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***technologies***

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Full Stack **DATA SCIENCE**

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Gen Al & Agentic **Al**

In Collaboration With

futureskills

prime

A MeitY-MASSCOM **Digital Skilling** initiative

**NASSCOM®**

Agentic Al

AD **Generative** Al

**LLM** Models

M **MLOps**

GANS

Prompt Engineering

**RAG**

**CICD Pipeline**

**Neural Network**

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**PYTHON**

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Introduction to Data Science

Introduction of Data Science

Discussion on Course Curriculum

Introduction to Programming

Python - Basics

Introduction to Python: Installation and Running (Jupyter Notebook, .py file from terminal, Google Colab)

• Data types and type conversion

✓ Variables

• Operators

Flow Control: If, Elif, Else

• Loops

• Python Identifier

• Building Funtions (print, type, id, sys, len )

Python - Data Types & Utilities

• List, List of Lists and List Comprehension

List creation

Create a list with variable

List mutable concept

• len() || append() || pop()

insert() || remove() || sort() || reverse()

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Backward Indexing

• Forward slicing

• Backward slicing Step slicing

Set

SET creation with variable

• len() || add() || remove() || pop() union() | intersection() || difference()

Tuple

TUPLE Creation

• Create Tuple with variable

Tuple Immutable concept

len() || count() || index()

• Forward indexing

• Backward Indexing

Dictionary & Dictionary comprehension

• Create a dictionary using variable

• keys:values concept

len() || keys() || values() || items() get() || pop() || update()

• comparision of datastructure Introduce to range()

pass range() in the list

range() arguments

For loop introduction using range()

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De **O Dictionary**

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Functions

Inbuilt vs User Defined

◆ User Defined Function

• Function Argument

• Types of Function Arguments

• Actual Argument

Global variable vs Local variable

• Anonymous Function | LAMBDA

Packages Map Reduce | OOP's

Class & Object:

What is mean by inbuild class

How to creat user class

℗ crate a class & object

• \_\_init\_\_ method

• Python constructor

Constructor, self & comparing objects

Instane variable & class variable

Methods

what is instance method

what is class method

what is static method

Accessor & Mutator

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Python DECORATOR:

how to use decorator

inner class, outerclass

Inheritence

Polymorphism

• duck typing

• operator overloading ⚫ method overloading

⚫ method overridding

• Magic method

Abstract class & Abstract method

Iterator

• Generators in python

Python - Production Level

• Error / Exception Handling

• File Handling

• Docstrings

Modularization

Pickling & Unpickling

Pandas

Introduction, Fundamentals, Importing, Pandas, Aliasing, DataFrame

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• Series - Intro, Creating Series Object, Empty Series Object, Create series from List/Array/Column from DataFrame, Index in Series, Accessing values in Series

NaN Value

• Series - Attributes (Values, index, dtypes, size)

Series - Methods – head(), tail(), sum(), count(), nunique() etc.,

Date Frame

Loading Different Files

Data Frame Attributes

Data Frame Methods

Rename Column & Index

Inplace Parameter

• Handling missing or NaN values

iLoc and Loc

Data Frame - Filtering

Data Frame - Sorting Data Frame - GroupBy Merging or Joining

Data Frame - Concat

DataFrame - Adding, dropping columns &rows

DataFrame - Date and time

DataFrame - Concatenate Multiple csv files

Numpy

Introduction, Installation, pip command, import numpy package, ModuleNotFoundError, Famous Alias name to Numpy

Fundamentals - Create Numpy Array, Array, Manipulation, Mathematical Operations, Indexing & Slicing

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Numpy Attributes

• Important Methods- min(),max(), sum(), reshape(), count\_nonzero(),

sort(), flatten() etc.,

• adding value to array of values

• Diagonal of a Matrix

✔ Trace of a Matrix

Parsing, Adding and Subtracting Matrices "Statistical Functions: numpy.mean()

• numpy.median()

• numpy.std()

• numpy.sum()

• numpy.min()"

Filter in Numpy

Matplotlib

Introduction

• Pyplot Figure Class Axes Class

Setting Limits and Tick Labels

• Multiple Plots

• Legend

Different Types of Plots:

Seaborn

catplot() function stripplot() function

• boxplot() function violinplot() function pointplot() function

• Line Graph Bar Chart

• Histograms, Scatter Plot

✔ Pie Chart

3D Plots

Working with Images

• Customizing Plots+

barplot() function

• Visualizing statistical relationship with Seaborn relplot() function scatterplot() function

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regplot() function Implot() function

Seaborn Facetgrid() function

• Multi-plot grids

Statistical Plots:

✔ Color Palettes:

• Faceting:

• Regression Plots:

Distribution Plots

Categorical Plots:

✓ Pair Plots

Scipy

Signal and Image Processing (scipy.signal,scipy.ndimage): Linear Algebra (scipy.linalg):

