Generative AI
MASTERS

Data Science + Generative AI + Agent AI

PROGRAM OVERVIEW

This 4-month program (16 weeks, 5 days/week, 1hours/day, 94 hours) covers a wide range of topics from Python basics to advanced AI technologies including Generative AI, Large Language Models (LLMs), Retrieval-Augmented Generation (RAG), and Agentic AI. It includes hands-on labs, case studies, and real-world applications.

Contents

1. Python. (20hours)
2. Data Science Libraries.(3hours)

3.Statistics & Probability in Decision Modeling. (15hours)

4.Methods and Algorithms in Machine Learning.(12 hours)

5.AI and Decision Sciences (Deep Learning, NLP)(20hours)

6.Generative AI (Gen AI) & AI Agent Creation. (27 hours)

7. Prompt Engineering.(2hours)

1.Python(20 hours)

Modelue1

A.introduction of python.

B.Assignment of variables.

c.comments

D.Primitive Data types

E.Type Casting

F.python string operations.

G.Non-privtive Data types. –(List,Tuples,Set,Dictionaries)

H.Python Conditions and If statements

I.Python - List Comprehension

J.The Python Match Statement

Note

1) Hands-on project on Conditional statements

2)Mock Test-1

Modelue2

A.Python Loops statement. (for,while)

B.python Functions

c.Python Lambda Function

D.Python OOPS Concepts

E.Python Modules creation.

F.Exceptional Handling

G.Exceptional Handling

H..Genrator,Itterator,Map,reduer,filter,apply functions.

Note

1.Final Project. 2.FinalMock Test-2

structured 20-hour Python learning curriculum (1 hour per day, 5 days per week, total 4 weeks). I'll design it step by step, so you'll have a clear day-wise schedule with progressive learning, including theory + coding practice.

Here's the structured Python Curriculum (20 Hours / 4 Weeks / 5 Days per Week / 1 Hour Daily)

Week 1 – Python Basics (5 Hours)

Day 1 (1 hr)

- Introduction to Python
- Python installation, IDEs (Google colab/Jupyter)
- Your first Python program (Hello World)
- Input & Output

Day 2 (1 hr)

- Assignment of variables
- Data types overview (Primitive vs Non-Primitive)
- Constants vs variables

Day 3 (1 hr)

- Comments (Single-line & Multi-line)
- Primitive Data Types (int, float, bool, str)
- type(), id(), isinstance()

Day 4 (1 hr)

- Type Casting (int(), float(), str(), bool())

- String operations: indexing, slicing, concatenation
- String methods (upper(), lower(), split(), strip())

Day 5 (1 hr)

- Non-Primitive Data Types overview
- Lists: create, access, modify
- Tuples: immutability, indexing
- Sets: uniqueness, operations (union, intersection)
- Dictionaries: key-value pairs

Week 2 – Control Flow & Collections (5 Hours)

- Goal: Master conditions, loops, and comprehension.

Day 6(1 hr)

- Python Conditions (if, elif, else)
- Nested if statements
- Logical operators

Day 7(1 hr)

- List Comprehension
- Set & Dict comprehensions
- Practical problems

Day 8(1 hr)

- The Python match statement (like switch-case)
- Examples with patterns

Day 9(1 hr)

- Loops – for and while
- break, continue, pass
- Loop with else

Day 10(1 hr)

- Nested loops
- Iterating over lists, sets, dicts
- Practical exercises

Week 3 – Functions & OOP (5 Hours)

- Goal: Learn functions and Object-Oriented Programming.

Day 11(1 hr)

- Python Functions: def, arguments, return
- Default & keyword arguments
- Docstrings
- Loop with else

Day 12(1 hr)

- Lambda functions
- map(), filter(), reduce()
- Apply() with Pandas intro

Day 13(1 hr)

- OOP Concepts: Class & Object
- __init__ method
- Instance vs Class variables

Day 14(1 hr)

- OOP: Inheritance
- Polymorphis
- Encapsulation & Abstraction

Day 15(1 hr)

- Constructors & Object Lifecycle
- Access Modifiers (public, private, protected)
- Static Methods & Static Variables

Day 16(1 hr)

- IS-A vs HAS-A Relationship
- Aggregation vs Composition
- Method Overriding & super keyword
- OOP Best Practices (Clean & Reusable Code)

Day 17(1 hr)

- Python Modules creation
- Importing & using built-in modules (math, random, os)
- Creating your own module

Week 4 –Python Libraries (5 Hours)

- Goal: Master python Libraries & practical usage.

