AI ARCHITECT

Core Foundation

Mathematics & Statistics

- ☐ Linear Algebra: vectors, matrices, eigenvalues
- ☐ Calculus: derivatives, integrals, optimization
- ☐ Probability & Statistics: Bayes theorem, distributions, hypothesis testing
- ☐ Graph Theory & Game Theory
- ☐ Numerical Methods
- ☐ Discrete Mathematics
- ☐ Optimization Techniques (Convex, Linear, Integer programming)

Programming Foundations

- ☐ Python (NumPy, pandas, scikit-learn, PyTorch)
- ☐ Java, R, C++, Go (for enterprise-level systems)
- ☐ Git, GitHub, code versioning
- ☐ Object-Oriented Programming (classes, inheritance)
- ☐ Data Structures and Algorithms (sorting, searching, trees, graphs)
- ☐ REST APIs, WebSocket, async programming
- ☐ Shell scripting and Bash for automation

AI and Machine Learning

Core AI Concepts

- ☐ Search algorithms (A*, Dijkstra)
- ☐ Heuristics and knowledge representation
- ☐ Expert systems and reasoning
- ☐ Reinforcement Learning (Q-Learning, Policy Gradients)
- ☐ Markov Decision Processes
- ☐ Constraint satisfaction problems

Machine Learning Mastery

- ☐ Supervised, unsupervised, semi-supervised learning
- ☐ Regression, Classification, Clustering
- ☐ Feature Engineering and Dimensionality Reduction (PCA, LDA)
- ☐ Ensemble learning (Random Forest, XGBoost)
- ☐ Hyperparameter optimization (Grid, Bayesian)
- ☐ Model evaluation, bias, and fairness

Deep Learning

- ☐ Neural Networks, CNNs, RNNs, LSTMs
- ☐ Attention Mechanisms and Transformers
- ☐ Generative Models (GANs, VAEs)
- ☐ Self-supervised learning
- ☐ Multimodal AI (vision + text + audio)
- ☐ Model quantization, pruning, and optimization
- ☐ Frameworks: PyTorch, TensorFlow, JAX, Keras

Data Science & Data Engineering

- ☐ SQL, NoSQL (MongoDB, Cassandra)
- ☐ ETL pipelines and workflow orchestration (Airflow, Dagster)
- ☐ Data preprocessing and cleansing
- ☐ Data warehousing and lakes (Snowflake, BigQuery)
- ☐ Big data processing (Hadoop, Spark, Kafka, Beam)
- ☐ Feature stores and transformation pipelines
- ☐ Real-time streaming and batch analytics
- ☐ Data visualization (Power BI, Tableau, Matplotlib, Plotly)

Cloud Computing & Infrastructure

- ☐ AWS (SageMaker, EC2, Lambda, S3)
- ☐ Azure AI (Cognitive Services, Synapse)
- ☐ Google Cloud AI Platform
- ☐ Containers (Docker, Podman)
- ☐ Kubernetes and Helm
- ☐ Terraform and Infrastructure as Code (IaC)
- ☐ Load balancing, autoscaling, caching mechanisms (Redis, CDN)
- ☐ Cloud-native serverless design

MLOps and System Engineering

- ☐ Continuous Integration / Deployment (CI/CD)
- ☐ GitHub Actions, Jenkins, Argo CD
- ☐ Model lifecycle management (MLflow, Weights & Biases)
- ☐ Model registry, monitoring, rollback
- ☐ Experiment tracking
- ☐ Automated data pipelines
- ☐ APIs for model serving: FastAPI, Flask
- ☐ Microservices architecture for AI systems

Specialized AI Domains

Natural Language Processing (NLP)

- ☐ Tokenization, embeddings (BERT, Word2Vec)
- ☐ Text classification, sentiment analysis
- ☐ Summarization, translation, question answering
- ☐ Large Language Models (GPT-4, Llama 3, Claude)
- ☐ Prompt engineering and fine-tuning
- ☐ RAG (Retrieval-Augmented Generation)
- ☐ LangChain, Semantic Kernel, Vector Databases (FAISS, Milvus)

Computer Vision

- ☐ Image processing (OpenCV)
- ☐ Object detection (YOLO, DETR)
- ☐ Image segmentation (U-Net)
- ☐ 3D vision and SLAM
- ☐ Pose estimation and facial recognition

Speech and Audio

- ☐ ASR (Automatic Speech Recognition)
- ☐ Speech synthesis (TTS)
- ☐ Audio embeddings and music analysis

Robotics and Edge AI

- ☐ ROS (Robot Operating System)
- ☐ Sensor data fusion
- ☐ Path planning, SLAM, and obstacle avoidance
- ☐ Edge TPU, NVIDIA Jetson deployment

Generative and Agentic AI

- ☐ Generative transformers (LLMs)
- ☐ Diffusion models (Stable Diffusion, DALL·E)
- ☐ AI agents and tool-augmented reasoning
- ☐ Multi-agent orchestration frameworks (CrewAI, AutoGen, LangGraph)
- ☐ Human-in-the-loop pipelines

AI System Architecture & Security

- ☐ Scalable data pipelines and distributed training
- ☐ High-performance computing (GPU/TPU clusters)
- ☐ Model parallelism and federated learning
- ☐ Computer architecture for AI (CPU vectorization, GPU, TPU, FPGA)
- ☐ API gateways, security, and encryption
- ☐ Access control and secret management (IAM, KMS, Vault)
- ☐ Model interpretability (SHAP, LIME)
- ☐ Compliance (GDPR, HIPAA)

Business, Ethics, and Governance

- ☐ AI governance frameworks and model risk management
- ☐ Ethical AI and fairness in automation
- ☐ AI-driven product management
- ☐ Cost-performance tradeoff and ROI analysis
- ☐ Team leadership, mentorship, and Agile practices
- ☐ AI strategy and enterprise transformation

Advanced Research Topics

- ☐ AutoML and Neural Architecture Search
- ☐ Quantum Machine Learning
- ☐ Causal Inference
- ☐ Graph Neural Networks
- ☐ Multimodal Fusion (text-audio-vision integration)
- ☐ Energy-efficient AI
- ☐ Domain-Specific architectures (Healthcare AI, FinTech AI)
- ☐ Reinforcement Learning at scale (DeepMind, OpenAI Gym)
