CS 401 Artificial Intelligence

FAST-NU

Lecture 12

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Brief Review

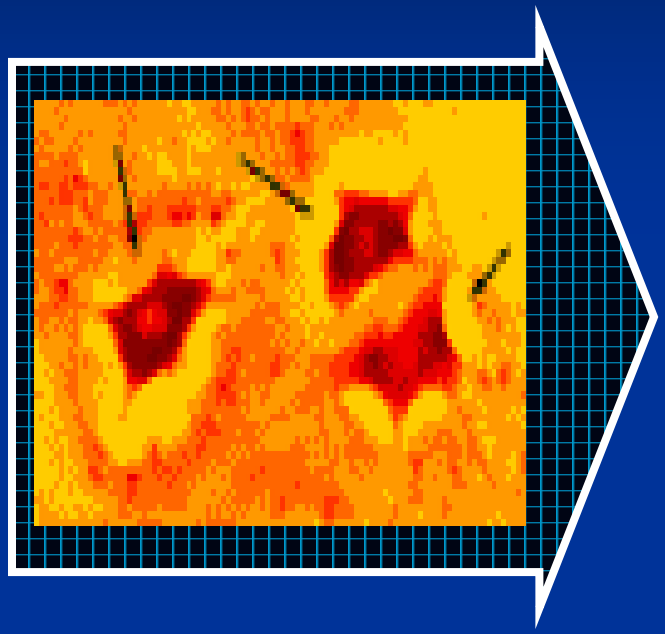
- An artificial neural network is an information processing system that has certain performance characteristics in common with biological neural networks.
- An ANN can be characterized by:
  1. ***Architecture:*** The pattern of connections between different neurons.
  2. ***Training or Learning Algorithms:*** The method of determining weights on the connections.
  3. ***Activation Function:*** The nature of function used by a neuron to become activated.

Architecture

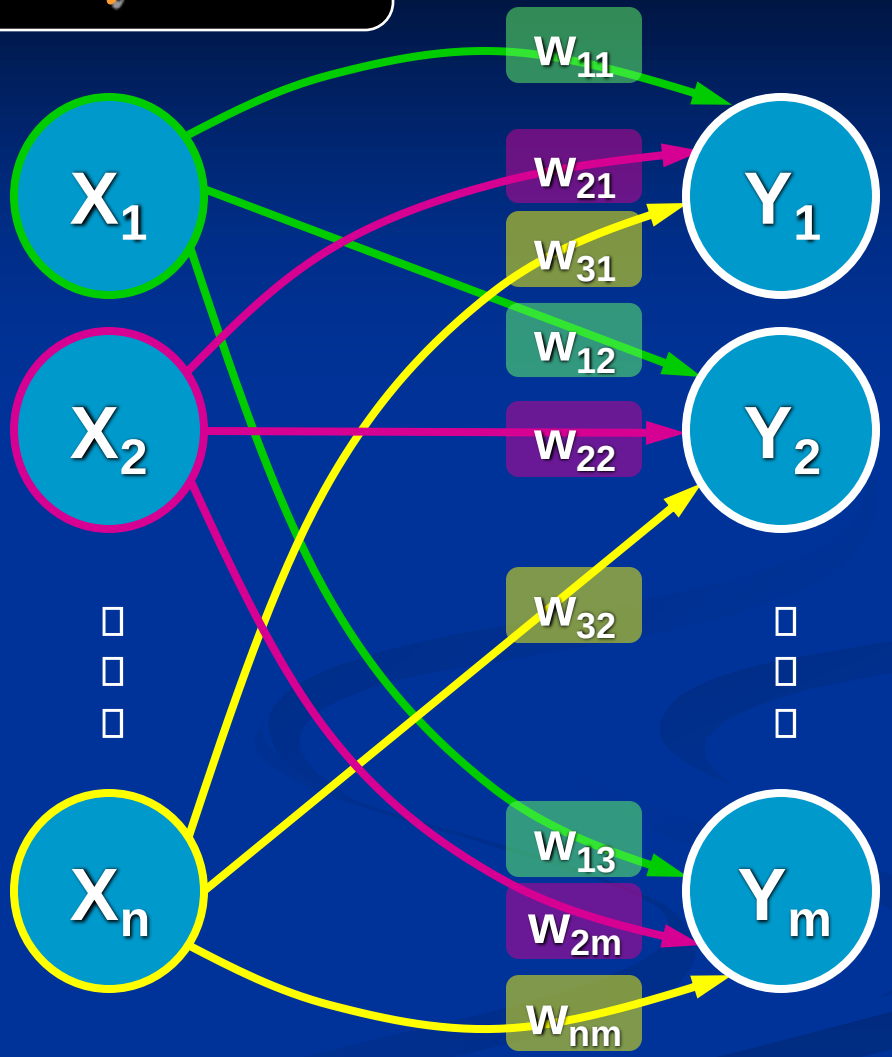
- There are two basic categories:

