Comprehensive Interview Questions - ML, RAG, Azure, Transformers, Neural Networks, CrewAI

# Machine Learning (Basics to Advanced)

1. 1. What is the difference between supervised, unsupervised, and reinforcement learning?
2. 2. Explain bias-variance tradeoff.
3. 3. What are overfitting and underfitting? How can you prevent them?
4. 4. What is cross-validation and why is it used?
5. 5. What are precision, recall, F1-score, and accuracy?
6. 6. Explain the confusion matrix.
7. 7. What is the difference between classification and regression?
8. 8. What are the assumptions of linear regression?
9. 9. How do you evaluate a regression model?
10. 10. What is feature scaling and why is it important?
11. 11. Explain decision trees and how they work.
12. 12. What is entropy and information gain in decision trees?
13. 13. What are ensemble methods like bagging and boosting?
14. 14. What is Random Forest and how does it work?
15. 15. What is the difference between AdaBoost, Gradient Boosting, and XGBoost?
16. 16. What are support vector machines and how do they work?
17. 17. What is the kernel trick in SVM?
18. 18. How does KNN algorithm work?
19. 19. What are distance metrics used in KNN?
20. 20. What is PCA (Principal Component Analysis) and when should you use it?
21. 21. Explain ROC and AUC.
22. 22. What is the curse of dimensionality?
23. 23. What are hyperparameters and how do you tune them?
24. 24. Explain L1 and L2 regularization.
25. 25. What is the difference between bagging and boosting in ensemble learning?
26. 26. What is the difference between generative and discriminative models?
27. 27. Explain the Expectation-Maximization algorithm.
28. 28. What are Gaussian Mixture Models (GMM)?
29. 29. Explain time series forecasting models like ARIMA, SARIMA.
30. 30. How do you detect and handle multicollinearity in regression?

# RAG (Retrieval-Augmented Generation)

1. 1. What is Retrieval-Augmented Generation (RAG)?
2. 2. How does RAG differ from traditional language models?
3. 3. What are the components of a RAG pipeline?
4. 4. How do retrievers and generators work in RAG?
5. 5. What is the difference between dense and sparse retrieval?
6. 6. Explain vector databases and their role in RAG.
7. 7. How do you fine-tune a RAG model?
8. 8. What are common use cases for RAG in industry?
9. 9. How do you evaluate a RAG system?
10. 10. What are the limitations and challenges in using RAG?

# Azure (Cloud & ML)

1. 1. What is Azure Machine Learning and its main features?
2. 2. How do you deploy a model on Azure ML?
3. 3. What are Azure ML Pipelines?
4. 4. How does Azure handle model monitoring and versioning?
5. 5. What is Azure Data Factory and how does it integrate with ML?
6. 6. How does Azure support AutoML?
7. 7. Explain the difference between Azure Blob Storage, Table Storage, and SQL Database.
8. 8. What are Azure Functions and how can they be used in ML pipelines?
9. 9. How do you secure data and models on Azure?
10. 10. What is Azure Cognitive Services and how is it used in AI development?

# Transformers (NLP & DL)

1. 1. What are transformers in deep learning?
2. 2. Explain the self-attention mechanism.
3. 3. What is the architecture of the Transformer model?
4. 4. How do encoder and decoder blocks work in transformers?
5. 5. What is BERT and how is it different from GPT?
6. 6. Explain positional encoding in transformers.
7. 7. What are attention masks and why are they used?
8. 8. How do transformers handle long context lengths?
9. 9. What are the main training objectives of BERT and GPT?
10. 10. How do you fine-tune a transformer for a downstream task?

# Neural Networks (Deep Learning)

1. 1. What is a neural network?
2. 2. Explain forward propagation and backpropagation.
3. 3. What are activation functions? Explain ReLU, Sigmoid, Tanh.
4. 4. What is the vanishing gradient problem?
5. 5. What is dropout and how does it help prevent overfitting?
6. 6. Explain the structure of CNNs and their applications.
7. 7. What are RNNs and how do they differ from feedforward networks?
8. 8. What is the difference between GRU and LSTM?
9. 9. How do you initialize weights in neural networks?
10. 10. What are batch normalization and layer normalization?

# CrewAI (Agent Framework)

1. 1. What is CrewAI and what is its core architecture?
2. 2. How does CrewAI manage tasks and agents?
3. 3. Explain the concept of agent collaboration in CrewAI.
4. 4. What types of agents can you define in CrewAI?
5. 5. How does CrewAI handle dynamic workflows?
6. 6. What are tools in CrewAI and how do agents use them?
7. 7. How do you integrate external APIs or services into CrewAI?
8. 8. How do you deploy and monitor a CrewAI system?
9. 9. How does CrewAI compare with LangChain and AutoGen?
10. 10. What are best practices for scaling and maintaining a CrewAI application?