# Generative AI

Python Fundamentals

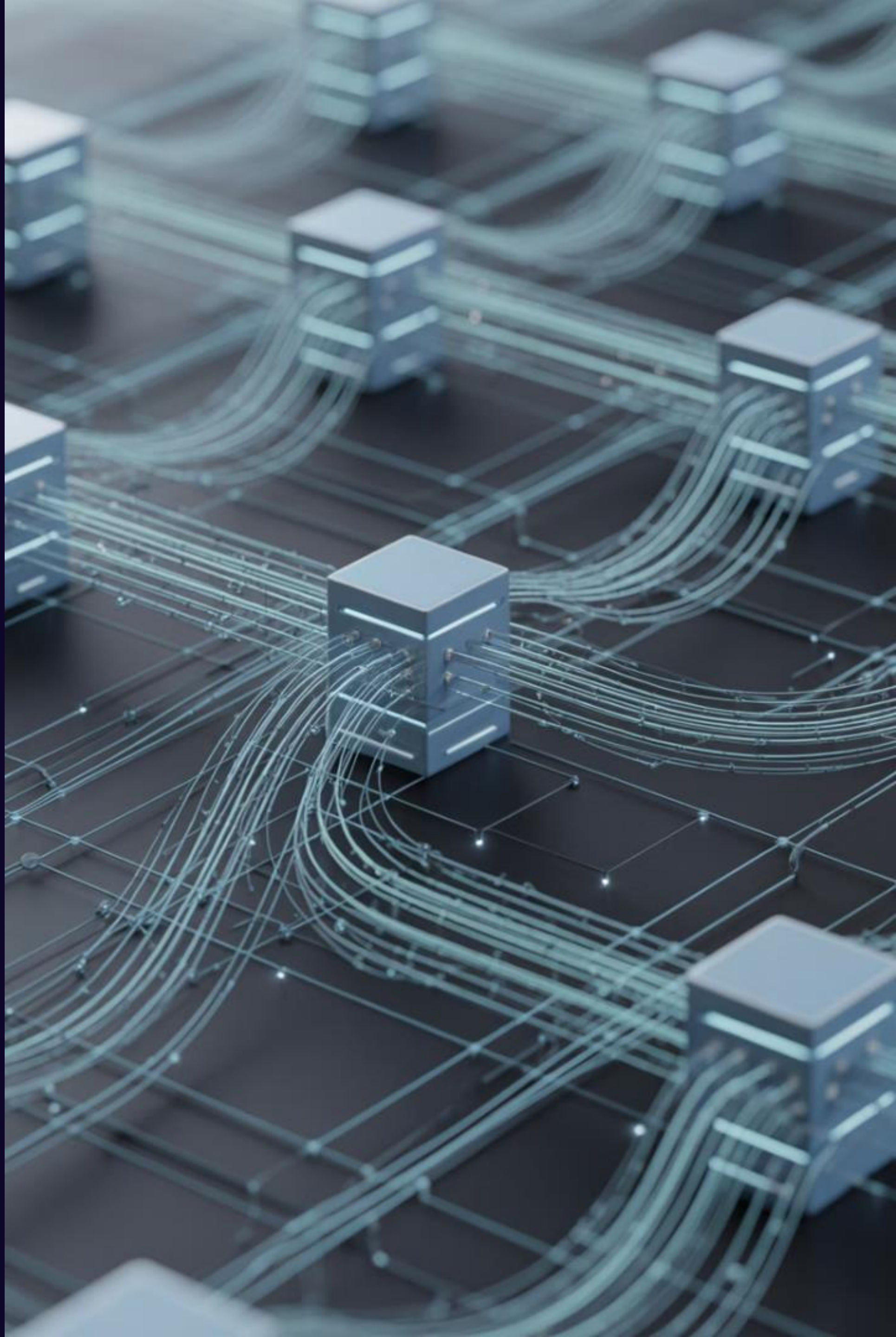
Deep Learning

NLP & RNNs

Generative & Agentic AI

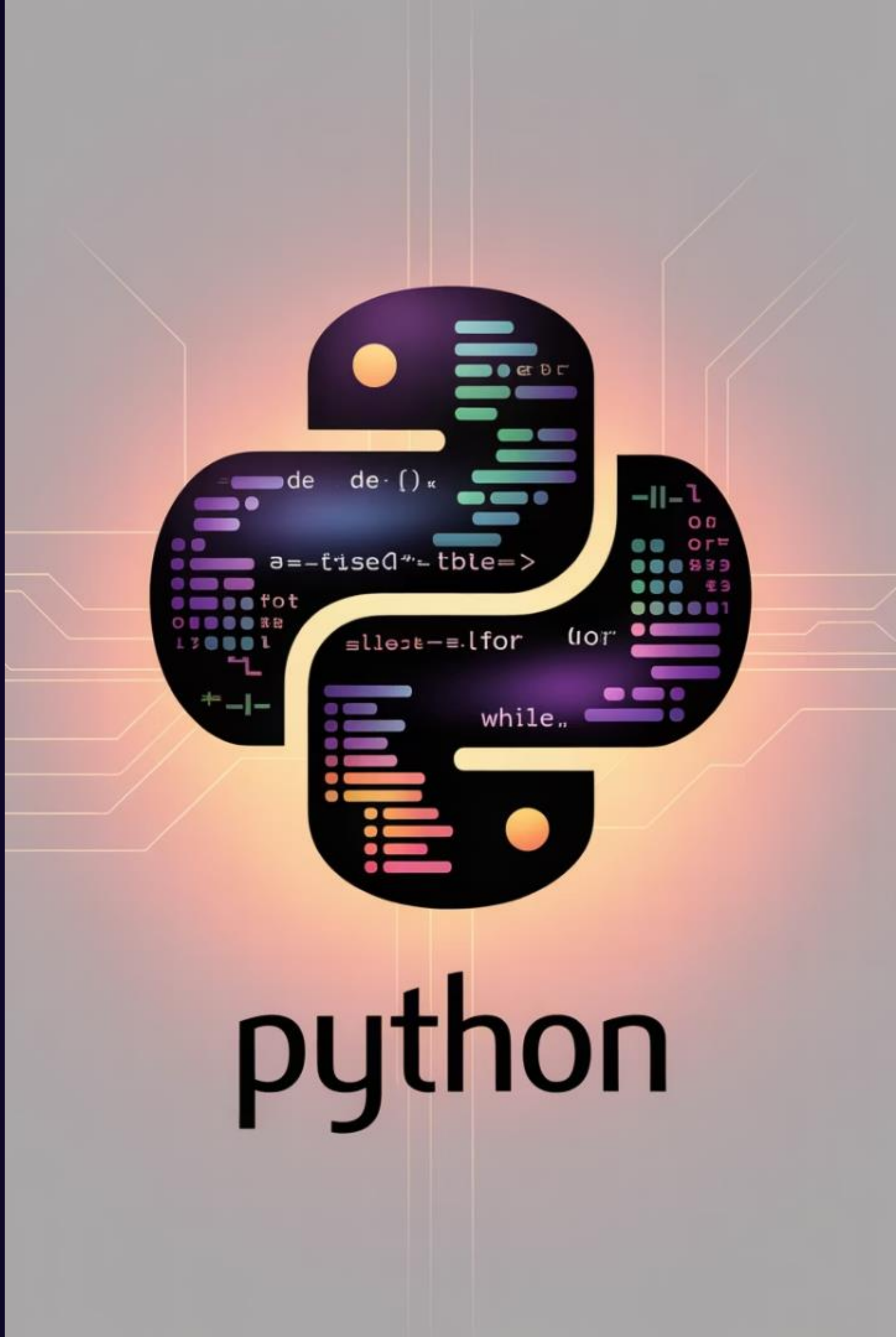
LLMOps

by L&L AI Solutions



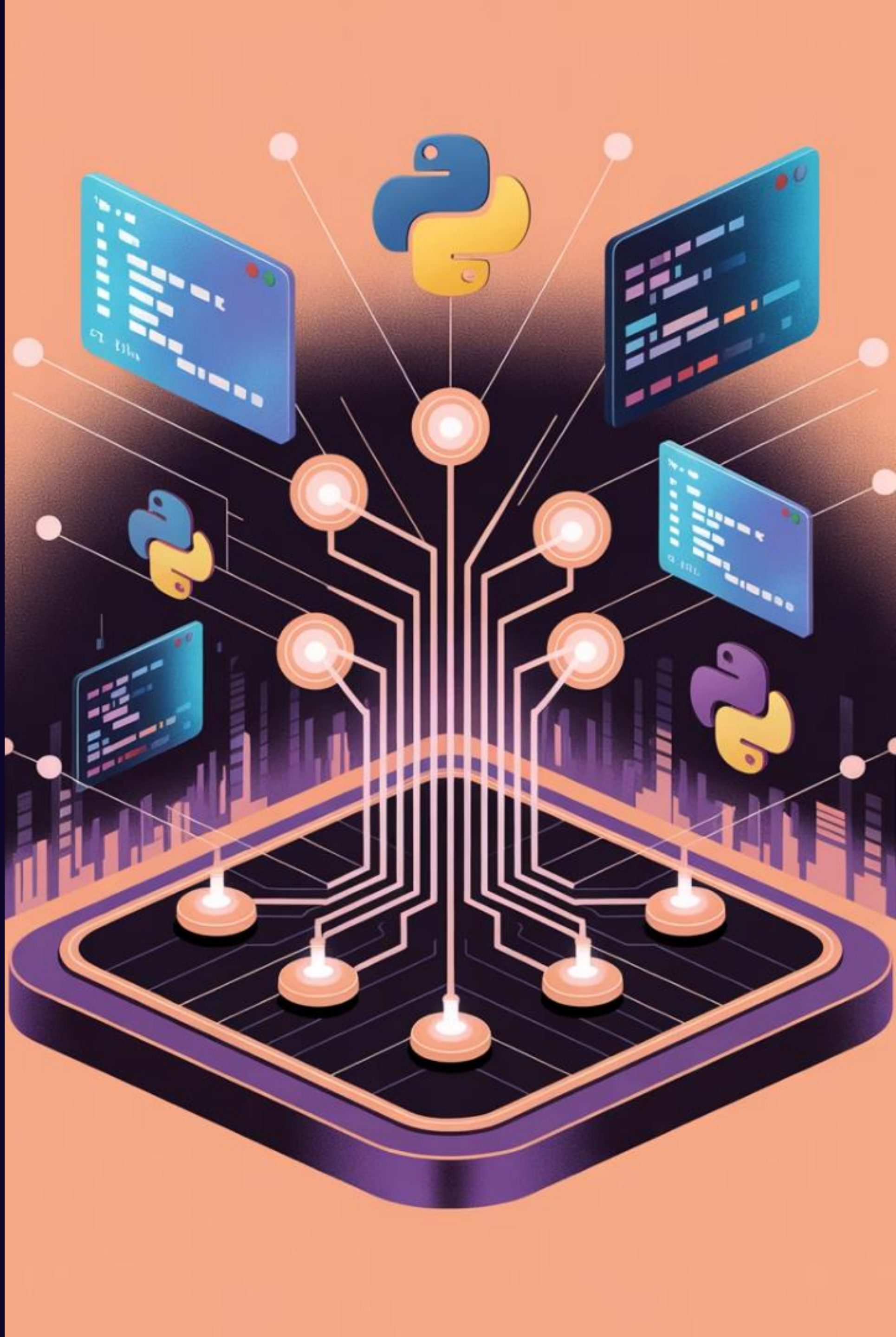
# Python

1. What is Python
2. Installation of Python – VS Code, PyCharm, Anaconda, Google Colab
3. 100 Python main function names
4. Integer, float, Boolean operations (like math calculations), arithmetic (+-*/==='=='), logical operators (and, or, xor)
5. What is variable, types, about print and format combinational operations, basics of strings
6. Strings and methods (user input)
7. List and tuple
8. Sets, Dictionaries (enumerate, zip)
9. Conditionals
    1. if, elif, else
10. Match, case
11. For loops, for–else, nested loops
12. Break, continue, pass, list comprehension, dictionary comprehension
13. While loops, while-else
14. Comments, docstrings, about functions and modules
15. Types of functions, scope of function working and creating functions
    1. Parameters, arguments, *args, **kwargs
    2. Global variable, local variable
16. Creating module, import module help(), dir() aliasing, renaming



# Python Topics

1. Lambda function, map, reduce, filter
2. Iterator, generator, decorator
3. Modules & packages
   - Math
   - Random
   - Date time
   - OS
   - Sys
   - Re module
   - if __name__ == "__main__" in Python
4. File handling
5. Logging
6. Error and exceptions handling
7. What is object, class, __init__ method, instance variables
8. Types of methods in Python
   - Instance method
   - Class method
   - Static method
9. Public, private, protected members and methods
10. Inheritance and Types of Inheritance
11. Polymorphism, encapsulation, abstract method