1. Feed-forward Neural Networks
   - These are the nets in which the signals flow from the input units to the output units, in a forward direction.
   - They are further classified as:
     1. Single Layer Nets
     2. Multi-layer Nets
2. Recurrent Neural Networks
   - These are the nets in which the signals can flow in both directions from the input to the output or vice versa.

Model 1: A Single Layer Net



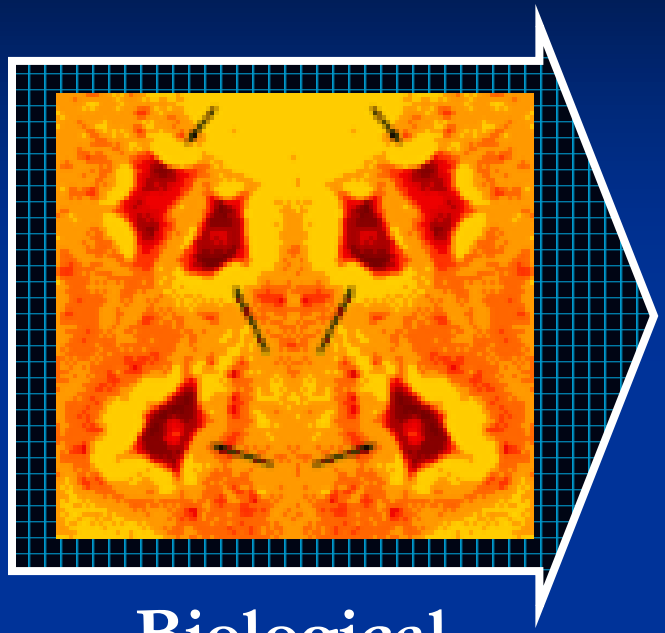
Biological Neurons In Action



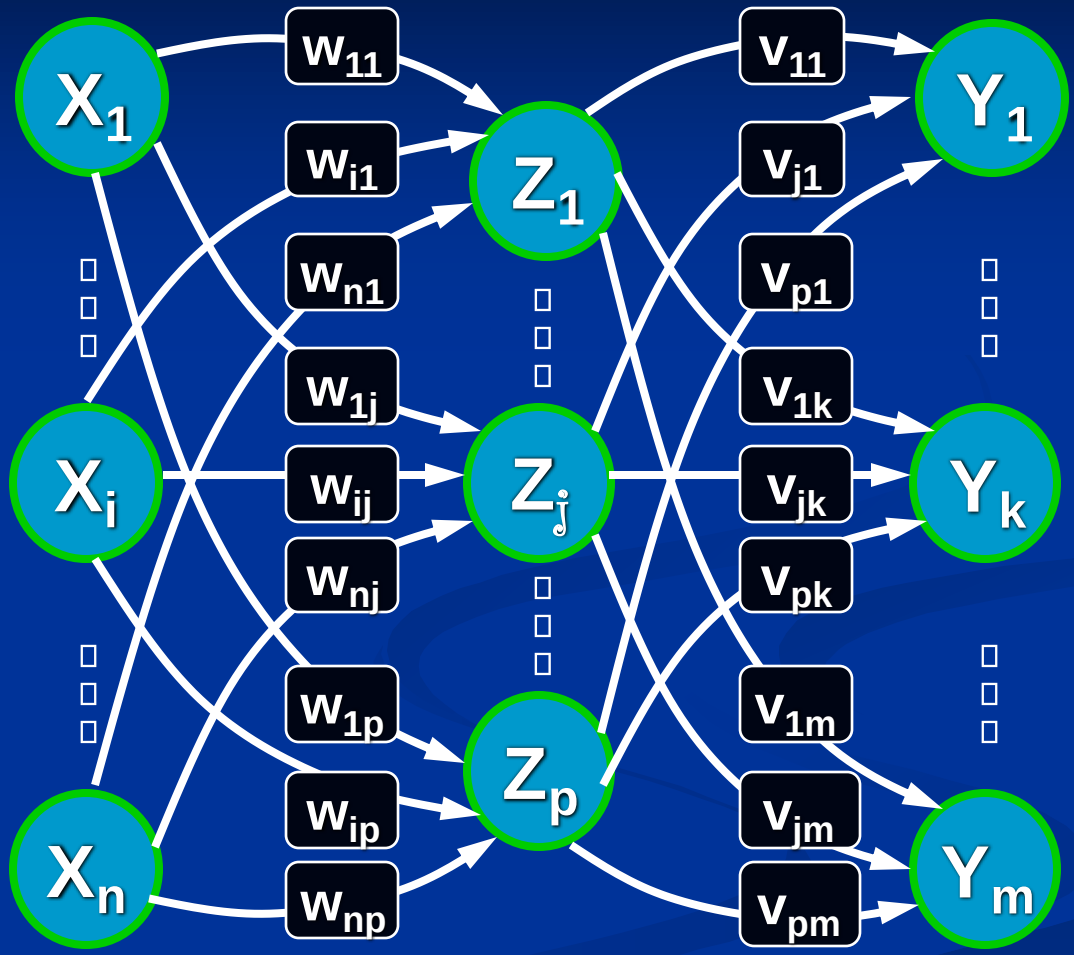
Input Units

Output Units

Model 2: A Multi-Layer Net



Biological Neurons In Action

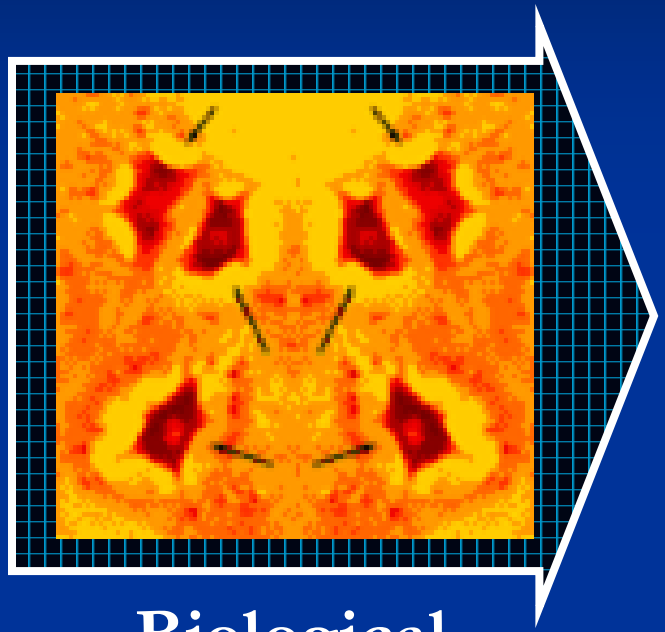


Input Units

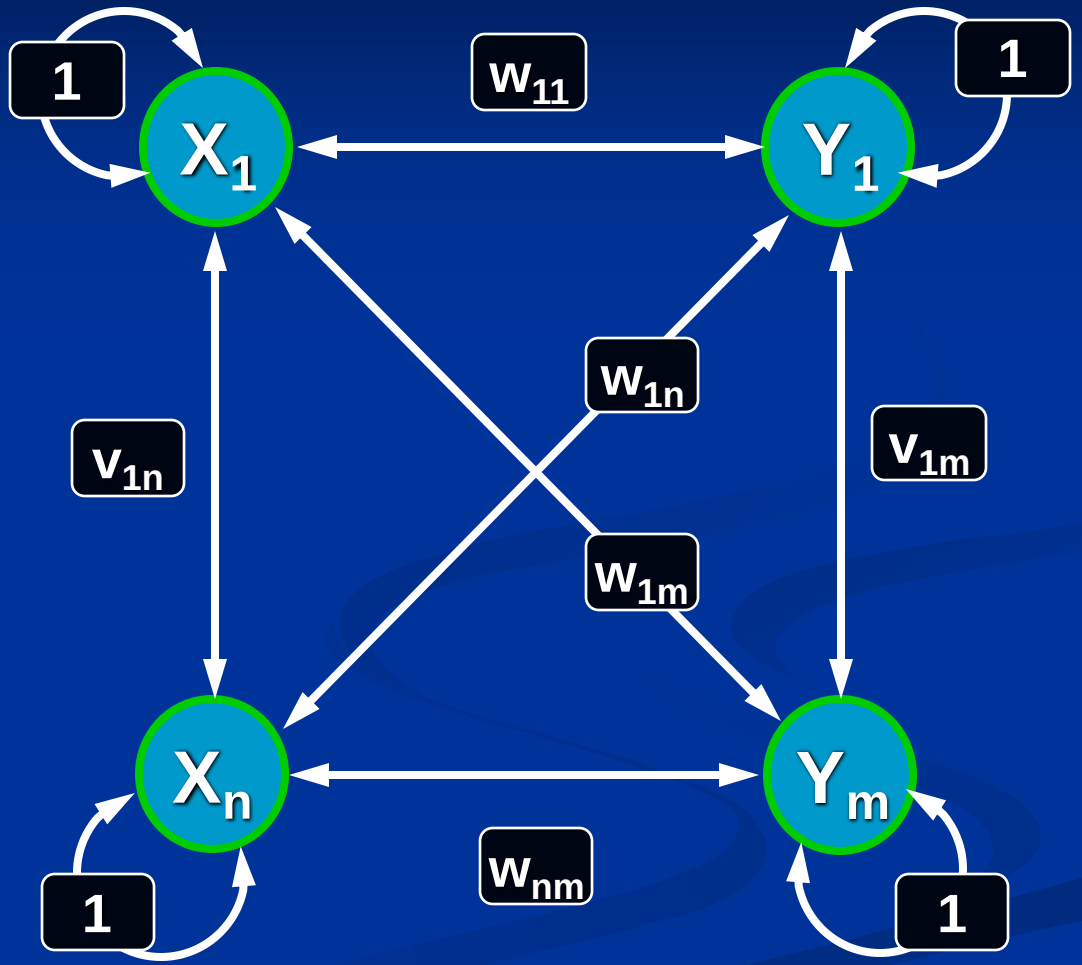
Hidden Units

Output Units

Model 3: A Recurrent Net



Biological
Neurons
In Action



Training

Supervised Training

