

Ex-1 Comprehensive Report on the Fundamentals of Generative AI and Large Language Models.

AIM:

To develop a comprehensive report for the following exercises:

1. Explain the foundational concepts of Generative AI.
2. The Transformer Architecture in Generative AI and its Applications.
3. 2024 AI Tools
4. Impact of Scaling in Generative AI and LLMs.
5. Explain what is an LLM and how it is built.

Algorithm:

Step 1: Define Scope and Objectives:

Step 2: Create Report Skeleton or structure.

Step 3: Research and Data Collection.

Step 4: Content Development

Step 5: Visual and Technical Enhancement.

Step 6: Review and Edit.

Step 7: Finalize and Export.

OUTPUT:

1. Foundational Concepts of Generative AI:

Generative AI refers to AI systems that learn from existing data and generate new content similar to the training data.

Key Characteristics:

- * Learns Probability Distributions
- * Produces Original Outputs
- * Works with text, images, audio, video and code.
- * Uses neural networks and latent representations.

Types of Generative AI Models:

* Generative Adversarial Networks (GANs):

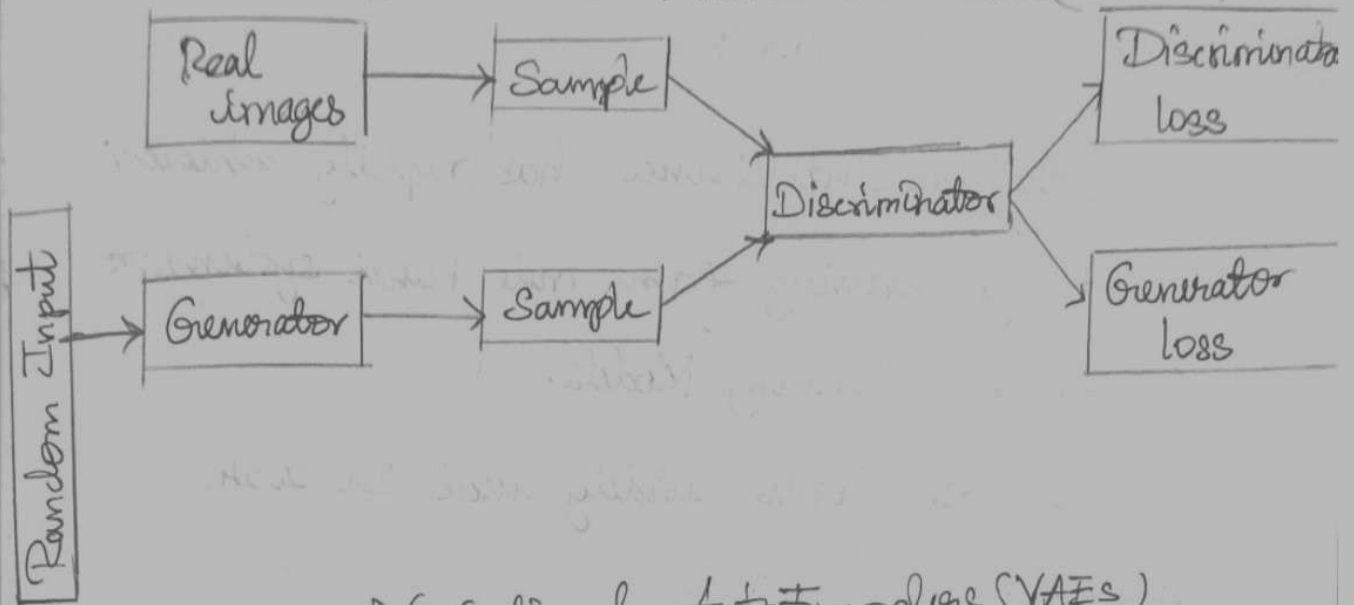
Generator and Discriminator compete to improve output quality.

* Variational Autoencoders (VAEs): Encode data into latent space for controlled generation.

