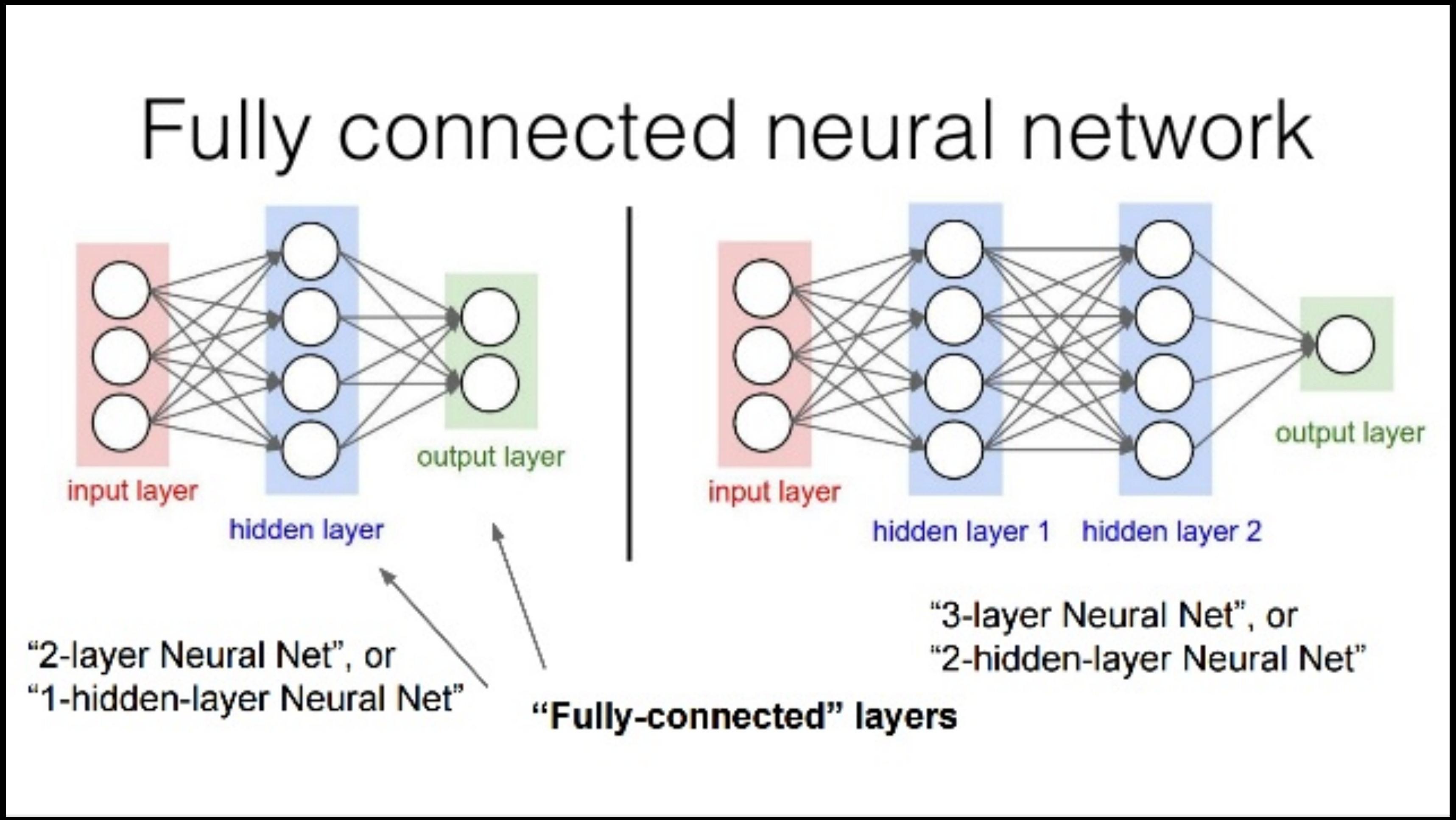


Dropout Layer

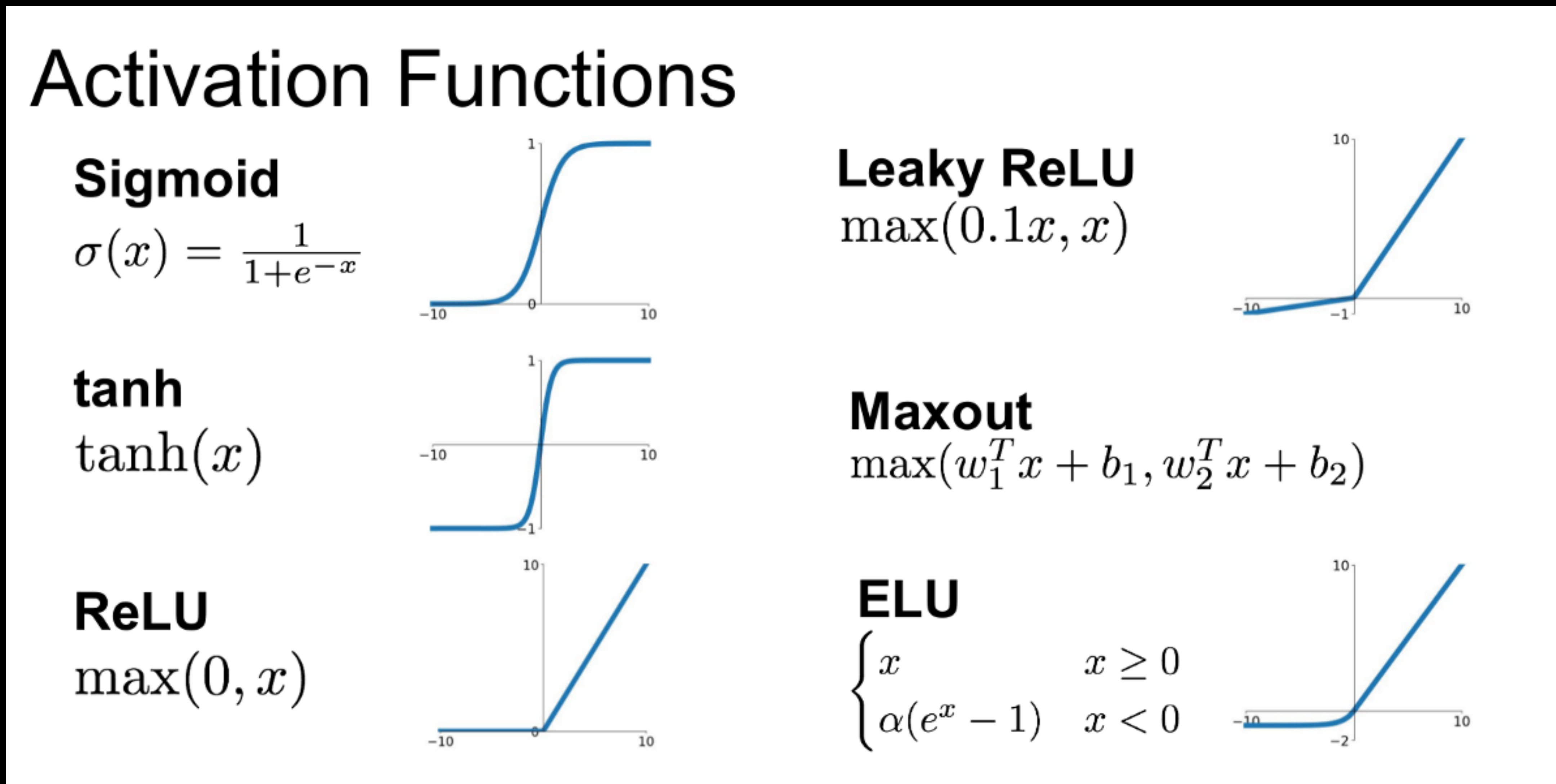


Pooling layer downsamples the volume spatially, independently in each depth slice of the input volume. **Left:** In this example, the input volume of size [224x224x64] is pooled with filter size 2, stride 2 into output volume of size [112x112x64]. Notice that the volume depth is preserved. **Right:** The most common downsampling operation is max, giving rise to **max pooling**, here shown with a stride of 2. That is, each max is taken over 4 numbers (little 2x2 square).