• Integration (scipy.integrate)

Statistics (scipy.stats):

Spatial Distance and Clustering (scipy.spatial):

Statsmodels

• Linear Regression (statsmodels.regression):

• Time Series Analysis (statsmodels.tsa):

• Statistical Tests (statsmodels.stats)

• Anova (statsmodels.stats.anova):

• Datasets (statsmodels.datasets):

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**Mathematics**

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Distributions

• Data Representation & Database Operations

Combinatorics

Feature Selection

• Permutations and Combinations for Sampling

• Hyperparameter Tuning

• Experiment Design

• Data Partitioning and Cross-Validation

Probability

Basics

• Theoretical Probability

• Empirical Probability

Addition Rule

Multiplication Rule

• Conditional Probability

• Total Probability

• Probability Decision Tree

✔ Bayes Theorem

• Sensitivity & Specificity in Probability

A

Bernouli Naïve Bayes, Gausian Naïve Bayes

Multinomial Naïve Bayes

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Distributions

• Binomial, Poisson, Normal Distribution, Standard Normal Distribution

Guassian Distribution, Uniform Distribution

> Z Score

• Skewness

Kurtosis

Geometric Distribution

✔ Hyper Geometric Distribution

Markov Chain

Linear Algebra

• Linear Equations

• Matrices(Matrix Algebra: Vector Matrix Vector matrix multiplication Matrix matrix multiplication)

Determinant

Eigen Value and Eigen Vector

Euclidean Distance & Manhattan Distance Calculus

Differentiation

Partial Differentiation

Max & Min

Indices & Logarithms

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**STATISTICS**

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Introduction

Population & Sample

• Reference & Sampling technique

Types of Data

Qualitative or Categorical - Nominal & Ordinal

• Quantitative or Numerical - Discrete & Continuous

Cross Sectional Data & Time Series Data

Measures of Central Tendency

• Mean, Mode & Median - Their frequency distribution

Descriptive statistic Measures of symmetry

• skewness (positive skew, negative skew, zero, skew) kurtosis (Leptokurtic, Mesokurtic, Platrykurtic)

Measurement of Spread

Range, Variance, Standard Deviation

Measures of variability

• Interquartile Range (IQR):

Mean Absolute Deviation (MAD)

Coefficient of variation

Average 100

350

SD = 10

SD = 50

300

250

200

150

100-

Covariance

<00

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230+

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Levels of Data Measurement

Nominal, Ordinal, Interval, Ratio

Variable

Types of Variables.

Categorical Variables - Nomial variable & ordinal variables

Numerical Variables: discreate & continuous

• Dependent Variable

• Independent Variable

• Control Moderating & Mediating

Frequency Distribution Table

Nominal, Ordinal, Interval, Ratio

Types of Variables.

Categorical Variables - Nomial variable & ordinal variables

Numerical Variables: discreate & continuous

• Dependent Variable

Independent Variable

Control Moderating & Mediating

Frequency Distribution Table

Relative Frequency, Cumulative Frequency

Histogram Scatter Plots

Calculate Class Width:

Range

✔ Create Intervals

Construct the Table

Count Frequencies

+

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Correlation, Regression & Collinearity

Pearson & Spearman Correlation Methods

• Regression Error Metrics

Others

• Percentiles, Quartiles, Inner Quartile Range

• Different types of Plots for Continuous, Categorical variable

• Box Plot, Outliers

Confidence Intervals

Central Limit Theorem

• Degree of freedom

Bias & Variance in ML | Entropy in ML | Information Gai n |Surprise in **ML**

Loss Function & Cost Function

Mean Squared Error, Mean Absolute Error - Loss Function

Huber Loss Function

Cross Entropy Loss Function

Inferential Statistics

Hypothesis Testing: One tail, two tail and pvalue

• Formulation of Null & Alternate Hypothesis

• Type-I error & Type-II error

Statistical Tests:

• Sample Test

ANOVA Test

Chi-square Test

Z-Test & T-Test

***90*%**

75***%***

***50***%

100

*80*

60

40

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**SQL**

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Introduction

DBMS vs RDBMS

Intro to SQL

SQL vs NoSQL

• MySQL Installation

Keys

Primary Key

• Foreign Key

Constraints

• Unique

Default

Not NULL Auto Increment

Check

CRUD Operations

Create • Update

Retrieve • Delete

SQL Languages

• Data Definition Language (DDL)

• Data Query Language

Data Manipulation Language (DML) Data Control Language

• Transaction Control Language

**SQL**

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SOL Commands

Create

Insert

Alter, Modify, Rename, Update

✔ Delete, Truncate, Drop

SQL Clause

Where

✓ Distinct

OrderBy

Operators

• GroupBy

• Having

Limit

• Comparison Operators

Logical Operators

• Membership Operators

• Identity Operators

• Grant, Revoke

Commit, Rollback

Select

Wild Cards Aggregate Functions

SQL Joins

Inner Join & Outer Join

Left Join & Right Join

✔ Self & Cross Join

Natural Join

दी MySQL

TM

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**EDA & ML**

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EDA

• Univariate Analysis

• Bivariate Analysis

• Multivariate Analysis

Data Visualisation

• Various Plots on different datatypes

Plots for Continuous Variables

Plots for Discrete Variables

Plots for Time Series Variables

ML Introduction

What is Machine Learning?

