

AI/ML Engineer Interview Preparation



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Complete 3-Month Roadmap for Meta, Google, Amazon & Top Tech Companies

Month 1: Mathematical Foundations & Core ML Concepts

Week 1: Linear Algebra & Statistics

Mathematical Foundation - Critical for ML

Topics to Cover:

- Vectors, matrices, eigenvalues, eigenvectors
- Matrix operations, decompositions (SVD, PCA)
- Probability distributions, Bayes' theorem
- Central limit theorem, hypothesis testing

Resources:

Text: Khan Academy Linear Algebra - <https://www.khanacademy.org/math/linear-algebra>

Video: 3Blue1Brown Linear Algebra Series - https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab

Text: Think Stats (Free PDF) - <https://greenteapress.com/thinkstats2/>

Video: StatQuest Statistics - <https://www.youtube.com/c/joshstarmer>

Implementation Practice:

- NumPy exercises for matrix operations
- Implement PCA from scratch in Python

Week 2: Calculus & Optimization

Essential for understanding backpropagation and gradient descent

Topics to Cover:

- Derivatives, partial derivatives, chain rule
- Gradients, Hessians
- Optimization techniques (gradient descent variants)
- Lagrange multipliers, constrained optimization

Resources:

Text: Khan Academy Calculus - <https://www.khanacademy.org/math/calculus-1>

Video: 3Blue1Brown Calculus Series - <https://www.youtube.com/playlist?list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr>

Text: Convex Optimization (Boyd & Vandenberghe) - <https://web.stanford.edu/~boyd/cvxbook/>

Video: Convex Optimization Lectures - <https://www.youtube.com/playlist?list=PL3940DD956CDF0622>

Implementation Practice:

- Implement gradient descent from scratch
- Code different optimization algorithms (SGD, Adam, RMSprop)

Week 3: Core Machine Learning Algorithms

Foundation algorithms every ML engineer must know

Topics to Cover:

- Linear/Logistic Regression
- Decision Trees, Random Forest
- SVM, K-means clustering
- Naive Bayes, KNN

Resources:

Text: Andrew Ng's ML Course Notes - <https://cs229.stanford.edu/syllabus-autumn2018.html>

Video: Andrew Ng ML Course - <https://www.coursera.org/learn/machine-learning> (Free audit)

Text: Hands-On Machine Learning (Free chapters) - <https://github.com/ageron/handson-ml3>

Video: StatQuest ML Algorithms - <https://www.youtube.com/c/joshstamer>

Implementation Practice:

- Implement each algorithm from scratch in Python
- Compare with scikit-learn implementations

Week 4: Model Evaluation & Feature Engineering

Critical for production ML systems

Topics to Cover:

- Cross-validation, bias-variance tradeoff
- Precision, recall, F1-score, AUC-ROC
- Feature selection, dimensionality reduction
- Overfitting, regularization (L1/L2)

Resources:

Text: Feature Engineering for ML (Free) - <https://github.com/PacktPublishing/Feature-Engineering-for-Machine-Learning>

Video: Feature Engineering Course - <https://www.youtube.com/playlist?list=PLeo1K3hjS3uuVQccZa7yJwdkmm2rQQjLN>

Text: Model Evaluation Guide - https://scikit-learn.org/stable/modules/model_evaluation.html

Video: Cross-validation Explained - <https://www.youtube.com/watch?v=fSytzGwwBVw>

Implementation Practice:

- Build complete ML pipeline with feature engineering
- Implement different validation strategies

Month 2: Deep Learning & Neural Networks

Week 5: Neural Network Fundamentals

Core concepts behind modern AI

Topics to Cover:

- Perceptron, multi-layer perceptrons
- Backpropagation algorithm (mathematical derivation)
- Activation functions, loss functions
- Weight initialization, batch normalization

Resources:

Text: Neural Networks and Deep Learning (Free) - <http://neuralnetworksanddeeplearning.com/>

Video: Deep Learning Specialization (Coursera) - <https://www.coursera.org/specializations/deep-learning>

Text: Deep Learning Book (Goodfellow) - <https://www.deeplearningbook.org/>

Video: 3Blue1Brown Neural Networks - https://www.youtube.com/playlist?list=PLZHQObOWTQDNU6Rl_67000Dx_ZCJB-3pi

Implementation Practice:

- Build neural network from scratch using only NumPy
- Implement backpropagation manually

Week 6: Convolutional Neural Networks (CNNs)

Essential for computer vision roles

Topics to Cover:

- Convolution operation, pooling layers
- CNN architectures (LeNet, AlexNet, ResNet)
- Transfer learning, fine-tuning
- Object detection basics (YOLO, R-CNN concepts)

Resources:

Text: CS231n Course Notes - <http://cs231n.stanford.edu/>

Video: CS231n Lectures - <https://www.youtube.com/playlist?list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv>

Text: Deep Learning for Computer Vision - <https://www.pyimagesearch.com/deep-learning-computer-vision-python-book/>

Video: CNN Explained - <https://www.youtube.com/watch?v=YRhxdVksIs>

Implementation Practice:

- Build CNN from scratch for image classification
- Implement ResNet architecture in PyTorch/TensorFlow

Week 7: Recurrent Neural Networks (RNNs) & Transformers

Crucial for NLP and sequence modeling

Topics to Cover:

- Vanilla RNN, LSTM, GRU architectures
- Sequence-to-sequence models
- Attention mechanism, self-attention
- Transformer architecture, BERT, GPT concepts

Resources:

Text: Understanding LSTMs - <https://colah.github.io/posts/2015-08-Understanding-LSTMs/>

Video: RNN Lectures - <https://www.youtube.com/watch?v=6niqTuYFZLQ>

Text: Attention Is All You Need Paper - <https://arxiv.org/abs/1706.03762>

Video: Transformer Explained - <https://www.youtube.com/watch?v=4Bdc55j80l8>

Implementation Practice:

