



# Generative AI



Roadmap 2024



# From Basics to Advanced

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Here's a step-by-step guide designed for absolute beginners looking to acquire skills in Generative AI.

Different Positions or Different Levels: ☒

- Developer Level 1 or Beginner Level
- Developer Level 2 or Senior Level
- Researcher Level

# This is broken into many sections:

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- Prerequisite
- Fundamentals
- Core Generative Models
- Developing Applications Powered by LLMs
- Projects and Practical Experience
- Miscellaneous Topics
- Advice for Productive Learning
- FAQs

# What is Generative AI?

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Generative AI generates new data based on training samples. Generative models can generate Image, Text, Audio, Videos.

Generative AI is a very huge topic,

- Generative Image Model(GANs, Various Diffusions Models)
- Generative Language Model(LLMs)

# Generative AI with Large Language Models

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When I refer to large language models, I mean natural language processing. Since NLP forms the foundation of massive language generated models(LLMs).

# Prerequisite

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## Programming Language:

Python is the most commonly used programming language for Data Science, Machine learning and AI domain.

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Here are some reasons why:

- Community Support
- Libraries and Frameworks
- Flexibility and Productivity
- Data Analysis and Visualization

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## Topics to Learn-

- Variables, Numbers, Strings
- Lists, Dictionaries, Sets, tuples
- If condition, for loop
- Functions, Lambda Functions
- Modules (pip install)
- Read, Write files
- Exception handling
- Classes, Objects



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## NoSQL DataBase:

Need for a NoSQL database in a deep learning project depends on the nature of your data. Deep learning projects often involve working with large volumes of unstructured data, such as images, text, or audio. In many cases, NoSQL databases are used to store and manage such unstructured data efficiently.

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## Reason by you should Nosql Database:

- Scalability and Flexibility
- Variety of Data Types
- Real-time Data Ingestion
- Distributed Computing
- Schema-less Design

My Preference: **MongoDB** or Cassandra DB

# Fundamentals

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## Math and Statistics for Data Science

Reason why we need to learn it-

Math and statistics are fundamental for data science and AI as they draw meaningful insights from complex datasets.

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## Topics to Learn in Statistics

- Descriptive statistics
- Inferential statistics
- Basic plot in statistics
- Measure of central tendency
- Types of distributions
- Central limit theorem
- Correlation and covariance
- Hypothesis testing

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## Topics to Learn in Mathematics

- Probability
- Linear Algebra
- Calculus

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## Basic Deep Learning

- Artificial Neural Networks
- activation functions and Loss functions
- Backpropagation, optimizers
- Regularisation, Normalisation
- Convolutional Neural Networks (CNNs)
- Recurrent Neural Networks (RNNs)
- Get hands-on experience with frameworks like TensorFlow or PyTorch

## Basics of Natural Language Processing

- Text Preprocessing:  
Regex, Lowercasing, Tokenization, Removing Punctuation, Removing Stop Words, Stemming, Lemmatization
- Text Representation: Countvectorizer, TF-IDF, BOW, OHE
- Text Classification: Naive Bayes
- Fundamental library: Spacy & NLTK

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## Word Embedding Techniques

- Word2Vec
- GloVe
- ELMO
- Fast Text



## Advance NLP Concepts

- Advance RNN like LSTM & GRU
- Encoder decoder & Encoder decoder with Attention Mechanism
- Transformer architecture: Self attention mechanism, key, query, value(KQV), Layer Normalisation & Positional Encoding
- BERT: Contextual embedding and mask language modelling
- GPT: Autoregressive Modelling

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**An important concept needs to be learnt.**

**Transfer Learning:** learned from past work and applied it to the current challenge.

**Fine-Tuning of Model:** Fine-tuning refers to the process of taking a pre-trained model and further training it on a domain specific task.

Different Sequence mapping: One to Many, Many to One, Many to Many

# Core Generative AI Models: LLMs

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## Milestone LLM Models

- **BERT:** Bidirectional Encoder Representations from Transformers (BERT) was developed by Google
- **GPT:** GPT stands for "Generative Pre-trained Transformer".The model was developed by OpenAI
- **XLNet:** Cross-lingual Language Model Pretraining by Guillaume Lample, Alexis Conneau.
- **T5:** The Text-to-Text Transfer Transformer It was created by Google AI
- **Megatron:** Megatron is a large, powerful transformer developed by the Applied Deep Learning Research team at NVIDIA
- **M2M-100:** multilingual encoder-decoder (seq-to-seq) model researchers at Facebook

