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Guide to Generative AI

3 days of Techniques, Tools, and Applications

FA-0138 · 3 days

Agentic & Generative AI · Data & Analytics

Introduction

In the dynamic landscape of artificial intelligence, Generative AI stands out as a revolutionary technology with the potential to transform various industries. From creating realistic images and videos to generating human-like text, Generative AI encompasses a wide range of applications that can enhance creativity, productivity, and decision-making processes. This 3-day course is designed to provide a comprehensive understanding of Generative AI, starting from fundamental concepts and techniques to advanced applications and frameworks like Retrieval-Augmented Generation (RAG), Llamaindex, and LangChain.

Generative AI is increasingly relevant in today's world as businesses and researchers seek innovative ways to solve complex problems and automate creative tasks. By leveraging Generative AI, organizations can streamline content creation, improve customer interactions, and gain deeper insights from data. This course aims to equip you with the knowledge and skills to harness the power of Generative AI, enabling you to implement and innovate with cutting-edge AI technologies.

Learning outcomes

By the end of this course, participants will be able to:

- Understand the foundational principles of Generative AI.
- Utilize various prompting techniques to guide AI models.
- Implement Retrieval-Augmented Generation (RAG) to enhance AI responses with external data.
- Explore and apply advanced frameworks such as Llamaindex and LangChain.
- Design and develop sophisticated AI applications using Generative AI techniques.
- Apply machine learning and deep learning concepts to generative models.
- Utilize natural language processing (NLP) techniques in AI applications.
- Troubleshoot and optimize Generative AI models for specific tasks.
- Stay updated with the latest trends and advancements in Generative AI.

Prerequisites

Before attending this course, participants should have:

- Basic understanding of machine learning and deep learning concepts.
- Familiarity with Python programming.
- Experience with AI frameworks such as TensorFlow or PyTorch.
- Basic knowledge of natural language processing (NLP) techniques.
- Access to a computer with internet connectivity and necessary software installations.

Training outline

1. Introduction to Generative AI

- Definition and significance of Generative AI
- Historical overview and key milestones
- Applications of Generative AI in various industries

2. Foundations of Generative AI

Overview of generative models: VAEs, GANs, and Transformers

Variational Autoencoders (VAEs)

- Architecture of VAEs
- Training VAEs
- Applications of VAEs

Generative Adversarial Networks (GANs)

- Architecture of GANs
- Training GANs: Discriminator and Generator
- Applications of GANs

Transformers

- Architecture of Transformer models
- Self-Attention Mechanism
- Training and Fine-Tuning Transformers

- Understanding latent space and sampling
- Training and evaluating generative models

3. Machine Learning and Deep Learning Fundamentals

Overview of Machine Learning

- Supervised, Unsupervised, and Reinforcement Learning
- Key algorithms: Linear Regression, Decision Trees, SVM

Introduction to Deep Learning

- Neural Networks: Basics and Architecture
- Training Neural Networks: Backpropagation and Optimization
- Introduction to Convolutional Neural Networks (CNNs)
- Introduction to Recurrent Neural Networks (RNNs)

4. Natural Language Processing (NLP)

Introduction to NLP

- Key concepts: Tokenization, Lemmatization, Stopwords
- Overview of NLP tasks: Text Classification, Named Entity Recognition (NER), Sentiment Analysis

NLP Techniques for Generative AI

- Sequence-to-Sequence Models
- Attention Mechanisms in NLP
- Transformers for NLP: BERT, GPT

5. Prompting Techniques

- Introduction to prompting in AI
- Types of prompts: direct, indirect, and structured prompts

  Crafting effective prompts for text generation

  Direct prompts

  - Examples and best practices

  Indirect prompts

  - Examples and best practices

  Structured prompts

  - Examples and best practices
- Practical examples and case studies of prompt engineering

6. Advanced Prompting Strategies

- Contextual prompting and its importance

- Few-shot and zero-shot prompting techniques

  Fine-tuning models with custom prompts
    - Custom dataset preparation
    - Training with custom prompts
    - Evaluating performance
- Hands-on exercises with real-world datasets

