神经网络

通往人工智能之门

预备知识

课前

- Coursera吴恩达《机器学习》WEEK 4、5

https://www.coursera.org/learn/machine-learning

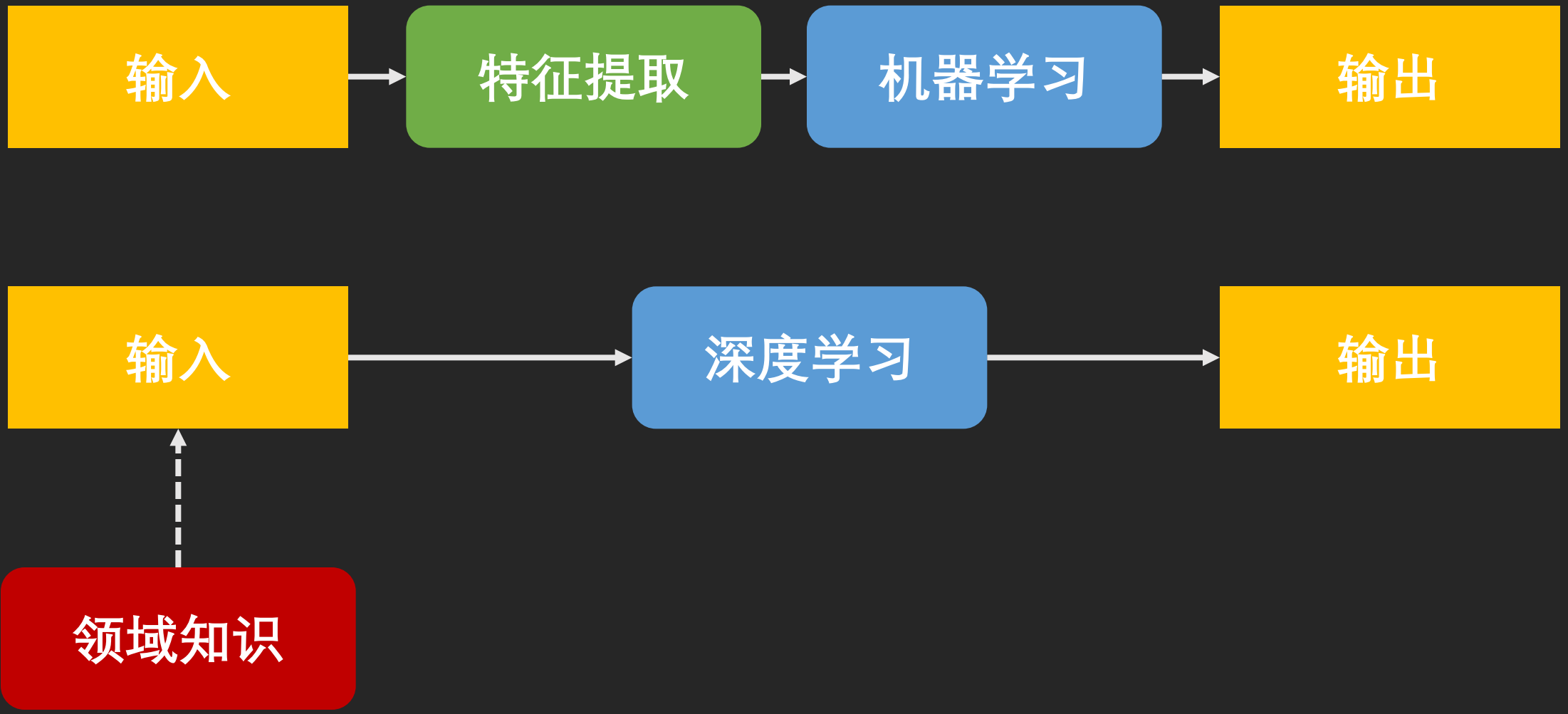
- 《数据挖掘导论》5.4节

课后

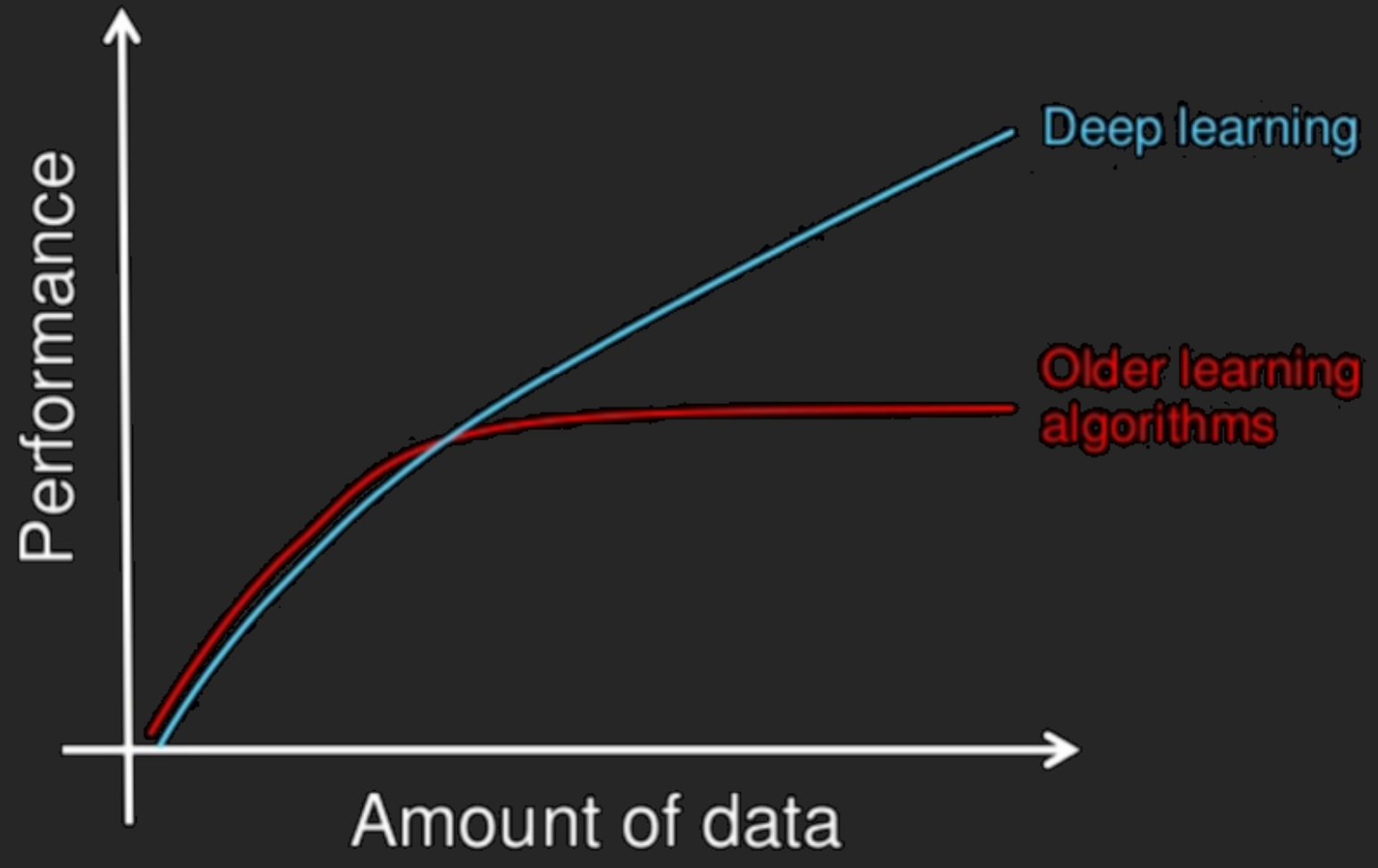