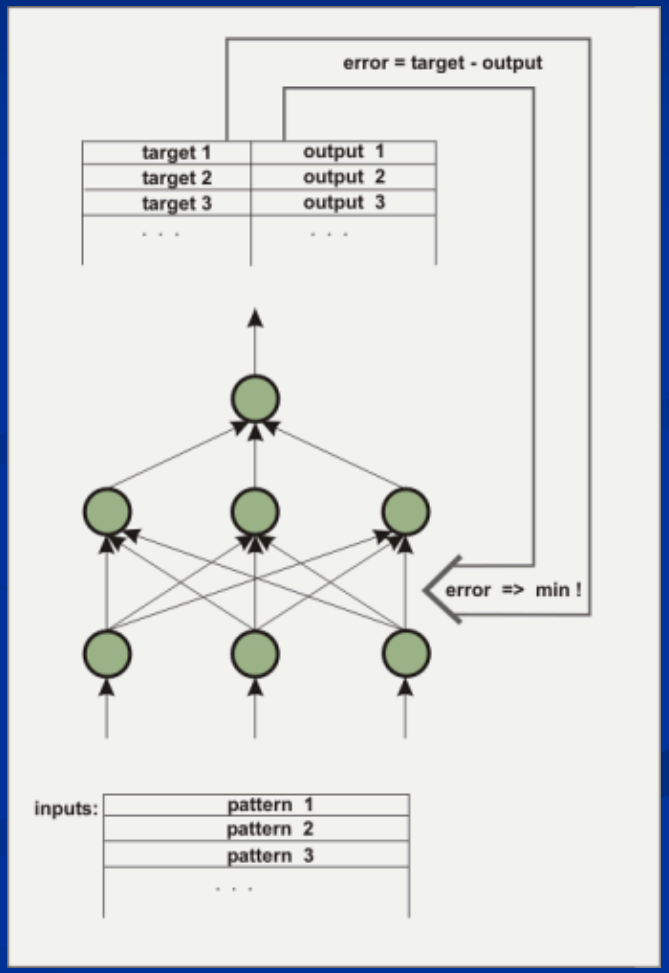
- Training is accomplished by presenting a sequence of training vectors or patterns, each with an associated target output vector.
- The weights are then adjusted according to a learning algorithm.
- During training, the network develops an associative memory. It can then recall a stored pattern when it is given an input vector that is sufficiently similar to a vector it has learned.

