ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC)

ಕ್ರಮಾಂಕ/ No. : MU/ACC/CR 3/2023-24/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
Office of the Registrar
Mangalagangothri – 574 199
ದಿನಾಂಕ/Date:10.10.2023

NOTIFICATION

Sub: Revised syllabus of Career Oriented Programme in Artificial Intelligence & Machine Learning
Ref: Academic Council approval vide agenda No.: ಎಸಿಸಿ:ಶೈ.ಸಾ.ಸ.2:24(2023–24) dtd 04.10.2023.

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The revised syllabus of Career Oriented Programme in Artificial Intelligence & Machine Learning which is approved by the Academic Council at its meeting held on 04.10.2023 is hereby notified for implementation with effect from the academic year 2023-24 and onwards.

Copy of the Syllabus shall be downloaded from the University Website (www.mangaloreuniversity.ac.in)

REGISTRAR

To

1. The Registrar (Evaluation), Mangalore University.
2. The Chairman, UG BOS in Computer Science and Computer Applications, Dept. of Computer Science, Mangalore University.
3. The Principals of the College Concerned.
4. The Superintendent (ACC), O/o the Registrar, Mangalore University.
5. The Asst. Registrar (ACC), O/o the Registrar, Mangalore University.
6. The Director, DUIMS, Mangalore University – with a request to publish in the website.
7. Guard File.

UGC CAREER ORIENTED COURSE ON

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Preamble:

In a world increasingly defined by technological advancements and digital transformation, the study of Artificial Intelligence has emerged as a transformative force that redefines the boundaries of human potential. The Artificial Intelligence and Machine Learning degree program at Mangalore University is born out of the conviction that AI is not merely a field of study but a revolutionary endeavour poised to reshape industries, societies, and the very fabric of human existence. The mission is to cultivate a community of innovators, problem solvers, and visionaries who harness the power of AI to address complex challenges, drive innovation, and unlock new opportunities for a better future. At the heart of our program lies a commitment to excellence, ethics, and the pursuit of knowledge that transcends disciplinary boundaries.

On the other hand, in the era of data-driven decision-making and transformative technological advancements, the study of Machine Learning has emerged as an indispensable discipline that empowers individuals to extract knowledge, patterns, and insights from data. The program is founded on the belief that machine learning is not merely a field of study but a powerful force that drives innovation, shapes industries, and unlocks the potential for a smarter, more interconnected world. We aim to cultivate a community of learners, researchers, and innovators who harness the power of machine learning to address complex problems, fuel innovation, and contribute to the advancement of science and society. Our program embodies a commitment to academic excellence, ethics, and the pursuit of knowledge at the forefront of machine learning.

Artificial Intelligence (AI) and Machine Learning (ML) have experienced tremendous growth in recent years, leading to a wide range of job opportunities across various industries. Some of the prominent job roles and career opportunities in the field of AI and ML include Machine Learning Engineer, Data Scientist, Computer Vision Engineer, Natural Language Processing (NLP) Engineer, Data Engineer, AI/ML Solutions Architect, Robotics Engineer, AI for Healthcare Specialist, AI in Finance Analyst, AI in Cyber security Analyst, AI in Marketing Analyst, etc. Job opportunities in AI and ML are diverse and continue to expand as businesses and industries increasingly adopt these technologies. The demand for skilled professionals in this field is expected to remain high in the coming years.

Course objectives:

The objectives of this career oriented course can vary depending on the level of the course (certificate, diploma and advanced diploma). However, some common objectives are as follows:

- To provide students with a comprehensive understanding of the fundamental concepts, theories, and principles of artificial intelligence and machine learning.
- To equip students with the practical skills necessary to develop, implement, and evaluate machine learning algorithms and AI systems.
- To enable students to effectively collect, pre-process, and analyse large and complex data sets for AI and ML applications.
- To foster students' ability to apply AI and ML techniques to solve real-world problems across diverse domains, including healthcare, finance, robotics, and natural language processing.
- To encourage collaboration across disciplines and departments, recognizing that AI and ML intersect with various fields, including computer science, mathematics, psychology, and economics.
- To promote a culture of research and innovation, enabling students to contribute to the advancement of AI and ML through research projects and initiatives.
- To provide opportunities for students to demonstrate their mastery of AI and ML concepts through capstone projects that tackle complex, real-world challenges.
- To prepare students for a wide range of career opportunities in academia, research, industry, and entrepreneurship within the AI and ML field.
- To encourage students to actively engage with the AI and ML community, participate in conferences, workshops, and hackathons, and contribute to open-source projects.

