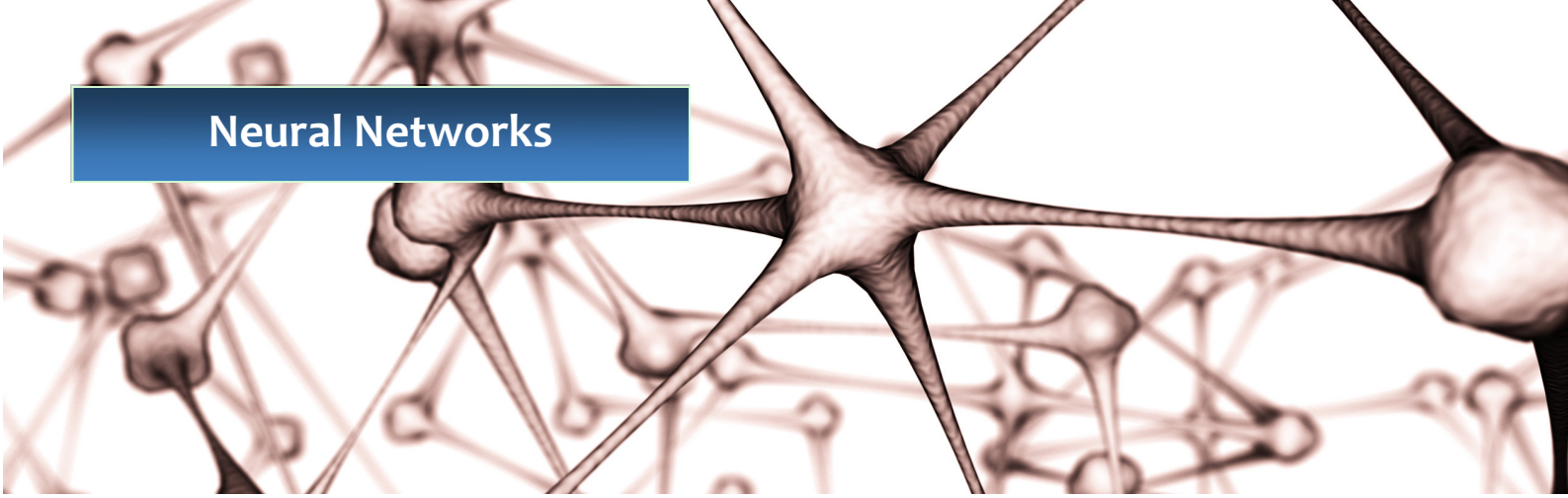

Neural Networks

"The greatest single human gift - the ability to chase down our dreams"

Professor Hobby (Artificial Intelligence – Movie)

Supplement for
Bachelors in Bio-Medical Engineering
Semester VIII
Bio-Medical College

Pramod Parajuli

Motivation

(Potassium cyanide)

(Video Presentation – From Computing Neuroscience to Computing Architecture)

(IBM Blue Gene project) 

WebLinks to surf

- http://www.biomedcentral.com/
- http://en.wikipedia.org/wiki/Blue_Gene
- http://bluebrain.epfl.ch/
- http://www.visualbiotech.ch/
- http://domino.research.ibm.com/comm/research_projects.nsf/pages/bluegene.index.html

(Video Presentation - Modeling the nature
– BarrySchuler_2008p – Genomics 101, 21:26
- Craig Venter_2008 – On the verge of creating synthetic life, 17:22
- KwabenaBoahen_2007G – Computer that works like brain, 17:48
- Juan Enriquez_2009 – Beyond the crisis, mindboggling science and the arrival of homo evolutes: 18:50)

Demo - Character decision making – simulation
Demo – Optical Character Recognition

Syllabus

NEURAL NETWORKS
Bachelors in Bio-Medical Engineering - VIII

COURSE OBJECTIVE

The objective of this course is to impart fundamental understanding Neural Networks, their computational structures – Artificial Neural Networks (ANNs), and use of ANNs in bio-medical problem modeling and solving.