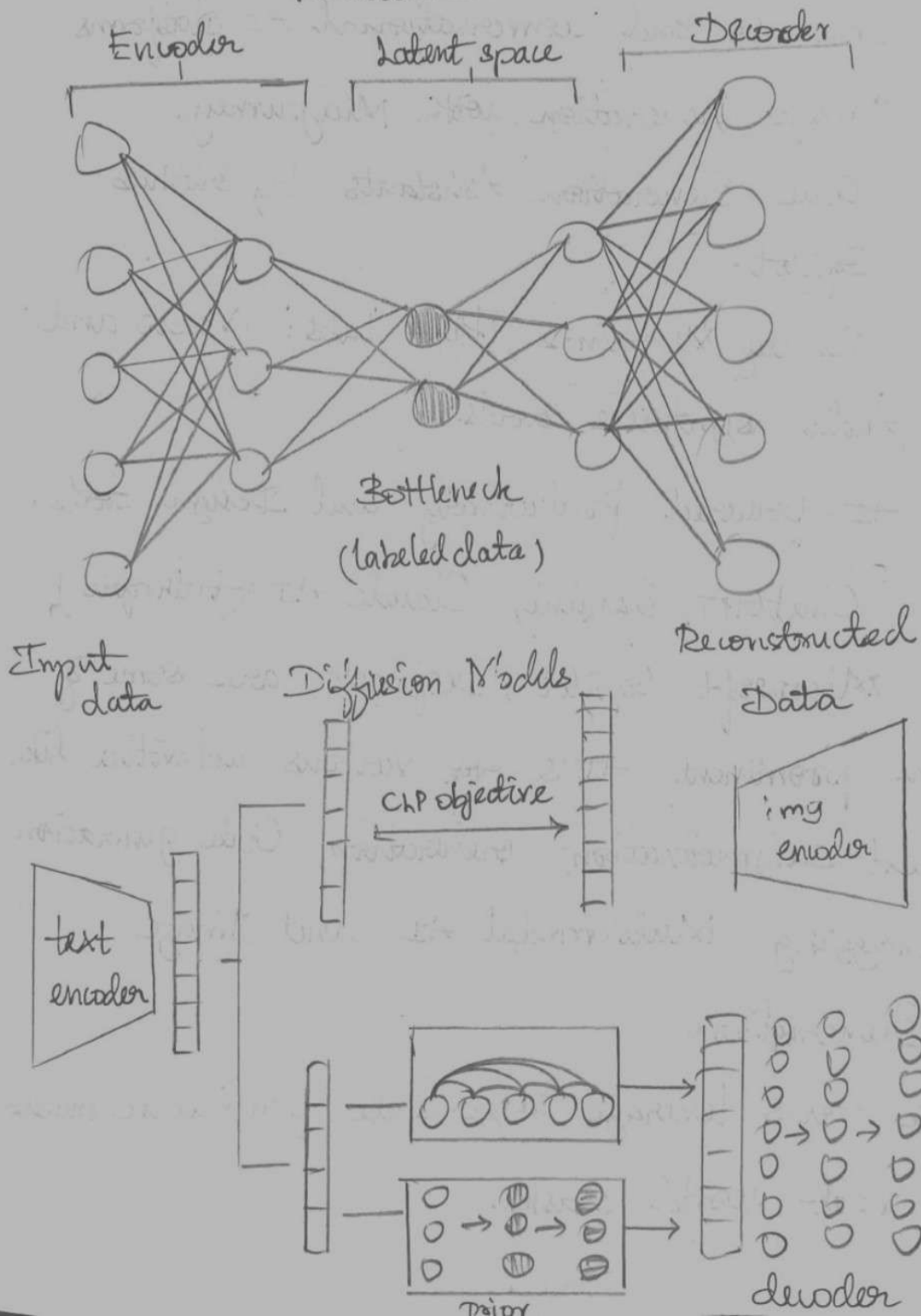
* Diffusion Models: Generate data by progressively denoising random noise.

* Transformer based LLMs: Use attention mechanisms for sequence modeling.

Generative Adversarial Networks (GANs)



Variational Autoencoders (VAEs)



2024 AI Tools:

Artificial Intelligence has rapidly achieved a lot by evolving from rule based systems to data-driven learning Models.

Common AI Tools widely used in 2024 include:

- * Chatbots and conversational AI Platforms
- * Image Generation with Midjourney
- * Code Generation Assistants by Github Copilot.
- * Runway ML Gen-2, Pika Labs: Video and Audio synthesis tools.
- * AI-powered Productivity and Design tools.
- * ChatGPT, Gemini, Claude AI (Anthropic), Microsoft Copilot, Deepseek are some of the prominent AI's for various activities like, Text summarization, Generation, Code generation, Debugging, Multimodal AI and Image Generation

These tools leverage large-scale generative models for real world tasks.