## Python Troubleshooting

1. Errors in Python
2. How to search on Google to find error corrections using Google, Stack Overflow, and documentation

## UI Frameworks

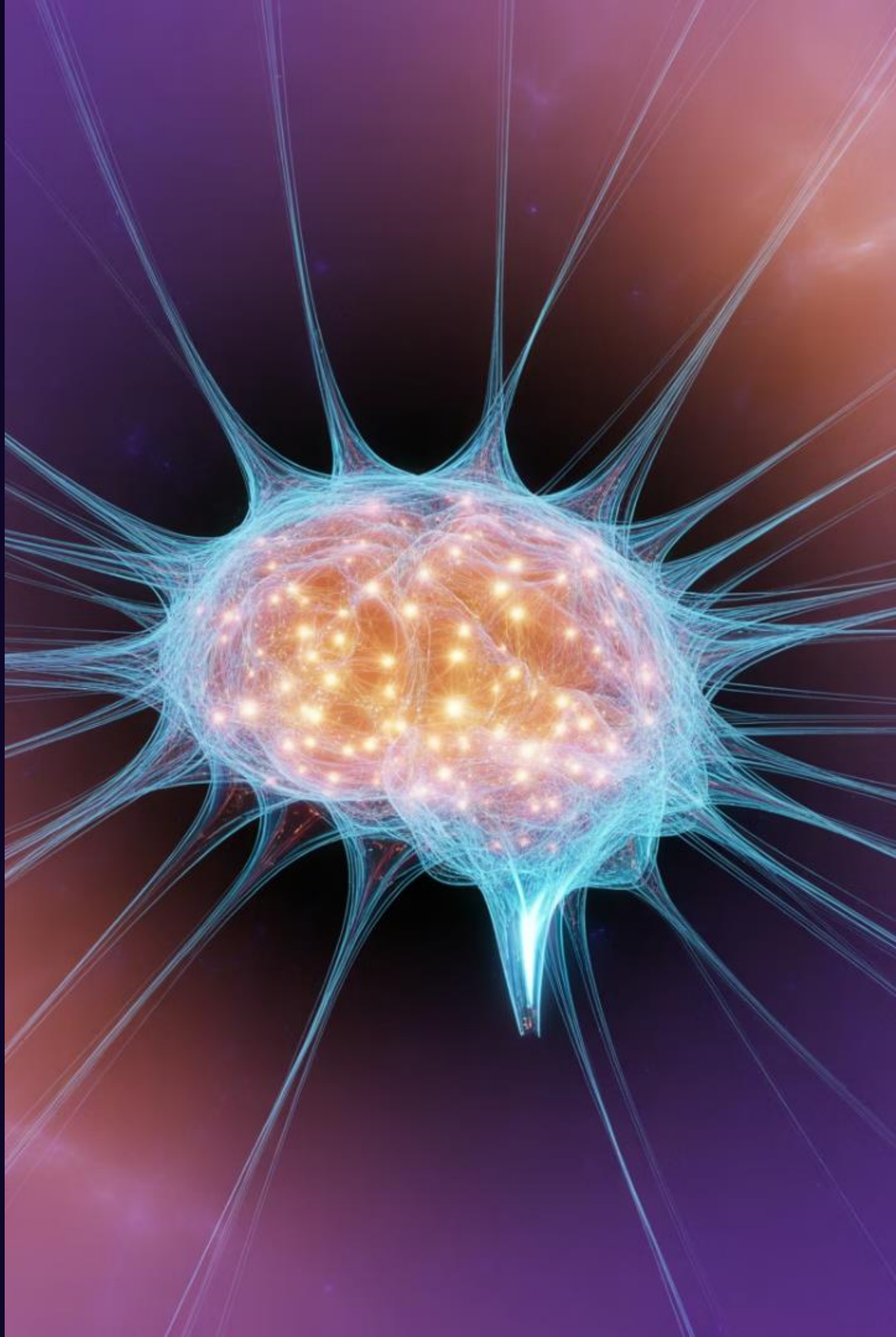
1. Flask / Fast API / Streamlit

## Projects

1. Calculator
2. Snake game

# Deep learning

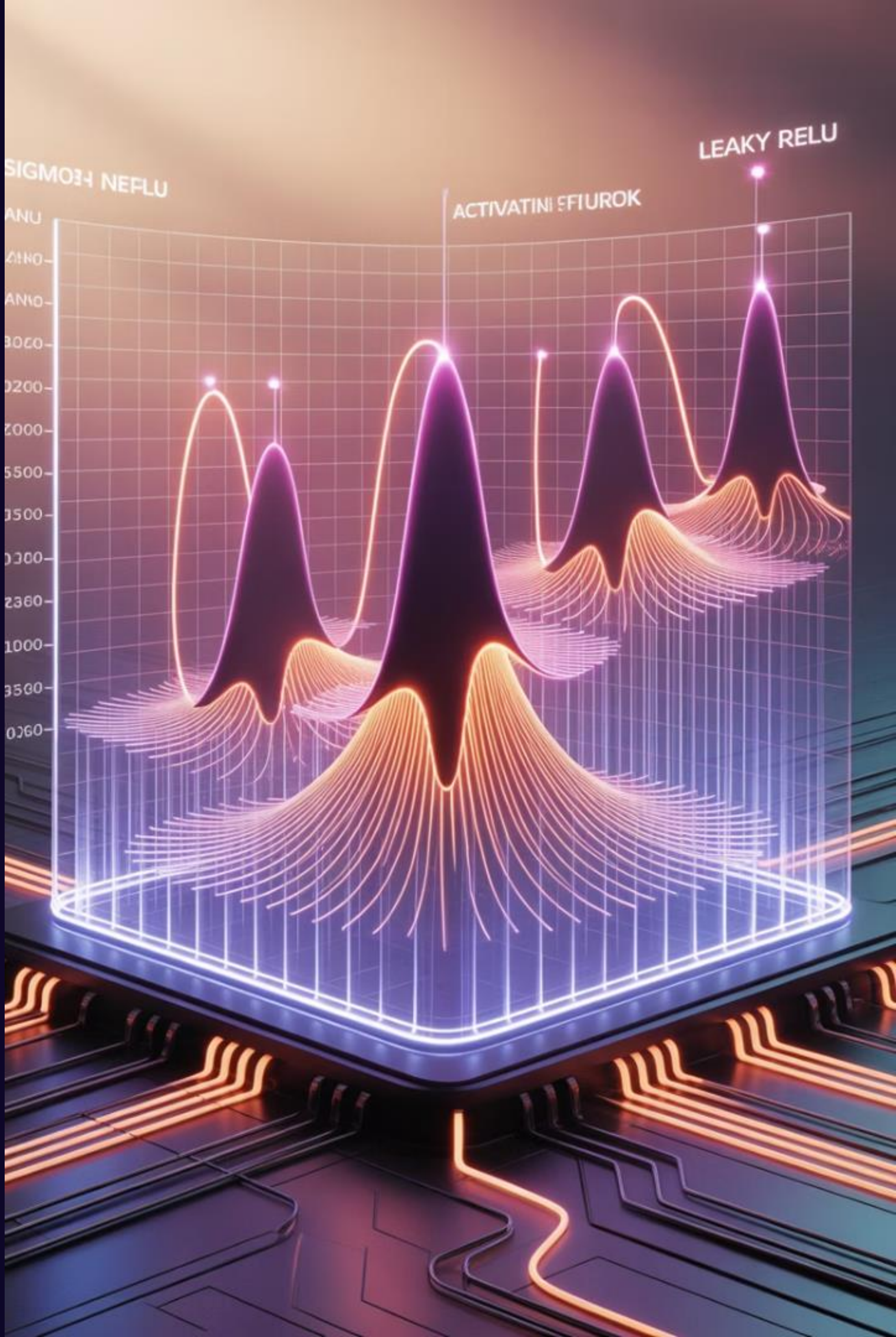
1. **Introduction to Neural Networks**
    1. History of Neural Networks
    2. Comparison with Biological Neurons
    3. How Human Brain Trains by Neurons
    4. How Perceptron Mimics Human Brain
    5. Neuron
    6. Perceptron
2. **Types of Neural Networks**
    1. Introduction to various types of neural networks:
        1. Single-layer Neural Networks
        2. Multilayer Neural Networks



# Activation Functions

## Types of Activation Functions

- Binary
- linear
- Non linear
  - Sigmoid
  - ReLU (Rectified Linear Unit)
  - Softmax
