WeeklyNote

2019.10.10

張慕琪

How Neural Networks Learn from Experience

Networks of artificial neurons can learn to represent complicated information. Such neural networks may provide insights into the learning abilities of the human brain

by Geoffrey E. Hinton

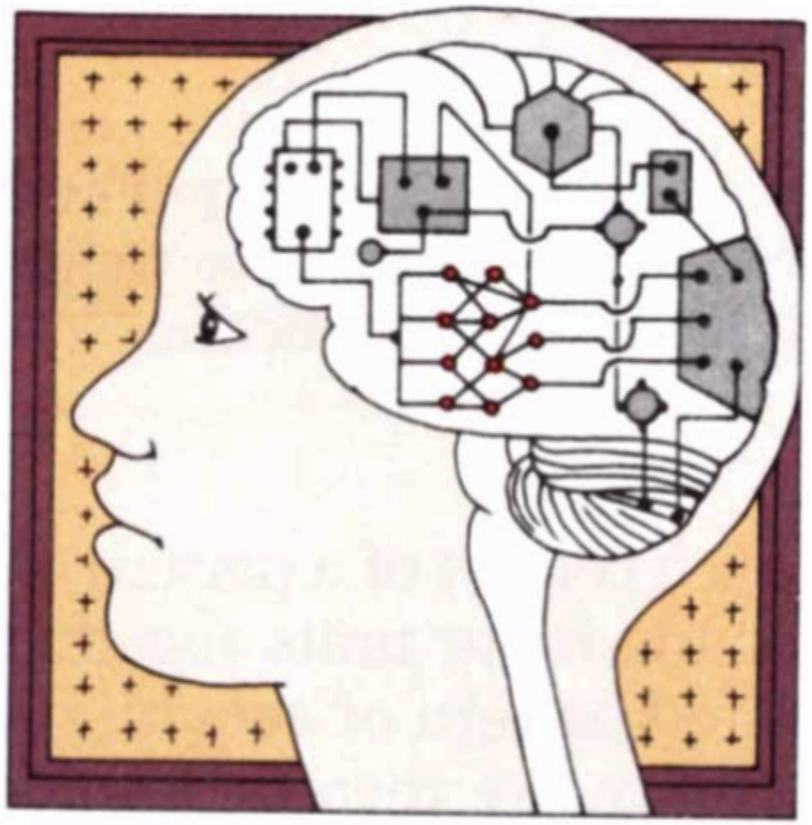
Introduction

The brain is a remarkable computer。

—快速解析场景中的模糊信息;

—在嘈杂的环境中分辨细微的声音;

—最重要的是，大脑可以在没有明确指示的情况下进行学习!



在现实世界中是否可以模拟脑内的学习过程?

