CSC 412 Machine Learning and Knowledge Discovery
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

- Input layer, output layer, hidden layer, fully connected layer (dense layer)

- Examples:

Multilayer Perceptron

- ANN contains a deep stack of hidden layers: Deep Neural Network (DNN)

- Deep Learning studies DNNs