Advance Machine Learning

COURSE SYLLABUS

LECTURER:
PHONE:
EMAIL ADDRESS:
CLASS HOURS: 45 hours
CREDITS: 3 credits

A. COURSE DESCRIPTION

This course offers an immersive introduction to machine learning and deep learning, guiding participants from fundamental concepts to advanced techniques. Covering essential topics like regression, classification, neural networks, and unsupervised learning, the curriculum is designed to build a solid foundation in machine learning principles. Learners will explore key algorithms and models, such as decision trees, SVMs, CNNs, and RNNs, and apply them using Sklearn TensorFlow and Keras. Through lectures, hands-on projects, and a capstone project, participants will develop the skills to construct, evaluate, and optimize machine learning models for real-world applications. Ideal for those seeking to enter the field of AI, this course blends theory with practice to prepare learners for further studies or careers in machine learning.

Data Scientist is the sexiest job in the world!

B. COURSE ORGANIZATION

The course on Machine Learning is meticulously designed to span over a comprehensive curriculum, encompassing a wide range of topics from foundational concepts to advanced techniques in machine learning and deep learning. The course is organized into distinct sessions, each aimed at achieving specific learning outcomes that progressively build upon each other to ensure a thorough understanding and practical knowledge of machine learning algorithms, models, and applications.

C. COURSE PREREQUISITE

N/A

D. COURSE LEARNING OUTCOME (LO)

Upon completion of this course, the students will be able to:

LO1	Define and explain machine learning fundamentals, differentiate between supervised and unsupervised learning.
LO2	Comprehend linear regression concepts, construct a linear regression model, and analyze the cost function to optimize model performance.
LO3	Apply polynomial regression techniques, identify overfitting and underfitting issues, and utilize regularization methods to enhance model reliability and performance.
LO4	Grasp the fundamentals of classification, implement logistic regression models, and understand the cost function to evaluate and optimize classification performance.
LO5	Construct decision trees, apply regression trees, and utilize random forests to improve prediction accuracy and address overfitting.
LO6	Comprehend KNN fundamentals, elucidate the mathematics behind KNN, and deploy KNN models for classification and regression tasks.

LO7	Understand SVM variants, define hyperplane and large margin concepts, and implement SVM models for classification and regression.
LO8	Master ensemble methods including bagging, boosting, and stacking to enhance model accuracy and stability.
LO9	Understand the concept of clustering, apply K-means clustering technique, and refine clustering models for optimal data segmentation.
LO10	Understand the structure and function of artificial neural networks, comprehend how neural networks learn through gradient descent, and apply this knowledge to train neural models.
LO11	Grasp the principles of convolutional neural networks, understand their operational mechanics, and apply this knowledge to construct and train CNN models for image processing tasks.
LO12	Understand recurrent neural networks, develop RNN models, and enhance their performance through evaluation and optimization techniques.
LO13	Comprehend and implement Long Short-Term Memory networks and Generative Adversarial Networks, applying them to solve complex sequential and generative
LO14	Grasp neural network fundamentals and deep learning concepts, explore activation functions, and apply TensorFlow and Keras for deep learning model development.
LO15	Integrate and apply machine learning concepts and techniques in a comprehensive project; critically review and evaluate model performance and decision-making processes.

E. COURSE OUTLINE

Week	*Session*	*Topic*	*Learning Outcomes*	*Number ofHour*
1	1	Foundation Machine Learning • Overview About Machine Learning • Application of Machine Learning • Supervised Learning vs Unsupervised Learning	LO1	1.5
	2	Linear Regression • Understanding Linear Regression • Building a Linear Regression Model • Cost function	LO2	1.5
	3	Advancing with Regression • Polynomial Regression • Overfitting and Underfitting • Regularization Techniques	LO3	3
2	1	Classification Techniques • Basics of Classification • Logistics Regression Theory • Cost Function in Linear Regression	LO4	3
	2	Decision Tree • Introduction to Decision Trees Algorithms • Building Decision Trees • Regression Tree (optional) • Random Forests	LO5	3

3	1	K nearest Neighbors • Intro KNNs • Mathematics behind KNNs • Building KNNs	LO6	3
	2	Support Vector Machines • Types of SVMs • Hyperplane in the SVMs • Large Margin • Building SVMs	LO7	3
4	1	Ensemble Algorithm • Bagging • Boosting • Stacking	LO8	3
	2	Unsupervised Learning Technique • Intro to Clustering • K-means Clustering • More on K-means	LO9	3
5	1	Deep Learning with Keras & TensorFlow • Introduction to Neural Networks and Deep Learning (Neural Network) • Activation Functions • TensorFlow Basic, Introduction to Keras	LO10	3
	2	Artificial Neural Network • Intro ANN: Artificial Neural Networks • How do Neural Networks work? • How do Neural Networks learn? • Gradient Descent	LO11	3
6	1	Convolutional Neural Networks • Introduction to CNNs • How do CNNs Work? • Building CNNs	LO12	3
	2	Advance Topics in Deep Learning • Recurrent Neural Network (RNNs), • Building RNN • Evaluating and Improving the RNN	LO13	3
7	1	• Long Short Term Memory (LSTM) Networks • Generate Adversarial Networks(GANs)	LO14	3
	2	Project final and Review	LO15	3
8		Final Exam		3

****These course outlines and schedules are subject to change without prior notice.*

F. RESOURCES AND REQUIRES SUPPLIES

References:

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow
2. Data Science for Business
3. Deep Learning Specialization

Coursework will be assessed as follows:

G. METHOD OF ASSESSMENT

- **Class Activity Involvement: 30%**
- **Mid-term Data Literacy Exam: 30%**
- **Final assessment: 40%**

I. CLASSROOM RULES OF CONDUCT

1. You should come to class regularly for better understanding of the lessons and you need to complete the assignments and projects. Any reports of free-riders within the group will be investigated, and you will get 0pt on your presentation if you have no contribution to the project work.
2. Please raise your hand if you have any questions. Questions will always be encouraged in this class. Activeness is appreciated!
3. As a student, you need to respect your classmates when they express their ideas or raise questions. In addition, you can also share your ideas if you have any!