Scheme of the course:

FIRST YEAR (LEADING TO CERTIFICATE)

Paper	Instruction (Hr.)	Duration of Examination (Hr.)	Marks for Final Exam	Marks for Internal Exam	Total Marks
CAIML Paper-I	03	03	100	50	150
Practical-I	03	03	100	50	150

SECOND YEAR (LEADING TO DIPLOMA)

Paper	Instruction (Hr.)	Duration of Examination (Hr.)	Marks for Final Exam	Marks for Internal Exam	Total Marks
CAIML Paper-II	03	03	100	50	150
Practical-II	03	03	100	50	150

III YEAR (LEADING TO ADVANCED DIPLOMA)

Paper	Instruction (Hr.)	Duration of Examination (Hr.)	Marks for Final Exam	Marks for Internal Exam	Total Marks
CAIML Paper-III	03	03	100	50	150
Practical-III	03	03	100	50	150
Project	03	--	100	--	100

Every student is expected to take up a project work under a guide relating to the areas of their study and submit a report containing detailed discussion about the project which will have two valuations (1 internal and 1 external) for a maximum of 50 marks. A viva voce examination is to be conducted based on their project report by the external examiner/examiners for a maximum of 50 marks.

Pedagogy:

- Tutorial and Group Discussion
- Practical Experience
- Projects and Assignments
- Course Presentation
- Industrial Visit
- Seminars and Workshops

FIRST YEAR:

CAIML PAPER-I:

1. Introduction to Artificial Intelligence and Problem-Solving Agent: Problems of AI, AI technique, Tic – Tac – Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, and issues in the design of search programs.
2. Search Techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best -first search, A* search, AO* search, Hill climbing search, simulated annealing search.
3. Python Basics: Python Data Structures, Python Programming Fundamentals, Conditions and Branching, Loops, Functions, Python Packages, Working with NUMPY, Working with Pandas, Introduction to Data Visualization, Introduction to Matplotlib and Seaborn, Basic Plotting with Matplotlib and Seaborn
4. Machine Learning Fundamentals: Introduction to machine learning, Supervised, unsupervised, and reinforcement learning, Overfitting and bias-variance tradeoff
5. Machine Learning Algorithms: Simple Linear regression, Multiple linear regression, Polynomial regression, Ridge regression, Lasso Regression (L1 Regularization),
6. Decision trees: Overview of decision trees, Introduction to Decision Trees, Understanding the basic structure of a decision tree, The concept of nodes, edges, and leaves in a tree, Gini impurity, entropy, and information gain, and mean squared error, Decision Tree Algorithms: ID3, C4.5

Text Books:

- Russell, Norvig, Artifificial Intelligence: A Modern Approach, Third edition, Prentice Hall,2010
- Tom Mitchell, "Machine Learning", McGraw Hill, 1997.
- E. Alpaydin, "Introduction to Machine Learning", PHI, 2005.
- Andrew Ng, Machine learning yearning, https://www.deeplearning.ai/machine-learningyearning/
- AurolienGeron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow, Shroff/O'Reilly",2017.
- Andreas Muller and Sarah Guido, "Introduction to Machine Learning with Python: A Guidefor Data Scientists", Shroff/O'Reilly, 2016.
- Kevin P. Murphey, "Machine Learning, a Probabilistic Perspective", The MIT Press Cambridge, Massachusetts, 2012.