Pooling Layer



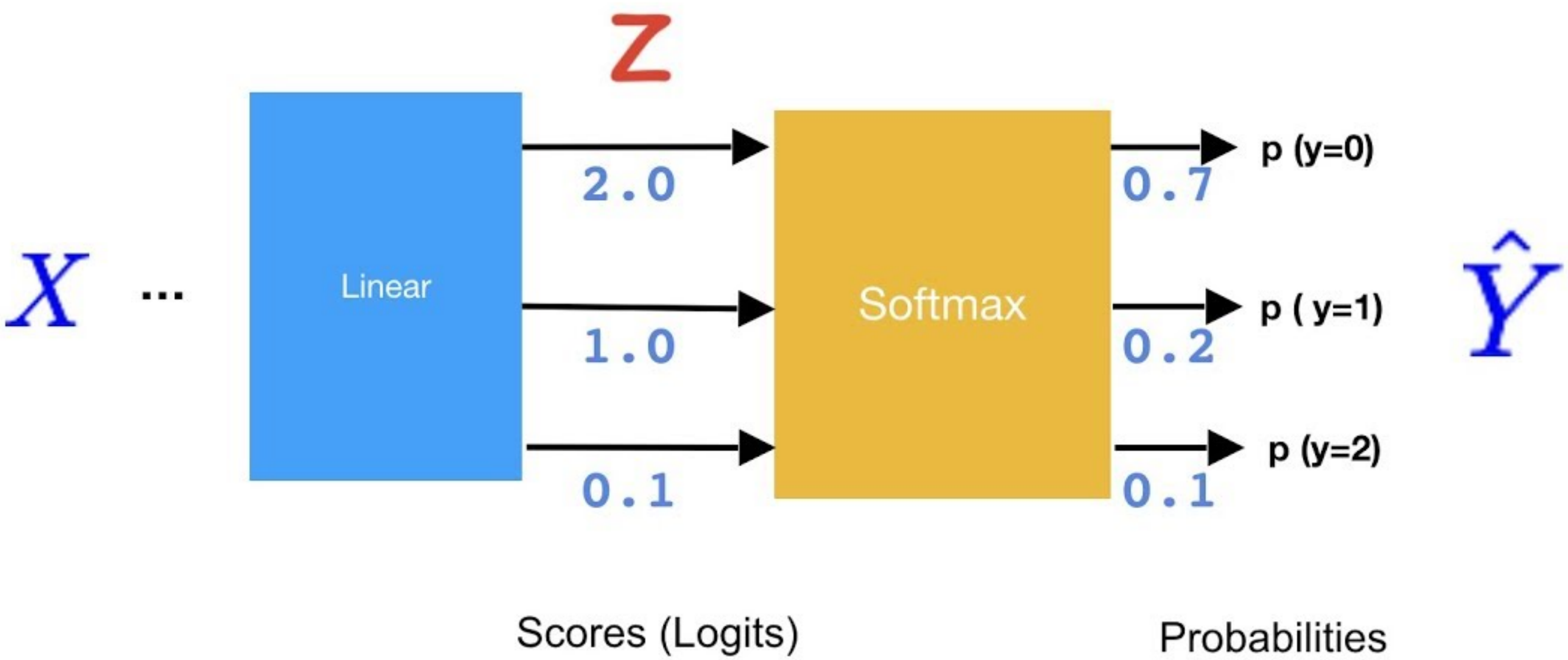
Fully Connected Layer



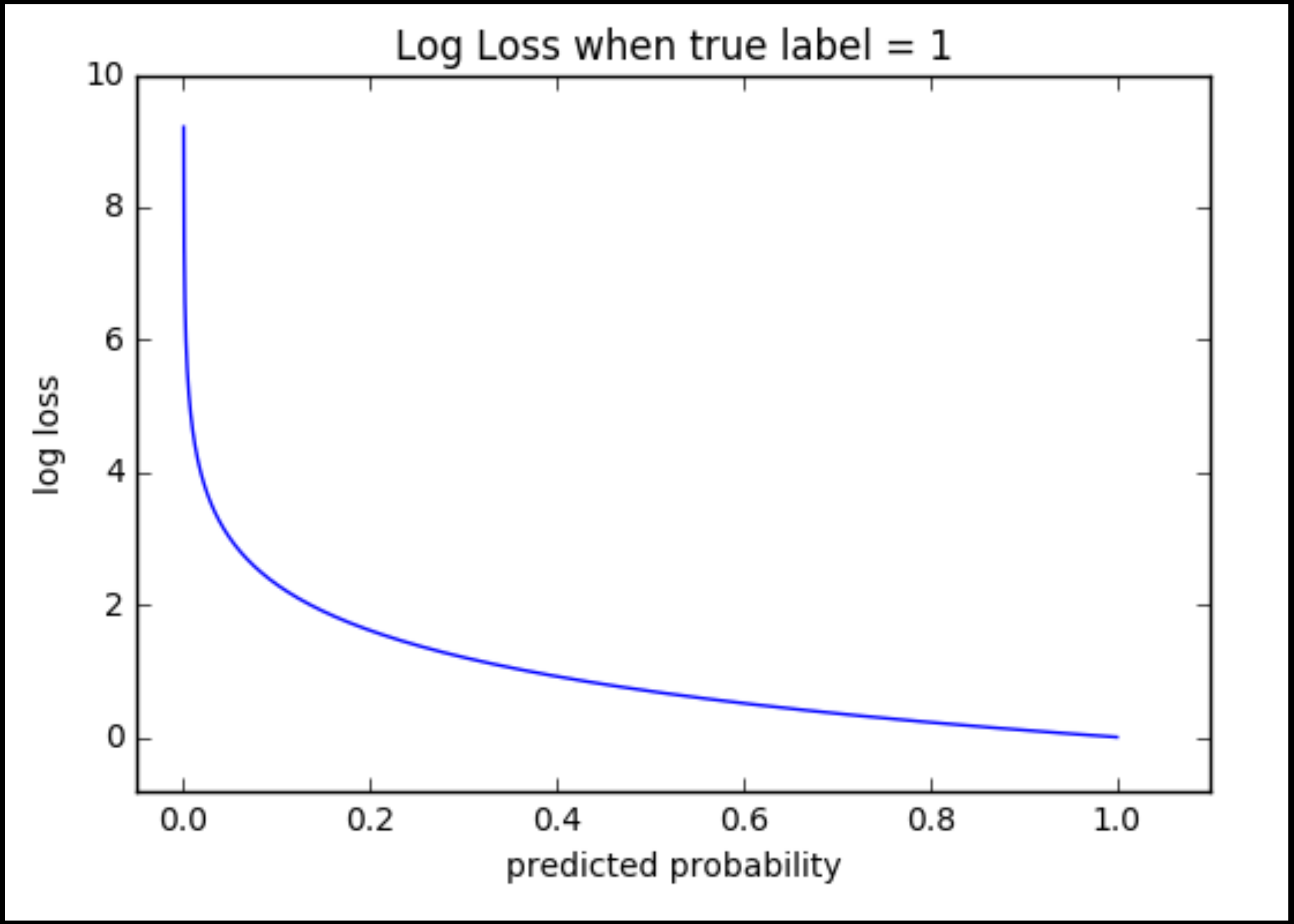
Activation Function

Meet Softmax

$$\sigma(\mathbf{z})_j = \frac{e^{z_j}}{\sum_{k=1}^{K} e^{z_k}} \quad \text{for } j = 1, \ldots, K.$$



Softmax



Cross Entropy or Log Loss

Link: https://datawookie.netlify.com/blog/2015/12/making-sense-of-logarithmic-loss/