7. Retrieval-Augmented Generation (RAG)

- Introduction to RAG and its significance

  Architecture and working principles of RAG
    - Retriever component
    - Generator component

  Integrating external knowledge sources with AI models
    - Knowledge databases
    - API integrations
- Implementing RAG in practical applications

8. Building RAG Models

Setting up the RAG framework
- Installing dependencies
- Configuring the environment

Preprocessing data for retrieval
- Data cleaning and formatting
- Indexing data for efficient retrieval

Training and fine-tuning RAG models
- Retriever training
- Generator training
- Combining retriever and generator

Case studies and hands-on projects with RAG
- Real-world applications and implementations

9. Introduction to Llamaindex

- Overview of Llamaindex and its applications

  Setting up and configuring Llamaindex

- Installation and setup
- Configuration options

Indexing and querying large datasets

- Creating indices
- Querying indexed data

- Integrating Llamaindex with generative models

10. Advanced Llamaindex Techniques

Optimizing index performance

- Indexing strategies
- Performance tuning

Implementing custom indexing strategies

- Custom data types
- Specialized indexing methods

Case studies and hands-on projects with Llamaindex

- Industry-specific applications

- Troubleshooting common issues in Llamaindex

11. Exploring LangChain

- Introduction to LangChain and its features

Setting up and using LangChain

- Installation and setup
- Basic usage and commands

Creating and managing AI workflows with LangChain

- Workflow design principles
- Building complex workflows

Practical examples of LangChain applications

- Case studies and real-world scenarios

12. Advanced LangChain Applications

Integrating LangChain with other AI frameworks

- Interoperability with TensorFlow, PyTorch, etc.

Automating complex AI tasks with LangChain

- Task automation strategies

- Best practices for automation

Hands-on projects using LangChain for real-world scenarios

- Practical implementation examples

- Best practices and optimization techniques for LangChain

13. Designing Generative AI Applications

Identifying suitable applications for Generative AI

- Industry use cases
- Problem-solving with Generative AI

Planning and designing AI-powered solutions

- Requirement analysis
- Solution architecture

Implementing end-to-end generative AI applications

- Development lifecycle
- Deployment strategies

Case studies of successful AI implementations

- In-depth analysis and insights

Ethics and Best Practices in Generative AI

Ethical considerations in Generative AI

- Bias and fairness
- Privacy and security

Ensuring fairness and transparency in AI models

- Techniques to mitigate bias
- Transparency guidelines

Best practices for responsible AI development

- Development standards
- Compliance with regulations

Future trends and advancements in Generative AI

- Emerging technologies
- Research directions

Hands-On Projects and Practical Sessions

Project 1: Developing a text generation model with advanced prompting techniques

- Dataset preparation
- Model training

- Evaluation and refinement

Project 2: Implementing a RAG-based knowledge retrieval system

- Data preprocessing
- Model integration
- Performance testing

Project 3: Creating a custom index and query application using Llamaindex

- Index creation
- Query implementation
- Optimization

Project 4: Automating a complex AI workflow with LangChain

- Workflow design
- Implementation
- Testing and validation

14. Troubleshooting and Optimization

Common issues in Generative AI models

- Debugging techniques
- Case study examples

Techniques for model optimization and performance enhancement

- Hyperparameter tuning
- Model pruning

Debugging and fine-tuning AI applications

- Practical tips and tricks

Tools and resources for continuous learning and improvement

- Latest tools and libraries
- Learning resources and communities

15. Course Review and Q&A

- Recap of key concepts and techniques covered in the course
- Addressing participant questions and challenges
- Open discussion on advanced topics and further learning resources
- Feedback and future learning pathways in Generative AI

By following this comprehensive and detailed outline, participants will gain a robust understanding of Generative AI, from basic principles to advanced applications, enabling them to innovate and implement AI solutions effectively in their respective fields.

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