**QUESTION 01**

**a) Definition of Generative AI & Key Components**

Generative AI refers to a category of artificial intelligence that can generate new content, such as text, images, audio, and even code, by learning patterns from existing data. Unlike traditional AI, which primarily focuses on recognizing patterns and making predictions, generative AI creates novel outputs that resemble human-generated content.

**Key Components of Generative AI:**

1. **Neural Networks:**

Deep learning models, such as transformers and GANs (Generative Adversarial Networks), are used to generate content.

1. **Training Data:**

The AI model learns from vast amounts of text, images, or other structured/unstructured data.

1. **Latent Space Representation:**

Generative AI maps data into a high-dimensional space to understand relationships and generate new samples.

1. **Loss Functions:**

These functions help improve the generated output by reducing the difference between the generated and actual data.

1. **Sampling Mechanisms:**

Techniques like beam search or temperature scaling help control randomness in the generated outputs.

**Difference Between Generative AI & Traditional AI**

* Traditional AI focuses on classification, prediction, and pattern recognition (e.g., spam detection, fraud detection) while Generative-AI produces new data based on learned patterns (e.g., ChatGPT generating human-like responses, DALL·E creating images).

**b) Prompt Engineering & Its Influence on Generative AI Output**

**Prompt Engineering** is the process of designing and refining input queries (prompts) to optimize the performance of a generative AI model. Since Generative AI models rely on natural language prompts, a well-structured prompt significantly impacts the quality, relevance, and creativity of the AI-generated output.

**How Prompt Engineering Influences AI Output**

1. **Clarity & Specificity:** More precise prompts yield more relevant responses.
2. **Context Inclusion:** Providing detailed context helps guide the model toward the desired output.
3. **Constraints & Style Control:** Prompts can specify word limits, tone, or formatting preferences.
4. **Few-Shot or Zero-Shot Learning:** Including examples in prompts (few-shot) improves accuracy, while a simple instruction (zero-shot) may result in generic answers.

For example:

* **Weak Prompt:** "Tell me about AI."
* **Better Prompt:** "Explain Generative AI in simple terms, focusing on its applications in healthcare."

### c) ****Difference Between Discriminative and Generative AI Models****

**Discriminative Models**:

* Focus on learning the boundary between different classes or categories in the data.
* Used for tasks like classification or regression.
* Examples: Logistic Regression, Support Vector Machines (SVM), Convolutional Neural Networks (CNNs) for image classification.

**Generative Models**:

* Focus on learning the underlying distribution of the data to generate new samples.
* Used for tasks like text generation, image synthesis, or music composition.
* Examples: Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), GPT (for text generation).

**Key Difference**:

* Discriminative models answer the question: "What label or category does this data belong to?"
* Generative models answer the question: "How can I create new data that looks like this?"

**d) Concept of Embeddings in Generative AI & Role in RAG Systems**

**Embeddings** are vector representations of words, sentences, or documents in a high-dimensional space, where similar concepts are placed closer together. These embeddings capture semantic relationships and contextual meanings.

**How Embeddings Contribute to RAG (Retrieval-Augmented Generation) Systems**

1. **Efficient Information Retrieval:** Helps AI retrieve relevant documents based on similarity rather than exact keyword matching.
2. **Context-Aware Responses:** Ensures AI-generated responses incorporate the most relevant factual data from retrieved sources.
3. **Dimensionality Reduction:** Converts high-dimensional text into dense vectors, improving search and retrieval speed.
4. **Better Generalization:** Helps AI models understand synonyms and related concepts better than keyword-based searches.

**Example:** In a RAG system, embeddings allow ChatGPT to fetch relevant information from a knowledge base when answering queries about recent events, ensuring factual accuracy.

**QUESTION 04**

1- What is the primary function of Generative AI?

b) Generating new content based on learned patterns

2- Which of the following is NOT a popular Large Language Model (LLM)?

c) ResNet-50

3- What is the main advantage of Retrieval-Augmented Generation (RAG)?

b) It enhances text generation by retrieving relevant external knowledge

4-What role does LangSmith play in AI development?

b) It provides monitoring, evaluation, and debugging tools for AIworkflows

5- What is a key characteristic of Agentic AI?

b) It autonomously makes decisions and takes actions based on objectives.