

IT3216: Machine Learning and Deep Learning

Credits: 4

Teaching Scheme Theory: 2 Hours/Week

Tut: 1 Hours/Week

Lab: 2 Hours/Week

Course Prerequisites: Linear Algebra, Statistics, Calculus, and Probability Basics

Course Objectives:

1. Understanding Human learning aspects.
2. Acquaintance with primitives in the learning process by computer.
3. Understanding the nature of problems solved with Machine Learning and Deep Learning.
4. To study different Machine learning algorithms.
5. To study different Deep learning algorithms.
6. To understand the application development process using ML and DL

Course Relevance: Machine Learning and Deep Learning are disruptive technologies. Powered by data science, machine learning and Deep Learning makes our lives easier. When properly trained, they can complete tasks more efficiently than a human. Understanding the possibilities and recent innovations of ML technology and Deep Learning are important for businesses so that they can plot a course for the most efficient ways of conducting their business. It is also important to stay up to date to maintain competitiveness in the industry.

SECTION-I

Topics and Contents

Introduction: What is Machine Learning, Training versus Testing, Cross-validation, Mathematical models. Concept Learning.

Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning.

Regression and Generalization: Regression: Linear and Logistic Regressions, Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting.

Classification: Binary and Multiclass Classification: Support Vector Machines (SVM), Soft Margin SVM, KNN Algorithm, Naïve Bayes Classifier, Decision Tree and Random

Forest.

Clustering: Distance Based Models: Distance based clustering algorithms - K-means and C-means, Hierarchical clustering, Association rules mining – Apriori Algorithm, Confidence and Support parameters.

SECTION-II

Topics and Contents

Trends in Machine Learning: Reinforcement Learning: Exploration, Exploitation, Rewards, Penalties. Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.

Deep Learning: Introduction to deep learning, Neural Network Basics, Batch Normalization, The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons. Introduction to ANN and RNN, LSTM and GRU, Optimization algorithms, Hyperparameters Tuning, Batch Normalization.

Deep Learning Strategy: Introduction to CNN, Numericals based on CNN, Introduction to GAN. GAN- Different types, Gen AI etc.

List of Tutorials: (any six)

1. Feature Selection Techniques
2. Supervised Learning
3. Unsupervised Learning
4. Reinforcement Learning
5. Collaborative filtering
6. Q Learning
7. Item based Recommender system
8. Real time applications
9. Shallow Neural Networks
10. Key concepts on Deep Neural Networks
11. Practical aspects of deep learning , Optimization Algorithms
12. Hyperparameter tuning, Batch Normalization, Programming Frameworks
13. Bird recognition in the city of Peacetopia (case study)
14. Autonomous driving (case study)
15. The basics of ConvNets
16. Deep convolutional models
17. Keras Tutorial
18. Detection Algorithms
19. Special Applications: Face Recognition & Neural Style Transfer
20. Natural Language Processing and Word Embeddings
21. Sequence Models and Attention Mechanism

List of Practicals: (Any Six)

1. Write Python code to find the statistical properties like- Mean, Median, Mode, Standard Deviation, Variance, Percentile, Data Distribution, Histogram, Big Data Distribution, Normal Data Distribution, Scatter Plot, Random Data Distributions etc.
2. Write Python code to apply Linear Regression and Logistic Regression for different datasets. Study different types of Regression techniques.
3. A Write Python code to train or fit the data in the model and predict the future using the KNN algorithm Use any data set.
4. Write a Python Code to design Decision Tree for the given dataset. Calculate Gini index and Information Gain.
5. Write Python code to apply different types of Dimensionality Reduction techniques on given data set. Convert higher dimensional data into lower dimensional form.
6. Write Python code to apply Random Forest Algorithm to given data.
7. Write Python code to implement K-Means Clustering Algorithm.
8. Write Python code to implement C-Means Clustering Algorithm.
9. Write Python code to implement Neural Network.
10. Write Python code to apply Convolutional Neural Network for the given data set.
11. Write Python code to apply Recurrent Neural Network for the given data set. Compare RNN with LSTM and GRU.
12. Write Python code to perform Data Augmentation using affine transform and GAN.