- 学堂在线《数据挖掘：理论与算法》WEEK 4

http://www.xuetangx.com/courses/course-v1:TsinghuaX+80240372X+2016_T2/about

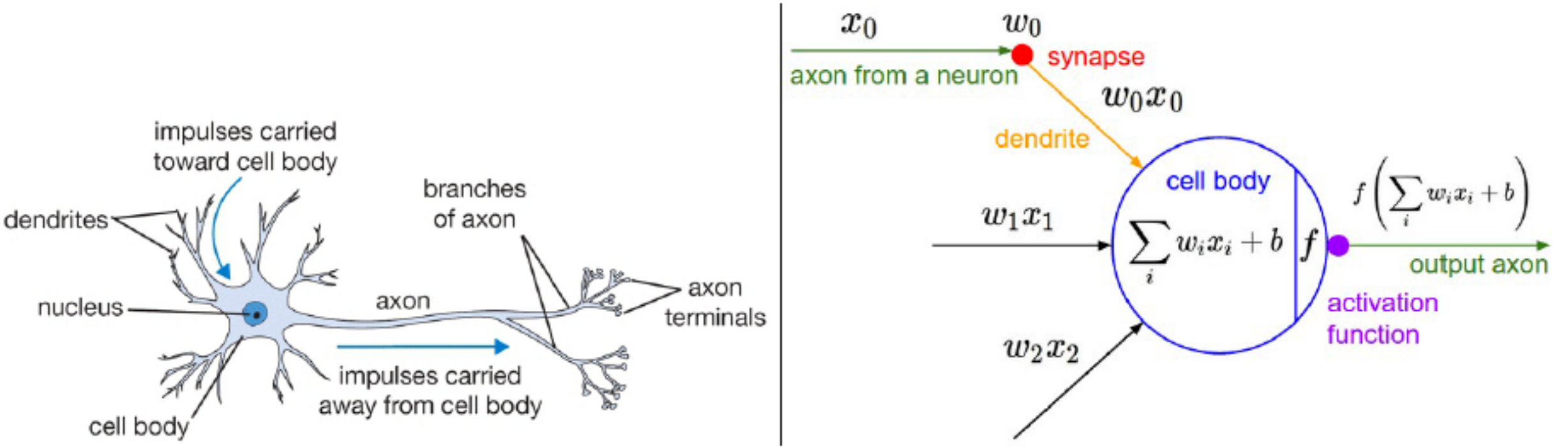
谁来做特征提取？



为什么要做深度学习？

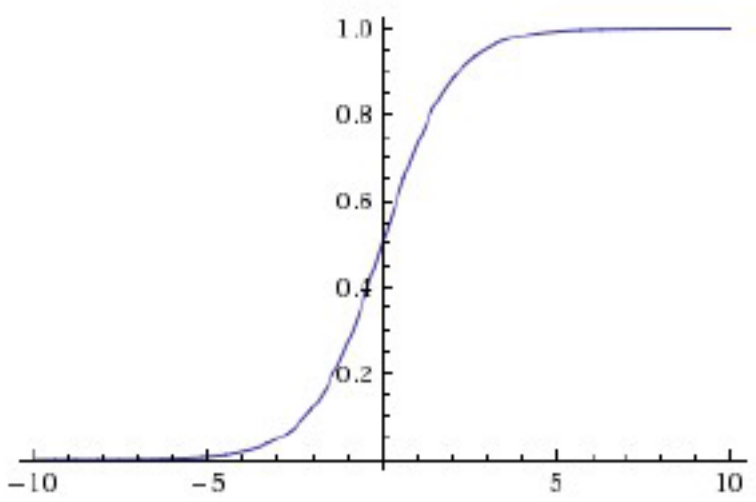

