DATA ANALYTICS & MACHINE LEARNING USING PYTHON

AI for Engineers & Managers
Nine-day certificate program by IIT Bombay

LEAD INSTRUCTOR

Prof. Asim Tewari

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INTRODUCTION

Why you should attend this program?

We have conducted 25 sessions till date and successfully trained more than 800 industry leaders and executives.

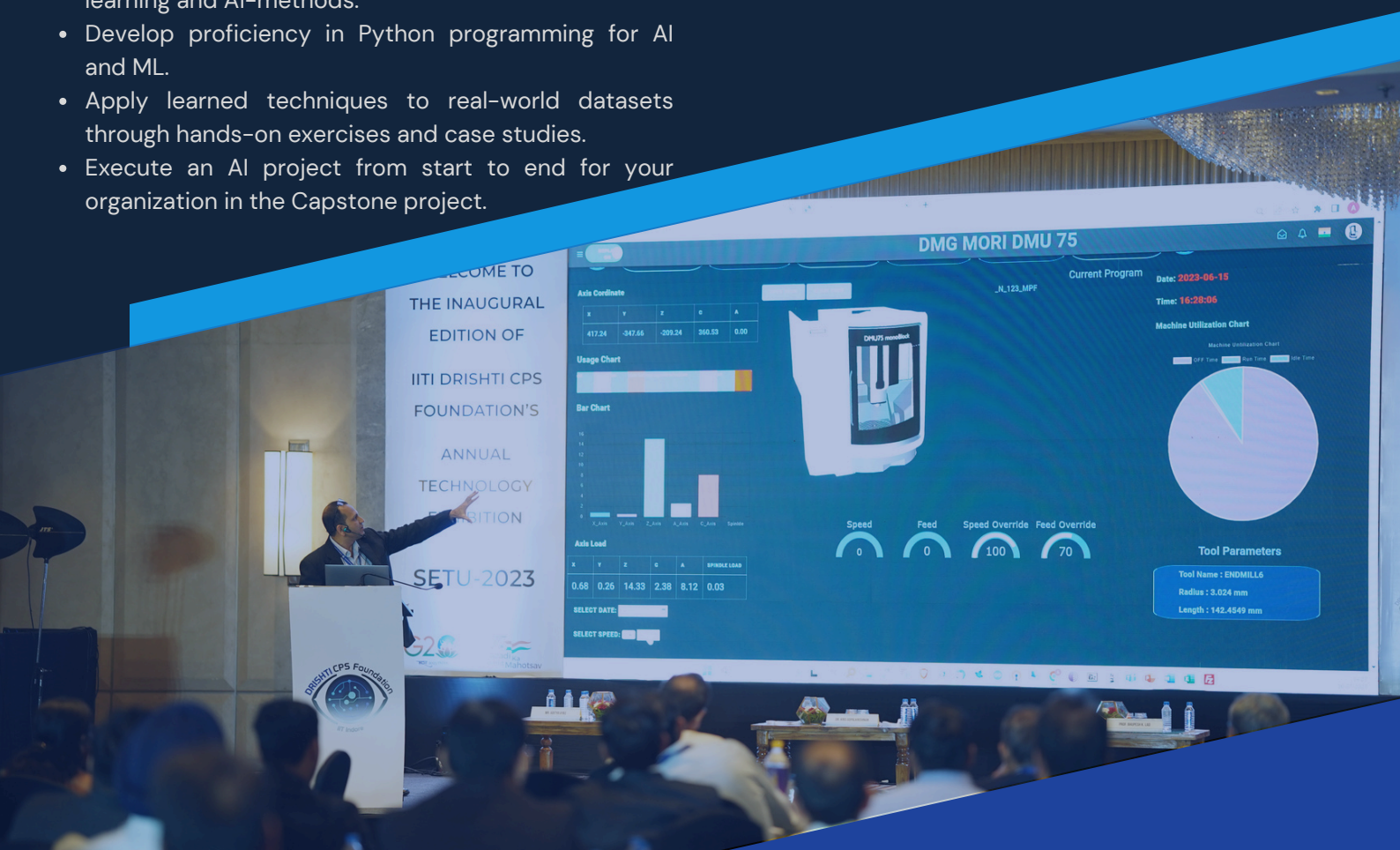
In today's data-driven world, every organization possesses vast amounts of data—but true impact lies in the ability to convert that data into actionable insights. Whether the goal is to boost productivity, enhance quality, reduce operational losses, or increase equipment reliability, Machine Learning (ML) and Artificial Intelligence (AI) play a critical role in unlocking the value hidden within data.
This course offers a comprehensive introduction to the core techniques and practical applications of ML and AI.

Learning Outcomes:

- Build a strong conceptual foundation in key machine learning and AI-methods.
- Develop proficiency in Python programming for AI and ML.
- Apply learned techniques to real-world datasets through hands-on exercises and case studies.
- Execute an AI project from start to end for your organization in the Capstone project.

Instruction Method:
The course combines theory lectures with practical lab sessions, where participants will implement data analytic techniques using Python. Real-world case studies and datasets will be used to reinforce learning and provide experience in handling complex data scenarios.

Target Audience:
This course is suitable for students, professionals, and researchers looking to develop foundational skills in machine learning and artificial intelligence with a focus on data analytics applications in engineering, business, and industrial systems.



Who should attend?

Industry Leaders

The program is exclusively designed for Middle-Level Executives. Intermediate knowledge of computer programming and mathematics is required to understand the course material.

