19CSE456	NEURAL NETWORKS AND DEEP LEARNING	L-T-P-C: 2-0-3-3

Pre-Requisite(s):19MAT111 Multivariable Calculus, 19MAT112 Linear Algebra, 19MAT205 Probability and Random Processes, 19CSE305 Machine Learning

Course Objectives

- This course provides an introduction to deep neural network models, and surveys some of the applications of these models in areas where they have been particularly successful.
- The course covers feedforward networks, convolutional networks, recurrent and recursive networks, as well as general topics such as input encoding and training techniques.

Course Outcomes

CO1: Understand the learning components of neural networks and apply standard neural network models to learning problems.
CO2: Analyze the learning strategies of deep learning – regularization, generalization, optimization, bias and variance.
CO3: Analyze regular deep learning models for training, testing and validation in standard datasets.
CO4: Apply neural networks for deep learning using standard tools.
CO5: Understand the mathematics for Deep learning.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3									3	2
CO2	3	2	3	2	2								3	2
CO3	3	2	3	2	3								3	2
CO4	3	1	2	1	2								3	2
CO5	3	1	2	1									3	2

Syllabus
Unit 1
Perceptrons – classification - limitations of linear nets and perceptrons - multi-Layer Perceptrons (MLP)- activation functions - linear, softmax, tanh, ReLU; error functions - feed-forward networks - Backpropagation - recursive chain rule (backpropagation) - Learning weights of a logistic output -Loss functions - learning via gradient descent - optimization – momentum method; Adaptive learning rates – RmsProp - mini-batch gradient descent - bias-variance trade off, regularization - overfitting - inductive bias – regularization - drop out - generalization.

Unit 2
Probabilistic Neural Network - Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders; Conditional Random Fields - Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

Unit 3
Introduction to deep learning - Deep neural networks - convolutional nets – case studies using Keras/Tensorflow - neural nets for sequences - Recurrent Nets – Long-Short-Term-memory; Introduction to Deep unsupervised learning – PCA to autoencoders.

Text Book(s)

Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning, MIT Press, Second Edition; 2016.

Reference(s)

Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. Second Edition;2001.
Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Fourth Edition. Academic Press;2008.
Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence;2003.
Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press;1995.
Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer;2001.
Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press;2009.

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

*CA – Can be Quizzes, Assignment, Projects, and Reports.