Types of Machine Learning Methods

Supervised Learning

• Unsupervised Learning

Reinforcement Learning)

Classification problem in general

• Validation Techniques: CV,OOB

Different types of metrics for Classification

• Curse of dimensionality

• Feature Transformations

Feature Selection

✔ Imabalanced Dataset and its effect on Classification

Bias Variance Tradeoff

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Important Element of Machine Learning

Multiclass Classification

One-vs-All

Overfitting and Underfitting

✔ Error Measures

• PCA learning

Statistical learning approaches

Introduce to SKLEARN FRAMEWORK

Data Processing

Creating training and test sets, Data scaling & Normalisation

**—**

Feature Engineering – Adding new features as per requirement, Modifying the data

• Data Cleaning - Treating the missing values, Outliers

• Data Wrangling - Encoding, Feature Transformations, Feature Scaling

✔ Feature Selection - Filter Methods, Wrapper Methods, Embedded Methods

• Dimension Reduction - Principal Component Analysis

(Sparse PCA & Kernel PCA), Singular Value Decomposition

Non Negative Matrix Factorization

Regression

• Introduction to Regression

• Mathematics involved in Regression Regression Algorithms:

• Simple Linear Regression

Multiple Linear Regression

Polynomial Regression

Lasso Regression

Ridge Regression

• Elastic Net Regression

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Evaluation Metrics for Regression:

Mean Absolute Error (MAE)

• Mean Squared Error (MSE)

Root Mean Squared Error (RMSE) R2 Adjusted R2

Classification

Introduction

K-Nearest Neighbors

• Logistic Regression:

Implementation & Optimizations Stochastic gradient descent algorithms Finding the optimal HyperParameters through Grid Search

• Support Vector Machines (Linear SVM):

Linear support vector machines

Scikit-learn implementation

Linear Classification

Kernel-based classification

Radial Basis Function

Polynomial Kernel

Sigmoid Kernel

Custom Kernels

• Non-linear examples

2 features forms straight line & 3 features forms plane

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Hyperplane and Support vectors

Controlled support vector machines

• Support vector Regression

Kernel SVM (Non-Linear SVM)

Naives Bayes:

Bayes theorem

Naive Bayes Classifiers

**74**%

*58%*

31%

765

**+256**

2016

2017

2018

2019

• Naive Bayes in scikit learn (Bernoulli, Naive Bayes, Mulitnomial Naive Bayes, Guassian Naive Bayes)"

Decision Trees:

Binary Decision Trees

Binary decisions

• CART Algorithm

Impurity measures (Gini impurity, index, Cross-entropy impurity

index, Misclassification impurity index)

Feature importance

Decision tree classification with scikit learn

• Random Forest / Bagging:

Random Forests and Features importance in Random Forest

✓ AdaBoost

• Gradient tree boosting

**•** Voting classifier

Ensemble:Bagging

• Ensemble:Boosting"

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✔ Ada Boost

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Gradient Boost

XG Boost

Evaluation Metrics for Classification:

Confusion Matrix

Accuracy & F1 Score

Precision & Recall

Sensitivity & Specificity

✔ True Positive Rate, False Positive Rate

ROC & ROC\_AUC

Clustering Introduction | K-Means Clustering:

Finding the optimal number of clusters

• Optimizing the inertia

• Cluster instability Elbow method

Hierarchical Clustering | Agglomerative clustering DBSCAN Clustering | Association Rules

• Market Basket Analysis

• Apriori Algorithm

Recommendation Engines

• Collaborative Filtering:

• User based collaborative filtering Item based collaborative filtering Recommendation Engines

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Time Series & Forecasting

What is Time series data

Different components of time series data

• Stationary of time series data

ACF, PACF Time Series Models:

AR ARMA

ARIMA

SARIMAX

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Model Selection & Evaluation | Over Fitting & Under Fitting

Biance-Variance Tradeoff

✓ Cross Validation:

