AMITY UNIVERSITY
KOLKATA

Course Title: Introduction to Deep Learning
Course Level: Graduate
Course Code: **Credit Units: 3**

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
2	0	2	0	3

Course Objectives:

- to introduce the fundamental set of techniques and algorithms that constitute deep learning algorithms,
- To understand the problem settings, and various deep learning applications to solve real world problems.
- Understand and apply various deep learning models to solve various domain's problems.

Pre-requisites:

1. Course of Machine Learning should have been done.
2. Knowledge of Python language is required.
3. Good Understanding of Linea Algebra and statistics.

Course Contents/Syllabus:

	Weightage (%)
Module I :	**20%**
Introduction to deep learning, Curse of Dimensionality, Neural Network Basics, Gradient descent and the backpropagation algorithm, Stochastic Gradient Descent, Activation Functions, Derivatives of MSE and cross-entropy loss functions, Problem of overfitting	
Module II:	**20%**
Supervised Learning: classification, Convolutional Neural Networks, Architectures, convolution / pooling layers, Invariance, stability, Variability models (deformation model, stochastic model), Properties of Convolutional Neural Networks representations: invertibility, stability, invariance. covariance/invariance: capsules and related	

models, Embeddings , inverse problems,	
Module III :	**20%**
Deep Unsupervised Learning, Encoder Decoder architectures, Autoencoders-standard, denoising, contractive, Variational Autoencoders, Backpropagation and Gradient Descent in Autoencoders, Maximum Entropy Distributions, Generative adversarial networks(GAN), difference between GAN and Autoencoder	
Module IV :	**20%**
Introduction to Markov chains, Recurrent Neural Networks, Learning from temporal datasets, Long Short Term Memory(LSTM), Fully recurrent neural networks, Gradient descent Optimization, Hopfield network, Global optimization methods	
Module V:	**20%**
Non-convex optimization for deep networks, Stochastic Optimization, Attention and Memory Models, Regularization- Lasso and Ridge, Dropout. Scalable Learning and Parallelization, Applications of Deep Learning to Computer Vision, Natural Language Processing, Image Processing	

Course Learning Outcomes:

- To Understand the principles, advantages, limitations and possible applications of popular deep learning approaches
- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Implement Memory based deep learning algorithms
- Able to formulate appropriate optimization method for deep learning

Pedagogy for Course Delivery:

The class will be taught using theory and applications. In addition to discussing real life applications, the course instructor will spend considerable time in understanding the concept. The instructor will cover the ways to think innovatively liberally using thinking techniques. Delivery of course will be covered using E-content based on 4-Quadrant approach.

List of Professional Skill Development Activities (PSDA):

NILL

Lab/ Practicals details, if applicable

1. Write a program to generate XOR function using McCulloch-Pitts neuron and appropriate values for weights, bias and threshold.
2. Write a program for perceptron net for an AND function with bipolar inputs and targets.
3. Build a neural network with one hidden layer, using forward propagation and backpropagation.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Build and train deep neural networks, and apply it to computer vision.
6. Implement Hidden Markov Model using Daily and Sports Activities dataset.
7. Implement Convolutional Neural Network for image classification
8. Implement Recurrent Neural Network for object recognition.
9. Build a autoencoder based network.
10. Case Study: Download cars donated by Marco Bohanec in 1997 data from the UCI Machine Learning Repository. Build a classification model using deep learning based classifier.

Assessment/ Examination Scheme:

Theory L/T (%)	**Lab/Practical/Studio (%)**	**Total**
67%	**33%**	**100%**

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment 40%					End Term Examination 60%
Components (Drop down)	**Attendance**	**Class Test**	**HA**	**Quiz**	**EE**
Weightage (%)	5	15	10	10	60

Lab/ Practical/ Studio Assessment:

Continuous Assessment/Internal Assessment 40%					End Term Examination 60%	
Components (Drop down	Performance	Lab Record	Viva	Attendance	Practical	viva
Weightage (%)	15	10	10	**5**	**30**	**30**

Text & References:

Text Books:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

2. T2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books:

- Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
- Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
- Kevin Patrick Murphy, Machine Learning: a Probabilistic Perspective, MIT Press (2012).

Any Other Material:

Online Material: http://ai.stanford.edu/people/nilsson/MLBOOK.pdf