Python / MATLAB Programming

Course Objectives:

1. Develop an in-depth understanding of Python programming for data science and Research Applications.
2. Equip students with skills to analyse, visualize, and interpret complex data sets.
3. Foster the ability to implement advanced machine learning algorithms.
4. Encourage the development of custom Python tools for specialized research needs.
5. Promote the integration of Python with other data science tools and platforms.

Unit 1: Python Programming Fundamentals

Introduction to Python: History, Features, and Installation, Python Basics: Variables, Data Types, and Operators, Control Structures: Conditional Statements, Loops, Functions and Modules: Creating and Using Functions, Importing Modules, File Handling: Reading and Writing Files, Exception Handling: Try, Except, Finally Blocks

Unit 2: Data Analysis with Python

Introduction to NumPy: Arrays, Mathematical Functions, Introduction to Pandas: Data Frames, Series, Data Manipulation, Data Cleaning: Handling Missing Values, Data Transformation, Data Aggregation and Grouping, Working with Dates and Times, Case Studies: Real-world Data Analysis Examples

Unit 3: Data Visualization

Introduction to Matplotlib: Basic Plotting, Customizing Plots, Advanced Visualization with Seaborn, Plotly for Interactive Visualizations, Data Visualization Best Practices, Visualizing Multivariate Data, Project: Creating Comprehensive Data Dashboards

Unit 4: Machine Learning with Python

Introduction to Scikit-Learn: Overview and Basic Concepts, Supervised Learning: Regression, Classification, Unsupervised Learning: Clustering, Dimensionality Reduction, Model Evaluation and Hyperparameter Tuning, Advanced Machine Learning Techniques, Case Studies: Implementing Machine Learning Algorithms

Unit 5: Advanced Topics and Research Applications

Natural Language Processing with NLTK and SpaCy,Time Series Analysis with Statsmodels, Deep Learning Basics with TensorFlow and Keras, Integrating Python with Big Data Tools: Hadoop, Spark, Developing Custom Python Packages, Research Project: Developing a Python Application for a Specific Research Problem

Assessment Methods:

Assignments: Regular assignments to assess understanding of concepts.

Projects: Real-world projects to apply learned skills.

Examinations: Periodic tests to evaluate theoretical knowledge.

Research Project: A comprehensive project to showcase the application of Python in a research context.

Course Outcomes:

1. Mastery of Python programming concepts and their application in data science.
2. Proficiency in using Python libraries for data analysis and visualization.
3. Ability to implement and evaluate machine learning models.
4. Capability to develop custom Python tools and applications for research.
5. Enhanced research productivity through efficient data handling and analysis.

Recommended Textbooks and Resources:

1. "Python Machine Learning" by Sebastian Raschka
2. "Python Data Science Handbook" by Jake VanderPlas
3. Online Resources: Kaggle, Coursera, edX

Artificial Intelligence

Course Objective:

1. To understand and implement various search algorithms such as depth-first search, breadth-first search, and uniform-cost search
2. To comprehend and implement the Mini-max algorithm for decision-making in adversarial environments.
3. To develop skills in automated theorem proving in first-order logic.
4. To gain a comprehensive understanding of different learning paradigms, including supervised, unsupervised, and reinforcement learning.

UNIT-I: Introduction:

Introduction to artificial intelligence, Scope and applications of AI: Natural Language Processing,Computer Vision, Speech Recognition, Robotics, and Expert Systems. **Intelligent Agents:** Structure and Working of Intelligent Agents.

UNIT-II: Problem-Solving

Solving Problems by Searching, Uninformed and Informed Search Strategies: Depth-first Search, Breadth-first Search,Heuristic Search Techniques: Hill climbing, Best-first search, **Game Playing:** Mini-max, Alpha-beta Pruning.

UNIT-III: Knowledge Representation

Building a knowledge Base: Propositional Logic Predicate Logic: Unification, Modes Pones, Resolution, Rule Based Systems: Forward Reasoning, Backward Reasoning, Conflict Resolution.

UNIT-IV: Structured Knowledge Representation

Semantic nets- slots, Exceptions and Default Frames, Conceptual Dependency, and Scripts. **Expert Systems:** Need and Justification for Expert Systems, and Knowledge Acquisition, and Component of an Expert System.

UNIT-V: Handling Uncertainty

Non-monotonic reasoning, probabilistic reasoning, use of certainty factors and fuzzy logic. **Learning:** Concept of learning, learning automation, Genetic Algorithm and Neural Networks.Paradigms, fuzzy logic and neural network.

urse Outcome:

1. Students will understand and implement various search algorithms to solve and optimize problems effectively.
2. Students will understand and implement gaming algorithms for decision-making in adversarial environments
3. Students will learn how to use automated theorem-proving techniques effectively.
4. Students will gain a comprehensive understanding of different learning

Books:

1. Introduction to Natural Language Processing, Applications, and Research Trends.
2. Nilsson, Nils, Artificial Intelligence: A new synthesis. Morgan Kaufmann Publishers, 1998. Russell, Stuart, and Norvig Peter
3. Artificial Intelligence: A Modern Approach, Prentice-Hall, 2003.
4. E. Rich and K. Knight, "Artificial intelligence-e"' TMH'