Performance
Amount of data
Deep learning
Older learning algorithms

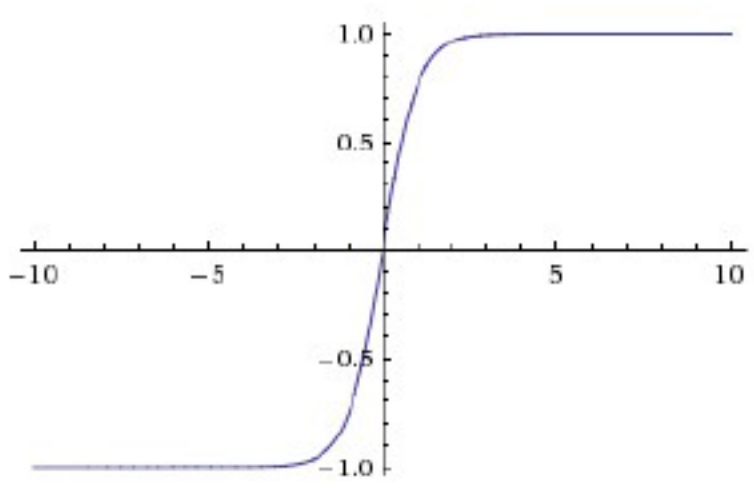
神经元



A cartoon drawing of a biological neuron (left) and its mathematical model (right).

Sigmoid和Tanh激活函数