Day 18(1 hr)

- Numpy
- operations

Day 19(1 hr)

- pandas
- Data Frames
- Operations

Day 20(1 hr)

- Matplotlib
- Data visualization
- Graphs & charts

Day 21(1 hr)

- Seaborn
- Statistical visualization Techniques

Day 22(1 hr)

- Final Project
- Simple To-Do App
- Uses functions, loops, conditions, exceptions, and OOP, Modules.

2. Statistics & Probability in Decision Modeling (15hours)

Tools: Python

1.Statistics

- A.Statistics, Limitations, Applicatinos statistics.
- B.Data, Types of Data.
- c.Population, samples
- D.Types of samplings
- E.Types of statistics.
- F.Descriptive statistics

1) Measure of central Tendency
2) Measure of Variability
3) Distribution shape
4) Graphical Visualization

INFERENTIAL STATISTICS

- Estmation parametr
- Regression analyses
- confidance interval
- Hypothesises Test.
- Statistical Tests
- Correlation & Association.

PROBABILITY

A.Trail and outcome

B.sample Space.

c.what is Event, Types of Event in probability.

D.Random variable,Types of Radom varible

E.Permitations and combinations

F.conditional probability.

G.Bayes' Theorem

H.probability Distrilbution

2.STATISTICS & PROBABILITY CURRICULUM (12 HOURS / 5 DAYS PER WEEK)

Week 1 – Statistics Fundamentals (5 Hours)

Day 1 (1 hr)

- Introduction to Statistics
- Limitations of Statistics
- Applications of Statistics in Data Science

Day 2(1 hr)

- Data & Types of Data (Qualitative, Quantitative)
- Population vs Sample
- Types of Sampling (Random, Stratified, Cluster, Systematic)

Day 3(1 hr)

- Types of Statistics → Descriptive vs Inferential
- Descriptive Statistics Overview

Day 4 (1 hr)

- Descriptive Statistics
- Measures of Central Tendency (Mean, Median, Mode)
- Measures of Variability (Range, Variance, Std. Dev, IQR)

Day 5(1 hr)

- Descriptive Statistics (continued)
- Distribution Shape (Skewness, Kurtosis)
- Graphical Visualization (Histogram, Boxplot, Bar, Pie, Scatterplot)

Week 2 – Inferential Statistics (3 Hours)

+ Probability Basics (2 Hours)

Day 6 (1 hr)

- Inferential Statistics Overview
- Estimation of Parameters
- Confidence Intervals (mean & proportion)

Day 7(1 hr)

- Hypothesis Testing (Null vs Alternative, Errors, p-value, significance level)
- Statistical Tests: t-test, Chi-square, ANOVA

Day 8(1 hr)

- Regression Analysis (Simple Linear, Logistic basics)
- Correlation & Association (Pearson, Spearman, Covariance)

Probability

Day 9(1 hr)

- Probability Basics
- Trial & Outcome, Sample Space
- Events & Types of Events (Mutually exclusive, Independent, Complementary)

Day 10(1 hr)

- Random Variables (Discrete, Continuous)
- Permutations & Combinations

Week 3 – Probability Advanced (2 Hours)

Day 11(1 hr)

- Conditional Probability
- Bayes' Theorem (with real-world example: medical test / spam filter)

Day 12(1 hr)

- Probability Distributions
- Discrete (Binomial, Poisson)
- Continuous (Normal, Uniform, Exponential

3.Methods and Algorithms in Machine Learning(20hours)

A. Supervised, Unsupervised, and Reinforcement Learning.

- B. Structured Data vs. Unstructured Data.
- c. Confusion Matrix.
- D. Data Cleaning and Preprocessing data for Analysis.
- E. Regression and Classification ML Algorithms.
- F. Model Selection and Cross-Validation.
- G. Feature Engineering.
- Discrete (Binomial, Poisson)
- Continuous (Normal, Uniform, Exponential
- NLP (Natural Language Processing) and Text Mining
- Text Preprocessing.

Week 1: ML Foundations & Data Basics (5 hrs)

Day 1(1 hr) Introduction + Data Types

- What is ML?
- Types of Learning: Supervised, Unsupervised, Reinforcement
- Learning.
- Structured vs Unstructured Data.

Day 2 (1 hr): Confusion Matrix & Evaluation Metrics

- TP, TN, FP, FN.
- Accuracy, Precision, Recall, F1-score.