PROGRAM OVERVIEW

What you will learn?

- Basic concepts and applications of various AI-ML techniques for regression and classification
- Perform various AI-ML tasks using Python programming
- Employ appropriate AI-ML techniques based on the problem definition at hand and also properly interpret the results of the analysis.
- Complete process of execution of a AI-ML project from start to end.

Program Delivery

The course will be offered through online mode over six days. This will be followed by three days of offline training to conduct a Capstone project.

BROAD TOPICS

Key Areas Covered

Python

- Python overview
- Python tools
- Basic programming and data structures with python
- Data Handling tools in python

Data Science

- Problem framing
  - Understanding business problems and framing the problem in terms of data science and ML
- Data Science Life Cycle
- Data Acquisition
- EDA
- Data Wrangling
  - Feature Engineering
- Model Development

Machine Learning

- What is machine learning? And Types of Learning
  - Supervised
  - Unsupervised
  - Semi-supervised
  - Reinforcement
- Basic Probability and Statistics
  - Common probability distributions
  - The Law of Large Numbers
  - Tail bounds, Markov, Chebyshev, Chernoff, and Gaussian Annulus
- Linear Algebra
- Classification vs. Regression
- Parameters vs. Hyperparameters
- Supervised Learning
  - Fundamental Algorithms
    - Linear Regression
    - Logistic Regression
    - KNN
    - Decision Trees
    - SVMs

BROAD TOPICS

Key Areas Covered

Machine learning

- Regularized Models
  - Ridge Regression
  - Lasso Regression
- Ensemble Learning
  - Bagging vs Boosting
  - Gradient Boosting
  - Random Forest
  - Boosting Algorithms
    - AdaBoost
    - XGBoost
    - LGBM
    - Catboost
- Un-Supervised Learning
  - Clustering
    - KMeans
    - DBSCAN, HDBSCAN, BIRCH, and Affinity propagation
    - Semi-Supervised Learning
- Introduction to Deep Learning and Neural N

Best Practices

- Bias-Variance Trade-off
  - Bias, Variance
  - Overfitting vs. Underfitting
- Feature Selection
- Handling Imbalanced Dataset
- Curse of Dimensionality/Dimensionality Reduction
  - PCA, SVD, ICA
- Hyperparameter Tuning
  - Cross Validation techniques
- Ensemble Learning/Combining Models
  - Blending
  - Voting
- Stacking/Multi-Stage Models
- Model Assessment
- Various metrics to monitor
- Which to use when?
- Model Explainability
- Experiments Tracking

BROAD TOPICS

Key Areas Covered

Model Deployment

- Monitoring ML Models
- Different Types of Data Drifts:
  - Covariate Shift
  - Label/Target Distribution Shift
  - Concept Drift
- Re-trainable Pipeline
- Introduction to REST APIs
- Building REST APIs in Python
- Types of Deployment Strategies:
  - Batch Inference vs. Real-Time Inference
- ML Model Serialization and Deployment
- Docker for ML Model Deployment

Capstone project

- Define project objective
  - Define the scope of work
  - Identify deliverables
- Perform Literature review
- Understand data requirements
  - Data type
  - Data availability (internal, open source, etc.)
  - Data size and independence
- Data wrangling exploration
  - Data gathering (from multiple sources)
  - Formatting and blending
  - Cleanup and missing data
  - Data visualization and exploration
- AI Model development
  - Identify candidate AI models
  - Perform feature engineering and subset selection
  - Separate data into training and validation sets
  - Perform model training (if needed bootstrapping)
- Model validation
  - Evaluate model results
  - MSE of training and testing
  - Perform hyperparameter tuning
- Model deployment with HMI
  - Develop HMI
  - Deploy model with HMI front end
  - Create basic test cases and user-help document
- Project report and presentation
  - Document the project process
  - Evaluate if the project objectives have been achieved
  - Provide suggestions for future improvements

About the Lead Instructor

LEAD INSTRUCTOR

Prof. Asim Tewari

Professor (HAG), Center for Machine Intelligence and Data Science (C-MInDS) and Mechanical Engineering, IIT Bombay, Powai, Mumbai 400074

Asim Tewari is a Professor (HAG) at the Center for Machine Intelligence and Data Science (C-MInDS) and the Department of Mechanical Engineering at the Indian Institute of Technology Bombay, Mumbai. He holds a B.Tech. from IIT Kanpur and an M.S. and Ph.D. from the Georgia Institute of Technology, Atlanta.

With over twenty-five years of experience across corporate R&D and national research laboratories, Professor Tewari has made significant contributions to the application of Artificial Intelligence in engineering systems and processes. He has authored more than 100 papers in international journals and conferences and holds eleven international and ten Indian patents. Under his supervision, eighteen Ph.D. and over fifty M.S. students have successfully graduated. Over the past decade, he has secured more than $15 million in research funding.

At IIT Bombay, he has played a pivotal role in setting up several state-of-the-art research facilities and established a Cyber-Physical Systems and Data Analytics group, focusing on AI applications across diverse industrial sectors. He is also the founder of Zwilling Labs Pvt. Ltd., a deep-tech start-up incubated at IIT Bombay, working on digital transformation using AI, Industrial IoT data fusion, and video comprehension through deep learning for applications in manufacturing, transportation, mining, safety, and surveillance.

Professor Tewari also conducts executive training programs on AI and digital transformation and has trained over 800 industry leaders and executives.

FOR FURTHER DETAILS

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