  - Leaky ReLU
  - Tanh
  - Swish



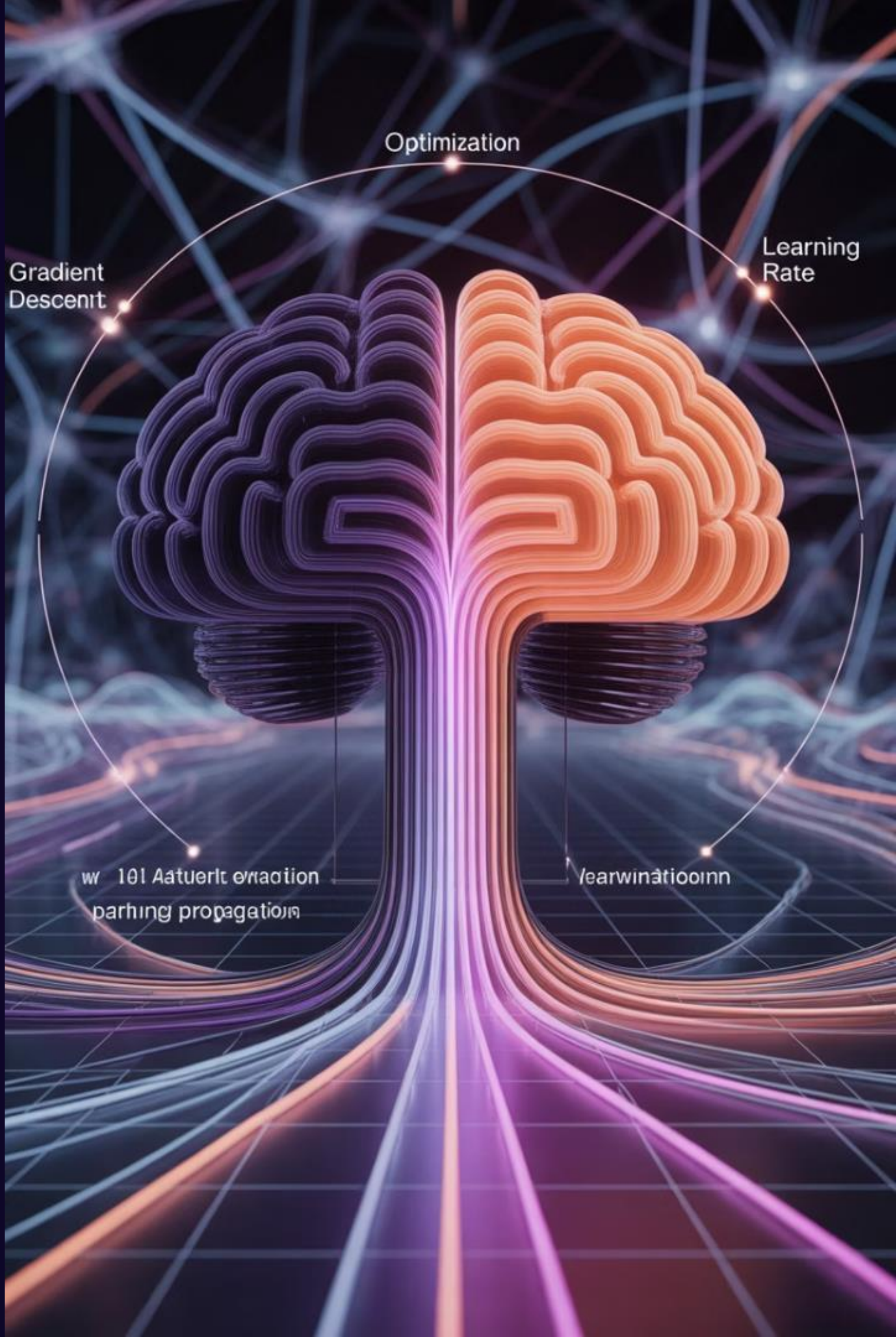
## 3) Learning Rate and Tuning

- Explanation of learning rate and its significance in training neural networks.
- Techniques for tuning the learning rate for optimal performance.

## 4) Gradient Descent and Problems

- **Parameters and Gradient Descent:** How parameters (weights) are updated using gradient descent.
- **Vanishing Gradient Problem:** Explanation of the issue where gradients become extremely small during backpropagation.
- **Exploding Gradient Problem:** Explanation of the issue where gradients become excessively large during backpropagation.

## 5) Forward propagation, Backward propagation. propagation.



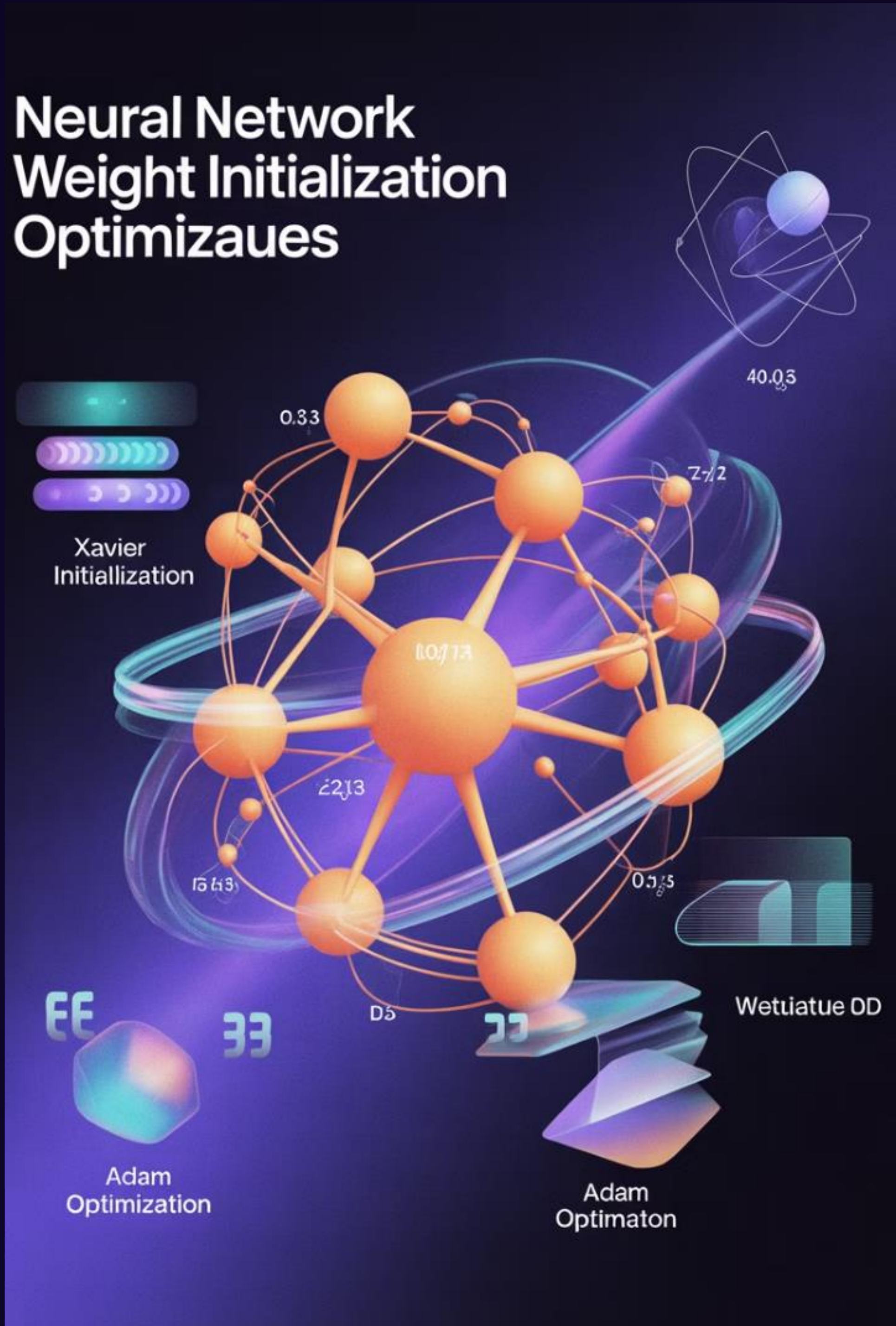
## 6) Weight initialization techniques

- uniform distribution
- xavier/glorot initialization techniqu
- kaimming he initialization

