**1. What are *hyperparameters* in machine learning?**

A. Parameters learned from training data  
B. Settings manually defined before training  
C. Weights of a neural network  
D. Hidden layer activations  
**Answer:** B

**2. Which of the following is an example of a hyperparameter?**

A. Weight matrix  
B. Bias term  
C. Learning rate  
D. Predicted output  
**Answer:** C

**3. What is the main goal of hyperparameter tuning?**

A. Reduce dataset size  
B. Improve model performance by finding optimal hyperparameter values  
C. Eliminate overfitting by removing features  
D. Increase training data  
**Answer:** B

**4. Which method tries all possible combinations of hyperparameter values?**

A. Random Search  
B. Grid Search  
C. Bayesian Optimization  
D. Gradient Descent  
**Answer:** B

**5. What is the main disadvantage of Grid Search?**

A. It cannot handle numerical parameters  
B. It is computationally expensive and time-consuming  
C. It works only on neural networks  
D. It ignores categorical variables  
**Answer:** B

**6. Which hyperparameter tuning technique uses probability models to choose the next best set of hyperparameters?**

A. Grid Search  
B. Random Search  
C. Bayesian Optimization  
D. Genetic Algorithm  
**Answer:** C

**7. Random Search is preferred over Grid Search when:**

A. The parameter space is very small  
B. The parameter space is large and continuous  
C. We know exact optimal values  
D. Training data is minimal  
**Answer:** B

**8. Which of the following can lead to *overfitting during tuning*?**

A. Using a separate validation set for tuning  
B. Evaluating models too many times on the same validation data  
C. Using cross-validation  
D. Reducing the learning rate  
**Answer:** B

**9. What is the key difference between model parameters and hyperparameters?**

A. Parameters are fixed; hyperparameters are learned  
B. Parameters are learned from data; hyperparameters are set before training  
C. Hyperparameters are random; parameters are constant  
D. Both are manually set  
**Answer:** B

**10. Which of the following tools can automate hyperparameter tuning in cloud environments?**

A. TensorFlow Tuner  
B. Google Vertex AI Hyperparameter Tuning  
C. AWS SageMaker Tuner  
D. All of the above  
**Answer:** D

**1. What is the main goal of Grid Search and Random Search in machine learning?**

A. To train deep neural networks  
B. To find the optimal hyperparameters for a model  
C. To reduce training data  
D. To improve feature selection  
**Answer:** B

**2. Grid Search works by:**

A. Randomly sampling hyperparameter combinations  
B. Testing every possible combination of hyperparameters in a specified grid  
C. Using a probabilistic model  
D. Automatically adjusting learning rates  
**Answer:** B

**3. Random Search works by:**

A. Testing every combination exhaustively  
B. Selecting random combinations of hyperparameters to evaluate  
C. Ignoring hyperparameter ranges  
D. Using gradient descent to find best parameters  
**Answer:** B

**4. Which of the following statements about Grid Search is *true*?**

A. It guarantees finding the global best combination within the grid  
B. It randomly explores the search space  
C. It ignores discrete hyperparameters  
D. It always performs faster than Random Search  
**Answer:** A

**5. The main advantage of Random Search over Grid Search is:**

A. It can cover more of the hyperparameter space efficiently  
B. It guarantees better accuracy  
C. It needs no computational resources  
D. It ignores invalid hyperparameters  
**Answer:** A

**6. Which tuning method is more suitable when you have limited computational resources and many hyperparameters?**

A. Grid Search  
B. Random Search  
C. Both are equally efficient  
D. Manual tuning  
**Answer:** B

**7. In Grid Search, increasing the number of hyperparameters leads to:**

A. Linear growth in combinations  
B. Exponential growth in combinations  
C. Constant runtime  
D. No effect  
**Answer:** B

**8. Random Search tends to perform well because:**

A. Some hyperparameters have more influence than others, and Random Search explores more combinations  
B. It tests every possible value  
C. It ignores search space boundaries  
D. It uses gradient descent optimization  
**Answer:** A

**9. In practice, Grid Search is often combined with which technique to avoid overfitting?**

A. Cross-validation  
B. Bagging  
C. Dropout  
D. Feature scaling  
**Answer:** A

**10. Which statement is *false* about Random Search?**

A. It is less likely to get stuck in local optima than Grid Search  
B. It can sample the same combination multiple times  
C. It provides a deterministic result every time  
D. It can find good results faster for large parameter spaces  
**Answer:** C