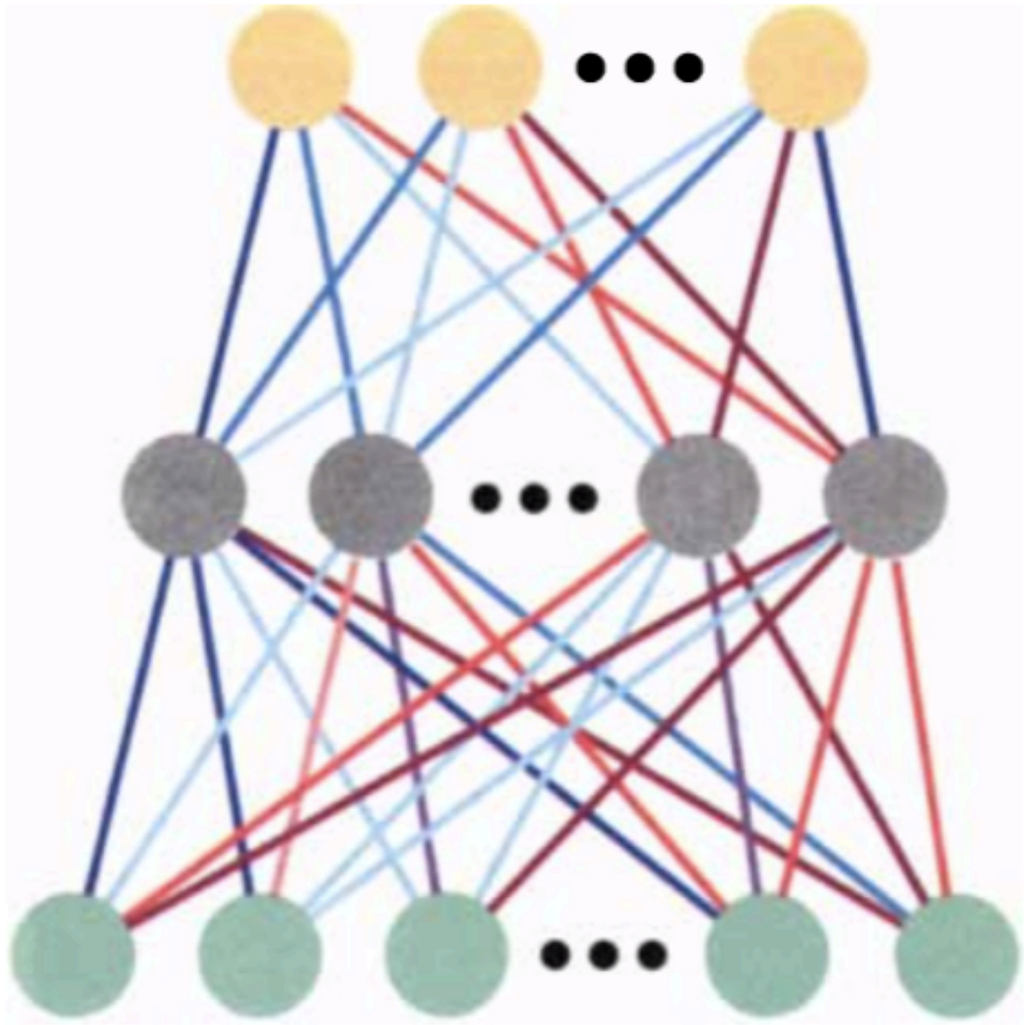
Introduction

—在人类大脑中，神经细胞专门负责收集信号；
—神经元之间通过无数个连接的轴突传递电信号；
—当轴突收到的信号高于原本的抑制信号时，它会沿着轴突继续向下传递电信号。

人工神经网络相应的通过“节点”、“权重”对人类大脑的神经细胞进行模拟。

Introduction

—人工神经网络的能力取决于输入和输出间的传递函数和权重两方面；
—传递函数一般分为三类：线性型、阈值型、sigmoid；
—人工神经网络包含三层：和隐藏层相连的输入层，和输出层相连的隐藏层；
—输出层的能力取决于隐藏层和输出层间的权重设计。



COMMON NEURAL NETWORK consists of three layers of units that are fully connected. Activity passes from the input units (*green*) to the hidden units (*gray*) and finally to the output units (*yellow*). The reds and blues of the connections represent different weights.

