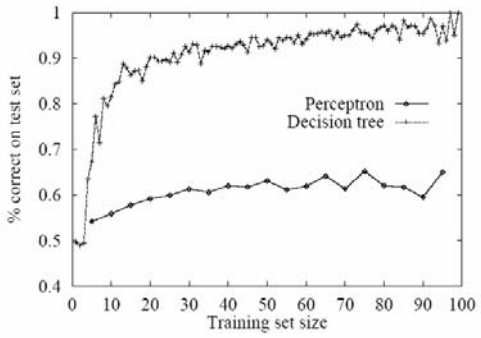
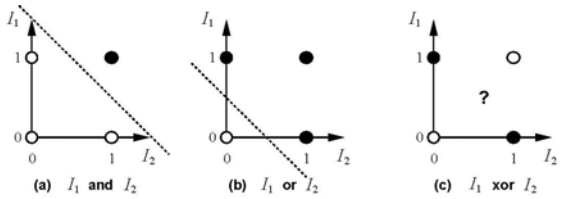
Neural Networks

CS472/CS473 – Fall 2005

Restaurant Data Set



Limited Expressiveness of Preceptrons

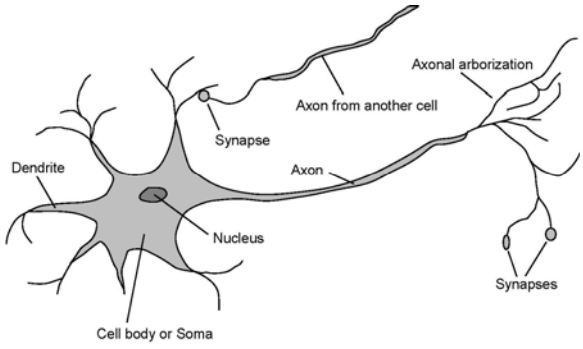


- Minsky and Papert (1969) showed certain simple functions cannot be represented (e.g. Boolean XOR). Killed the field!
- Mid 80th: Non-linear Neural Networks (Rumelhart et al. 1986)

Neural Networks

- Rich history, starting in the early forties (McCulloch and Pitts 1943).
- Two views:
  - **Modeling the brain**
  - **"Just" representation of complex functions** (Continuous; contrast decision trees)
- Much progress on both fronts.
- Drawn interest from: *Neuroscience, Cognitive science, AI, Physics, Statistics, and CS/EE.*

Neuron



Why Neural Nets?

Motivation:

Solving problems under the constraints similar to those of the brain may lead to solutions to AI problems that would otherwise be overlooked.

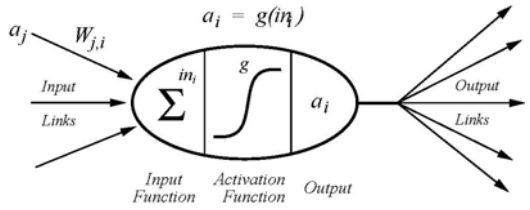
- **Individual neurons operate very slowly**
  massively parallel algorithms
- **Neurons are failure-prone devices**
  distributed representations
- **Neurons promote approximate matching**
  less brittle

Connectionist Models of Learning

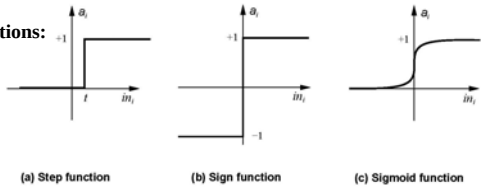
Characterized by:

- **A large number of very simple neuron-like processing elements.**
- **A large number of weighted connections between the elements.**
- **Highly parallel, distributed control.**
- **An emphasis on learning internal representations automatically.**

Artificial Neurons

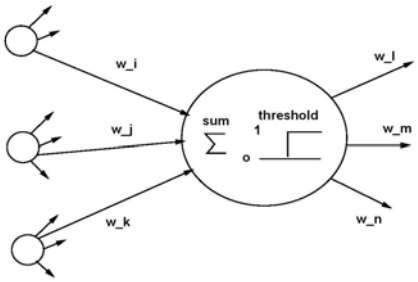


Activation Functions:

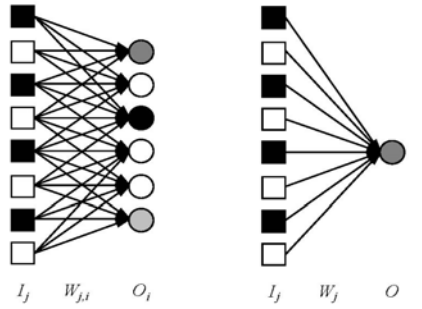


(a) Step function (b) Sign function (c) Sigmoid function

Example: Perceptron



Perceptron Network



Perceptron Network Single Perceptron