List of Projects:

1. Stock market prediction
3. Sentiment analysis
4. Iris Flowers Classification Project.
5. Housing Prices Prediction Project.
6. MNIST Digit Classification Project.
7. Stock Price Prediction using Machine Learning.
8. Fake News Detection Project.
9. Bitcoin Price Predictor Project.
10. Uber Data Analysis Project.
11. Credit Card Fraud Detection Project
12. Healthcare Analytics
13. Predictive Analytics etc.

List of Course Seminar Topics:

1. Validation
2. Naive Bayes Algorithm
3. Machine And Privacy
4. Limitations of ML
5. Ensemble Learning
6. Dimensionality reduction algorithms
7. Comparison of Machine Learning algorithms
8. Feature Extraction In Machine Learning
9. Reinforcement Learning
10. Probabilistic Model
- 11.Dropout: a simple way to prevent neural networks from overfitting
- 12.Deep Residual Learning for Image Recognition
13. Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift
- 14.Large-Scale Video Classification with Convolutional Neural Networks
15. Generative adversarial nets
16. High-Speed Tracking with Kernelized Correlation Filters
17. Do we need hundreds of classifiers to solve real world classification problems
Scalable Nearest Neighbor Algorithms for High Dimensional Data
18. A survey on concept drift adaptation

List of Home Assignments:

Design:

1. Propensity to Foreclose: Predicting propensity of the customer to foreclose their loans. The objective is to retain the customer for the maximum tenure.
2. Portfolio & Price Prediction for Intra-day trades: Price movement prediction using a masked set of features - This involves predicting short-term to mid-term price movements using a combination of multiple features.
3. Smart Building Energy Management System using Machine Learning
4. Quick analysis of quality of cereals, oilseeds and pulses using ML
5. Video Library Management System using Machine Learning
6. Building a Recurrent Neural Network
7. Character level Dinosaur Name generation
8. Music Generation
9. Operations on Word vectors
10. Neural Machine translation with attention

Case Study:

1. Product Recommendation: Given a purchase history for a customer and a large inventory of products, identify those products in which that customer will be interested and likely to purchase. A model of this decision process would allow a program to make recommendations to a customer and motivate product purchases. Amazon has this capability. Also think of Facebook, GooglePlus and LinkedIn that recommend users to connect with you after you sign- up.
2. Medical Diagnosis: Given the symptoms exhibited in a patient and a database of anonymized patient records, predict whether the patient is likely to have an illness. A model of this decision problem could be used by a program to provide decision support to medical professionals.
3. Stock Trading: Given the current and past price movements for a stock, determine whether the stock should be bought, held or sold. A model of this decision problem could provide decision support to financial analysts.

Survey Based:

Refer atleast 15 research papers based on recent topic in Machine Learning/Deep Learning and prepare Survey paper.

Blog Based:

Publish blog on recent trends in Machine Learning or Deep Learning or Generative AI.

Text Books: (As per IEEE format)

1. T. Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.
3. Deep Learning with Python by François Chollet, Manning Publications Co, ISBN: 9781617294433
4. Deep Learning - A Practical Approach by Rajiv Chopra, Khana Publications, ISBN: 9789386173416

Reference Books: (As per IEEE format)

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT press, 2004.
2. Jacek M. Zurada, "Introduction to Artificial neural System", JAICO publishing house, 2002,.
3. Deep Learning by Ian Goodfellow and Yoshua Bengio and Aaron Courville Published by An MIT Press book.

Moocs Links and additional reading material:

www.nptelvideos.in

Course Outcomes:

1. Explore Different Machine Learning Techniques.
2. Apply Regression and Classifier Algorithms.
3. Use different Clustering Algorithms to different objects.
4. Acquaint with Trends in Machine Learning
5. Build and train a Deep Neural Network.
6. Understand functionality of all layers in a Convolutional Neural Network.

Future Courses Mapping:

MS in Machine Learning, MS in Deep learning

Job Mapping: *ML Engineer, DL Engineer, Data Scientist*