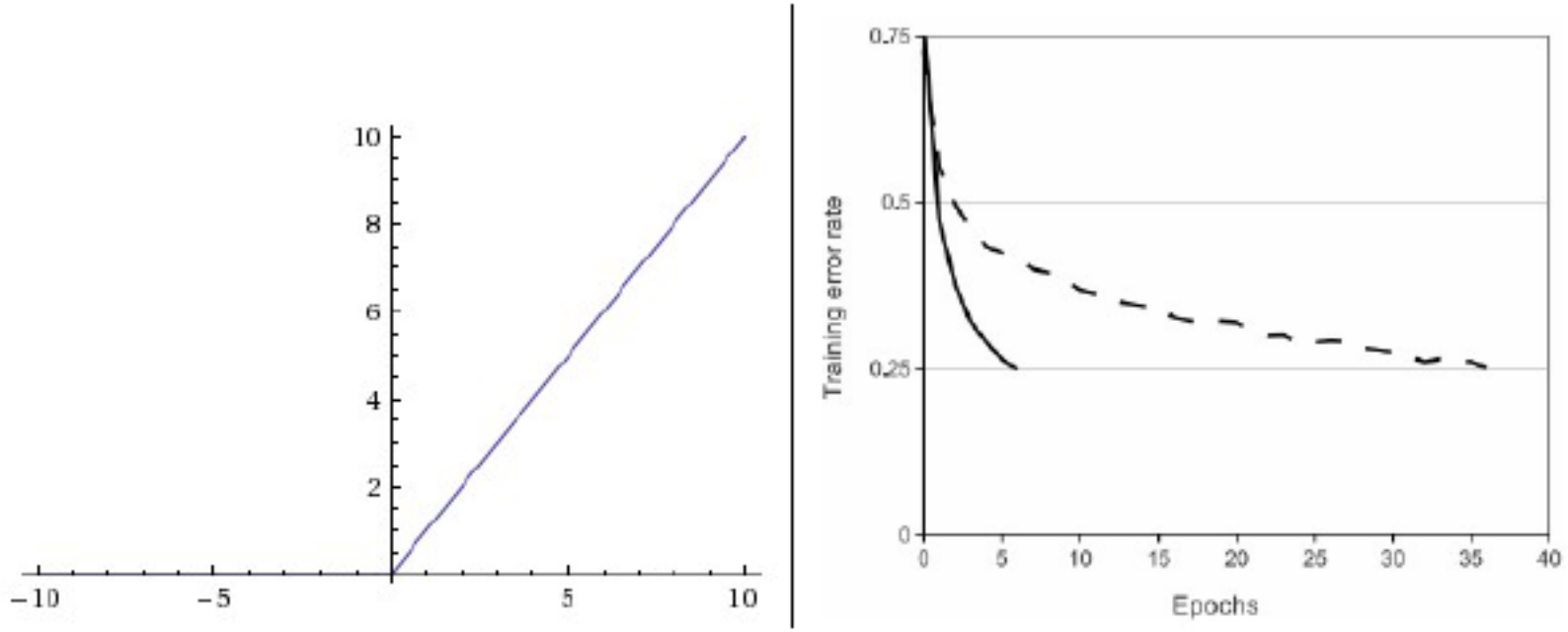




Left: Sigmoid non-linearity squashes real numbers to range between [0,1] **Right:** The tanh non-linearity squashes real numbers to range between [-1,1].

