

Deep Learning Roadmap

Phase 1: Prerequisites (Review and Solidify)

Mathematics:

- Linear Algebra: vectors, matrices, eigenvalues.
- Calculus: derivatives, gradients, chain rule.
- Probability: distributions, Bayes theorem.
- Optimization: gradient descent, cost functions.

Python Libraries:

- NumPy, Pandas, Matplotlib, Seaborn
- Scikit-learn (for preprocessing and baseline models)

Phase 2: Neural Network Fundamentals

- Perceptron, Activation Functions (ReLU, Sigmoid, Tanh)
- Loss Functions: MSE, Cross-Entropy
- Forward & Backward Propagation
- Gradient Descent (SGD, Adam, RMSprop)
- Vanishing/Exploding Gradient Problems

Phase 3: Build Neural Networks from Scratch

- Implement basic NN with NumPy
- Use PyTorch/TensorFlow to build simple binary and multiclass classifiers

Projects: MNIST classifier, Titanic survival prediction

Phase 4: Convolutional Neural Networks (CNNs)

- Convolutions, Pooling, Padding, Stride

Deep Learning Roadmap

- Transfer Learning (ResNet, VGG)
- Data Augmentation

Projects: Cat vs Dog, Mask Detection, Plant Disease

Phase 5: RNNs & NLP

- RNN, LSTM, GRU, Word Embeddings (word2vec, GloVe)
- Attention Mechanism and Transformers (basics)

Projects: Sentiment Analysis, Next Word Prediction

Phase 6: Computer Vision & Transformers

- Vision Transformers (ViT)
- Object Detection: YOLO, SSD, RCNN
- Image Segmentation: U-Net, Mask R-CNN

Projects: Face Detection, OCR, Caption Generator

Phase 7: Generative Models

- Autoencoders (Vanilla, VAE)
- GANs (DCGAN, Conditional)

Projects: Image Denoising, Anime Face Generator

Phase 8: Advanced Topics

- Self-supervised learning, Reinforcement Learning (DQN)
- Multi-modal models, Efficient architectures (MobileNet)

Phase 9: Deployment and MLOps

Deep Learning Roadmap

- Model Saving and Serving: h5, pt, onnx, Flask, FastAPI

- Docker, Monitoring, AutoML

Projects: Streamlit App, Cloud deployment, Mobile inference

Tools by Area

Frameworks: PyTorch, TensorFlow

Visualization: TensorBoard, W&B

Deployment: Flask, FastAPI, Docker

CV: OpenCV, torchvision, YOLO

NLP: HuggingFace, NLTK

Weekly Study Plan

Week 1-2: Math, Python Review

Week 3-4: NN Basics, Small projects

Week 5-6: CNNs, Image classification

Week 7-8: RNNs, NLP

Week 9-10: Transformers, Vision Transformers

Week 11-12: GANs, Autoencoders

Week 13-14: MLOps & Deployment

Final Projects Ideas

- Parkinson Disease Voice Classifier

- Resume Screener

- Sign Language Interpreter (CNN + RNN)

- Chatbot using seq2seq with Attention