## 7) Epochs, Batch

## 8) Optimizers

- **Definition and Functioning:** Explanation of optimizers and their role in minimizing loss during training.
- **Types of Optimizers**
  - Gradient Descent
  - Stochastic Gradient
  - Descent
  - Adagrad
  - Adadelta
  - RMSprop
  - Adam



## iii) Loss functions

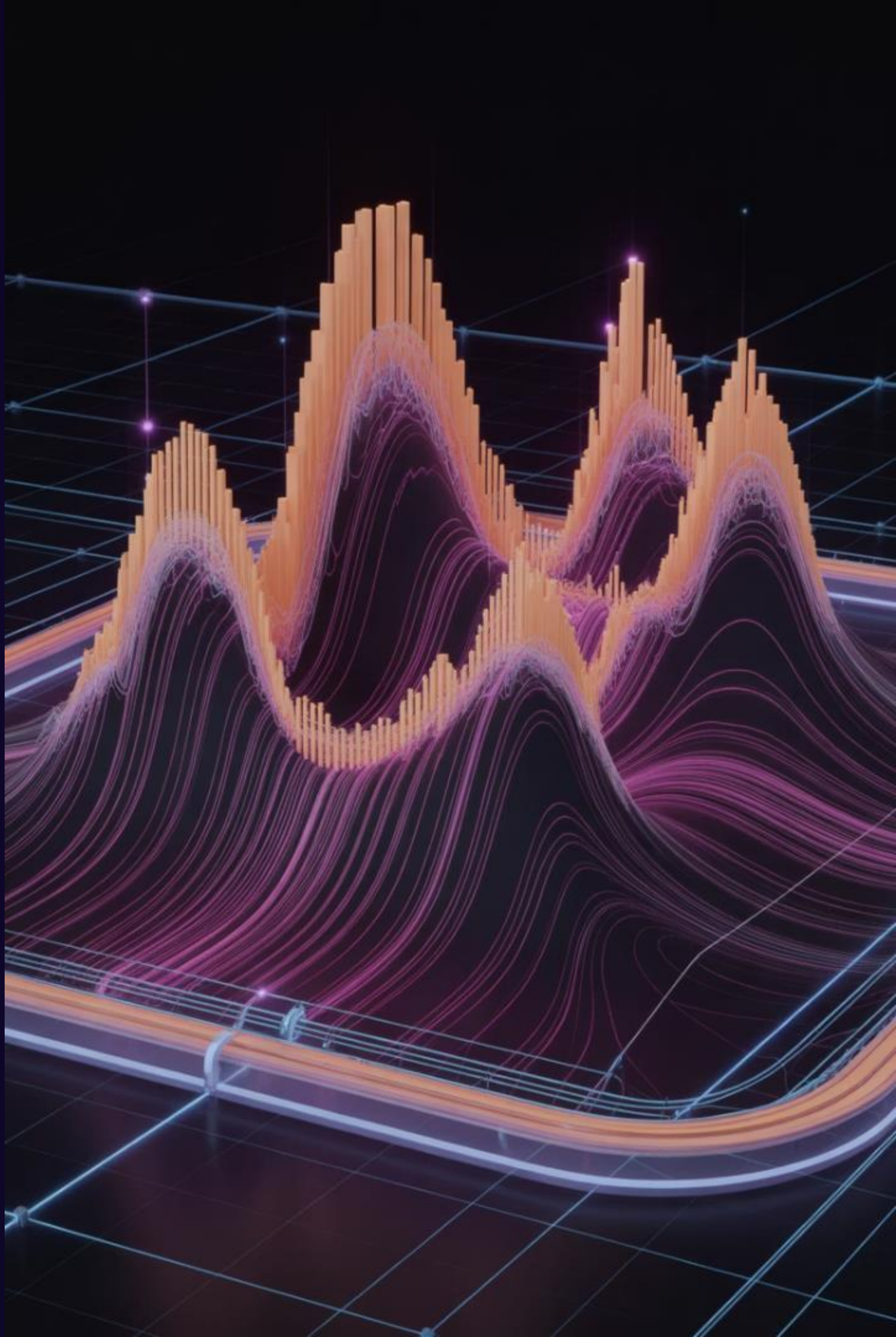
- a)For regression(MSE ,MAE ,Huber loss)
- b)Classification (Binary cross entropy ,categorical cross entropy ,sparse categorical cross entropy,hinge loss , KL divergence

## 6) Weight Initialization, Regularization, Drop-out Drop-out Layers

- i)Explanation of techniques to initialize weights, prevent overfitting through regularization, and improve generalization using dropout layers.

## 8) i)Training Steps and Flow:

Basic steps involved in training single-layer and multilayer Neural Networks



## 9) Architecture Required for Deep Deep Learning (GPU, CPU):

- Explanation of the hardware requirements for training deep learning models, including GPUs and CPUs.

## 10) Types of Artificial Neural Networks:

- **i)ANN:** Artificial Neural Networks
- **ii)RNN:** Recurrent Neural Networks

.

# Libraries in Deep Learning:

- Overview of popular deep learning libraries:
  - TensorFlow
  - Keras
  - PyTorch
  - Jax
  - maxnet

# ANN Projects

### Real vs. Fake News Classifier

Goal: Build an ANN to classify whether a news article is real or fake using NLP.

Key Concepts: Text classification, word embeddings, binary classification, overfitting handling

### House Price Prediction Using Deep ANN

Goal: Predict house prices based on features like size, location, and number of rooms.

Key Concepts: Feature scaling, normalization, regression metrics, model tuning

### Handwritten Signature Verification (Genuine (Genuine or Forged)

Goal: Classify whether a handwritten signature is genuine or fake using an ANN.

Key Concepts: Image flattening, ANN over image vectors, binary classification

### Student Performance Predictor

Goal: Predict final exam scores based on hours studied, attendance, past grades, etc.