$$\tanh(x) = 2 * \text{sigmoid}(2x) - 1$$

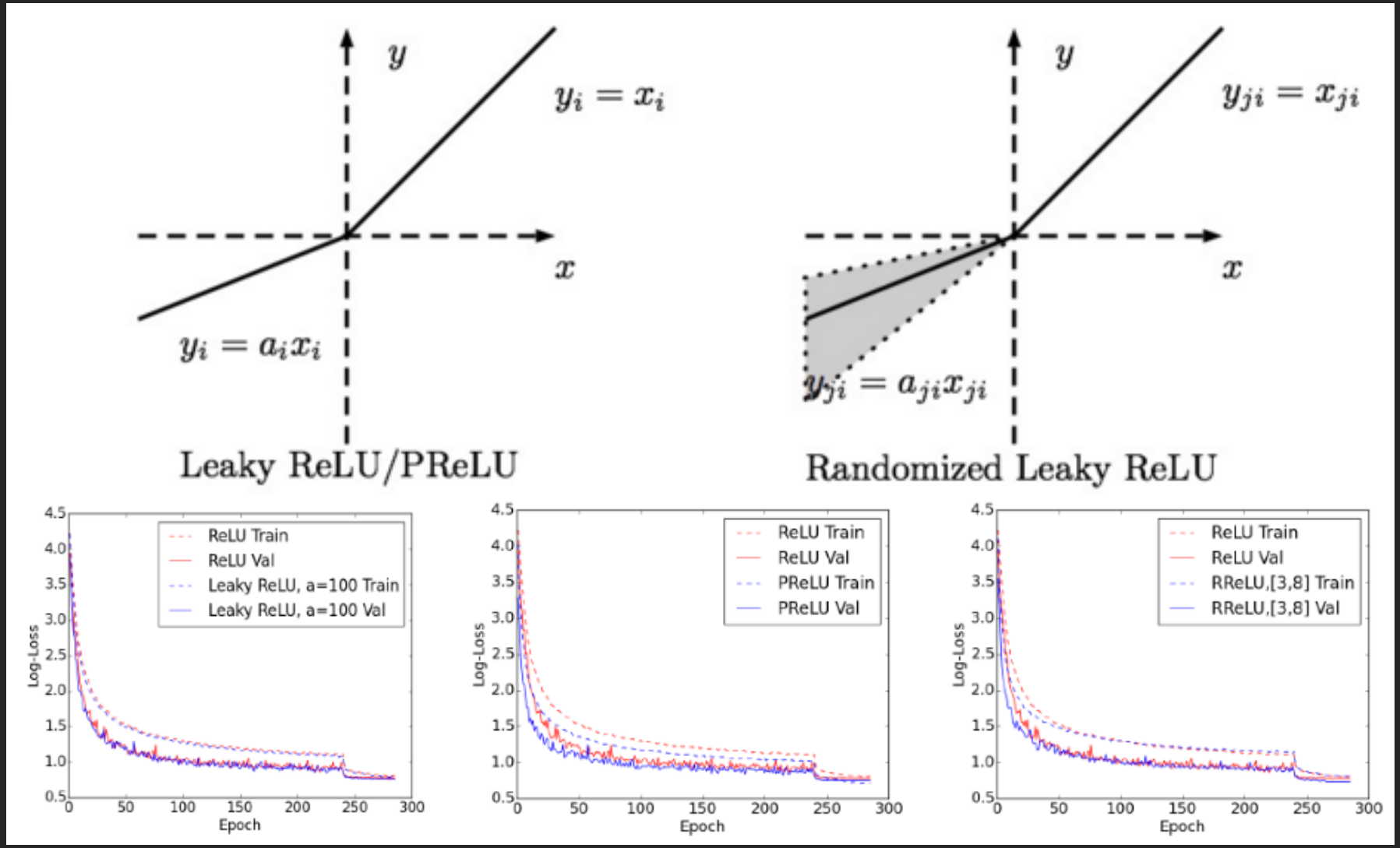
ReLU



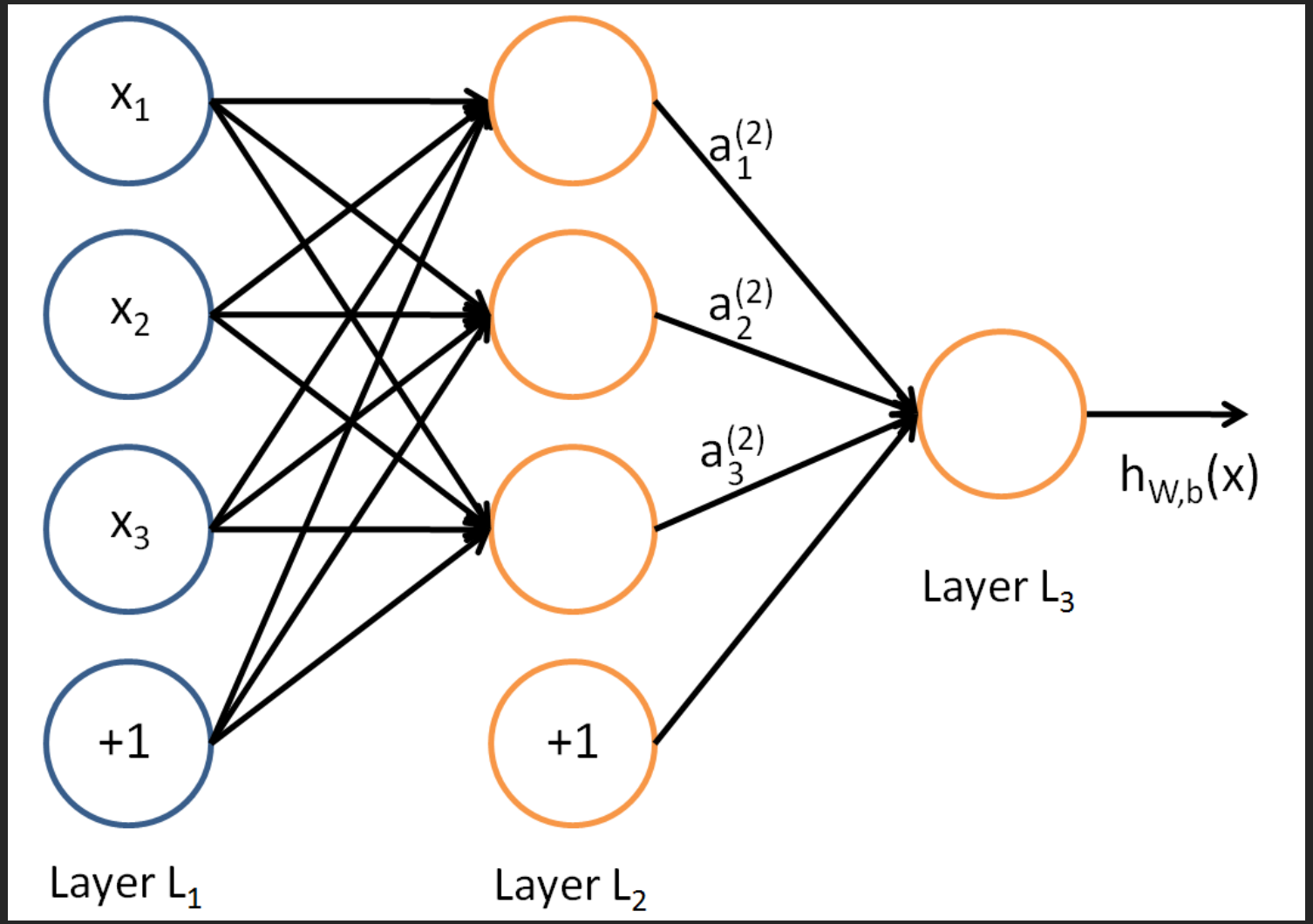
Left: Rectified Linear Unit (ReLU) activation function, which is zero when x < 0 and then linear with slope 1 when x > 0. **Right:** A plot from Krizhevsky et al. (pdf) paper indicating the 6x improvement in convergence with the ReLU unit compared to the tanh unit.

