

**A short course on “Neural Networks” given in Fall 2015  
to HCMUTE graduate students**

**Contents:**

**About Neural Networks:** Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, and Potential Applications of ANN.

**Essentials of Artificial Neural Networks:** Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

**Single Layer Feed Forward Neural Networks:** Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model.

**Multilayer Feed forward Neural Networks:** Generalized Delta Rule, Derivation of Back Propagation (BP) Training, Summary of Back Propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

**Associative Memories** Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis.

**RBF Neural Networks:** Neural networks using RBF as activation function; Function approximation using RBF NN; learning rules for RBF NN.

**Applications of Neural Networks:** Pattern recognition; nonlinear signal processing; Process identification.

**References:**

- 1) M.T. Hagan & M.H. Beale, "Neural Networks Design", 2nd edition, M. Hagan Publisher, 2014
- 2) C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007
- 3) S. Samarasinghe, "Neural Networks for Applied Sciences and Engineering", Auerbach Publications, 2006
- 4) S. Haykin, "Neural Networks and Learning Machines", 3rd edition, Prentice Hall, 2008