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Topic: Agricultural Analysis and Prediction Using Satellite Imagery

Book name: A Course in Machine Learning
Chapter: 10, Neural Networks
Author: Hal Daumé III
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NEURAL NETWORKS

- Nonlinear
  - Decision Trees
  - Nearest Neighbor Models
- Perceptron (Classic Linear Model)
- Nonlinear Learning Models
  - single-layer network
  - multi-layer network
  - **Bio-inspired Multi-Layer Networks**
    - collection of perceptrons
    - NEURAL NETWORKS
      - two-layer network
        - activation function (link function)
          - Hidden unit
            - Input features
            - Output unit
          - sign function
          - hyperbolic tangent function (sigmoid functions)
        - Two-Layer Networks are Universal Function Approximators

Lots of hidden units
- very complicated function
- better performance
  - Overfit the data

Back propagation algorithm
- Gradient Descent
  - input error / hidden error
  - Gradient Computation (for u)
    - optimization active
      - Early-stopping Regularization
  - Gradient Computation (for h)
    - Activation function (h)
      - squared error (loss)
        - optimization objective
          - Two layered network training process
          - Algorithm Back Propagation
- Chain Rule
  - Loss function
    - Output weights
    - input weights
  - Gradient Computation (for u)
    - Activation function (f)
      - Exponential loss
      - weight techniques
      - Regularization

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Zero Weights

Neural Network Initialization
- Random Initialization
  - Benefits of Random Initialization

Sensitivity to Initialization
- Local Optima Problem
- Symmetric Modes in Weight Space
  - Challenges in Neural Network Tuning
    - Number of Layers
      - Hidden Layers
        - Learning rate Initialization
          - Stopping IIteration or Weight regulaization
    - Difficulty in Interpretingator
      - Weights in Multilayer Networks

Generalization beyond two layers
- Arbitrary DAG
  - Compute activtions
  - **Backpropagation Algorithm**
    - Computing Grdients
      - Basic Functions
      - **RBF**
        - **Gaussian Bumps**
          - **Optimal Gaussian Vriables**
    - Check Circuit Complexity
      - Depth
        - Parity Function
          - Architecture Selection
            - Layer-wise Initialization
      - Breadth