Practical-I

1. Write a Python Program to Print a Multiplication Table for the given number.
2. Write a Python Program to check whether the given number is prime or not.
3. Write a Python Program to display the Fibonacci series for a given number.
4. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
5. Write a Python Program to implement List Operations (Nested List, Length, Concatenation, Membership, Iteration, Indexing and slicing).
6. Write a Python Program to Transpose the Matrix.
7. Write a Python Program to implement the simple Calculator.
8. Write a Python Program to implement the List Methods (Add, Append, Extend & Delete)
9. Write a Python Program to implement the Breadth first Search Traversal.
10. Write a Python Program to implement Tic-Tac –Toe game.
11. Write a Python Program to Find factorial of the given number
12. Write a Python Program to implement the simple chat bot.
13. Implement a python program to perform Hill climbing algorithm
14. Implement a python program to perform logistic regression
15. Assuming a set of data that need to be classified, use a decision tree model to perform this task.

SECOND YEAR:

CAIML PAPER-II:

1. Knowledge representation issues, predicate logic- logic programming, semantic nets-frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Baye's probabilistic interferences and Dempster Shafer theory.
2. First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Explanation based learning, Statistical Learning methods, Reinforcement Learning.
3. Clustering: Distance measures, Different clustering methods -Distance, Density, Hierarchical, Iterative distance-based clustering, Dealing with continuous, categorical values in K-Means, Constructing a hierarchical cluster, K-Medoids, k-Mode and density-based clustering, Measures of quality of clustering
4. Naïve Bayes Classifier, Model Assumptions, Probability estimation, Required data processing, M-estimates, Feature selection, Mutual information Classifier,
5. Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.
6. Feature Reduction/Dimensionality reduction: Principal components analysis (Eigen values, Eigen vectors, Orthogonality), Linear discriminant analysis

Text Books:

- Tom Mitchell, "Machine Learning", McGraw Hill, 1997.
- E. Alpaydin, "Introduction to Machine Learning", PHI, 2005.
- Andrew Ng, Machine learning yearning, https://www.deeplearning.ai/machine-learningyearning/
- AurolienGeron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow, Shroff/O'Reilly",2017.
- Andreas Muller and Sarah Guido, "Introduction to Machine Learning with Python: A Guidefor Data Scientists", Shroff/O'Reilly, 2016.
- Kevin P. Murphey, "Machine Learning, a Probabilistic Perspective", The MIT Press Cambridge, Massachusetts, 2012.
- Russell, Norvig, Artifificial Intelligence: A Modern Approach, Third edition, Prentice Hall,2010
- Michael Nielsen, "Neural Networks and Deep Learning", Goodreads (eBook), 2013.
- Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall,1994
- Ian Goodfellow, YoshuaBengio and Aeron Courville," Deep Learning", MIT Press, First Edition, 2016.

Practical-II:

1. Implement the K-Means algorithm from scratch in Python
2. Apply K-Means to a synthetic dataset to understand the clustering process.
3. Use the scikit-learn or R's built-in functions to perform K-Means clustering on real-world datasets.
4. Implement hierarchical clustering algorithms like agglomerative or divisive clustering.
5. Apply hierarchical clustering to datasets with varying structures (e.g., single-linkage vs. complete-linkage clustering).
6. Apply DBSCAN to cluster data with varying densities.
7. Perform cross-validation to assess the stability and robustness of clustering solutions.
8. Apply clustering algorithms to real-world datasets from various domains (e.g., customer segmentation in retail, document clustering in NLP, image segmentation).
9. Implement a simple linear SVM classifier using scikit-learn or the SVM functions available in your chosen programming language.
10. Develop a linear SVM to a real-world dataset for binary classification.

11. Develop a python program to explore non-linear SVM classification using kernel functions (e.g., polynomial kernel, radial basis function (RBF) kernel).
12. Develop a program to extend SVM for multi-class classification tasks using one-vs-one or one-vs-all strategies.
13. Develop a program to explore the impact of feature scaling (e.g., standardization, normalization) on SVM performance.
14. Develop a program to pre-process text data (e.g., tokenization, TF-IDF) and use SVM for classification.
15. Develop a program to imolement principal component analysis.
16. Develop a program to implement linear discriminant analysis.