Stratified Cross validation

K-Fold Cross validation

Hyper Parameter Tuning

Joblib And Pickling

Others

• Dummy Variable, Onehotencoding

• gridsearchcv vs randomizedsearchcv

ML Pipeline ML Model Deployment in Flask

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**PowerBI**

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Introduction

Power BI for Data scientist

• Types of reports

Data source types

Installation

Basic Report Design

Data sources and Visual types

Canvas and fields

Table and Tree map

• Format button and Data Labels

Legend,Category and Grid

• CSV and PDF Exports

Visual Sync, Grouping

Slicer visual

• Orientation,selection process

• Slicer:Number,Text,slicer list

Bin count,Binning

Hierarchies, Filters Creating Hierarchies

• Drill Down options

訂

Executive Metrics **Dashboard** & Share Dashboard

Expected Rev

$85.22M

Marketing Site Traffic

:wwwwww

Crack Tend

$2.22M

EURO

NORTH

AMERICA

AccounCount

$4.07M

Number of Visits Expenditure (M)

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Marketing Campaign Metrics

• Expand and show

• Visual filter,Page filter,Report filter

• Drill Thru Reports

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Power Query

Power Query transformation

Table and Column Transformations

• Text and time transformations

• Power query functions

Merge and append transformations

DAX Functions

DAX Architecture,Entity Sets

• DAX Data types,Syntax Rules ✓ DAX measures and calculations

Creating measures

• Creating Columns

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**Deep Learning**

Deep learning at Glance

Introduction to Neural Network

Biological and Artificial Neuron

• Introduction to perceptron

• Perceptron and its learning rule & drawbacks

• Multilayer Perceptron, loss function

Neural Network Activation function

Training MLP: Backpropagation | Cost Function

Gradient Descent Backpropagation - Vanishing & Exploding Gradient Problem

Introduce to Py-torch | Regularization | Optmizers

Hyperparameters and tuning of the same TENSORFLOW FRAMEWORK

Introduction to TensorFlow

TensorFlow Basic Syntax

• TensorFlow Graphs

Variables and Placeholders

• TensorFlow Playground

ANN (Artificial Neural Network)

✔ ANN Architecture

Forward & Backward Propagation, Epoch

Introduction to TensorFlow, Keras

Vanishing Gradient Descend

Fine-tuning neural network hyperparameter

Number of hidden layers, Number of neurons per hidden layer

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RNN (Recurrent Neural Network)

✔ Introduction to RNN

• Back Propagation through time ✔ Input and output sequences

RNN vs ANN

• LSTM (Long Short-Term Memory)

Different types of RNN: LSTM, GRU

Biirectional RNN

**Input** Layer

AiLabPage

Hidden Layer

Sequential-to-sequential architecture (Encoder Decoder) BERT Transformers

• Text generation and classification using Deep Learning

• Generative-AI (Chat-GPT)

Basics of Image Processing

Histogram of images

Basic filters applied on the images

Convolutional Neural Networks (CNN)

• ImageNet Dataset

• Project: Image Classification

• Different types of CNN architectures

• Recurrent Neural Network (RNN)

Using pre-trained model: Transfer Learning

**Output Layer**

AlLabPage

A

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**CONVOLUTIONAL NEURAL NETWORKS (CNNS) AND LAYER TYPES**

**Input**

181 237 170 223 2x2 **max** pooling **with a**

237 237 223

229 181 108

229

181 89 108

109 **93** 48 66

158 21 71

stride of 1

158

93

**71**

2x2 max pooling **with a**

**stride** of 2

237 223

14

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**Natural Language Processing (NLP)**

Natural Language Processing (NLP)

Text Cleaning

✔ Texts, Tokens

Basic text classification based on Bag of Words

Document Vectorization

Bag of Words

TF-IDF Vectorizer

n-gram: Unigram, Bigram

• Word vectorizer basics, One Hot Encoding

Count Vectorizer

• Word cloud and gensim

Word2Vec and Glove

Text classification using Word2Vec and Glove

• Parts of Speech Tagging (POS Tagging or POST) Topic Modelling using LDA

• Sentiment Analysis

Twitter Sentiment Analysis Using Textblob

TextBlob

Installing textblob library

Simple TextBlob Sentiment Analysis Example

Using NLTK's Twitter Corpus

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Spacy Library

Introduction, What is a Token, Tokenization

Stop words in spacy library

• Stemming

• Lemmatization,

• Lemmatization through NLTK

• Lemmatization using spacy

• Word Frequency Analysis

• Counter

Part of Speech, Part of Speech Tagging

Pos by using spacy and nltk

• Dependency Parsing

✔ Named Entity Recognition(NFR)

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NLP

**Natural** language **processing**

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**Computer Vision**

Human vision vs Computer vision

CNN Architecture

CONVOLUTION - MAX POOLING - FLATTEN

LAYER - FULLY CONNECTED LAYER

CNN Architecture

• Striding and padding

Max pooling

• Data Augmentation

• Introduction to OpenCV & YoloV3 Algorithm

Image Processing with OpenCV

• Image basics with OpenCV

Opening Image Files with OpenCV

Drawing on Images, Image files with OpenCV

• Face Detection with OpenCV

Video Processing with OpenCV

Introduction to Video Basics, Object Detection

• Object Detection with OpenCV

Reinforcement Learning

Introduction to Reinforcement Learning

• Architecture of Reinforcement Learning Reinforcement Learning with Open Al Policy Gradient Theory