Day 3 (1 hr): Data Cleaning

- Handling missing values.
- Removing duplicates

Day 4 (1 hr): Data Preprocessing I

- Encoding categorical features (LabelEncoder, OneHotEncoder)

Day 5 (1 hr): Data Preprocessing II

- Feature scaling (StandardScaler, MinMaxScaler).
- Train-test split

Week 2: Core ML Algorithms (5 hrs)

- Linear Regression, Multiple Regression
- Regularization: Ridge, Lasso, ElasticNet

Day 7 (1 hr): Classification Basics

- Logistic Regression.
- Naive Bayes.
- k-Nearest Neighbors

Day 8 (1 hr): Decision Trees

- Splitting criteria: Gini, Entropy.
- Overfitting in trees, pruning

Day 9 (1 hr): Ensemble Methods

- Bagging: Random Forest
- Boosting: AdaBoost, Gradient Boosting, XGBoost

Day 10 (1 hr): Support Vector Machines (SVM)

- Linear & Nonlinear SVM
- Kernel trick (RBF, Polynomial)

Week 3: Feature Engineering & Recommendation Systems (5 hrs)

Day 11 (1 hr): Feature Engineering

- Creating new features
- Feature selection (filter, wrapper, embedded methods)

Day 12 (1 hr): Dimensionality Reduction

- PCA (Principal Component Analysis)
- t-SNE (intro only)

Day 13 (1 hr): Hyperparameter Tuning

- GridSearchCV
- Content-based filtering.
- RandomizedSearchCV

Day 14 (1 hr): Recommendation Systems Basics

- Collaborative filtering (user-based, item-based).

Day 15 (1 hr): Recommendation Systems Advanced

- Matrix Factorization (SVD).
- Surprise library

Week 4: NLP & Text Mining (5 hrs)

Day 16 (1 hr): NLP Basics

- What is NLP & Text Mining?
- Real-world applications

Day 17 (1 hr): Text Preprocessing I

- Tokenization
- Lowercasing, removing punctuation, stopwords.

Day 18 (1 hr): Text Preprocessing II

- Bag of Words, TF-IDF
- Lemmatization, stemming.

Day 19 (1 hr): Text Classification

- Naive Bayes, Logistic Regression for text

Day 20 (1 hr): Capstone Project

- End-to-End Project combining numerical + text features.
- Workflow: data cleaning → feature extraction → model → evaluation.

4.AI and Decision Sciences (Deep learning)

- A. Artificial Neural Networks (ANNs)
- B. Deep Learning
- c. Convolutional Neural Networks (CNNs)
- D. Recurrent Neural Networks (RNNs)

- E. Long Short-Term Memory (LSTM)
- F. Generative Adversarial Networks (GANs)
- G.Transformer Architecture

Day 1 (1 hr): Artificial Neural Networks (ANNs)

- Introduction to Neural Networks.
- Neuron structure: inputs, weights, bias, activation
- Common activation functions: Sigmoid, Tanh, ReLU, Softmax.
- Use cases of ANNs in decision sciences

Day 2 (1 hr): Deep Learning Foundations

- Shallow vs Deep networks.
- Training process: Forward pass, Backpropagation, Loss functions.
- Gradient Descent & Optimizers (SGD, Adam, RMSProp)

Day 3 (4 hrs): Convolutional Neural Networks (CNNs)

- CNN architecture: Convolution, Pooling, Fully Connected layers.
- Image feature extraction & hierarchical learning.
- Popular CNN models: LeNet, AlexNet, VGG, ResNet.
- Transfer Learning with CNNs.

Day 4 (4 hrs): Recurrent Neural Networks (RNNs) & LSTMs/GRUs

- RNN architecture & sequence modeling
- Challenges: Vanishing/exploding gradients.
- Long Short-Term Memory (LSTM): gates & memory cells.
- Gated Recurrent Units (GRU) as a simpler alternative

Day 5 (2 hrs): Advanced Generative & Attention-Based Models

- Generative Adversarial Networks (GANs): Generator vs
- Discriminator, applications in synthetic data & images.

- Variational Autoencoders (VAEs): Encoding, decoding, latent representations.
- Transformers: Attention mechanism, encoder-decoder structure.
- Pretrained Large Models: BERT, GPT, Vision Transformers.