3. Transformer Architecture in Generative AI

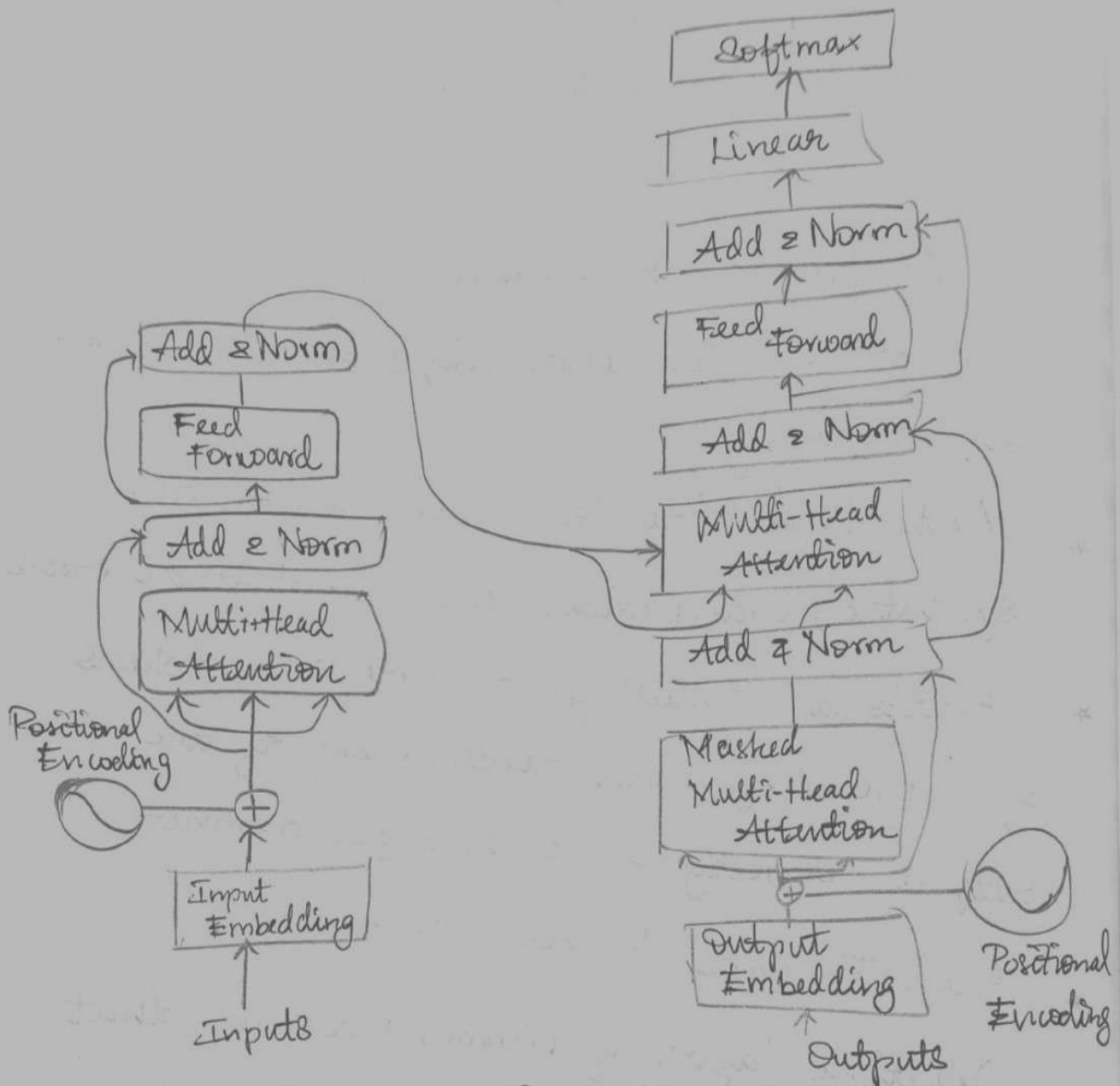
The transformer architecture is the backbone of modern Generative AI.

Core Components:

- * Self Attention Mechanisms: To identify & understand the relationships between words simultaneously.
- * Multi-Head Attention: for checking the syntactic, grammatical and contextual errors.
- * Positional Encoding: to order the tokens for processing and reassembling of the output correctly in an arranged manner.
- * Feed Forward Neural Networks:
Multiple layers of Neural Networks that process and find the most appropriate next word (output) that uses Natural Language Processing (NLP).
- * Encoder and Decoder: Consists of the all components and helps in separation of the data process, generation and output presentation.

Popular Transformer Models : GPT, BERT.

Output Probabilities



Applications of Generative AI:

- * Chatbots
- * Content & Code Generation
- * Image and video synthesis
- * Healthcare and drug discovery.
- * Education and research.
- * Business Automation

4. Impact of Scaling in Generative AI and LLMs.

Scaling refers to increasing:

- * Model parameters
- * Training data
- * Compute resources

Effects of Scaling:

- * Improved reasoning and coherence.
- * Emergent Abilities.
- * Better generalisation
- * Increased computational and environmental cost.

Scaling laws show performance improves predictability with size.

Training Process and Data Requirements:

- * Large and Diverse Datasets
- * Supervised and Unsupervised learning.
- * Pretraining followed by Fine tuning.
- * Use of reinforcement learning for alignment.

5. What is an LLM? How it is built?

A large language model is a deep learning model trained on massive text datasets to understand and generate human-like languages.

How LLMs are built?

- * Tokenization of text.
- * Training on large corpora
- * Use of Transformer Architecture.
- * Optimization using loss functions and gradient descent.
- * Fine-tuning and alignment.

RESULT:

Thus the comprehensive report on Fundamentals of Generative AI and Large Language Models has been finalised and completed successfully.