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OPEN AI

Introduction to Open Al

Generative Al

• Chat Gpt (3.5)

LLM (Large Language Model)

Classification Tasks with Generative Al

Content Generation and Summarization with Generative Al

Information Retrieval and Synthesis workflow with Gen Al

Time Series & Forecasting

Time Series Forecasting using Deep Learning

• Seasonal-Trend decomposition using LOESS (STL) models. Bayesian time series analysis

MakerSuite Google

PaLM API

MUM modelsBayesian time series analysis

Azure ML

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**Advanced Course on Agentic Al**: **Single-Agent & Multi-Agent Systems**

Module 1: Introduction to Agentic Al

What is Agentic Al? From Traditional Al to Autonomous Al

Single-Agent vs Multi-Agent Systems (MAS)

• Agentic Al in Large Language Models (LLMs)

Applications of Agentic Al in Automation, Research, and Business

**Hands-on:**

Running a basic autonomous agent using OpenAI API

• Setting up a local agent with Python

Module 2: Building Single-Agent Systems

• Single-Agent Al: Concepts & Architectures

Decision-Making in Single-Agent Al

Memory & Long-Term Planning

Integrating LLMs with Agents (LangChain, OpenAI, Hugging Face) Handling User Inputs & Actions with Tool-Use Capabilities

**Hands-on:**

• Building a goal-driven single Al agent with LangChain

• Implementing memory-based reasoning with FAISS

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Module 3: Multi-Agent Systems (MAS)

• What are Multi-Agent Systems (MAS)?

Agent Communication & Coordination

• Role Assignment in Multi-Agent Environments Task-Oriented Al vs Autonomous Decision-Making Swarm Intelligence & Distributed Agents

**Hands-on:**

Creating a multi-agent research assistant Implementing a task-based workflow with CrewAl

Module 4: Al Agents with CrewAl

Overview of CrewAI: Al Agents Working in Teams Role-Based Agent Assignments

Orchestrating Task Execution Between Agents Implementing Workflow Pipelines with CrewAl

**Hands-on:**

• Creating an Al-powered content generation team Using CrewAl for multi-step research tasks

Module 5: SmolAgent - Lightweight Al Agents

• Introduction to SmolAgent: Minimalistic Al Agents When to Use SmolAgent vs Heavyweight Al Agents

• Optimizing Al Agents for Cost and Performance Combining SmolAgent with LLMs for Fast Execution

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**Hands-on:**

• Deploying a SmolAgent-based chatbot

• Running SmolAgent on an edge device

Module 6: Phi Data - Memory & Context Optimization

• Introduction to Phi Data: Al Agent Memory & Learning

• Vector Database Integration (FAISS, Pinecone, ChromaDB)

• Retrieval-Augmented Generation (RAG) for Al Agents

✔ Personalized Al Assistants with Memory

**Hands-on:**

Implementing Phi Data for long-term memory

Storing and retrieving context for Al-powered Q&A

Module 7: Building & Deploying Agentic Al Applications

Deploying Al Agents on Cloud (Hugging Face, AWS, Azure)

• Integrating Al Agents into Web Applications (FastAPI, Streamlit) Security Considerations in Autonomous Al

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**Mastering**

**Prompt Engineering for LLMs**

Module 1: Introduction to Prompt Engineering

>What is Prompt Engineering?

The role of prompts in LLMs

How LLMs process and interpret prompts

**→**Why Learn Prompt Engineering?

Optimizing LLM performance

• Reducing hallucinations & improving accuracy

• Enhancing Al-driven applications

**Hands-on:**

• Experimenting with OpenAl's API for basic text generation

Module 2: LLM Model Settings & **Configurations**

**>** Understanding LLM Settings:

Temperature, Top-k, Top-p (Nucleus Sampling)

• Stop Tokens, Context Length & Tokenization

Fine-tuning vs Prompt Optimization

Customizing Model Behavior with System Prompts

**Hands-on:**

Experimenting with different model settings in OpenAl Playground

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Module 3: Prompt Elements & Structuring

**>** Key Components of a Well-Designed Prompt:

Instructions Context Input Data

>Optimizing Prompts for Accuracy & Consistency

**Hands-on:**

• Structuring prompts for summarization, classification, & question-answering

Module 4: Prompt Engineering Techniques (Shot-Based Prompting**)**

• Zero-Shot Prompting

• One-Shot Prompting

• Few-Shot Prompting

• Comparing Shot-Based Techniques for Different Use Cases

**Hands-on:**

• Designing and testing different shot-based prompts on GPT models

Module 5: Chain of Thought (COT) Prompting

What is CoT Prompting?