COURSE CONTENTS

Unit 1 – Introduction to Neural Networks **[__ hrs.]**

1.1. Introduction to Neural Networks
1.2. Historical background
1.3. Application of Neural Networks in Medicine
1.4. Neural networks vs. conventional computers – a comparison

Unit 2 – Neural Network Architecture **[__ hrs.]**

2.1. Biological Neural Networks (structure, activation, lateral inhibition)
2.2. Learning mechanism

Unit 3 – Artificial Neural Networks (ANNs) **[__ hrs.]**

3.1. History of ANNs (Mc Culloch and Pitts, Connectionist, XOR Problem)
3.2. Feedback (auto-associative networks)
3.3. Perceptrons
3.4. Multi-Layered Perceptrons

Unit 4 – Learning Mechanisms **[__ hrs.]**

4.1. Supervised learning methods
- 4.1.1. Back-propagation
- 4.1.2. Conjugate Gradient method
- 4.1.3. Levenberg-Marquardt (LM) method
- 4.1.4. Madaline
- 4.1.5. Radial-Basis Networks
- 4.1.6. Cascade-Correlation Networks
- 4.1.7. Polynomical Networks
- 4.1.8. Recurrent Networks
  Time Series, back-propagation through time, finite impulse response (FIR)
  MLP, temporal differences method (TD)

4.2. Unsupervised learning methods
- 4.2.1 Kohonen Self-Organizing Maps (SOMs)

Unit 5 – Associative Models **[__ hrs.]**

5.1. Linear Associative Memory (LAM)
5.2. Hopfield Networks
5.3. Brain-State-in-a-Box (BSB)
5.4. Boltzmann Machines and Simulated Annealing
5.5. Bi-Directional Associative Memory (BAM)

Unit 6 – Application of ANNs **[__ hrs.]**

6.1. Pattern recognition
6.2. Optimization problems

Unit 7 – Neural Networks in Medicine **[__ hrs.]**

7.1. Modeling and Diagnosing the Cardiovascular System
7.2. Electronic noses - detection and reconstruction of odors by ANNs
7.3. Instant Physician - a commercial neural net diagnostic program

Unit 8 - Introduction to Genetic Algorithms and Fuzzy Logic **[__ hrs.]**

CASE STUDIES

Some case studies related with application of ANNs in medical field with sufficient level of complexity shall be conducted throughout the course.

LEARNING OUTCOMES

At the successful completion of the course, the learners are expected to have;

- a brief understanding of biological neural networks,
- a good understanding of modeling of neural networks,
- a thorough understanding of ANNs and their use in medical field.

EXPECTED STUDY HOURS

Total lecture hours = 45

EVALUATION CRITERIA

Sessional (internal) evaluation---------- 10**0**
Mid-term 25
Assessment 25
Assignments, attendance, classroom performance 25
Project/presentation/case studies 25
Final examination evaluation ----------__
Total

COURSE REFERENCES

Haykin, S., *Neural Networks – A comprehensive introduction, Second Edition,* Pearson.

Anderson, J. A., *An Introduction to Neural Networks,* PHI, 2006.

Kosko, B., *Neural Networks and Fuzzy Systems,* PHI.

Aleksander, I., Morton, H., *An introduction to neural computing. 2nd edition*

Davalo, E., Naim, P., *Neural Networks*

Rumelhart, Hinton and Williams, *Learning internal representations by error propagation,* 1986.

PRACTICAL

1. Introduction and Key Features of Matlab
2. Working with Neural Network Toolbox and familiar with recognition, clustering and network training
3. Network Architectures
    a. Supervised Networks
        i. Feed forward
        ii. Radial basis
        iii. Dynamic networks
        iv. learning vector quantization

   b. Unsupervised Networks
4. Training and Learning Functions
   a. Back-propagation algorithm
5. Modeling and Diagnosing the Cardiovascular System
6. Electronic noses - detection and reconstruction of odors by ANNs

SUPPLEMENTS

A CD containing relevant supplement materials to the Neural Networks will be provided.

Further supplements are available at: **http://www.pramodparajuli.com/**