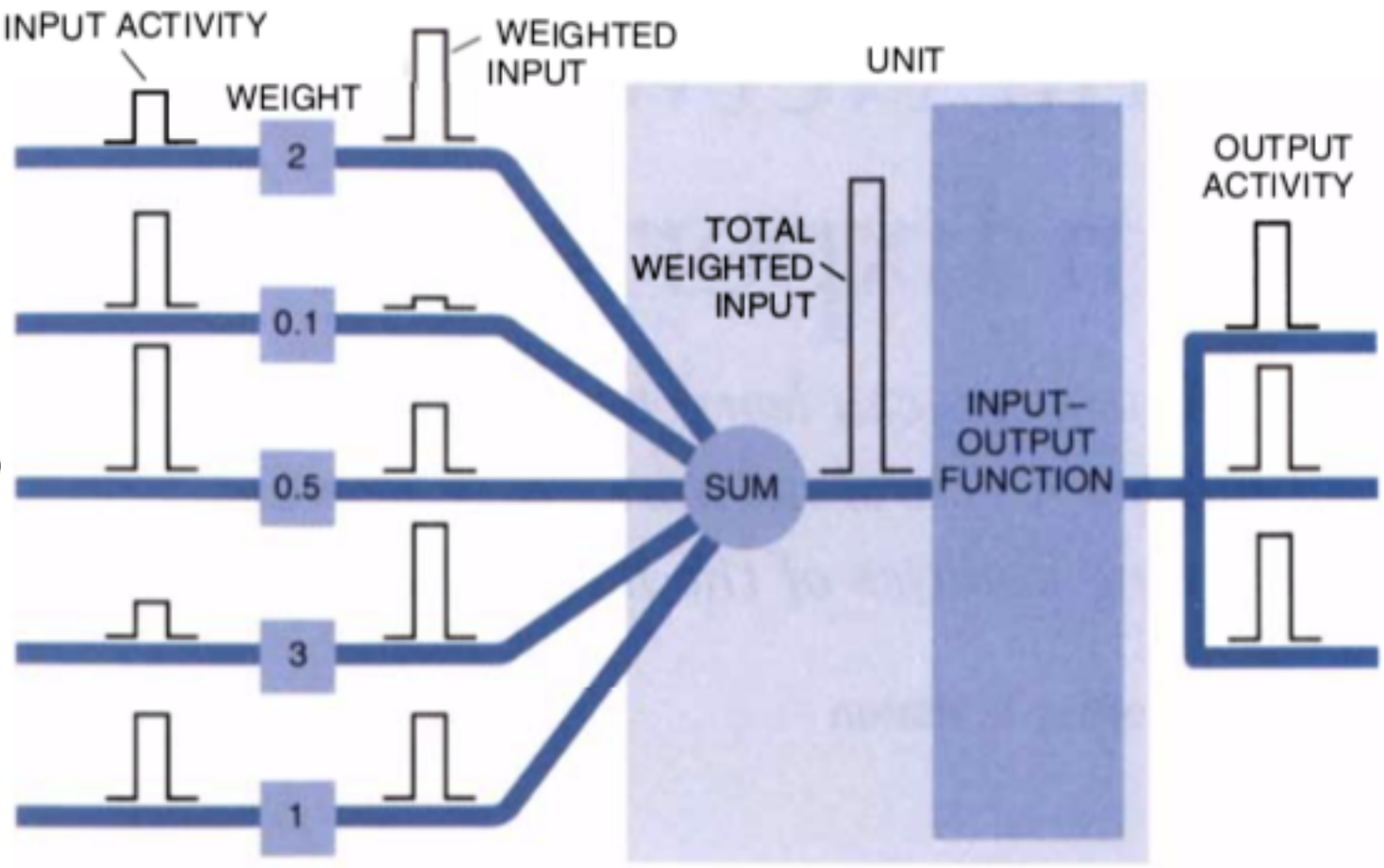
Introduction

如何判断网络已经被调节至最优?

——均方根误差（RMSE）

但如何调整网络已达到最佳?

——Back Propagation（BP算法）



Back propagation

- Get the gradient: back propagation
- We can represent the computation with the computation graphs