$$\text{ReLU}(x) = \max(0, x)$$

ReLU变种


y
$y_i = x_i$
x
$y_i = a_i x_i$
Leaky ReLU/PReLU
y
$y_{ji} = x_{ji}$
x
$y_{ji} = a_{ji} x_{ji}$
Randomized Leaky ReLU
ReLU Train
ReLU Val
Leaky ReLU, a=100 Train
Leaky ReLU, a=100 Val
Log-Loss
Epoch
ReLU Train
ReLU Val
PReLU Train
PReLU Val
Log-Loss
Epoch
ReLU Train
ReLU Val
RReLU,[3,8] Train
RReLU,[3,8] Val
Log-Loss
Epoch

神经网络



神经网络的数学本质

神经网络的输出：

$$Y = f_n(X_{n-1}) = f_n(f_{n-1}(X_{n-2})) = \cdots = f_n(f_{n-1} \cdots f_1(X_{n-2}))$$

结论：

$$Y = F(X_{输入})$$

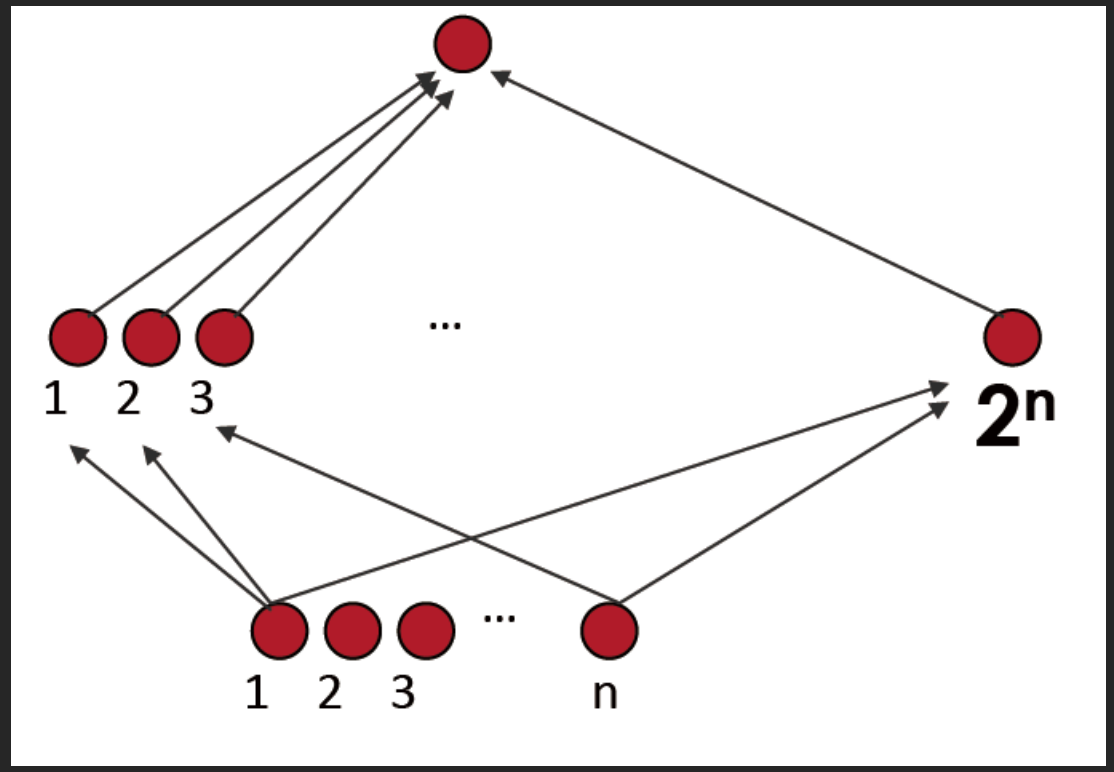
神经网络拟合的是关于输入的函数！

拟合任意函数

- 理论证明
- 具有1个隐藏层的神经网络