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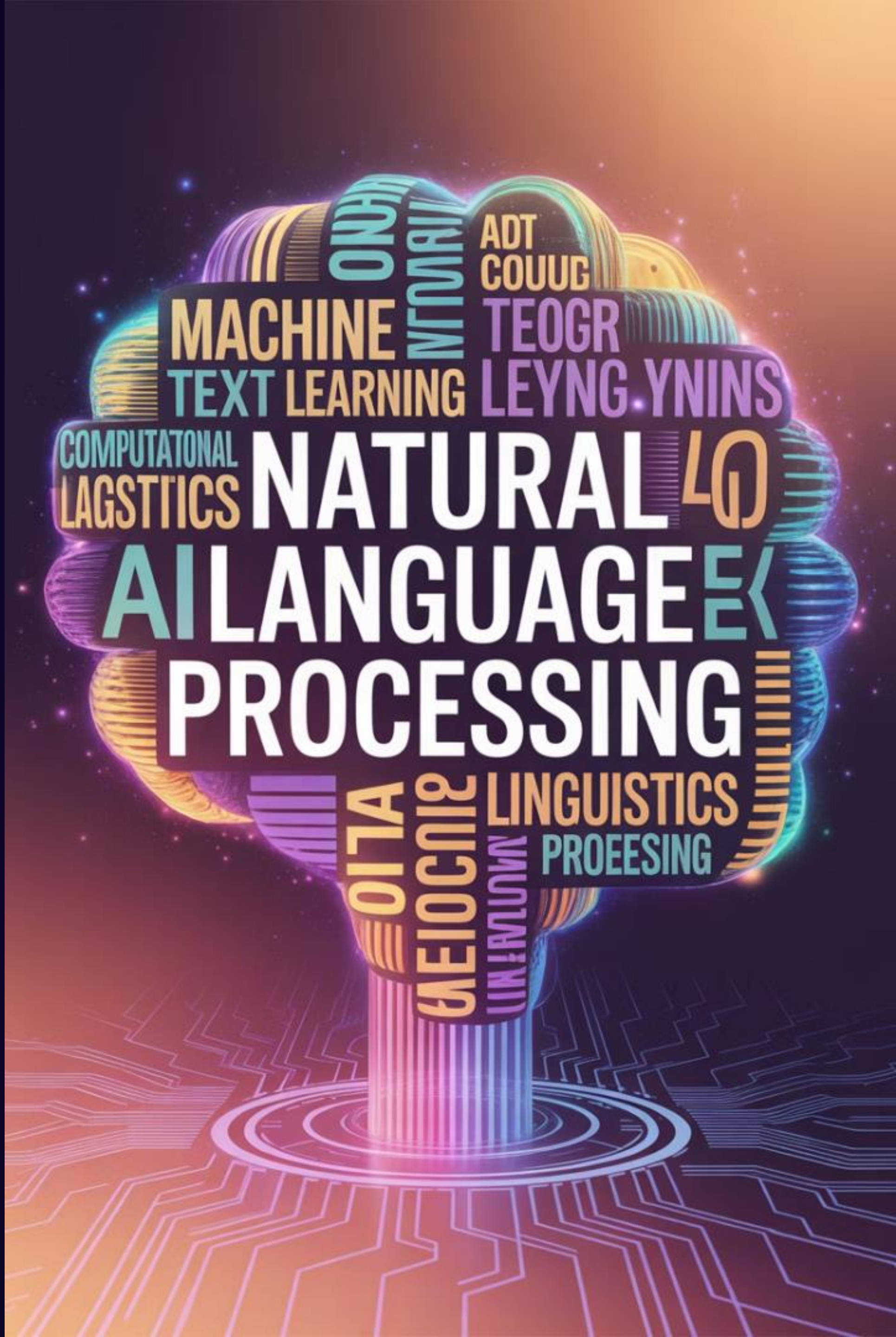
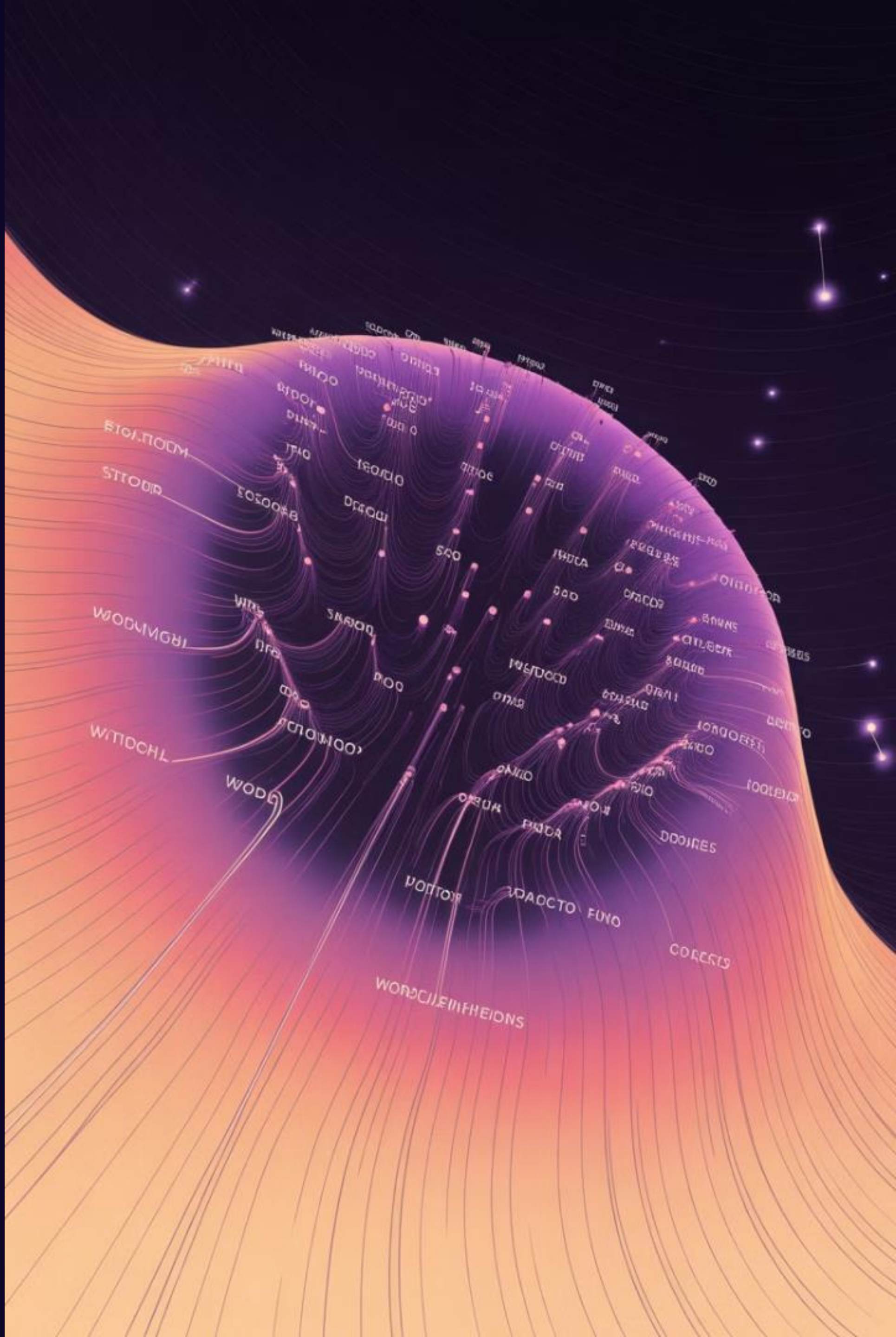
# NLP

## Module 1: Foundations of NLP

- Introduction to NLP
  - Understanding the scope and applications of NLP. Key terminologies: words, sentences, documents, corpus.
- Text Preprocessing Techniques
  - Segmentation and Tokenization.
  - Text normalization: case conversion, spell correction, one gram, bi grams, n-grams.
  - Cleaning text: removing stop words, punctuations, and white spaces.
  - Stemming and Lemmatization.
  - Part-of-Speech (POS) Tagging.
  - Rephrasing text for clarity.



- Word Embeddings
  - One-hot encoding.
  - Bag of Words (BoW).
  - TF-IDF.
  - Word2Vec.
  - GloVe.



## NLP Libraries Overview

- NLTK.
- SpaCy.
- Gensim.
- fastText.
- Stanford NLP Toolkit.

## Module 2: Sequential Models in NLP

### Introduction to Sequential Models

- Understanding the need for sequential models in NLP.

### Recurrent Neural Networks (RNNs)

- Architecture and working.
- Challenges: vanishing and exploding gradients.

### Long Short-Term Memory (LSTM) Networks

- LSTM architecture and gates.
- Advantages over traditional RNNs.

### Gated Recurrent Units (GRUs)

- GRU architecture.
- Comparison with LSTMs.

# Hands-on Implementations

- Building RNN, LSTM, and GRU models using TensorFlow/Keras.
- Projects:
  - Sentiment analysis on the IMDB dataset.
  - Text generation tasks.
  - Named Entity Recognition (NER).

# Module 3: Advanced NLP Applications Applications

### Web Scraping and Data Collection

- Techniques for extracting textual data from websites.

### Text Visualization

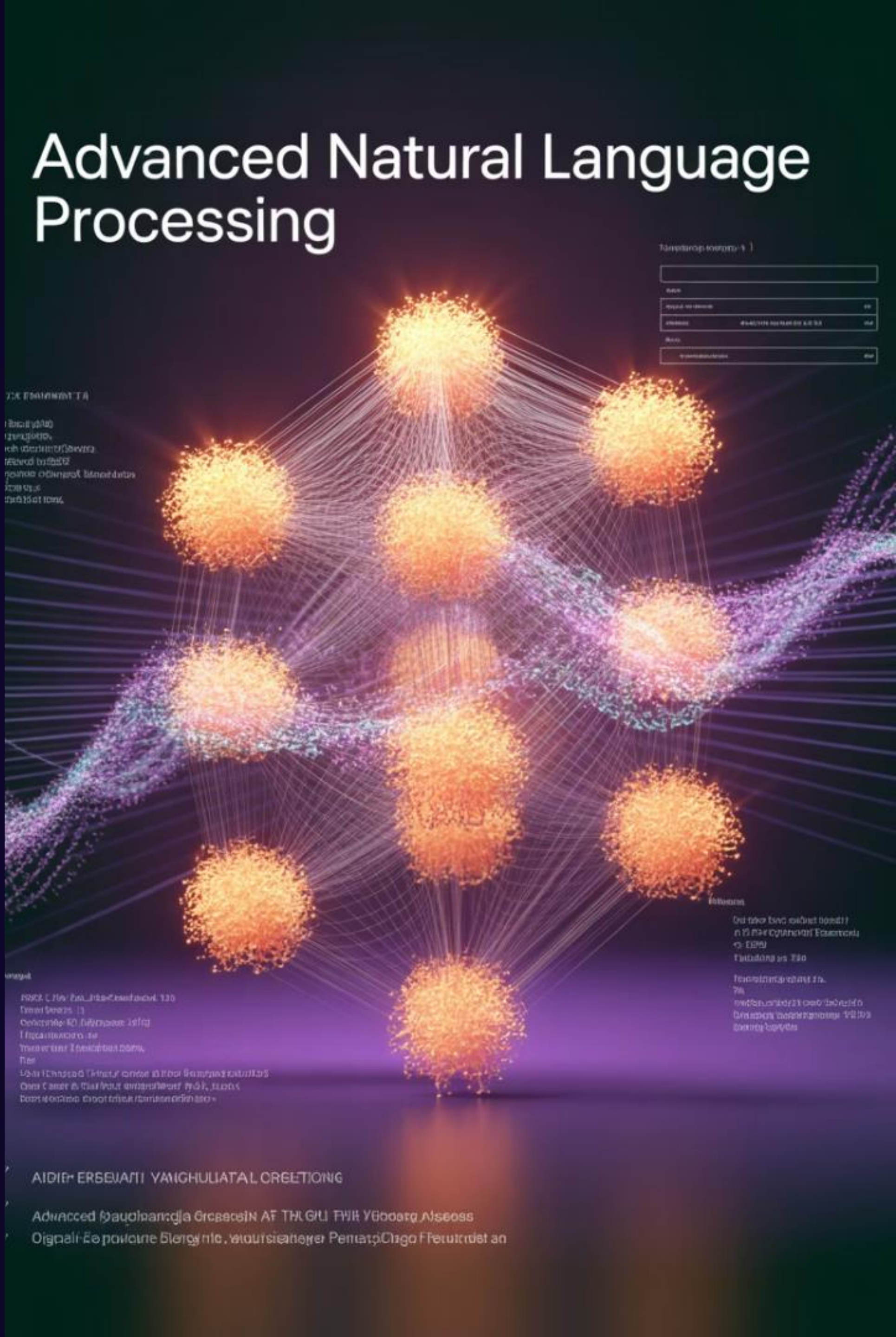
- Creating Word Clouds.
- Exploratory Data Analysis (EDA) for text data.