Step-by-Step Reasoning in LLMs

Implementing CoT in Math, Logic & Coding Tasks

**Hands-on:**

• Using CoT to improve reasoning-based problem-solving

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Module 6: Self-Consistency in Prompt Engineering

What is Self-Consistency?

Generating Multiple Answers & Selecting the Best

Improving Output Reliability with Self-Consistency

**Hands-on:**

Implementing Self-Consistency for multi-answer tasks

Module 7: Out-of-Date Learning in Prompt Engineering

How LLMs Handle Outdated Information

• Strategies to Overcome Out-of-Date Learning:

Prompting with External Data

Fine-Tuning vs Retrieval-Augmented Generation (RAG)

When to Use Updated APIs & Tools

**Hands-on:**

Experimenting with model responses on time-sensitive queries

Module 8: Role-Playing in Prompt Engineering

What is Role-Playing in Prompting?

Creating Al Personas for Specialized Tasks

Enhancing Response Accuracy with Role-Based Prompts

**Hands-on:**

• Designing Al assistants with different personas (e.g., Doctor, Lawyer, Coder)

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Module 9: RAG (Retrieval-Augmented Generation) in Prompt Engineering

What is RAG & Why is it Important?

Integrating Vector Databases (FAISS, Pinecone, ChromaDB) Enhancing Al Responses with External Knowledge

**Hands-on:**

• Implementing a RAG-based chatbot using FAISS & OpenAI

Module 10: ReAct (Reasoning + Acting) in Prompt Engineering

What is ReAct Framework?

Combining CoT + Tool Use for Autonomous Agents Building Al Agents that Reason & Execute Actions

**Hands-on:**

Implementing a ReAct-based agent using LangChain

Module 11: DSP (Dynamic Structured Prompting**)**

What is Dynamic Structured Prompting (DSP)?

Generating Structured & Dynamic Prompts Based on Context Using DSP for Adaptive Al Interactions

**Hands-on:**

Creating dynamically structured prompts for personalized Al responses

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**Advanced Course on Generative Al:**

Module 1: Introduction to Generative Al

What is Generative Al?

Types of Generative Al Models:

Text-based (GPT, LLAMA, Claude)

• Multimodal (CLIP, DALL-E, Stable Diffusion)

Text-based (GPT, LLAMA, Claude)

Multimodal (CLIP, DALL·E, Stable Diffusion)

•Use Cases in NLP, Image Generation, & Code Generation

**Hands-on:**

Running a simple text-based generative model using OpenAI API

Module 2: Text-Based Generative Models

How Text-Based Models Work

Training LLMs (Large Language Models) with Transformers Pretrained Models vs Fine-Tuned Models

Popular LLMs: GPT-4, LLaMA, Mistral, Falcon

**Hands-on:**

• Generating text using Hugging Face Transformers

Module 3: Multimodal Models (Text + Image + Audio)

What are Multimodal Models?

Combining Text & Vision Models for Al Applications

• Examples of Multimodal Models: CLIP, DALL·E, Gemini, GPT-4 Turbo

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**Hands-on:**

Running OpenAl's CLIP model for text-to-image retrieval

Module 4: CLIP (Contrastive Language-Image Pretraining) **Architecture**

How CLIP Works: Text-Image Pairing

Applications of CLIP in Image Search & Generation

Fine-tuning CLIP for Custom Tasks

**Hands-on:**

Using CLIP to find relevant images based on text prompts

Module 5: VQGAN & Taming Transformers

Introduction to VQGAN (Vector Quantized GAN)

How Taming Transformers Improve Image Quality Combining VQGAN + CLIP for Al Art

**Hands-on:**

Generating Al Art using VQGAN + CLIP

Module 6: Autoencoders & VAES (Variational Autoencoders)

What is an Autoencoder?

Difference Between Autoencoders & VAEs

Generating High-Resolution Images with VAES

**Hands-on:**

Implementing a simple Variational Autoencoder (VAE) in PyTorch

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Module 7: Retrieval-Augmented Generation (RAG)

What is RAG & Why It Matters for Al?

Enhancing LLMs with External Knowledge

Vector Databases for RAG (FAISS, Pinecone, ChromaDB)

**Hands-on:**

• Implementing a RAG-based chatbot using LlamalIndex & FAISS

Module 8: Hugging Face Ecosystem

Overview of Hugging Face Transformers

• Fine-tuning LLMs with Hugging Face

Deploying Models Using Hugging Face Spaces

**Hands-on:**

Fine-tuning a text generation model on Hugging Face

Module 9: CrewAl for Multi-Agent Al Systems

What is CrewAI?

Building Teams of Al Agents

Role-Based Task Assignment in CrewAl

**Hands-on:**

Setting up an Al research team using CrewAl

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Module 10: Groq - High-Speed Al Inference

• What is Groq?