**1. What is the main purpose of Bayesian Optimization in machine learning?**

A. To visualize data distributions  
B. To optimize hyperparameters efficiently with fewer evaluations  
C. To train deep learning models faster  
D. To find correlations between features  
**Answer:** B

**2. Bayesian Optimization builds a model of:**

A. Training data  
B. The objective (performance) function  
C. The gradient of loss function  
D. The weight updates  
**Answer:** B

**3. The function that Bayesian Optimization tries to optimize is usually:**

A. Continuous and differentiable  
B. Expensive to evaluate and black-box  
C. Simple and known  
D. Always convex  
**Answer:** B

**4. Which of the following is commonly used as a surrogate model in Bayesian Optimization?**

A. Linear Regression  
B. Decision Tree  
C. Gaussian Process (GP)  
D. Logistic Regression  
**Answer:** C

**5. In Bayesian Optimization, the acquisition function is used to:**

A. Train the model  
B. Select the next set of hyperparameters to evaluate  
C. Reduce model complexity  
D. Calculate feature importance  
**Answer:** B

**6. Which of the following is *not* an example of an acquisition function?**

A. Expected Improvement (EI)  
B. Upper Confidence Bound (UCB)  
C. Probability of Improvement (PI)  
D. Gradient Descent Function (GDF)  
**Answer:** D

**7. The acquisition function balances which two objectives?**

A. Accuracy and precision  
B. Exploration and exploitation  
C. Training and testing  
D. Bias and variance  
**Answer:** B

**8. In Bayesian Optimization, exploration refers to:**

A. Evaluating parameters already tested  
B. Trying new and uncertain areas of the search space  
C. Fine-tuning near the best result  
D. Increasing model regularization  
**Answer:** B

**9. Which of the following is a key advantage of Bayesian Optimization over Grid or Random Search?**

A. It does not require a validation set  
B. It efficiently finds good hyperparameters with fewer evaluations  
C. It guarantees global optimum  
D. It works only on discrete parameters  
**Answer:** B

**10. Bayesian Optimization is particularly useful when:**

A. The objective function is easy to compute  
B. The search space is small  
C. The evaluation of each model is computationally expensive  
D. Data is unstructured  
**Answer:** C

**11. Which Python library provides an implementation of Bayesian Optimization?**

A. scikit-learn only  
B. Optuna, Hyperopt, and Scikit-Optimize  
C. TensorFlow only  
D. None of the above  
**Answer:** B

**12. What does the Gaussian Process (GP) in Bayesian Optimization represent?**

A. A deterministic function  
B. A probabilistic model over possible objective functions  
C. A neural network  
D. A regression loss  
**Answer:** B

**13. The output of Bayesian Optimization is:**

A. The best-performing model only  
B. The most probable hyperparameter configuration with high expected performance  
C. A confusion matrix  
D. A loss curve  
**Answer:** B

**14. One major limitation of Bayesian Optimization is:**

A. It cannot handle categorical parameters efficiently  
B. It cannot work on continuous spaces  
C. It ignores uncertainty  
D. It needs manual gradient computation  
**Answer:** A

**15. In AutoML platforms like Google Vertex AI or AWS SageMaker, Bayesian Optimization is used for:**

A. Data cleaning  
B. Model explainability  
C. Automated hyperparameter tuning  
D. Feature selection  
**Answer:** C

**1. What is manual hyperparameter tuning?**

A. Automatically finding optimal hyperparameters  
B. Manually adjusting hyperparameters based on experience and model performance  
C. Using Bayesian Optimization  
D. Randomly selecting values using automation tools  
**Answer:** B

**2. Which of the following is an example of manual hyperparameter tuning?**

A. Running Grid Search with sklearn  
B. Adjusting learning rate and epochs based on validation accuracy manually  
C. Using Optuna to find the best parameters  
D. Using AutoML pipelines  
**Answer:** B

**3. What is a major advantage of manual hyperparameter tuning?**

A. Fully automated  
B. Deep understanding of model behavior  
C. Guaranteed optimal results  
D. No need for domain knowledge  
**Answer:** B