Unsupervised Training

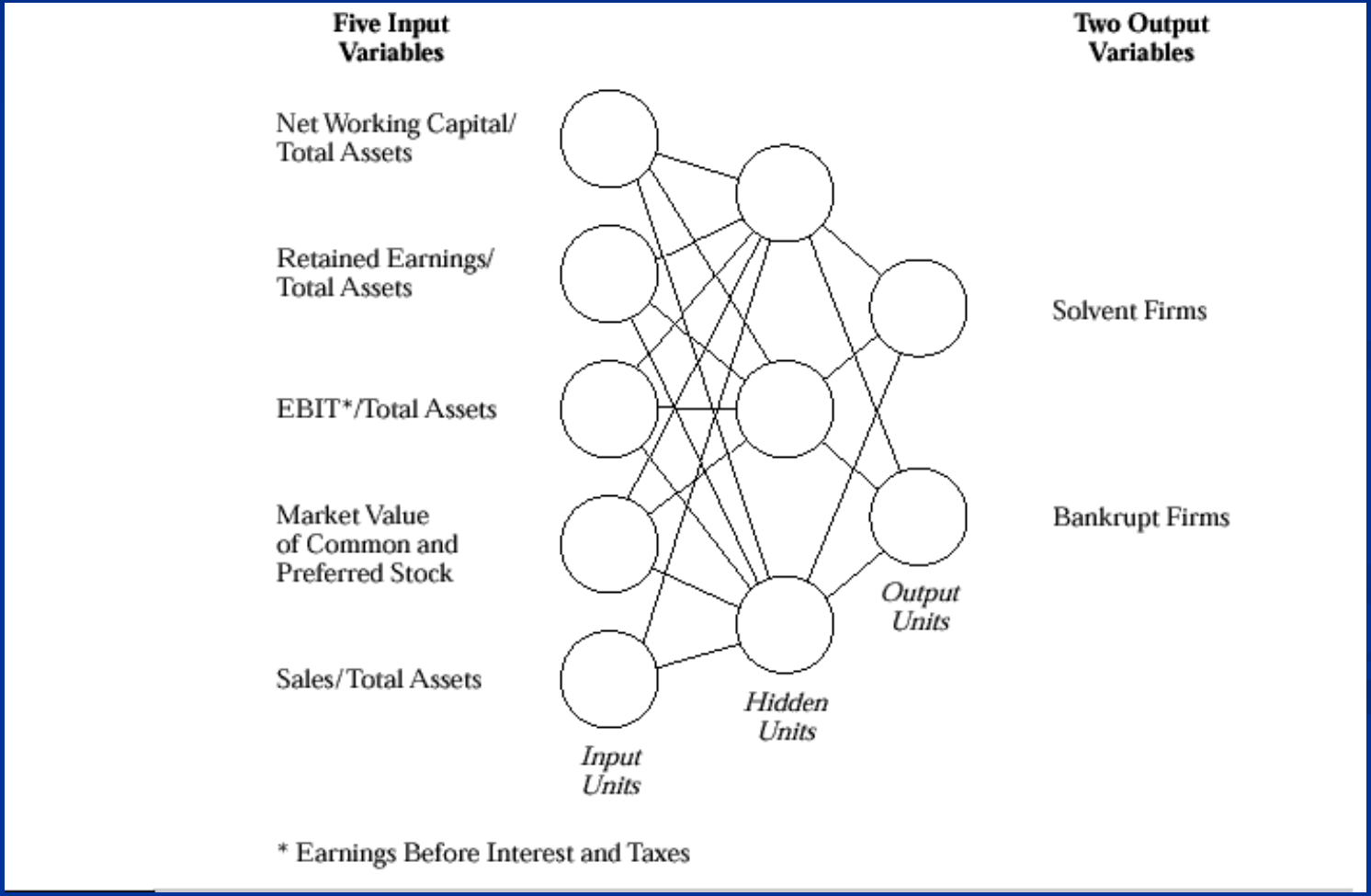
- A sequence of input vectors is provided, but no target vectors are specified in this case.
- The net modifies its weights and biases, so that the most similar input vectors are assigned to the same output unit.