6.Generative AI (Gen AI) & AI Agent Creation. (27hours)

- Week 1: Generative AI & LLM Foundations (5 hrs)
- Day 1: Introduction to Generative AI
- What is Generative AI?
- Applications (Text, Image, Audio, Video, Code)

Day 2: Introduction to Large Language Models (LLMs)

- What are LLMs?
- Training concepts (pre-training, fine-tuning, RLHF)

Day 3: Word Embeddings

- Concepts of embeddings.
- Word2Vec, GloVe, contextual embeddings

Day 4: Hugging Face Basics

- Introduction to Hugging Face Hub
- Exploring pre-trained models

Day 5: Hugging Face Pipelines

- Using pipeline for NLP tasks (sentiment, summarization, Q&A)

Week 2: Hugging Face Model Usage & Fine-tuning (5 hrs)

Day 6: Hugging Face Without Pipelines

- Loading models/tokenizers manually
- Inference with Transformers

Day 7: Fine-Tuning Models on Hugging Face

- Dataset preparation.
- Training & evaluation basics.

Day 8: Fine-Tuning Hands-On (Text Classification)

- Train a classifier using Hugging Face Trainer API.

Day 9: Hugging Face Advanced Use

- Model saving, deployment options.

Day 10: Project Discussion

- Choosing use cases for fine-tuned models.

Week 3: LangChain Foundations (5 hrs)

Day 11: Introduction to LangChain

- What is LangChain?
- Why it's important for GenAI apps.

Day 12: LangChain Core Components

- Prompt Template, LLM, Output Parsers.

Day 13: LangChain Chains

- Sequential chains.
- Input/Output design.

Day 14: LangChain Memory

- Conversation Buffer, Conversation Summary
- Memory in chatbots.

Day 15: LangChain Agents

- Tools & Agents.
- When to use agents.

Day 16: LangGraph

- What is LangGraph?
- Why LangGraph is needed beyond LangChain
- Graph-based control flow for LLMs
- Nodes, edges, and state
- Deterministic vs dynamic execution
- LangChain vs LangGraph comparison

Day 17: LangGraph Core Concepts

- State management in LangGraph
- Conditional edges and branching logic
- Cycles and looping behavior
- Human-in-the-loop workflows

Week 4: Retrieval-Augmented Generation (RAG) (5 hrs)

- Day 16: RAG Introduction
- What is RAG?
- Architecture & workflow.
- Day 17: Vector Databases
- Embeddings storage.
- Using FAISS/Chroma.

Day 18: RAG Implementation

- Document loaders, splitters, embeddings.
- Building a retriever

Day 19: Building a retriever

- Connecting retriever + LLM
- Testing with real datasets

Day 20: Validating RAG Performance

- Evaluating precision/recall in RAG.

Week 5: Advanced GenAI Applications (5 hrs)

- Day 21: Mastering Chatbots with Memory
- Multi-turn conversations.
- Long-term memory.

Day 22: LangChain Advanced Agents

- Multi-tool agents
- Planning vs Reactive agents

Week 6: Advanced GenAI Applications (5 hrs)

- Day 1: Introduction to Agentic AI

- What is Agentic AI?
- Evolution of AI (Rule-based → ML → LLMs → Agentic AI)
- LLMs vs Chatbots vs AI Agents

- Day 2: AI Agent Architecture

- What is an AI Agent?
- Core components of an Agentic AI system
- Agent lifecycle (Think → Plan → Act → Observe → Iterate)

Day 3: Agent Reasoning & Planning

- Reasoning in Agentic AI
- Chain-of-Thought & ReAct pattern
- Planning-based agents vs Reactive agents.

Day 4: Agentic AI Framework – LangChain Agents

- Why frameworks are needed for Agentic AI
- LangChain Agents overview
- Chains vs Agents vs RAG

Day 5: Agentic AI Applications & Design

- Real-world Agentic AI use cases
- multi-agent systems (conceptual)

Day 6: Introduction to MCP (1 hrs)

- What is MCP (Model Context Protocol)?
- Why MCP is needed in modern GenAI systems
- Limitations of tool calling without MCP
- MCP as a standardized interface between

- LLMs
- Tools
- Data sources
- MCP vs traditional API integrations
- Role of MCP in scalable Agentic AI
- **Day 7: MCP Architecture & Core Concepts (1 hrs)**
- MCP architecture overview
- MCP servers and MCP clients
- Resources, tools, and prompts in MCP
- Context management and state sharing
- Security and access control concepts
- How MCP enables reusable AI tools

7. Prompt Engineering. (2hours)

- Day 1: Advanced Prompt Engineering (Part 1)
- Principles of effective prompting
- Zero-shot, Few-shot, Chain-of-thought prompting

Day 2: Advanced Prompt Engineering (Part 2)

- Structured outputs (JSON, tables)
- Prompt optimization & evaluation techniques.

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