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**Superior University Lahore**

***Lab Task # 11***

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# Course: Programming for Artificial Intelligence (Lab)

**Difference Between Key Concepts in AI**

**1. LangChain**

**Definition:**  
LangChain is a Python framework used to develop applications powered by Large Language Models (LLMs). It allows integration of LLMs with tools like search engines, databases, APIs, and custom memory to build advanced NLP applications.

**Example Use Case:**  
A customer support chatbot that uses a knowledge base (PDFs, documents) to answer customer queries accurately using OpenAI’s GPT model and document retrieval via LangChain.

**Key Features:**

* Modular chaining of components (e.g., prompt templates + memory + tools).
* Can integrate with vector databases and retrievers.
* Popular for building Retrieval-Augmented Generation (RAG) apps.

**2. RAG (Retrieval-Augmented Generation)**

**Definition:**  
RAG is an architecture that enhances language model responses by retrieving relevant external information before generating an answer. It combines two components:

* **Retriever:** Searches and fetches relevant documents.
* **Generator:** Uses these documents to produce an accurate, grounded answer.

**Example Use Case:**  
A medical chatbot that retrieves information from medical research papers before answering a patient’s question about symptoms or treatments.

**Benefits:**

* Improves factual accuracy.
* Reduces hallucinations (wrong or made-up information).

**3. LLMs (Large Language Models)**

**Definition:**  
LLMs are deep learning models trained on large text corpora to understand and generate human-like text. They work using millions (or billions) of parameters to learn patterns and context in language.

**Examples of LLMs:**

* GPT-4 (by OpenAI)
* PaLM (by Google)
* LLaMA (by Meta)

**Applications:**

* Chatbots
* Text summarization
* Language translation
* Coding assistants

**4. FAISS (Facebook AI Similarity Search)**

**Definition:**  
FAISS is a library developed by Facebook AI for efficient similarity search in high-dimensional spaces. It’s primarily used for searching through embeddings (vectors) to find the most similar items.

**Example Use Case:**  
In a document search system, when a user asks a question, FAISS retrieves the top 5 most relevant document chunks based on semantic similarity.

**Key Features:**

* Very fast at handling large-scale vector datasets.
* Supports indexing, searching, and clustering.

**5. Vector**

**Definition:**  
In NLP and machine learning, a vector is a numeric representation of data such as words, sentences, or images. Vectors capture semantic meaning, allowing comparison using mathematical operations.

**Example Use Case:**  
The word “king” might be represented as a 300-dimensional vector, and the word “queen” will have a similar vector with slight differences. This allows for operations like:  
king - man + woman ≈ queen

**Vector Examples:**

* Word2Vec embeddings
* Sentence transformers
* Image feature vectors

**6. VectorDB (Vector Database)**

**Definition:**  
A vector database is a specialized database for storing and searching vectors. It enables fast retrieval of similar items based on vector similarity (cosine similarity, dot product, etc.).

**Examples of VectorDBs:**

* Pinecone
* Weaviate
* Chroma
* Qdrant

**Use Case:**  
A search engine that finds articles similar to a user’s query using vector similarity instead of keyword matching.

**7. Generative AI**

**Definition:**  
Generative AI refers to models that can create new content based on the data they’ve been trained on. It includes models that generate text, code, images, audio, or video.

**Popular Generative AI Models:**

* GPT (text)
* DALL·E / Midjourney (images)
* MusicLM (music)
* Codex (code generation)

**Example Use Case:**  
Generating product descriptions for an e-commerce site using GPT based on product specs.

**8. GANs (Generative Adversarial Networks)**

**Definition:**  
GANs consist of two neural networks:

* **Generator:** Creates fake data (like images).
* **Discriminator:** Evaluates whether the data is real or generated.  
  They are trained together, and over time, the generator becomes very good at creating realistic data.

**Example Use Case:**  
Generating realistic human faces that do not exist (used in deepfake technologies).

**Real-World Uses:**

* Image synthesis
* Face aging apps
* Fashion design mockups