## OpenAI LLM Models

- **GPT-4 and GPT-4 Turbo:** A set of models that improve on GPT-3.5 and can understand as well as generate natural language or code
- **GPT-3.5:** A set of models that improve on GPT-3 and can understand as well as generate natural language or code
- **DALL·E:** A model that can generate and edit images given a natural language prompt
- **TTS:** A set of models that can convert text into natural sounding spoken audio
- **Whisper:** A model that can convert audio into text

## Google AI LLM models

- PaLM2
- Gemini-pro
- Gemini -pro-vision

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- **Meta AI LLM Models**

- LLaMA & LLaMA2

- **Open Source LLM Models**

- BLOOM
- Llama 2
- PaLM
- Falcon
- Claude
- MPT-30B
- Stablelm

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# Prompt Engineering

- Type of Prompting:
  - Zero shot prompting(Direct Prompting)
  - Few shot prompting
  - Chain-of-thoughts prompting
- Prompt Creation: Length,context structure and specific instruction
- Prompt Communities: Prompt Hero, FlowGPT, Snack Prompt

# Developed application powered by LLMs

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## Explore Generative Model APIs

- OpenAI API
- Hugging Face API
- Gemini API



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## Framework for Developing LLM application

- LangChain
- Chainlit
- Llama Index2

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## Vector Databases

- ChromaDB
- Waviet
- Pinecone
- OpenAI Faiss

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## Tools and Framework for Web-Application

- Streamlit
- Gradio
- FastAPI
- Flask

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## Deployment of LLM model

- AWS
- GCP
- Azure
- LangServe
- Hugging Face Spaces

## Few Advance Topics:

- ChatGPT: Understanding of Chat Gpt Training and RLHF (Reinforcement learning through human feedback) Concept
- RAG :Retrieval-Augmented Generation (RAG) Systems
- PEFT :Parametric efficient fine tuning
- Adaptive Ranking: low rank adaptation(LoRa) and Quantized Low Rank Adaptation(Qlora)
- Evaluation of LLMs: Find evaluation metrics of results generated by LLM

# Projects and Practical Experience:

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## Hands-on Projects:

Work on small projects to apply what you've learned.

Experiment with different datasets and model architectures.

## Kaggle Competitions and Open Source Contributions:

Participate in Kaggle competitions related to generative tasks. Contribute to open-source projects in the generative AI field.

# Miscellaneous Topics

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## Platform To Explore:

1. LIDA (Automatic Generation of Visualisations and Infographics)
2. Slides ( AI Presentation Maker )
3. Content Creation (Jasper, Copy.ai, Anyword)
4. Grammar checkers and rewording tools (Grammarly, Wordtune, ProWritingAid)
5. Video creation (Descript, Wondershare Filmora, Runway)
6. Image generation (DALL·E 2, Midjourney)
7. Research (Genei, Aomni)

# Miscellaneous Topics

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**GANs:** Variational Autoencoders (VAEs)  
Generative Adversarial Networks (GANs)

**Stable Diffusion Models:** Deliberate, Realistic Vision etc.

**Training Environment:** High end performance GPUs  
(GCP, AWS, Azure), Data Crunch, PaperSpace, Google colab and google colab pro,  
Kaggle instance etc.

**Continuous Learning:** Keep up with the latest: news, trends, research paper and  
community



# Advice for Productive Learning:

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1. Define specific, achievable learning goals
2. Consistent learning
3. Don't forget to Implementing your learning
4. Experiment and Iterate
5. Constructive feedback

# FAQs

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## 1. Do I need a background in machine learning or deep learning to start learning Generative AI?

While a basic understanding of machine learning concepts is beneficial, some introductory courses in machine learning can help bridge the knowledge gap.

Deep learning is a fundamental part of Generative AI, and a background in it is highly recommended. Familiarity with neural networks, backpropagation, RNNs and common deep learning frameworks like TensorFlow or PyTorch is advantageous for comprehending generative models.

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## 2. **How much mathematics knowledge is required for Generative AI?**

Mathematics is a key component of understanding the algorithms behind generative models. Students inquire about the level of mathematical knowledge needed, with a focus on linear algebra, calculus, and probability. A foundational understanding of these mathematical concepts is beneficial.

## 3. **Can I start with Generative AI without prior experience in AI or computer science?**

Yes, you can start but a background in AI or computer science can provide a smoother start, there are beginner-friendly resources available to help newcomers build their skills. You can refer to this **video** for more details.

# Thankyou

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