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# Artificial Neural Networks and Their Applications

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# Artificial Neural Networks and Their Applications

## Motivation and Applications

- **Need for models where:**
  - many hypotheses are pursued in parallel
  - high computation rates are required
  - current best systems are poor compared to human performance
- **Applications:**
  - Knowledge Discovery and Data Mining.
  - Speech and image recognition
  - Manufacturing quality control
  - Financial prediction and risk management
  - Medical field—spotting cancerous cells

## Challenges

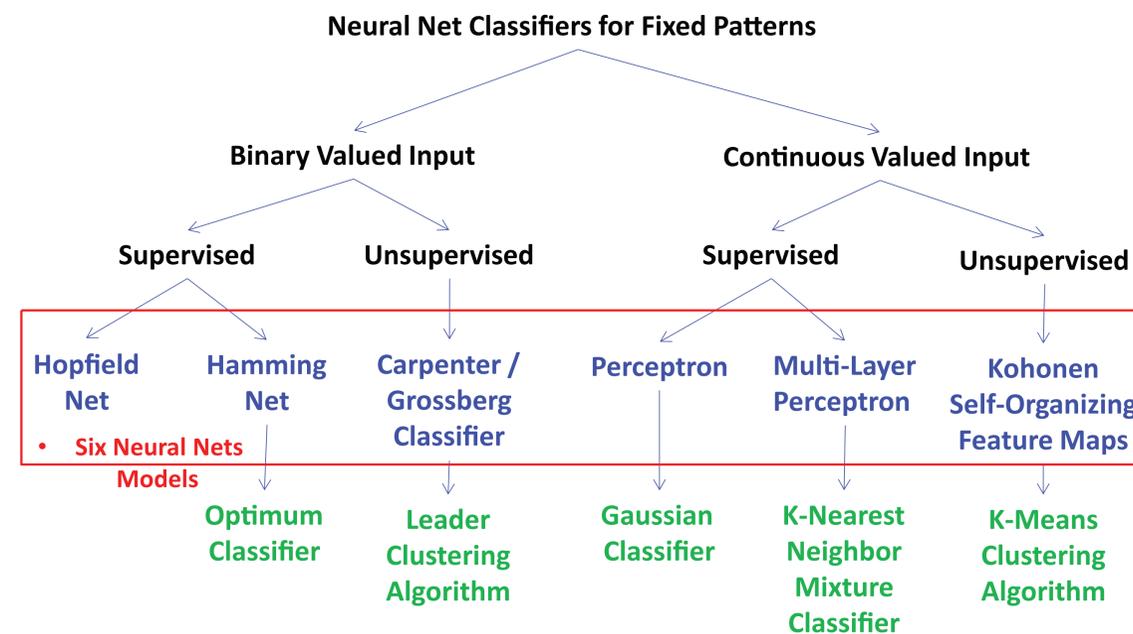
- **Neural Net Models are specified by:**
  - net topology = net's shape
  - node characteristics = offset & nonlinearity
  - learning/training rules

There are **challenges** in specifying the **initial set of weights** and **how weights should be adapted** to improve performance.

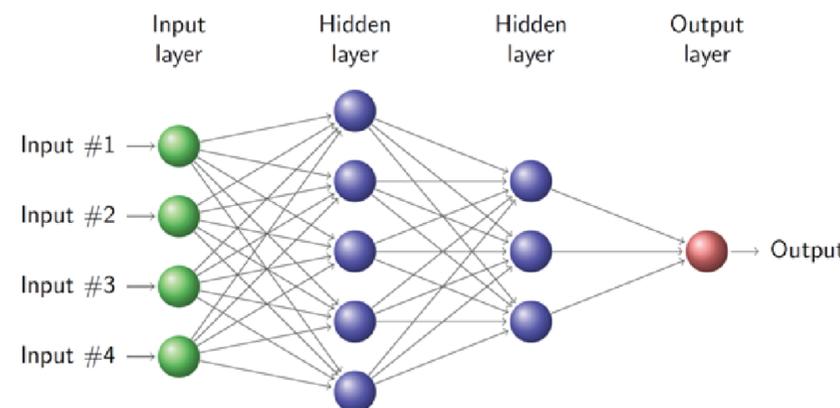
## Problem Formulation

- **Given**
  - Six important Neural Net models
- **Review each Neural Net model**
  - Describe the purpose and design of each net
  - Relate each Neural Net to existing pattern classification and clustering algorithms
  - Illustrate design principles used to obtain parallelism using neural-like processing elements
- **Objective**
  - Provide an introduction to Neural Nets
- **Constraints**
  - The Single layer Perceptron and Multi-Layer Perceptron are the only ANNs implemented using MatLab and Java code.

## 6 Popular Artificial Neural Net Models



## Artificial Neural Net Structure



## Results

- **Hopfield Net:**
  - Separates the classes by example. Every example is used for training (classifying with supervised training). Thus, the Net can run out of nodes for training.
- **Hamming Net:**
  - Separates the classes by example. However, the Net iterates until it gets close to an example (classifying with supervised training). Thus, the Net needs less examples and has less chance of running out of nodes for training.
- **Carpenter/Grossberg Net:**
  - Separates the classes by example. However, the Net selects its own examples (clustering with unsupervised training). The Vigilance-Test makes sure the examples created by the Net are not too similar. However, there is an issue with noisy data.
- **Kohonen Self-Organizing Feature Maps:**
  - Separates the classes by example. The Net selects its own examples (clustering with unsupervised training). However, this Net removes the issues with noisy data by using neighborhoods.
- **Perceptron (Single Layer) Net:**
  - Separates the classes with a straight line /hyperplane (classifying with supervised training).
- **Perceptron (Multi-Layer) Net:**
  - Separates classes by a complex nonlinear line/hyperplane (classifying with supervised training).