Classification / Regression

Neural Networks 2

Neural networks

- Topics
  - Perceptrons
    - structure
    - training
    - expressiveness
  - Multilayer networks
    - possible structures
      - activation functions
    - training with gradient descent and backpropagation
    - expressiveness

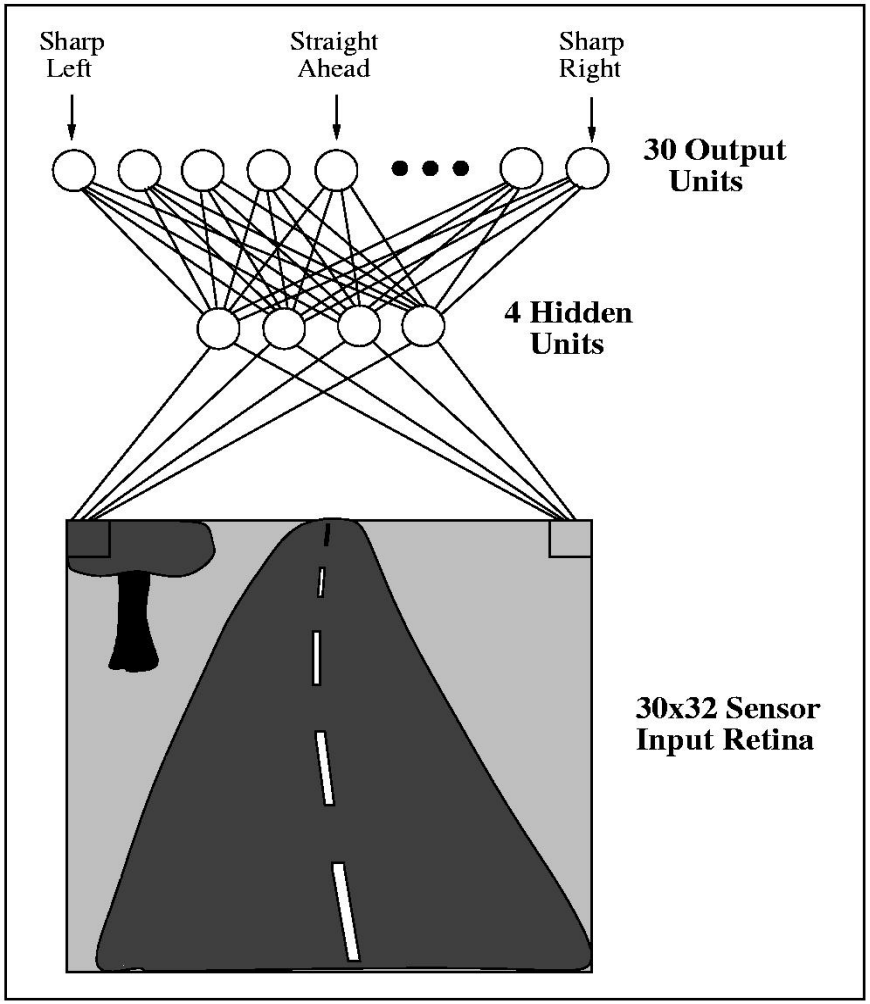
Neural network application

ALVINN: An Autonomous Land Vehicle In a Neural Network

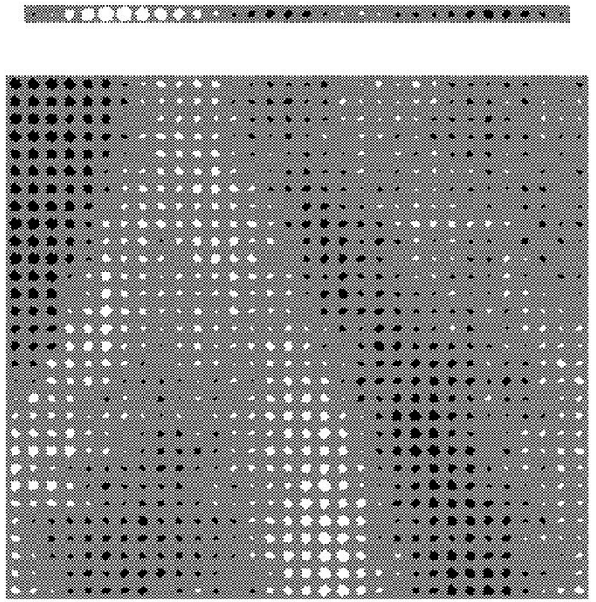
(Carnegie Mellon University Robotics Institute, 1989-1997)

ALVINN is a perception system which learns to control the NAVLAB vehicles by watching a person drive. ALVINN's architecture consists of a single hidden layer back-propagation network. The input layer of the network is a 30x32 unit two dimensional "retina" which receives input from the vehicles video camera. Each input unit is fully connected to a layer of five hidden units which are in turn fully connected to a layer of 30 output units. The output layer is a linear representation of the direction the vehicle should travel in order to keep the vehicle on the road.

