Data Science Real Time Course Content

1. Python Foundations :

Sub-topic :

- Python Basics
- Object-Oriented Programming (OOP)
- File I/O and Exception Handling
- NumPy for Numerical Computing
- Pandas for Data Analysis
- Matplotlib for Visualization

Description :

Variables, data types, conditionals, loops, and functions.
Classes, objects, inheritance, encapsulation, and polymorphism.
Reading/writing files, handling errors with try-except.
Arrays, vectorized operations, broadcasting.
Data Frames, Series, indexing, grouping, and cleaning data.
Creating plots and charts for exploratory data analysis.

2. ML & Deep Learning Foundations :

Sub-topic :

- Supervised Learning
- Unsupervised Learning
- Scikit-learn Workflow
- Neural Network Basics
- TensorFlow Basics
- PyTorch Basics

Description :

Regression, classification, evaluation metrics.
Clustering, dimensionality reduction (PCA).
Pipelines, model training, testing, cross-validation.
Perceptron, activation functions, loss functions.
Building and training simple models using TensorFlow.
Model definition and training using PyTorch.

3. Introduction to Generative AI :

Sub-topic :

- What is Generative AI?
- GANs (Generative Adversarial Nets)
- VAEs (Variational Autoencoders)
- Diffusion Models
- Large Language Models (LLMs)
- Prompt Engineering

Description :

Overview of Gen AI, use cases in NLP, CV, Audio, Code.
Architecture, generator-discriminator dynamics, training instability.
Encoding-decoding probabilistic models.
Denoising diffusion process for image generation.
Evolution and capabilities of GPT, BERT, and other LLMs.
Designing effective prompts for LLMs (zero-shot, few-shot).

4. NLP & Transformers :

Sub-topic :

- Hugging Face Ecosystem
- BERT & GPT Architecture
- T5 and Sequence-to-Sequence Models
- Fine-tuning LLMs
- Text Generation with GPT
- Lang Chain Basics

Description :

Transformers, Datasets, Tokenizers libraries.
Transformer encoder vs decoder, pretraining vs fine-tuning.
Translation, summarization, and Q&A using T5.
Customizing models with domain-specific datasets.
Temperature, top-k, nucleus sampling.
Tool chaining, agents, and memory for building conversational LLM apps.

5. Image, Audio & Code Generation :

Sub-topic :

- Stable Diffusion
- DALL·E API
- GANs for Image Generation
- Whisper for Audio Transcription
- Text-to-Speech (TTS)
- RVC / Audio Craft
- Codex and CodeT5

Description :

Imagegeneration pipeline, custom prompts.
Text-to-image via Open AI's API.
Training GANs on custom image datasets.
Speech-to-text using Open AI Whisper.
Generating human-like speech from text.
Voice cloning and music generation.
AI-assisted code generation and explanation.

6. Backend Development :

Sub-topic :

- Flask Basics
- Fast API for Async APIs
- REST API Design
- JWT Authentication
- MongoDB Integration
- PostgreSQL with SQL Alchemy
- Serving ML Models via API

Description :

Routes,views, request handling, template rendering.
Async endpoints, pydantic models, documentation (Swagger UI).
GET/POST/PUT/DELETE, request/response cycle.
Secure login system using JSON Web Tokens.
CRUD operations using PyMongo or ODMs.
SQL model definitions and querying.

Exposing AI models through backend endpoints.

7. Frontend with React :

Sub-topic :

- React Components
- State Management
- API Integration
- Responsive Design
- Tailwind CSS Styling

Description :

Functional components, props, and JSX.
Use State, Use Effect, lifting state, Context API.
Fetching data from backend using Axios or Fetch API.
Layouts using Flexbox/Grid and media queries.
Utility-first CSS framework for design.

8. Full Stack Gen AI Application :

Sub-topic :

- Project Architecture
- Connecting React with Flask API
- Session Handling and Storage
- File Upload / Download
- Real-time AI Interaction

Description :

Folder structure, routing, environment setup.
HTTP requests, CORS, frontend-backend data flow.
Using local Storage, cookies, or sessions.
React + Flask integration for handling media files.
Building Gen AI-powered tools (e.g., chatbot, image gen).

9. ML Ops & Deployment :

Sub-topic :

- Docker Basics
- CI/CD Pipelines
- Model Tracking with ML flow
- Deployment to Cloud
- Redis and Celery
- Monitoring and Scaling

Description :

Containerizing backend and frontend.
GitHub Actions or GitLab CI for continuous integration.
Logging metrics, artifacts, versioning.
Using Render, Heroku, AWS EC2, or GCP Cloud Run.
Asynchronous task queues for image/audio generation.
Uptime monitoring, resource scaling, logging.

10. Capstone Projects

Sub-topic :

- Project Planning Git & GitHub
- Integration Team
- Collaboration (optional) Final
- Submission & Evaluation

Description :

Choosing project idea and tech stack.
Version control, branching, pull requests.
Working in teams using GitHub projects.
Rubric-based grading and feedback.

11. Appendices :

Sub-topic :

- Software Setup Guide
- API Key & Secrets Management
- Hugging Face / Open AI Setup
- Learning Resources & References

Description :

Installing Python, Node.js, MongoDB, React CLI.
Managing API keys securely with .env files.
Generating access tokens and using SDKs.
Blogs, docs, courses, YouTube channels, research papers.

Thank You