Supervised Learning

- Each element in a training set is paired with an acceptable response
- Network makes successive passes through the examples
- The weights adjust toward the goal state.

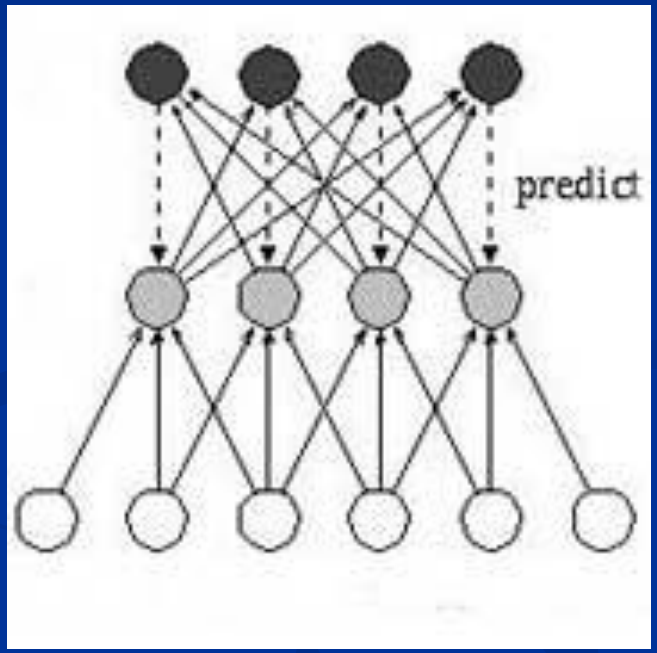


A Supervised Neural Network (An Example)



Unsupervised Learning

- No external factors can influence adjustment of input's weights
- No advanced indication of correct or incorrect answers
- Adjusts through direct confrontation with new experiences



Business Applications (1)

- **Risk management**
  - Appraise commercial loan applications
  - NN trained on thousands of applications, half of which were approved and the other half rejected by the bank's loan officers
  - Through supervised learning, NN learned to pick risks that constitute a bad loan
  - Identifies loan applicants who are likely to default on their payments

Business Applications (2)

- **Predicting Foreign Exchange Fluctuations:**
  - A set of relevant indicators were identified, used as inputs to NN
  - NN was trained for exchange rates of US dollar against Swiss franc and Japanese yen, using data from first 6 months of 1990. Then it was tested over an 8- to 11-week period
  - Results revealed return on capital of about 20%

Business Applications (3)

- **Mortgage Appraisals:**
  - Neural network uses the data in the mortgage loan application
  - It estimates value of the property based on the immediate neighborhood, the city, and the country
  - The system comes up with a valuation for the property and a risk analysis for the loan.

Reading Assignment & References

1. Section 10.1.1, 10.2.1 and 10.2.2 of George F. Luger
2. Chapter 4 page 81-124, Machine Learning by Tom M. Mitchell
3. Study the system ALVINN in detail.

http://www-2.cs.cmu.edu/afs/cs/project/ai-repository/ai/areas/neural/systems/nevprop/np.c