THE CORE CURRICULUM

PHASE 1: FOUNDATIONS (2-3 months)

Week 1-4: Mathematical Foundations
Key Resources:
Primary: "*The Matrix Calculus you need for Deep Learning*" by Terrence Parr and Jeremy Howard
Secondary Resources:
"Mathematics for Deep Learning" by Peter Deisenroth.
3Blue1Brown's Neural Networks and Linear Algebra series

Topics:
1. Linear Algebra Implementation
- Build matrix operations from scratch
- Implement backpropagation manually
- **Project: Create a linear algebra library**

2. Calculus & Optimization
- Implement gradient descent variants
- Automatic differentiation basics
- **Project: Build autograd engine**

Week 5-8: Neural Networks from Scratch
Resources:
Papers:
"*Learning representations by back-propagating errors*" (Rumelhart, Hinton)
Book:
"Neural Networks and Deep Learning" by Michael Nielsen
"*Deep Learning*" (Goodfellow, Bengio, Courville) - Chapters 6-9

Project Work:
1. Week 5-6: Basic Neural Network
- Implement forward/backward pass
- Various activation functions
- Different optimization methods

2. Week 7-8: Advanced NN Components
- Batch normalization
- Dropout
- Different initialization methods

Week 9-12: Modern Deep Learning & Transformers
Resources:
- "Attention is All You Need" paper
- Andrej Karpathy's "minGPT" implementation

- "A Survey of Transformers" (2023 paper)

Projects:

1. Mini-Transformer Implementation

- Self-attention mechanism
- Multi-head attention
- Positional encoding

PHASE 2: PARALLEL TRACKS (3-6 months)

Track A: Large Language Models (LLM)

Weeks 1-4: Foundation

Core Resources:

"A Mathematical Framework for Transformer Circuits" (Anthropic)

GPT, BERT, T5 original papers

Attention Mechanics Deep Dive (Stanford CS324)

Projects:

1. Week 1-2: Tokenizer Implementation

- Build BPE tokenizer from scratch
- Implement sub-word tokenization
- Challenge: Create a multilingual tokenizer

2. Week 3-4: Basic Language Model

- Implement GPT-style architecture
- Build causal attention mechanism
- Challenge: Train on a small dataset

Weeks 5-8: Advanced LLM Topics

- Resources:
  - "Constitutional AI" paper (Anthropic)
  - "Training Language Models to Follow Instructions" (InstructGPT)
  - RLHF papers

Projects:

1. Week 5-6: Fine-tuning & RLHF

- Implement RLHF components
- Build reward model
- Challenge: Fine-tune open-source LLM

2. Week 7-8: Model Optimization

- Implement quantization
- Knowledge distillation
- Challenge: Create efficient inference pipeline

Track B: Computer Vision
Weeks 1-4: Modern Architectures
Resources:

- Vision Transformer paper
- ConvNext papers
- MAE papers

Projects:
1. Week 1-2: Vision Transformer
   - Implement ViT from scratch
   - Patch embedding
   - Challenge: Add hierarchical structure

2. Week 3-4: Modern CNN
   - Implement ConvNext blocks
   - Attention mechanisms in CNN
   - Challenge: Hybrid CNN-Transformer

Weeks 5-8: Generative Models
Resources:

- DDPM paper
- Stable Diffusion papers
- Score-based models

Projects:
1. Week 5-6: Basic Diffusion
   - Implement DDPM
   - Noise scheduling
   - Challenge: Add classifier guidance

2. Week 7-8: Advanced Diffusion
   - Latent diffusion
   - Conditioning mechanisms
   - Challenge: Text-to-image system

Track C: Reinforcement Learning
Resources:

- Primary Text: "Reinforcement Learning: An Introduction" by Sutton & Barto
- Supplementary: David Silver's RL Course (DeepMind)
- OpenAI's Spinning Up in Deep RL
- David Silver's RL Course (DeepMind lectures)

Week 1-2: Core Concepts

- Markov Decision Processes
- Value Functions & Policies

- Dynamic Programming Project: Implement value iteration and policy iteration from scratch

Week 3-4: Model-Free Methods

- Monte Carlo Methods
- Temporal Difference Learning
- Q-Learning Project: Implement Q-learning for simple environments

PHASE 3: ADVANCED TOPICS & DEPLOYMENT (3-4 months)

Weeks 1-4: Distributed Training

Resources:

- DeepSpeed documentation
- FSDP papers
- "MLOps: Continuous Delivery and Automation Pipelines in Machine Learning"

Projects:

1. Week 1-2: Data Parallelism

- Implement basic DDP
- Gradient accumulation
- Challenge: Multi-node training

2. Week 3-4: Advanced Parallelism

- Pipeline parallelism
- Model parallelism
- Challenge: Implement ZeRO-like optimization

Weeks 5-8: Production ML

Resources:

- "Designing Machine Learning Systems" by Chip Huyen
- MLOps papers from major tech companies

Projects:

1. Week 5-6: Model Serving

- Build inference server
- Implement batching
- Challenge: A/B testing system

2. Week 7-8: Monitoring & Maintenance

- Implement metrics collection
- Drift detection
- Challenge: Auto-retraining pipeline

Key People to Follow:
1. Researchers:
Andrej Karpathy (@karpathy) - for deep technical insights and first principles thinking

François Chollet (@fchollet) - practical ML insights and industry perspective, creator of the Keras library.
Yann LeCun (@ylecun) - deep learning pioneer, fundamental concepts, AI researcher at Meta
Jeremy Howard (@jeremyphoward)
Lex Friedman (@lexfridman)- great takes on issues, interviews with key people, researchers and leaders in AI and technology in general.)

2. Companies/Labs:
DeepMind
Anthropic
Stability AI
Midjourney

Members are encouraged feel free to:

- Showcase their implementations
- Provide peer feedback and improvements
- Find AI edge cases share and document them.
- Propose solutions
- Share interesting resources and AI development you find
- Ask questions and interact freely and confidently- no question is too basic
- Help others when you can
- Document your learning journey, documenting publicly on twitter if you can.