Generative AI (PyTorch)

01_GAN_MNIST_Digit_Generation.md

- **Topic:** Implement a Vanilla GAN in PyTorch to generate MNIST digits.

02_DCGAN_CIFAR10_Visualization.md

- **Topic:** Train a DCGAN on CIFAR-10 using PyTorch and visualize generated images.

03_VAE_FashionMNIST_Reconstruction.md

- **Topic:** Build a Variational Autoencoder (VAE) in PyTorch to reconstruct Fashion-MNIST samples.

04_ConditionalGAN_MNIST.md

- **Topic:** Implement a Conditional GAN (cGAN) in PyTorch for class-specific MNIST digit generation.

05_StyleGAN2_Custom_Dataset.md

- **Topic:** Fine-tune a pre-trained StyleGAN2 (NVIDIA) on a custom dataset using PyTorch.

06_WGAN_vs_GAN_Comparison.md

- **Topic:** Compare Wasserstein GAN (WGAN) and standard GAN performance in PyTorch.

07_Transformer_Text_Generation.md

- **Topic:** Implement a GPT-2-like Transformer in PyTorch for text generation.

Agentic AI (Multi-Agent & RL)

PROF

08_MultiAgent_RLlib_Simulation.md

- **Topic:** Simulate a multi-agent environment with RLlib (PyTorch) for cooperative/competitive tasks.

09_DQN_CartPole_Solution.md

- **Topic:** Solve CartPole using a Deep Q-Network (DQN) implemented in PyTorch.

10_PPO_LunarLander_Training.md

- **Topic:** Train a Proximal Policy Optimization (PPO) agent in PyTorch on LunarLander-v2.

11_Custom_MARL_Environment.md

- **Topic:** Build a custom Multi-Agent RL environment with PyTorch and Gymnasium.

12_MCTS_NeuralNetwork_Agent.md

- **Topic:** Combine Monte Carlo Tree Search (MCTS) with a neural network in PyTorch.

13_Imitation_Learning_Demo.md

- **Topic:** Train an agent via Imitation Learning (Behavioral Cloning) in PyTorch.

14_LLM_RL_Decision_Making.md

- **Topic:** Integrate an LLM with RL in PyTorch for decision-making tasks.

Transfer Learning (PyTorch)

15_ResNet50_Custom_Classification.md

- **Topic:** Fine-tune ResNet-50 on a custom image dataset using PyTorch.

16_ViT_Feature_Extraction.md

- **Topic:** Use PyTorch's `torchvision` to extract features from a pre-trained Vision Transformer (ViT).

17_Domain_Adaptation_MNIST_SVHN.md

- **Topic:** Implement Domain Adaptation (MNIST → SVHN) with a pre-trained CNN in PyTorch.

18_BERT_FineTuning_vs_LinearProbing.md

- **Topic:** Compare fine-tuning vs. linear probing on BERT for text classification in PyTorch.

19_Wav2Vec2_Audio_Transfer_Learning.md

- **Topic:** Adapt a pre-trained Wav2Vec2 model to a custom audio dataset in PyTorch.

20_GPT2_FewShot_Text_Generation.md

- **Topic:** Few-shot learning with GPT-2 in PyTorch for custom text generation.

21_MAML_Fast_Adaptation.md

- **Topic:** Implement Model-Agnostic Meta-Learning (MAML) in PyTorch for rapid task adaptation.

Reinforcement Learning (PyTorch)

22_DDQN_Atari_Stability.md

- **Topic:** Improve Atari game training stability with Double DQN (PyTorch).

23_A2C_Pong_Training.md

- **Topic:** Train an Advantage Actor-Critic (A2C) agent on Pong-v5 using PyTorch.

24_DDPG_Continuous_Control.md

- **Topic:** Implement Deep Deterministic Policy Gradient (DDPG) in PyTorch for continuous control.

25_Hierarchical_RL_Task_Decomposition.md

- **Topic:** Build a Hierarchical RL agent in PyTorch for complex task decomposition.

26_Inverse_RL_Reward_Learning.md

- **Topic:** Recover reward functions from expert trajectories using Inverse RL (PyTorch).

27_SAC_MuJoCo_HalfCheetah.md

- **Topic:** Train a Soft Actor-Critic (SAC) agent on MuJoCo's HalfCheetah in PyTorch.

28_RL_Neural_Architecture_Search.md

- **Topic:** Combine RL with Neural Architecture Search (NAS) in PyTorch.

Deep Learning (Advanced PyTorch)

29_Neural_ODE_Dynamic_Systems.md

- **Topic:** Implement Neural ODEs in PyTorch for dynamic systems modeling.

30_Spiking_Neural_Network_SNN.md

- **Topic:** Train a Spiking Neural Network (SNN) in PyTorch for neuromorphic tasks.

Bonus Challenges

31_Diffusion_Model_Scratch.md

- **Topic:** Build a diffusion model from scratch in PyTorch for image generation.

32_WorldModel_DreamerV2.md

- **Topic:** Implement DreamerV2 (model-based RL) in PyTorch.

33_SimCLR_Self_Supervised_Learning.md

- **Topic:** Apply SimCLR for self-supervised learning in PyTorch.
