Notes from bibliography

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Contents

1 Fundamental of Higher Order Neural Networks for Modeling and Simulation (Madan M. Gupta)

Biological neuron
1. Synaptic operation - strength (weight) is represented by previous knowledge. 2. Somatic operation - aggregation (summing), thresholding, nonlinear activation and dynamic processing - output after certain threshold

if neuron was only linear the complex coginition would disappear

First neuron modeled (1943)

$$u = \sum_{i=1}^{n} w_i x_i$$

1.1 Higher Order Terms of Neural Inputs

year 1986, 1987, 1991, 1992, 1993

$$u = \sum_{j=i}^{n} \sum_{i=1}^{n} w_{ij} x_i x_j$$

1.2 Activation functions

1.2.1 Sigmoid

$$\phi(x) = \frac{1}{1 + e^{-x}}$$

1.3 SONU/QNU

$$u = \mathbf{x}_a^T \mathbf{W}_a \mathbf{x}_a = \sum_{j=i}^{n} \sum_{i=1}^{n} w_{ij} x_i x_j$$

$$y = \phi(u)$$

1.3.1 Learning

2 Nonconventional Neural Architectures and their Advantages for Technical Applications (Ivo Bukovsky)

- first mathematical model of neuron 1943
- principals for modeling of dynamic systems
  - customable non-linearity
  - order of dynamics of state space representaion of a neuron
  - adaptable time delays

2.1 HONU, HONN

- PNN - polynomial neural networks
- LNU, QNU, CNU
- linear optimization, avoidance of local minima

bio-inspired neuron, *perceptron*, *recurent* (dynamic, hopfield)

static vs dynamic
continous vs discrete implementation of static/dynamic HONN

2.2 Gradient optimization methods

- back propagation
- gradient descent rule
- Levenberg-Marquardt algorthm

2.3 RHONN

- RTRL

2.4 RTRL-real time recurrent learning

- dynamic version of gradient descent

2.5 BPTT-back propagation throught time

- batch traning technique
- can be implemented as combination of RTRL and L-M algorithm => RHONU