### Text Similarity Measures

- Cosine Similarity.
- Jaccard Similarity.

### Building NLP Applications

- Developing a spam classifier.
- Creating a basic chatbot using rule-based approaches.


Advanced Natural Language Processing
AIDIF ERSBUAN VANGHULIATAL CRELTIONG

# Projects

### 1. Text Summarization for News Articles

- **Objective**: Generate concise summaries of lengthy news articles.
- **Techniques**: Extractive summarization using TextRank.
- **Tools**: Gensim, spaCy.
- **Dataset**: CNN/Daily Mail Dataset.Guvi+5Fynd Academy+5The Knowledge Academy+5

### 2. Chatbot for Customer Service

- **Objective**: Develop a chatbot to handle customer inquiries.
- **Techniques**: Rule-based responses, intent classification.
- **Tools**: Rasa, Dialogflow.
- **Dataset**: Custom intents and responses.ProjectPro+2Fynd Academy+2Guvi+2

### 3. Language Translation System

- **Objective**: Translate text from one language to another.
- **Techniques**: Sequence-to-sequence models with attention mechanisms.
- **Tools**: TensorFlow, Keras.
- **Dataset**: Multi30k Dataset.

# Generative AI

## Module 1: Foundations of AI & Generative Models

1. Introduction to AI
2. AI vs ML vs DL
3. Types of Learning
    1. Supervised
    2. Unsupervised
    3. Reinforcement
4. Core Difference between ML and DL

## Module 2: Introduction to Natural Language Processing (NLP)

1. History of NLP
2. Intro to RNN, LSTM, GRU, BERT
3. Problems with RNN, LSTM, GRU
4. Shift from RNNs to Transformers

## Module 3: Understanding Generative AI

1. What is Generative AI?
2. Why are Generative Models Required?
3. Understanding Generative Models and Their Significance
4. Generative AI vs Discriminative Models
5. Recent Advancements and Research in Generative AI

# Module 4: Transformers – The Foundation of Modern Generative AI

1. In-Depth Intuition of the Transformer Architecture *(Attention is All You Need Paper)*
2. Transformer Variants:

Encoder-only (e.g., BERT)

**BERT Models-** Google

1. BERT(Bidirectional Encoder Representations from Transformers)
2. RoBERTa (Robustly Optimized BERT Approach)
3. DistilBERT
4. ALBERT
5. XLNet

ii)Decoder-only (e.g., GPT)

iii)Encoder-Decoder (e.g., T5, BART)

1. When to Use Which Transformer Architecture
2. Generative AI End-to-End Project Lifecycle
3. Key Applications of Generative Models
4. Real-world Use Cases of Large Language Models (LLMs)

## Module 5: Introduction to Large Language Models (LLMs)

1. What is llm
2. Types of llm
3. LLM providers
    1. hugging face
    2. open ai
    3. groq

# Module 6:

1. Hugging Face Overview:
    1. What is Hugging Face?
    2. How to Use Hugging Face Models
    3. API Key Generation
2. Selecting Models & Tokenizers
3. Pre-trained Models in HF:
    1. Text-to-Text
    2. Text-to-Image
    3. Text-to-Speech
    4. Text to video
    5. Speech-to-Text
    6. Speech to speech
    7. Image to text

**Projects:**

1. Project on using hugging face (making the conversation with hugging face model)
2. Project (image to text)

## 7. Open ai

- exploring the open ai play ground
- accesing the models, and api key
- How ChatGPT is Trained – Behind the Scenes

## Project

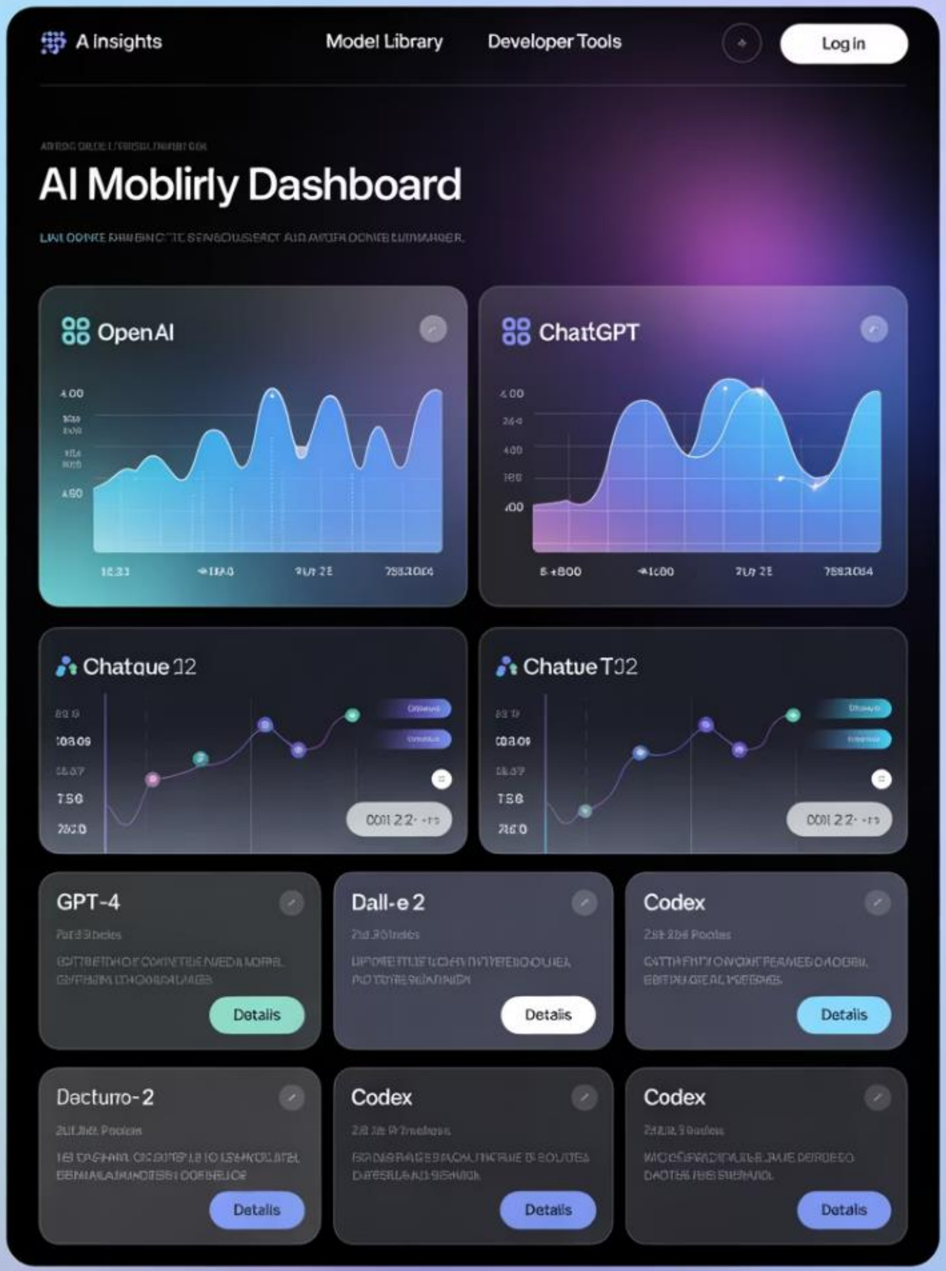
- text completion (blog creation)
- restaurant chat bot (taking orders from customer)

## 8) Groq

- Explaring the playground in groq
- get the api key and access the models for projects