- Build LSTM for text generation
- Implement basic transformer encoder from scratch

Week 8: Advanced Deep Learning Topics

Cutting-edge techniques used in production

Topics to Cover:

- Generative models (VAE, GAN basics)
- Reinforcement learning fundamentals
- Model compression, quantization
- Distributed training concepts

Resources:

Text: GAN Papers - <https://github.com/nashory/gans-awesome-applications>

Video: GAN Lectures - <https://www.youtube.com/watch?v=5WoItGTWV54>

Text: RL Introduction (Sutton & Barto) - <http://incompleteideas.net/book/the-book.html>

Video: RL Course - <https://www.youtube.com/playlist?list=PLqYmG7hTraZDM-OYHWgPebj2MfCFzFObQ>

Implementation Practice:

- Build simple GAN for image generation
- Implement basic Q-learning algorithm

Month 3: Production ML & System Design

Week 9: MLOps & Production Systems

Critical for senior ML engineer roles

Topics to Cover:

- ML pipeline design, model versioning
- Data validation, model monitoring
- A/B testing for ML models
- Docker, Kubernetes for ML

Resources:

Text: MLOps Guide - <https://ml-ops.org/>

Video: MLOps Course - https://www.youtube.com/playlist?list=PL3N9eeOICrP6Nhv4UFp67IsQ_TVDpXqXK

Text: Google ML Engineering - <https://developers.google.com/machine-learning/guides>

Video: ML System Design - <https://www.youtube.com/watch?v=7q4XFAOdJf0>

Implementation Practice:

- Deploy ML model using Docker and Flask/FastAPI
- Set up monitoring and logging for ML model

Week 10: Large-Scale ML Systems

System design for big tech interviews

Topics to Cover:

- Distributed training strategies
- Feature stores, model serving
- Real-time vs batch inference
- Handling data drift, model retraining

Resources:

Text: Designing ML Systems (Chip Huyen) - Key concepts available online

Video: ML System Design Interviews - https://www.youtube.com/watch?v=4Sfo3LCZ_xc

Text: High Scalability ML - <http://highscalability.com/blog/category/machine-learning>

Video: Distributed ML - https://www.youtube.com/watch?v=KSNQb_7LJbg

Implementation Practice:

- Design and document a complete ML system architecture
- Build scalable feature pipeline

Week 11: Generative AI & LLMs

Hot topic for current interviews

Topics to Cover:

- Large Language Model architectures
- Fine-tuning techniques (LoRA, QLoRA)
- Prompt engineering, RAG systems
- Embedding models, vector databases

Resources:

Text: LLM Course - <https://github.com/mlabonne/llm-course>

Video: LLM Fundamentals - <https://www.youtube.com/watch?v=5sLYAQS9sWQ>

Text: Hugging Face Course - <https://huggingface.co/course/chapter1/1>

Video: Transformers Course - https://www.youtube.com/playlist?list=PLo2ElpI_JMQvWfQndUesu0nPBAtZ9gP1o

Implementation Practice:

- Fine-tune a small language model
- Build RAG system with vector database

Week 12: Interview Preparation & Mock Interviews

Final preparation phase

Topics to Cover:

- Common ML interview questions
- Coding challenges in ML context
- System design case studies
- Behavioral interview preparation

Resources:

Text: ML Interview Questions - <https://github.com/alexeygrigorev/data-science-interviews>

Video: Mock ML Interviews - https://www.youtube.com/results?search_query=machine+learning+interview+mock

Text: Cracking ML Interviews - <https://github.com/khangich/machine-learning-interview>

Video: System Design for ML - <https://www.youtube.com/watch?v=lnDXdFqeSeI>

Practice Activities:

- Solve 50+ ML coding problems
- Practice 10+ system design questions
- Take mock interviews

Weekly Implementation Schedule

Daily Structure (2-3 hours/day):

- 45 minutes: Theory study (videos/reading)
- 60 minutes: Hands-on implementation
- 30 minutes: Practice problems/coding challenges

Weekend Projects:

- Build end-to-end projects combining weekly learnings
- Create GitHub portfolio showcasing implementations

Key Programming Skills to Develop

Essential Libraries:

- NumPy, Pandas, Scikit-learn
- TensorFlow/Keras or PyTorch
- Matplotlib, Seaborn for visualization
- SQL for data manipulation

Tools & Platforms:

- Git/GitHub for version control
- Docker for containerization
- AWS/GCP for cloud ML services
- Jupyter notebooks for experimentation

Interview-Specific Preparation**Technical Areas to Master:**

- Explain complex ML concepts simply
- Code ML algorithms from scratch
- Debug and optimize ML models
- Design scalable ML systems

Meta: Computer vision, recommendation systems, NLP

Google: Large-scale ML, TPU optimization, search/ads

Amazon: Recommendation systems, AWS ML services, retail ML

Success Metrics

- **Month 1:** Solid foundation in math and basic ML
- **Month 2:** Ability to implement neural networks from scratch
- **Month 3:** Ready to design production ML systems

Final Goal: Confidently discuss any ML topic, implement solutions, and design systems at the level expected by top tech companies.

Additional Success Tips

- Join ML communities (Reddit r/MachineLearning, Discord servers)
- Follow ML research papers and blogs
- Practice explaining concepts to others
- Build a strong GitHub portfolio
- Network with ML engineers at target companies
- **Remember:** Consistency is key - dedicate 2-3 hours daily

© 2025 AI/ML Engineer Interview Preparation Guide

Prepared for success at Meta, Google, Amazon, and other top tech companies

Stay consistent, practice daily, and you'll be interview-ready in 3 months!