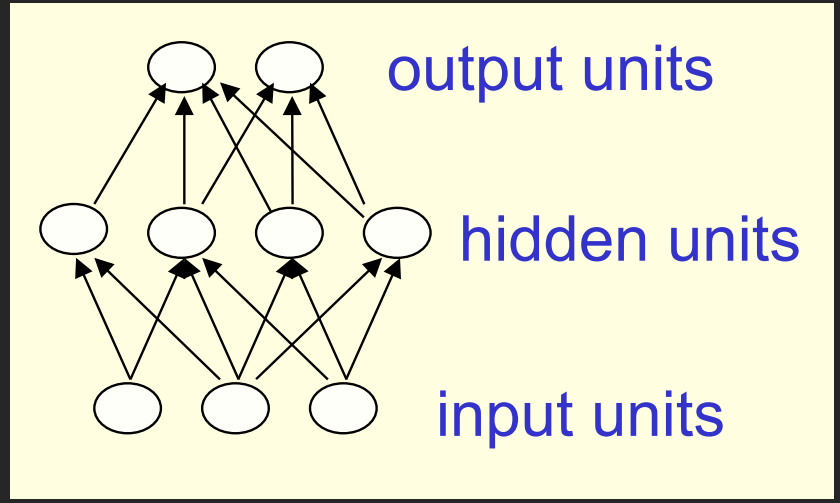
可以拟合任意函数

- 深度的意义
- 节省指数级的神经元

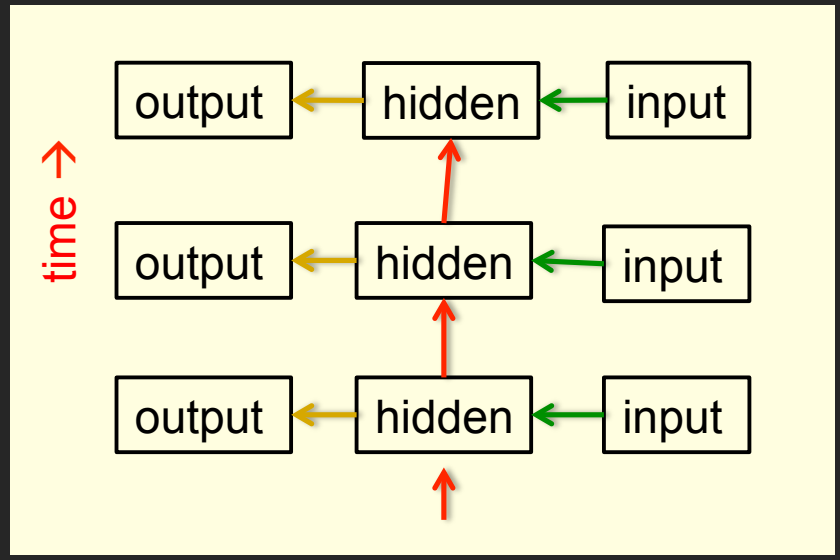


两种重要的神经网络

- 前馈神经网络
- Feedforward Neural Network



- 循环神经网络
- Recurrent Neural Network



Next Class – 神经网络（真枪实弹）

课前

- 学习Python的基本语法

https://docs.python.org/2/tutorial/index.html

- 了解Python的Scikit-Learn和TensorFlow机器学习框架

http://scikit-learn.org/

https://www.tensorflow.org/

Next Next Class – 正则化方法

课前

- Coursera吴恩达《机器学习》WEEK 6

https://www.coursera.org/learn/machine-learning

- 《数据挖掘导论》4.4节

课后

- 学堂在线《数据挖掘：理论与算法》WEEK 5.4

http://www.xuetangx.com/courses/course-v1:TsinghuaX+80240372X+2016_T2/about