CSC 480 Artificial Intelligence

Neural Networks

Biological Neural Networks

(Try to create artificial intelligence based on natural intelligence)

Biological Neurons

- Synapses (outputs) connect to the dendrites (inputs) of other neurons
- Signals "move" via electrochemical impulses
- The synapses release chemical signals called neurotransmitters
  (the sum of which can cause a threshold to be reached, causing the neuron to "fire")
- Synapses can be inhibitory or excitatory
  (depends on the neurotransmitters, as some of them inhibit the neuron from firing)

Natural Neural Networks: The Brain

- Massively interconnected neurons
- We are born with about 100 billion neurons
- A neuron may connect to as many as 100,000 other neurons

Real Neural Learning

- Hebb's Rule: "Neurons that fire together, wire together"
  (When two connected neurons are firing at the same time, the strength of the synapse between them increases.)
- Synapses change size and strength with experience.

Artificial Neural Networks

- Analogy to biological neural networks
- Attempt to understand natural biological systems through computational modeling
- Intelligent behavior as an "emergent" property of a large number of simple units rather than from explicitly encoded symbolic rules and algorithms

The Perceptron

- TLU (Threshold Logic Unit) = Linear + Threshold (Step Function)
- Common step functions:
- A Perception: A single layer of TLUs
- Fully connected layer (dense layer): input layer + output layer
- examples

Multilayer Perceptron

- ANN contains a deep stack of hidden layers: Deep Neural Network (DNN)
- Deep Learning studies DNNs
- How to train: Backpropagation