## Project

- Text Summarization



# Module 8: Types of LLMs & Project Applications

## 1. Text Completion Models(level – projects)

- 🔧 Projects:
- Redaction Improver
- Blog Post Generator
- Text Summarization

# RAG Architecture with Langchain

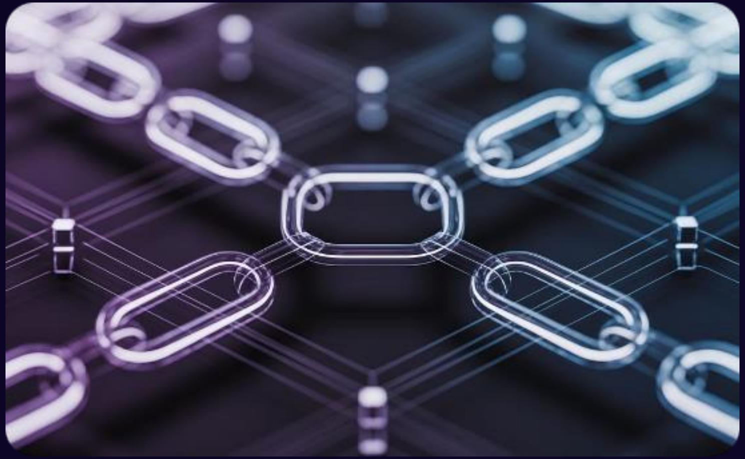
- What is langchain?
- Exploring the langchain documentation
- Flow of RAG:
  - Data Loaders(different types)
    - Analyzing CSV, PDF, and JSON Files using LangChain
  - Splitters
  - Prompt and prompt engineering
    1. What & Why of Prompt Engineering
    2. Prompt Engineering with ChatGPT Custom Instructions
    3. Deciding What Context to Add
    4. Zero-, One-, and Few-Shot Prompting, chain of thought, Tree of thought, React prompting
    5. Providing Effective Prompts to LLMs
  - Embedding Techniques (types)

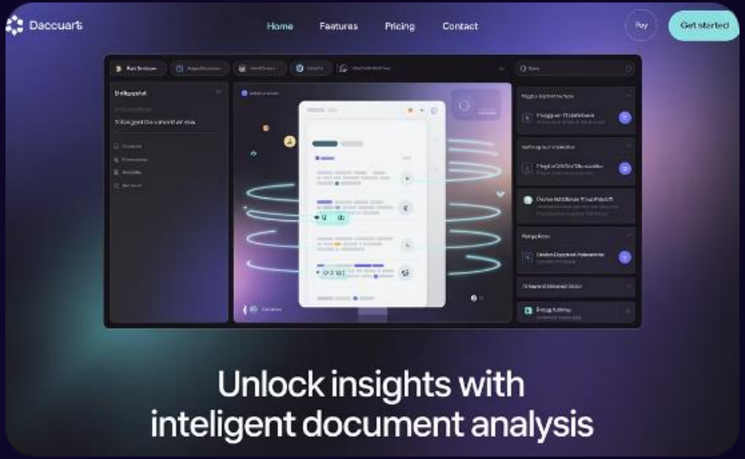
> This section explores vector databases, their types, and applications in similarity search, with a focus on popular implementations like ChromaDB, FAISS, and Pinecone, concluding with an overview of retrievers in chains.

- Vector Databases (types)
  1. Introduction to Vector Databases
  2. Vector DB Use Cases
  3. Text Embedding & Similarity Search
  4. Types of Vector Databases:
     1. ChromaDB
     2. FAISS
     3. Pinecone
     4. Milvus (with Attu UI)
     5. Weaviate
     6. Neo4j for Graph + Vector Search
- Retrievers with Chains (types)

# LangChain Expression Language (LCEL)

A visual overview of key LCEL concepts and applications





Unlock insights with
inteligent document analysis

## Chains and Runnables

Built-in Runnables and Functions in LCEL

Combining LCEL Chains for Complex Workflows

## Practical RAG Demo

Implement RAG with LCEL components

Memory integration for context retention

## LLM Integration

Get access to any one LLM

🔧 **Project: Q&A on Your Own Documents**

Types of RAG implementations

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# RAG Architecture with Llamaindex

- What is Llamaindex
- Key Differences: LlamaIndex vs. LangChain vs. Llama (the model)
- i)exoring the Llamaindex documentation
- ii) Flow of RAG:
- Data Loaders
- Splitters
- Embedding Techniques
- Build Index

i)Vector Databases

- Retrievers with Chains
- Setup Memory Context
- LLM Integration
- 🔧 **Project: Q&A on Your Own Documents(csv file)**
- 2. Types of RAG s

- **LangChain Ecosystem Overview: LangServe, LangGraph, LangSmith**
    - Hands-on Demo: LangServe for Deployment
    - Hands-on Demo: LangGraph for Building Agentic Workflows
    - Hands-on Demo: LangSmith for Debugging, Testing, and Monitoring

## Level 1 Application Development

1. Advanced Chatbot with Memory
2. Key Data Extraction
3. Sentiment Analysis Tool
4. SQL-based Question Answering Application
5. PDF-based Question Answering
6. Basic Retriever Applications
7. RAG Application

# Level 2 Application Development

1. Application for Converting Slang to Formal English
2. Blog Post Generation Application
3. Text Summarization with Split
4. Text Summarization Tools
5. Key Data Extraction from Product Reviews
6. Interview Questions Creator Application
7. Medical Chatbot Project

# Level 2 Application Deployment

1. Multimodal Gen AI Applications
    1. Steps to implement Multimodal LLM Applications
    2. Building Multimodal LLM Applications with LangChain & GPT 4o Vision

# Level 3 (Professional) Application Development

Introduction to Level 3 Application

- Project 1: Advanced RAG-Based Knowledge Management System
- Project 2: Medical Diagnostics Support Application
- Project 3: Image generation (DALL·E, Midjourney)
- Project 4: Youtube video summarizer and youtube script writing

# Agentic AI

## Section 1: Introduction to Agentic AI

- What is Agentic AI?
- Overview and importance of Agentic AI systems
- AI as Software Engineers
- How AI systems like Devin function as autonomous developers
- The Rise of AI Agents
- Examples: SIMA by Google and its capabilities
- The Role of AI Agents in Autonomous Decision-Making
- Agentic AI vs. Generative AI

# Section 2: Building AI Agents

| | |
|---|---|
| Introduction to Building AI Agents | Overview of agent development |
| Key Considerations Before Building Agents | Ethical and design principles |
| Hands-On: Building Our First AI Agent | Step-by-step guide to creating an agent from scratch |
| Connecting Open Source Models to AI Agents | Integrating models like LLama-3 with frameworks like CrewAI |
| Developing a Research Agent | Use case: Building an agent for academic research |

## Section 3: Advanced Tools and Frameworks for Agentic AI

- OpenInterpreter Light - Deep Dive
- Understanding OpenInterpreter and its role in tasking AI
- Tasking AI Tutorial
- Creating task-driven agents with specific outputs

### Perplexity AI: A Versatile Agent Platform

- Overview of features and functionalities
- Co-pilot Feature

## Section 4: Agent Features and Customization

- Collections and Agents in Perplexity AI
- Organizing and managing multiple agents
- Exploring Agent Libraries
- Building reusable components for AI agents
- Agent Playgrounds
- Experimentation and testing environments for agents
- User Profiles and Personalization
- Creating personalized user experiences with AI agents

## Section 5: Domain-Specific Agents

- Top 5 Agent Use Cases
- Academic Research Agent
- Business Analyst Agent
- Content Creation Agent
- Financial Research Agent
- New Product Research Agent

## Section 6: Real-World Applications of Agentic AI

- Pre-Sales Research Agent
- Automating and optimizing sales strategies
- Student Research Agent
- Enhancing learning experiences for students
- Voice of the User Agent
- Understanding and leveraging user feedback
- Wolfram Alpha Research Agent
- Integrating external computational engines

# Section 7: Future Trends and Advanced Topics

## Future Trends

- GPT-4o: The Next Generation of Intelligent Agents
- Capabilities and integration of advanced GPT models
- Announcements from Mistral AI Agents
- Exploring emerging technologies and future innovations