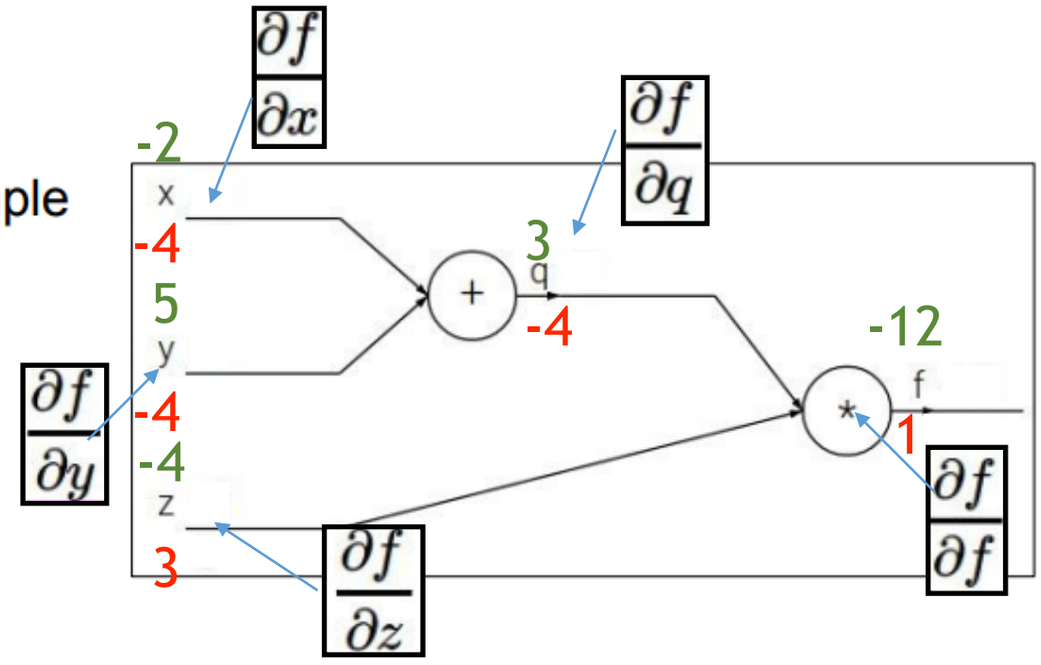
Backpropagation: a simple example

$$f(x, y, z) = (x + y)z$$

e.g. x = -2, y = 5, z = -4

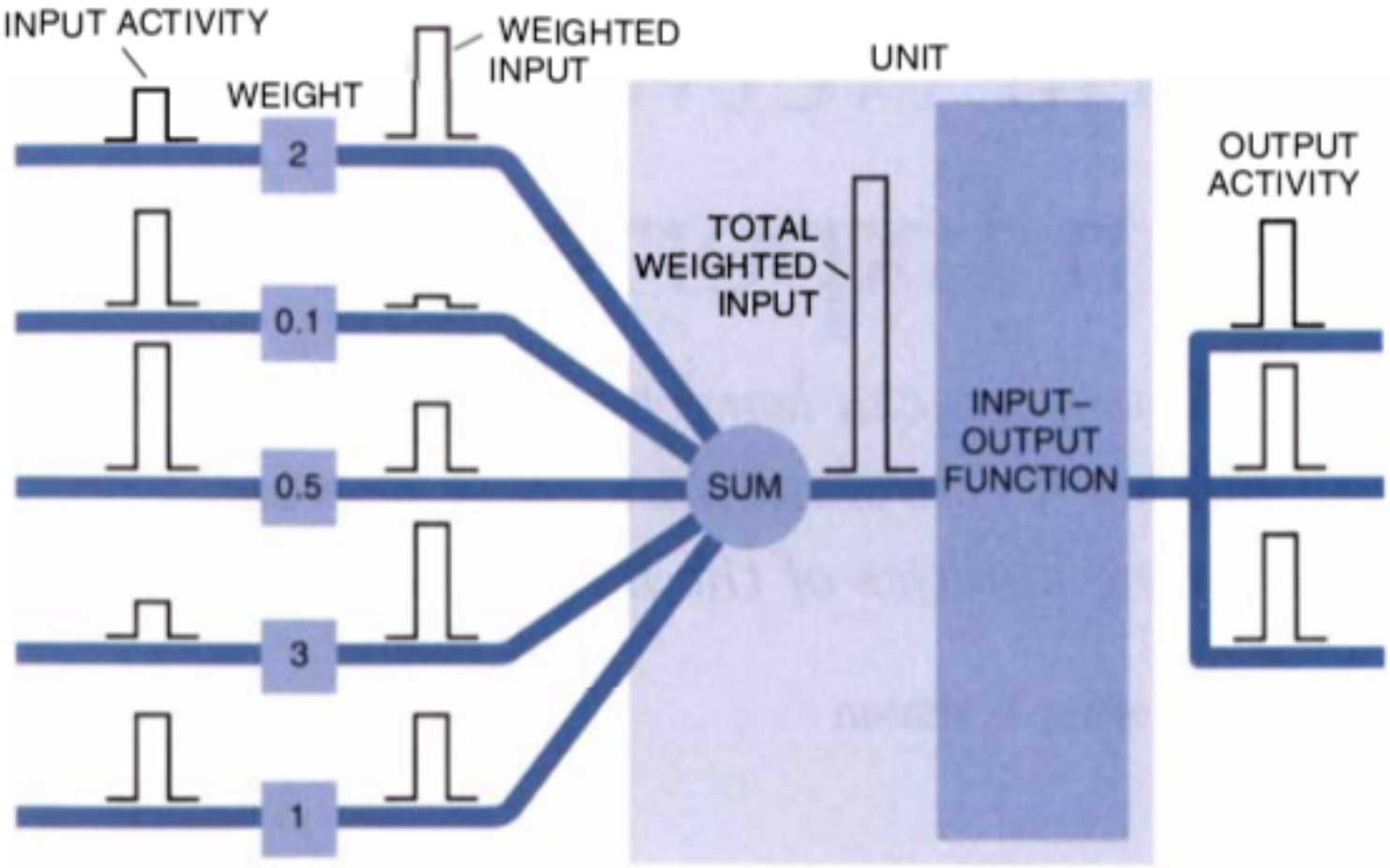
$$q = x + y \qquad \frac{\partial q}{\partial x} = 1, \frac{\partial q}{\partial y} = 1$$

$$f = qz \qquad \frac{\partial f}{\partial q} = z, \frac{\partial f}{\partial z} = q$$