Running Al Models at Lightning Speed

✔ Optimizing Large Models for Low Latency

**Hands-on:**

Deploying a transformer model with Groq hardware

Module 11: Stable Diffusion for Image Generation

Understanding Stable Diffusion Architecture Text-to-Image Generation with Diffusion Models Fine-Tuning & Customizing Stable Diffusion

**Hands-on:**

Running Stable Diffusion on a local machine

Module 12: GitHub Copilot for Al-Powered Coding

How GitHub Copilot Uses Al for Code Generation Best Practices for Using Al in Software Development Comparing Copilot with Other Al Coding Tools

**Hands-on:**

• Writing Al-assisted Python scripts using GitHub Copilot

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Module 13: LlamaIndex - Al-Powered Document Processing

What is Llamalndex?

Connecting LLMs to Private Data

Using Llamalndex for Enterprise Al Applications

**Hands-on:**

Implementing LlamaIndex for a document-based Al assistant

Module 14: FastAPI for Al Model Deployment

Introduction to FastAPI for Al

Building a REST API for LLMs

Deploying Al Models as Web Services

**Hands-on:**

• Deploying a text-based LLM using FastAPI

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**Advanced Course on : LLMs**

Module 1: Introduction to Generative AI & LLMs

What is Generative Al?

Types of Generative Al Models (Text, Image, Multimodal, Speech)

• Comparison of Leading Al Models (GPT, Gemini, LLaMA, Claude, Mixtral, DeepSeek, Grok)

Foundation Models vs Fine-Tuned Models

**Hands-on:**

• Running a basic LLM-powered chatbot using OpenAI API

Module 2: OpenAl's Al Ecosystem | LangChain **Framework**

Introduction to LangChain

✔ Building Al Agents with LangChain

Memory & Context Handling in LangChain Connecting LLMs with External Data Sources

**Hands-on:**

Implementing a chatbot using OpenAI + LangChain **o** OpenAl Whisper (Speech-to-Text Al)

What is OpenAl Whisper?

• Multilingual Speech Recognition

Building Real-World Applications with Whisper

**Hands-on:**

Transcribing audio into text using OpenAl Whisper

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Module 3: Google's Generative Al Ecosystem

• Gemini Al: Google's Multimodal LLM

Introduction to Gemini Al

✔ Comparison with OpenAI & Meta Models

Using Gemini API for Text & Image Generation

**Hands-on:**

Generating text & images using Gemini API

**O** Google Vision: Al for Image Analysis & Recognition

What is Google Vision?

.Al-Powered Image Processing & OCR

•Building Al-powered Image Search Systems

**Hands-on:**

Using Google Vision API for image classification

Module 4: DeepSeek, Mistral, Mixtral, Grok & **Claude**

DeepSeek AI

• Overview of DeepSeek Language Model

Optimizing Search and Al Retrieval with DeepSeek Applications in Al-Assisted Knowledge Systems

**Hands-on:**

• Running DeepSeek for document-based Al search **O** Mistral &Mixtral: High-Performance Open-Source Al

What is Mistral &Mixtral?

Dense vs Sparse Transformer Models Optimizing Mixtral for Multi-Task Al

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**Hands-on:**

• Running Mixtral models on Hugging Face

**O** Grok (X Al by Elon Musk)

How Grok is Designed for Real-Time Al Processing Comparison with GPT, Gemini & Claude

Use Cases of Grok in Al Chatbots & Assistants

**Hands-on:**

Running Grok on X (formerly Twitter) API **o** Claude (Anthropic Al)

What is Claude & How It Differs from Other LLMs? Claude's Approach to Al Safety & Constitutional Al Fine-Tuning Claude for Enterprise Applications

**Hands-on:**

Building an Al-powered assistant with Claude API

Module 5: Meta's Generative Al Ecosystem

LLAMA 3: Open-Source LLM by Meta

Introduction to LLAMA 3

Comparison with GPT-4, Gemini, Mixtral, & Claude Fine-Tuning & Customizing LLaMA for Specific Tasks

**Hands-on:**

• Running LLaMA 3 on a local machine using Hugging Face **O** Building Generative Al on Cloud

Cloud Platforms for AI (AWS, GCP, Azure, Meta Cloud)

• Deploying LLMs on Cloud for Scalability

• Building Al-Driven Web Apps with Cloud-Based LLMs

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**Hands-on:**

Deploying an LLM-powered chatbot on Cloud

**O** Meta's Foundation Models

Understanding Meta's Al Foundation Models Pre-Trained Models vs Custom Models

Adapting Foundation Models for Industry Use Cases

**Hands-on:**

Using Meta's Al Models for custom NLP tasks

Module 6: Fine-Tuning LLMs with Quantization, LoRA&**QLORA**

Fine-Tuning Large Language Models (LLMs)

Why Fine-Tune an LLM?

• Datasets & Preprocessing for LLM Fine-Tuning Fine-Tuning vs Prompt Engineering

LORA (Low-Rank Adaptation) Fine-Tuning

What is LoRA?