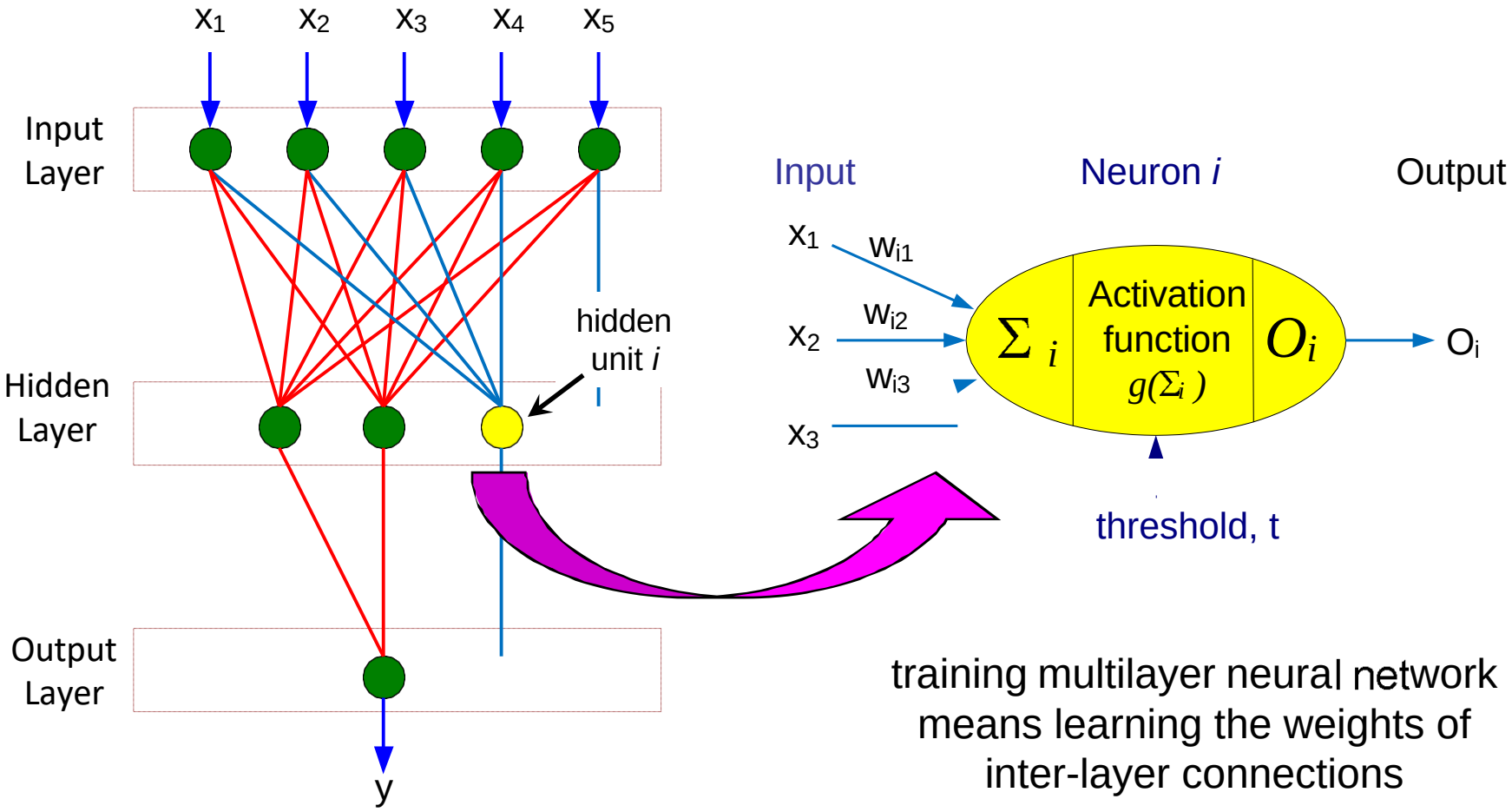
Neural network application



ALVINN drives 70 mph on highways!