THIRD YEAR

CAIML PAPER-III:

1. Software Agents Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.
2. Ethical considerations in AI, Bias and fairness in AI algorithms, Guidelines for ethical AI development
3. Introduction to Neural networks, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Back propagation Networks, Back propagation Learning, Variation of Standard Back propagation Neural Network.
4. Multi-layer neural networks and Back Propagation, Practical aspects of Deep Learning: Train/ Development/ Test sets, Bias/variance, Vanishing/exploding gradients, Gradient checking, Hyper Parameter Tuning.
5. CNN Convolution Neural Network–Feature Selection–Max Pooling–Filters and Feature Maps–Convolution Layer–Applications, Natural Language Processing (NLP): Introduction to NLP, Tokenization and text pre-processing, Sentiment analysis and text classification
6. Machine Learning Applications: AI in image recognition, Speech recognition and synthesis, Recommender systems

Text Books:

- Russell, Norvig, Artifificial Intelligence: A Modern Approach, Third edition, Prentice Hall,2010
- Michael Nielsen, "Neural Networks and Deep Learning", Goodreads (eBook), 2013.
- Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall,1994
- Ian Goodfellow, YoshuaBengio and Aeron Courville," Deep Learning", MIT Press, First Edition, 2016.
- Adam Gibson and Josh Patterson," Deep Learning, A practitioner's approach", O'Reilly, FirstEdition, 2017.
- Francois Chollet," Deep Learning with Python", Manning Publications Co, First Edition, 2018.

Practical-III:

1. Develop a program to implement a basic feedforward neural network using a deep learning framework (e.g., TensorFlow or PyTorch).
2. Develop a program to train the network on a synthetic dataset (e.g., XOR problem) to understand the basics of forward and backward propagation.
3. Develop a program to create a CNN for image classification using a popular dataset like CIFAR-10 or MNIST.
4. Develop a program to experiment with different CNN architectures (e.g., VGG, ResNet, Inception) and assess their performance.

5. Develop a program to fine-tune a pre-trained deep learning model (e.g., a pre-trained VGG or ResNet model) on a specific image classification task.
6. Develop a program to implement a region-based CNN (e.g., Faster R-CNN) for object detection in images.
7. Optimize neural network training with learning rate schedules, weight decay, and batch normalization.
8. Apply deep learning models to real-world problems such as autonomous driving, medical image analysis, or recommendation systems.

FINAL PROJECT

Students will work on a artificial intelligence/machine learning project using the skills learned throughout the course. Presentation of final projects and discussion.

Case Studies and Projects:

Artificial Intelligence Projects:

- Create a chatbot using NLP techniques that can answer user queries or assist with tasks.
- Build a recommendation system for movies, books, or products using collaborative filtering or content-based filtering.
- Develop an AI agent that can play and excel in classic games like chess, Go, or video games like Flappy Bird.
- Create a diagnostic AI model that can predict diseases or conditions based on patient data like medical images, symptoms, and patient history.
- Build a stock price prediction model using time series analysis and sentiment analysis of news articles.
- Develop an AI system that can recognize and classify objects in images or videos.
- Create an image captioning system that generates descriptions for images.
- Build an AI system that can predict and mitigate the impact of natural disasters, such as earthquakes or hurricanes, using sensor data.

Machine Learning Projects:

- Train a machine learning model to identify plant diseases from images, aiding in crop management.
- Create a machine learning model to predict creditworthiness based on customer data for a financial institution.
- Build a robot that can navigate its environment and perform tasks using computer vision and reinforcement learning.
- Develop a dashboard that provides real-time sentiment analysis of social media data for a brand or product.
- Create a fraud detection model for financial transactions to identify potentially fraudulent activities.
- Build a predictive model that forecasts patient hospital readmissions or disease progression.
- Develop a speech recognition model that can transcribe spoken words into text, useful for voice assistants or transcription services.
- Create a deep learning model for generating art, faces, or other creative content using techniques like Generative Adversarial Networks (GANs).