Reducing Computation for LLM Training Implementing LORA with Hugging Face &PyTorch

QLORA (Quantized LORA) for Efficient Model Fine-Tuning

What is QLORA?

• Memory Optimization for Large LLMs

Running Fine-Tuned Models on Low-End Hardware

**Hands-on:**

Fine-tuning a LLaMA 3 model using LoRA&QLoRA

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Module 7: End-to-End Al Model Deployment & Optimization

Deploying Al Models with APIs (FastAPI, Flask) Optimizing AI Models for Performance & Cost Best Practices for Al Model Security & Governance

**Hands-on:**

Deploying a fine-tuned LLM as a FastAPI web service

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**Vector database**

Module 1: Introduction to Vector Databases

What is a Vector Database?

✔ Difference Between Traditional & Vector Databases

Why Use Vector Databases in Generative Al & LLMs?

• How Vector Embeddings Work in Al Search & Retrieval

**Hands-on:**

• Generating vector embeddings from text using OpenAl's text-embedding-ada-002

Module 2: Understanding Vector Embeddings

• What Are Embeddings in Al?

How LLMs Convert Text, Images & Audio to Vectors

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Similarity Metrics: Cosine Similarity, Euclidean Distance, Dot Product Choosing the Right Embedding Model (OpenAI, Hugging Face,

Sentence Transformers, BERT, etc.)

**Hands-on:**

Generating embeddings with OpenAI, Hugging Face, and BERT models

Module 3: Implementing FAISS (Facebook Al **Similarity Search)**

What is FAISS & How It Works?

Indexing & Searching Large-Scale Vectors with FAISS

Optimizing FAISS for Fast Retrieval

**Hands-on:**

Implementing a FAISS-based search engine for document retrieval

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Module 4: Using Pinecone for Scalable Al Search

Introduction to Pinecone: A Managed Vector Database Building Real-Time Al Search Applications with Pinecone ✔ Comparing FAISS vs Pinecone vs Milvus

**Hands-on:**

Creating a question-answering chatbot using OpenAI + Pinecone

Module 5: ChromaDB for LLMs & Al Applications

What is ChromaDB?

How ChromaDB Works with LangChain

Building RAG (Retrieval-Augmented Generation) Pipelines with ChromaDB

**Hands-on:**

Integrating ChromaDB with OpenAl's GPT for Al-powered search

Module 6: Exploring Weaviate& Its Al Capabilities

Overview of Weaviate as a Hybrid Search Engine

• Using Weaviate for Semantic Search & Knowledge Graphs Deploying Weaviate on Cloud & Local Environments

**Hands-on:**

Implementing a semantic search engine with Weaviate

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Module 7: Milvus &Qdrant for Large-Scale Al **Applications**

• Milvus (Distributed & Cloud-Based Vector Search)

Introduction to Milvus for Al Applications

Optimizing Milvus for Large-Scale Data Processing

Qdrant (High-Performance Open-Source Vector DB) What is Qdrant & How It Works?

Fine-Tuning Qdrant for Al Search & Recommendation Systems

**Hands-on:**

Deploying Milvus &Qdrant for Al-driven search and recommendations

Module 8: Building Al-Powered Search & RAG **Applications**

What is Retrieval-Augmented Generation (RAG)?

Integrating Vector Databases with LLMs for Intelligent Search

• Building Enterprise Al Assistants Using Vector Databases

**Hands-on:**

Building an RAG pipeline using LangChain, Pinecone, and OpenAl

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**MLOps & CI/CD Pipeline for Al & Machine Learning**

Module 8: Building Al-Powered Search & RAG Applications

• What is MLOps& Why is it Important?

• DevOps vs MLOps: Key Differences

MLOps Lifecycle & Stages

Understanding CI/CD Pipelines in AI/ML Projects

Challenges in Deploying ML Models at Scale

**Hands-on:**

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Setting up a basic CI/CD pipeline for ML models using GitHub Actions

Module 2: Containerization & Model Packaging with Docker

Why Containerize ML Models?

Building & Running Docker Containers for ML Applications Deploying ML Models inside Docker Containers Optimizing Containers for Al Workloads

**Hands-on:**

Containerizing an ML Model with Docker & Running it Locally

Module 3: CI/CD Pipeline for ML with GitHub Actions & Jenkins

What is CI/CD & How Does It Work in ML? Setting up a CI/CD Pipeline for ML Models

• Automating Model Testing, Validation & Deployment

CI/CD with GitHub Actions,

**Hands-on:**

Implementing a CI/CD Pipeline for an Al Model Deployment Using GitHub Actions

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Module 4: MLOpswith Mlflow

Introduction to Kubeflow for AI & ML

Integrating with MLflow for Experiment Tracking

**Hands-on:**

• Building an ML Workflow with Kubeflow Pipelines

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