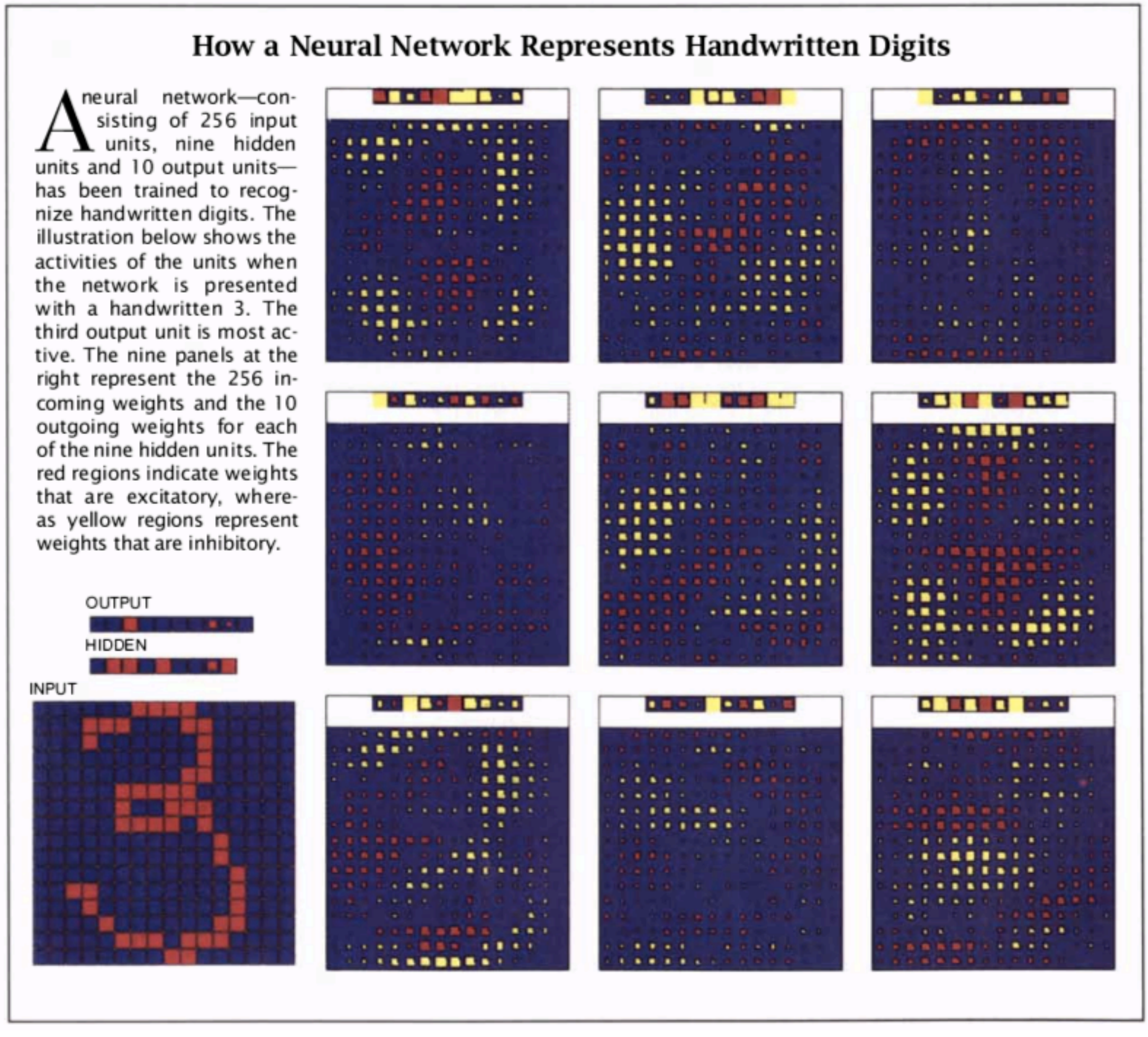
Introduction

Back Propagation（BP算法）
还可以通过训练网络判断癌变细胞的存在。



Introduction

For example:



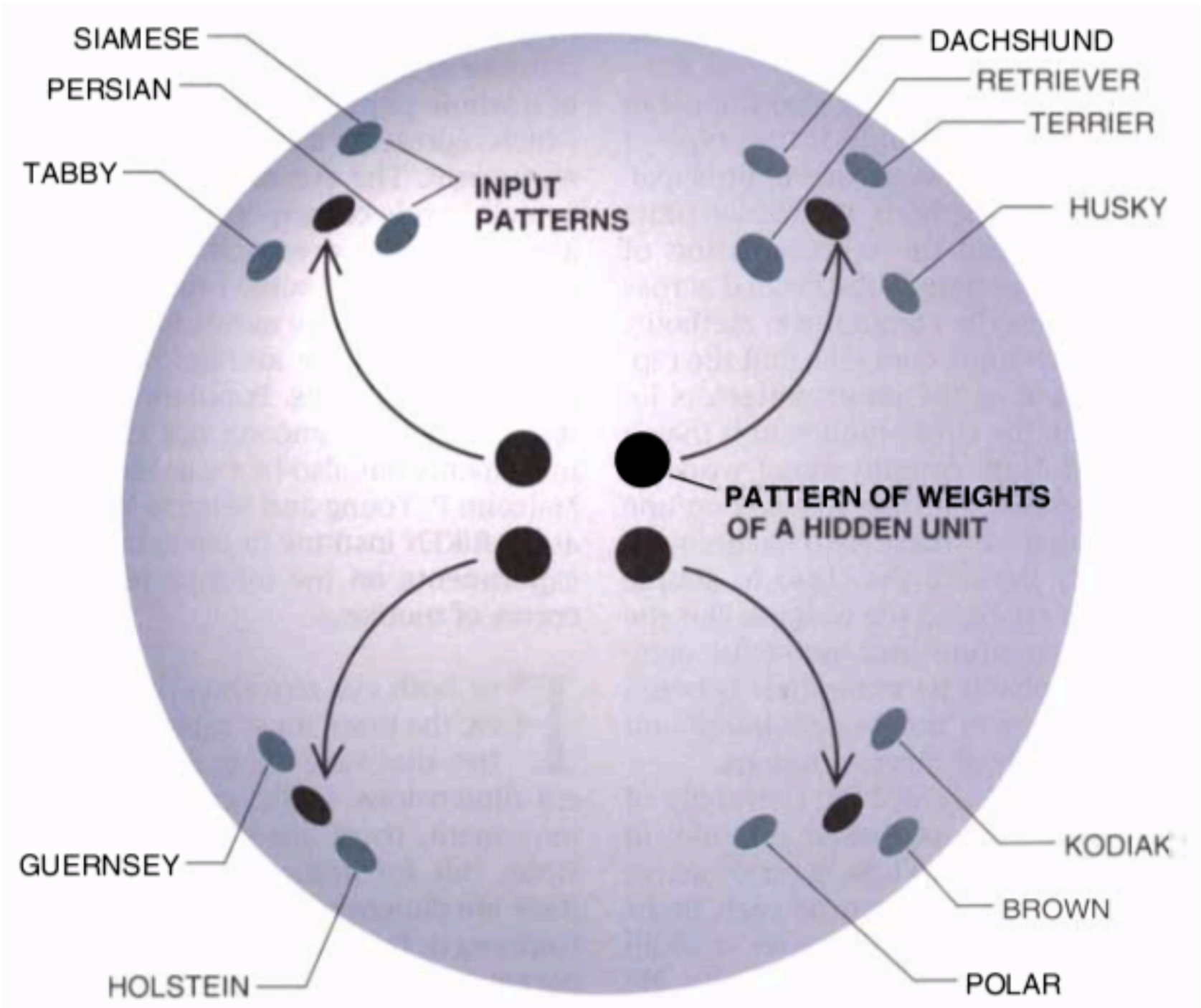
Introduction

几乎所有的非监督学习都可以被视为实现最小的代码成本和重建（reconstruction cost）成本的方法。
—代码成本即描述隐藏层活动所需的代码；
—重建成本即描述原始输入和从隐藏层中重构的对原始输入最佳近似的复制品之间的误差（The reconstruction cost is the number of bits required to describe the misfit between the raw input and the best approximation to it that could be reconstructed from the activities of the hidden units.）；
—重建成本和原始输入和其重建的复制品间的方差成正比。

Introduction

主成分分析方法的提出：如果成对的输入变量相关联，那么对其分别描述是一种资源浪费。

Competitive learning



COMPETITIVE LEARNING can be envisioned as a process in which each input pattern attracts the weight pattern of the closest hidden unit. Each input pattern represents a set of distinguishing features. The weight patterns of hidden units are adjusted so that they migrate slowly toward the closest set of input patterns. In this way, each hidden unit learns to represent a cluster of similar input patterns.

More...

-Population coding;
-Bumps of activity.
计算机的神经网络需要提供正确的信息来完成训练，相反的，人们大多数时候的学习并不会得到老师的指导，我们在没有任何直接帮助的情况下学会了解语句和视觉场景。人工神经网络如何模拟这一步？

谢谢