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Advanced GenAI Programming

From Theory to Real-World Applications in 2 DAYS

FA-0030 · 2 DAYS

Agentic & Generative AI · Software Development

Introduction

Welcome to the Advanced Training Plan for Generative AI, designed for individuals who are ready to delve deep into the intricacies of this transformative technology. This course is crafted for those with a strong foundation in machine learning, deep learning, and mathematical concepts, looking to master advanced generative models such as GANs, VAEs, and Transformers. Generative AI is revolutionizing fields like art, design, and natural language processing by enabling machines to generate realistic images, text, and more. Led by an instructor with over 30 years of industry experience, this training provides in-depth, industry-demanded content focused on practical skills and applications rather than academic theory. By the end of this course, you will be equipped with the expertise to develop, optimize, and deploy sophisticated generative models for real-world use cases.

Learning outcomes

Upon completion of this course, participants will be able to:

- Comprehend and implement advanced generative algorithms such as GANs, VAEs, and Transformer-based models.
- Design and develop custom model architectures suited for specific generative tasks.
- Optimize and fine-tune complex models for improved performance and efficiency.
- Utilize advanced features of libraries like TensorFlow and PyTorch to build and deploy custom models.
- Analyze and evaluate generative models using advanced metrics and interpret their outputs.
- Apply generative AI techniques to real-world scenarios, developing innovative solutions for industry-specific problems.

Prerequisites

Advanced Python Programming:

- Proficiency in object-oriented programming, data structures, and algorithms.
- Experience with libraries such as NumPy, Pandas, and Scikit-Learn.

Strong Foundation in Machine Learning:

- Deep understanding of supervised and unsupervised learning algorithms.
- Prior experience with deep learning frameworks such as TensorFlow or PyTorch.
- Ability to design, train, and evaluate machine learning models.

Mathematical Proficiency:

- In-depth knowledge of linear algebra, calculus, probability, and statistics.
- Understanding of optimization techniques and concepts such as gradient descent, backpropagation, and regularization.

Training outline

1. 1. Deep Dive into Generative AI Techniques

Comprehensive Overview of Generative Models

- Detailed comparison of generative models: GANs, VAEs, and Transformers.
- Strengths and weaknesses of each model in different applications.

Advanced Generative Algorithms

In-depth exploration of GANs (Generative Adversarial Networks):

- Understanding the adversarial training process.
- Types of GANs: DCGAN, WGAN, Conditional GANs.
- Implementing and optimizing GAN models.

Advanced VAEs (Variational Autoencoders):

- Theory of latent space and KL-divergence.
- Implementing and training VAEs with custom architectures.

Transformer Models for Generation:

- Understanding the self-attention mechanism.
- Building language models with transformers (e.g., GPT, BERT).
- Implementing sequence-to-sequence models for text generation.

2. 2. Model Architectures and Custom Implementations

Designing Complex Architectures

- Layer architectures: Convolutional layers, recurrent layers, and attention mechanisms.
- Custom model architectures for specific tasks (e.g., style transfer, music generation).

Building Custom Models from Scratch

- Writing custom layers and loss functions in TensorFlow and PyTorch.
- Implementing complex architectures: Residual Networks, Attention Networks, etc.
- Building hybrid models combining different generative techniques.

3. 3. Advanced Tools and Frameworks

In-depth Usage of TensorFlow and PyTorch

- Leveraging advanced features such as custom callbacks, TensorFlow datasets, and PyTorch's dynamic computation graph.
- Implementing and optimizing data pipelines for large-scale model training.

Custom Model Development

- Creating custom training loops and implementing complex data augmentation techniques.
- Using distributed training and model parallelism for training large models.
- Efficient use of hardware accelerators (GPUs and TPUs) for model training.

4. 4. Model Optimization and Performance Tuning

Model Training and Optimization Techniques

- Advanced training strategies: Learning rate schedules, adaptive optimizers, and batch normalization.
- Regularization techniques to prevent overfitting: Dropout, L2 regularization, and data augmentation.

Hyperparameter Tuning

- Systematic approaches to hyperparameter tuning using grid search, random search, and Bayesian optimization.
- Automated hyperparameter optimization with libraries like Optuna or Ray Tune.

Performance Metrics and Evaluation

- Advanced metrics for evaluating generative models: Inception Score (IS), Frechet Inception Distance (FID), and others.
- Visualizing and interpreting latent space representations.
- Understanding and mitigating mode collapse in GANs.

5. 5. Real-World Applications and Case Studies

Industry Case Studies

- In-depth analysis of successful generative AI projects in industries such as fashion, healthcare, and entertainment.
- Exploring unique use cases: AI-generated art, drug discovery, and beyond.

Project Development and Deployment

- Developing a complete project from ideation to deployment.
- Integration with cloud platforms for model deployment and scaling.
- Deploying models in production environments: Challenges and best practices.

6. 6. Advanced Research Topics and Future Directions

Exploring Cutting-edge Research in Generative AI

- Overview of recent advancements and research papers in generative models.
- Exploring new architectures and techniques such as Diffusion Models and Energy-Based Models.

Ethics and Challenges in Generative AI

- Discussing ethical considerations and potential misuse of generative AI.
- Understanding bias and fairness in generative models.
- Addressing technical challenges like scalability and interpretability.

Future Trends

- Predicting future trends in generative AI: Multimodal generation, reinforcement learning for generation, etc.
- Opportunities for research and innovation in generative AI.

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