AI Python Syllabus

AI with Python Syllabus

Module 1: Introduction to Artificial Intelligence

- **What is AI?**
  - Definition and history of AI.
  - Types of AI: Narrow AI vs. General AI vs. Superintelligent AI.
  - Applications of AI in different industries (healthcare, finance, robotics, etc.).
- **AI Problem-Solving Approaches**
  - Search algorithms: Uninformed search (BFS, DFS), informed search (A*, Greedy).
  - Problem representation: State space search, problem formulation.

Module 2: Python Fundamentals for AI

- **Python for AI Development**
  - Overview of Python libraries for AI: **NumPy**, **Pandas**, **Matplotlib**, **SciPy**, **Scikit-learn**.
  - Object-oriented programming (OOP) principles in Python.
- **Working with Data**
  - Data manipulation with **Pandas** and **NumPy**.
  - Data preprocessing, cleaning, and exploration.
  - Handling missing values, outliers, and data scaling.

Module 3: Machine Learning Fundamentals

- **Introduction to Machine Learning**
  - Types of machine learning: Supervised, unsupervised, reinforcement learning.
  - Key concepts: Training, testing, overfitting, underfitting.
- **Supervised Learning**
  - Linear Regression and Logistic Regression.
  - K-Nearest Neighbors (KNN) and Support Vector Machines (SVM).
  - Decision Trees and Random Forest.
  - Model evaluation: Accuracy, confusion matrix, precision, recall, F1 score, ROC curves.
- **Unsupervised Learning**
  - K-Means Clustering and Hierarchical Clustering.
  - Dimensionality reduction: PCA (Principal Component Analysis).
  - Anomaly detection.

Module 4: Deep Learning Fundamentals

- **Introduction to Deep Learning**
  - Artificial Neural Networks (ANN): Basic structure and working principles.
  - Deep Neural Networks (DNN) and their architecture.
- **Training Neural Networks**
  - Forward propagation, loss functions, backpropagation.
  - Gradient Descent and optimization algorithms.
- **Activation Functions**
  - Sigmoid, ReLU, Tanh, Softmax.
- **Deep Learning Libraries**

- **TensorFlow** and **Keras**: Building and training neural networks in Python.

Module 5: Advanced Deep Learning Techniques

- **Convolutional Neural Networks (CNNs)**
  - Overview of CNN architecture: Convolution layers, pooling layers.
  - Applications of CNNs: Image classification, object detection.
  - Hands-on with CNNs using **Keras/ TensorFlow**.
- **Recurrent Neural Networks (RNNs) and LSTMs**
  - Introduction to RNNs and LSTM (Long Short-Term Memory) networks.
  - Applications: Time series forecasting, text generation, speech recognition.
  - Implementation using **Keras/ TensorFlow**.

Module 6: Natural Language Processing (NLP)

- **Text Preprocessing**
  - Tokenization, stemming, lemmatization.
  - Removing stop words, text vectorization (Bag of Words, TF-IDF).
- **NLP Algorithms**
  - Sentiment Analysis, Text Classification.
  - Named Entity Recognition (NER), Part-of-Speech tagging.
- **Word Embeddings**
  - Word2Vec, GloVe, FastText.
- **Sequence Models**
  - RNNs and LSTMs for text generation, language modeling.

Module 7: Reinforcement Learning

- **Introduction to Reinforcement Learning**
  - Key concepts: Agents, states, actions, rewards.
  - Exploration vs exploitation.
  - Markov Decision Processes (MDP).
- **Reinforcement Learning Algorithms**
  - Q-learning, SARSA, Temporal Difference learning.
  - Deep Q Networks (DQN).
- **Applications of Reinforcement Learning**
  - Game playing (e.g., AlphaGo).
  - Robotics and control systems.

Module 8: AI in Computer Vision

- **Computer Vision Basics**
  - Image processing with **OpenCV**.
  - Image classification and object detection using deep learning.
  - Face recognition, gesture recognition, and OCR.
- **Advanced Techniques**
  - YOLO (You Only Look Once), SSD (Single Shot Multibox Detector).
  - Transfer learning in computer vision.

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Module 9: AI Ethics and Safety

- **Ethical Considerations in AI**
  - Bias in AI models, fairness, and transparency.
  - Ethical dilemmas: Autonomous vehicles, AI in decision-making.
  - AI and privacy concerns.
- **AI Safety**
  - Ensuring robustness and reliability in AI systems.
  - Adversarial attacks and defense strategies.

Module 10: Projects and Case Studies

- **End-to-End AI Project**
  - Solving a real-world problem using AI (e.g., predicting stock prices, facial recognition).
  - Data collection, preprocessing, model building, evaluation, deployment.
- **Capstone Project**
  - A comprehensive AI-based project to showcase skills in machine learning, deep learning, and NLP.
  - Present results using **Jupyter Notebooks** or dashboards.

Tools and Libraries Covered in the Course:

- **NumPy**: Mathematical operations on arrays.
- **Pandas**: Data manipulation and analysis.
- **Scikit-learn**: Machine learning algorithms.
- **TensorFlow** and **Keras**: Deep learning and neural network development.
- **OpenCV**: Computer vision tasks.
- **Matplotlib** and **Seaborn**: Data visualization.
- **NLTK** and **spaCy**: NLP tasks.

Assessment and Learning Activities:

- Quizzes and assignments after each module to reinforce key concepts.
- Hands-on coding exercises and practice problems.
- Final project with real-world application of AI techniques.
- Peer-reviewed assignments or group collaborations.

Learning Outcomes:

By the end of this course, students should be able to:

- Understand and apply key AI and machine learning concepts.
- Implement machine learning algorithms using **Scikit-learn** and **TensorFlow**.
- Build deep learning models for tasks like image recognition and natural language processing.
- Solve real-world AI problems and deploy AI models.