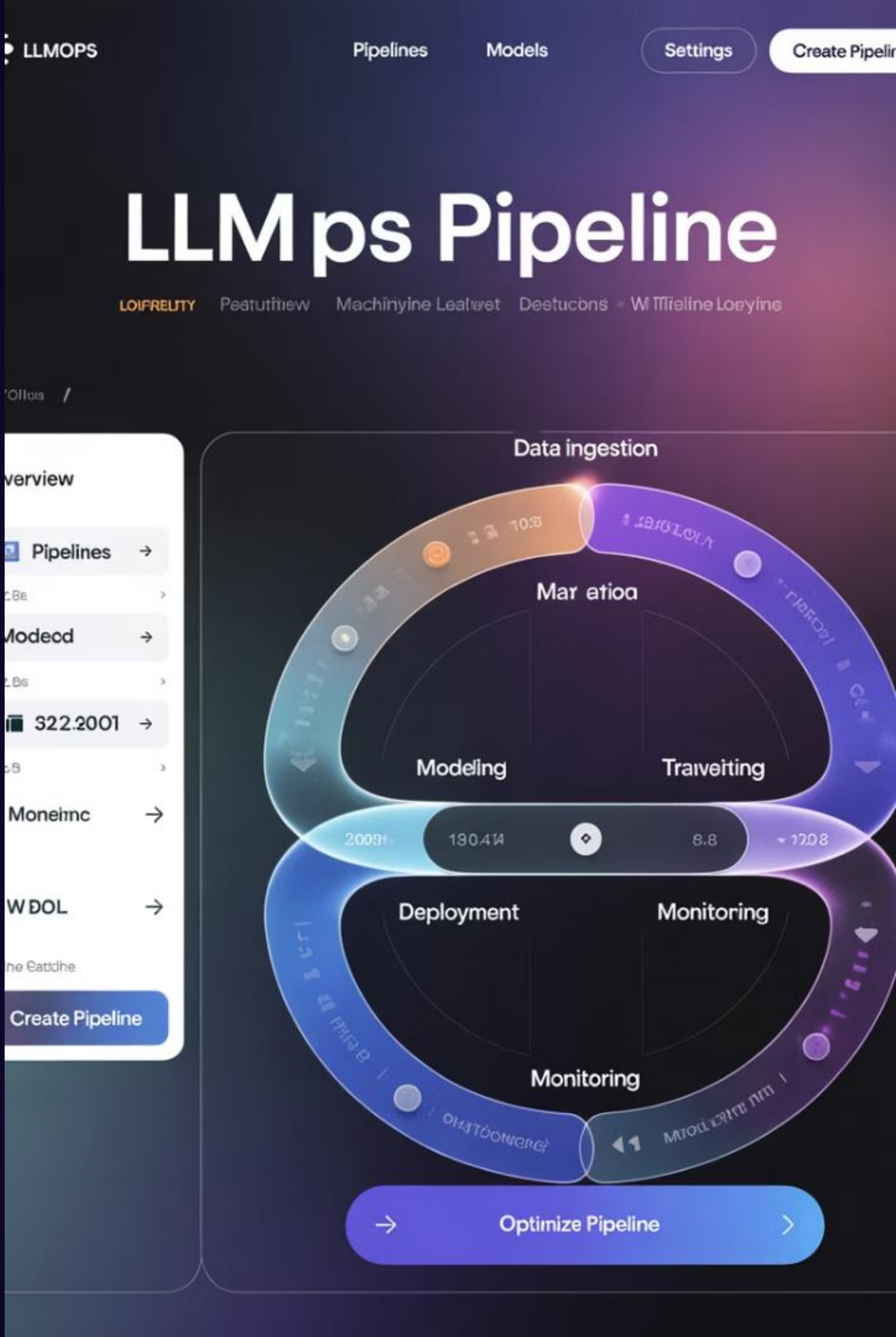
## Capstone Projects

- Build a Custom Academic Research Agent
- Using Hugging Face models for data retrieval and analysis
- Develop a Financial Analysis Agent
- Automate stock trend analysis using Wolfram Alpha integration
- Create a Business Analyst Agent
- Collect and summarize market insights for decision-making

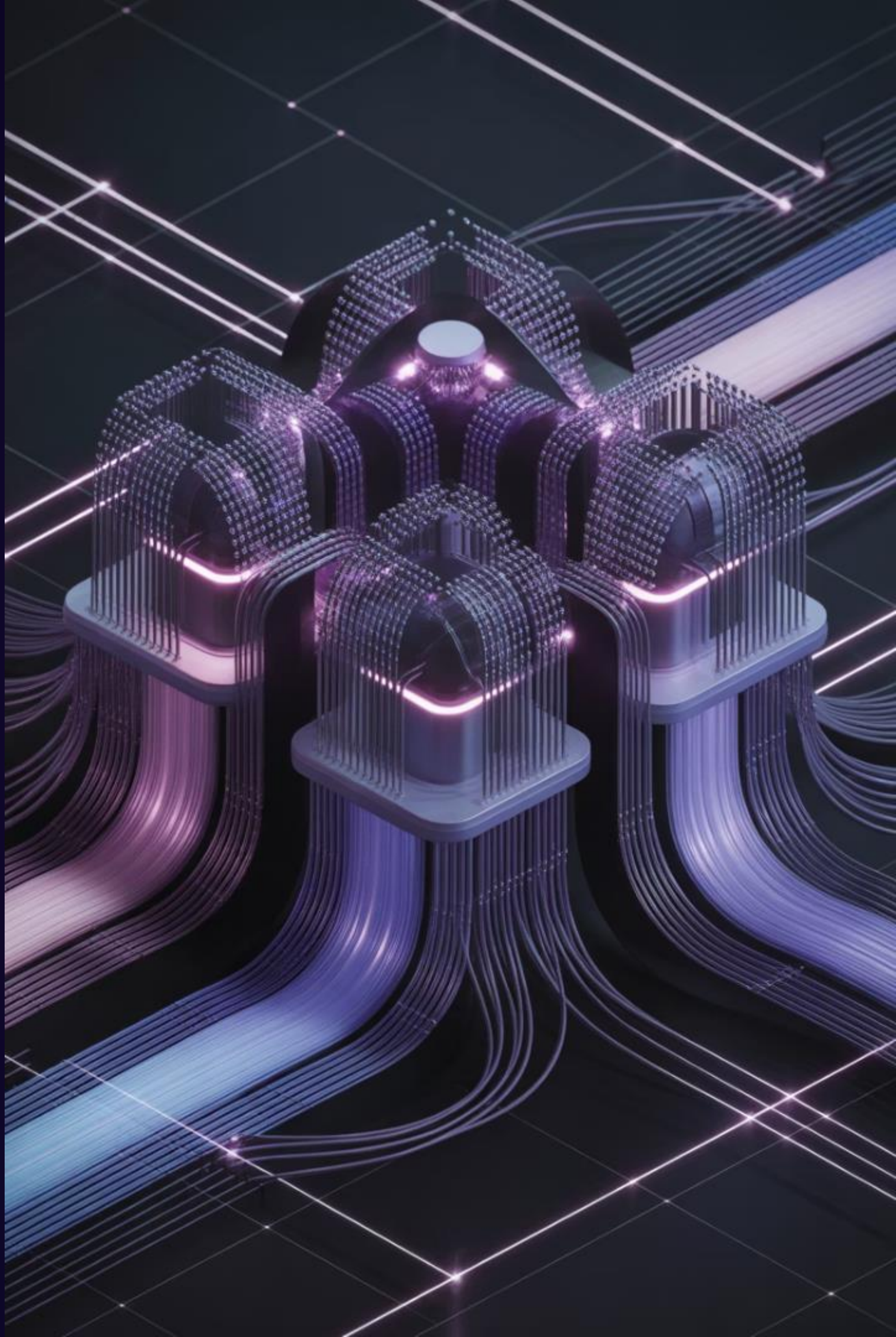
## Introduction to LLMOps

# LLMOps

1. What is LLMOps?
2. Why LLMOps is Different from Traditional MLOps
3. The Evolution from MLOps to LLMOps
4. Key Challenges in LLMOps
5. Overview of the LLM Lifecycle
6. Core Components of an LLMOps Pipeline
7. Tools and Frameworks Shaping LLMOps
8. Real-World Use Cases of LLMOps
9. Skills Required to Become an LLMOps Engineer
10. Course Overview and How to Navigate This Series



1. Foundation of LLMs
2. Understanding Transformer Architectures
3. Anatomy of a Large Language Model
4. Tokenization and embeddings
5. How Self-Attention Mechanism Works
6. Understanding Context Window in LLMs
7. Prompt Engineering: Basic Concepts
8. Prompt Engineering: User & System Prompts in LLMs
9. Open Source vs Proprietary LLMs
10. Comparison: LLaMA, GPT, Claude, Mistral, Gemini
11. Pretraining vs Fine-tuning vs Instruction-tuning



# LLMOps Tooling Landscape

- Introduction to LangChain
- Introduction to LlamaIndex
- Introduction to Haystack
- LangChain vs LlamaIndex vs Haystack
- Introduction to Vector Databases
- Introduction to Pinecone
- Introduction to Weaviate
- Introduction to FAISS
- Introduction to ChromaDB
- Introduction to LangSmith
- Introduction to LangServe

# LLM Development Topics

- Introduction to HuggingFace Inference Endpoints
- Introduction to FastAPI for LLM Inference
- Setup MLflow on AWS for LLMOps
- Training Models with MLflow: A Hands-On Guide
- MLflow for Model Inference: Techniques and Practices
- Building CI/CD Pipelines with GitHub Actions
- Data Management for LLMs
- Data Collection Strategies for LLMs
- Scrapping Web for LLM Datasets
- Cleaning & Preprocessing Raw text data
- Chunking Strategies
- Embedding Data for Retrieval

# Building a Private Knowledge Base

- Using LLMs to Generate Synthetic Data
- Training and Fine-tuning LLMs
    - Introduction to Fine-tuning
    - RAG vs Fine-tuning
    - Introduction to PEFT
    - Introduction to LoRA & QLoRA
    - Fine-tuning LLMs using PEFT
- Retrieval-Augmented Generation (RAG)
    - What is Retrieval-Augmented Generation (RAG)?

- Working with Custom Data (Data Loaders) & RAG Basic Concepts
- RAG Implementation with LCEL
- Introduction to Model Inference
- Dockerizing LLM Inference Services
- Evaluation & Monitoring
- Different RAG Components like ( Splitters, Embeddings, Vector Stores, Retrievers, Top k)
- Model Serving and Inference
- Serving LLMs with FastAPI
- Serving LLMs with LangServe

# Course Outline

- LLM Evaluation With MLFlow And Dagshub
- LLM Monitor and Tracing with LangSmith
- LLMOps Platforms
- Why we need LLMOps Platform
- Generative AI with Google Cloud (Vertex AI) a LLMOps Platform
- Vertex AI Hands-On on Google Cloud

## Vertex AI Local Setup - Run Gemini Pro on Local Machine

- RAG on Vertex AI with Vector Search and Gemini Pro
- LLM powered application on Vertex AI
- Fine tuning Foundation Model VertexAI
- Introduction to AWS Bedrock
- Hands-on AWS Bedrock
- Capstone Projects
- Project Walkthrough
- Project Setup & Template
- Data Ingestion: Chunking, Embedding and Vector store
- RAG Pipeline and User App
- Project Deploy: AWS CICD

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