General structure of multilayer neural network



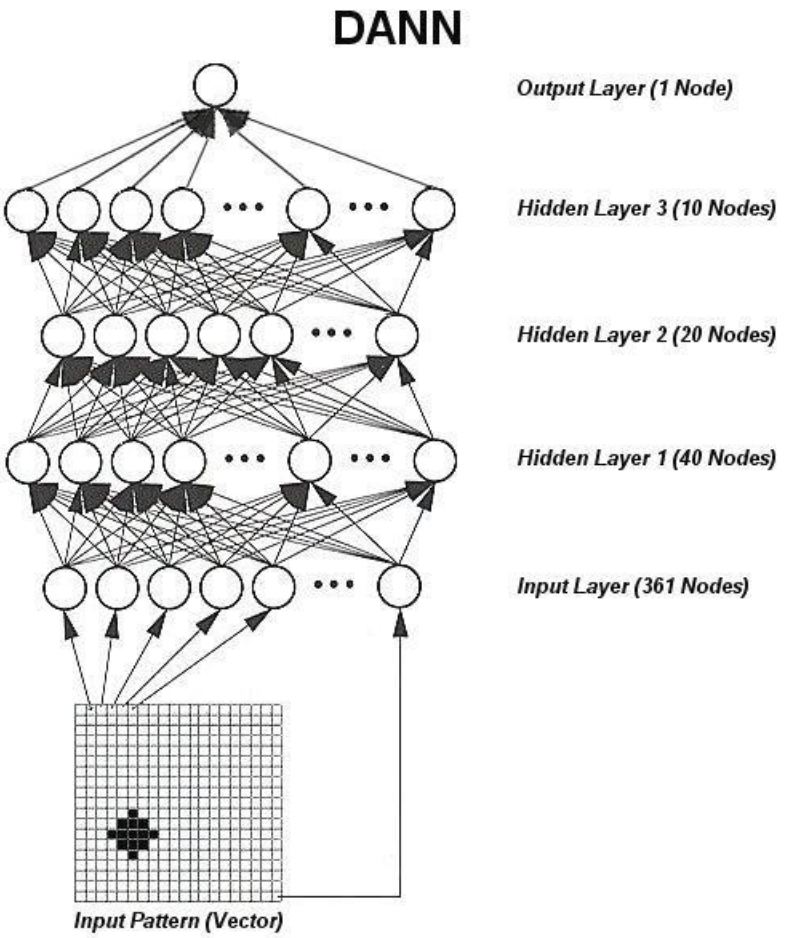
training multilayer neural network means learning the weights of inter-layer connections

Neural network architectures

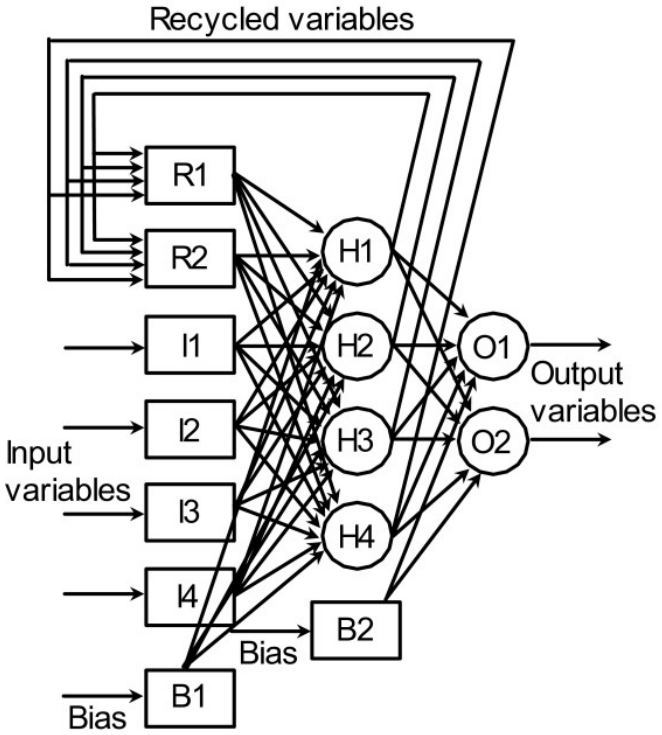
- All multilayer neural network architectures have:
  - At least one hidden layer
  - Feedforward connections from inputs to hidden layer(s) to outputs

  but more general architectures also allow for:
  - Multiple hidden layers
  - Recurrent connections
    - from a node to itself
    - between nodes in the same layer
    - between nodes in one layer and nodes in another layer above it

Neural network architectures



More than one hidden layer



Recurrent connections

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