**4. What is a major disadvantage of manual hyperparameter tuning?**

A. It is computationally efficient  
B. It is time-consuming and subjective  
C. It uses probabilistic models  
D. It is easy to automate  
**Answer:** B

**5. During manual tuning, the best practice is to:**

A. Change multiple hyperparameters at once  
B. Change one hyperparameter at a time and observe performance changes  
C. Avoid using validation data  
D. Skip model evaluation steps  
**Answer:** B

**6. Which hyperparameter is often tuned first in manual tuning for neural networks?**

A. Batch size  
B. Learning rate  
C. Dropout rate  
D. Number of neurons  
**Answer:** B

**7. When manually tuning hyperparameters, how can overfitting be detected?**

A. Training and validation accuracy both increase  
B. Validation accuracy decreases while training accuracy continues to increase  
C. Training loss increases sharply  
D. Learning rate remains constant  
**Answer:** B

**8. Manual hyperparameter tuning is most practical when:**

A. The model is large and has hundreds of parameters  
B. The model is small or for quick prototyping  
C. Running on distributed clusters  
D. Using reinforcement learning  
**Answer:** B

**9. Which visualization technique helps during manual tuning?**

A. Learning curves (loss vs. epoch)  
B. ROC curve  
C. Confusion matrix  
D. PCA scatter plot  
**Answer:** A

**10. To make manual hyperparameter tuning more efficient, practitioners often:**

A. Automate all processes  
B. Use heuristics, domain knowledge, and prior experiments  
C. Skip validation checks  
D. Avoid recording results  
**Answer:** B

1. What does model deployment refer to in machine learning?  
   A. Training a model  
   B. Using a trained model to make predictions on new data  
   C. Collecting and cleaning data  
   D. Visualizing datasets  
   **Answer:** B
2. Which AWS service is primarily used to deploy ML models as endpoints?  
   A. AWS Lambda  
   B. Amazon EC2  
   C. Amazon SageMaker  
   D. AWS CloudFormation  
   **Answer:** C
3. In SageMaker, a *model endpoint* is best described as:  
   A. A dataset storage location  
   B. A REST API for real-time inference  
   C. A feature extraction tool  
   D. A training script file  
   **Answer:** B
4. When deploying a model on SageMaker, which step comes *before* creating an endpoint?  
   A. Model packaging into a Docker container  
   B. Monitoring data drift  
   C. Evaluating confusion matrix  
   D. Tuning hyperparameters  
   **Answer:** A
5. Which of the following is a **benefit** of cloud deployment over local deployment?  
   A. Complete control over hardware  
   B. Limited scalability  
   C. On-demand scalability and managed infrastructure  
   D. Manual maintenance required  
   **Answer:** C
6. Local model deployment is ideal when:  
   A. Real-time inference is needed at scale  
   B. You want to test the model before cloud deployment  
   C. You have no access to local compute  
   D. You require elastic scaling  
   **Answer:** B
7. Inference latency refers to:  
   A. Time taken to train a model  
   B. Time taken for the model to predict a result after receiving input  
   C. Model deployment cost  
   D. Network data transfer time  
   **Answer:** B
8. What file is required to define model behavior for deployment in SageMaker?  
   A. train.py  
   B. requirements.txt  
   C. inference.py  
   D. metrics.json  
   **Answer:** C
9. Batch transform jobs in SageMaker are typically used for:  
   A. Real-time inference  
   B. Offline, large-scale predictions on stored datasets  
   C. Model evaluation  
   D. Data visualization  
   **Answer:** B
10. Which SageMaker feature automatically scales model endpoints based on traffic?  
    A. SageMaker Pipelines  
    B. Auto Scaling  
    C. Batch Transform  
    D. CloudFormation  
    **Answer:** B
11. What is the main purpose of model monitoring?  
    A. To retrain the model automatically  
    B. To detect data and prediction drift over time  
    C. To improve model accuracy through manual tuning  
    D. To visualize confusion matrices  
    **Answer:** B
12. Which AWS service is used to monitor deployed models?  
    A. Amazon Comprehend  
    B. AWS CloudWatch  
    C. Amazon Polly  
    D. AWS QuickSight  
    **Answer:** B
13. SageMaker Model Monitor primarily checks for:  
    A. Hardware utilization only  
    B. Data drift, concept drift, and model quality issues  
    C. Inference cost  
    D. Network latency  
    **Answer:** B
14. Which type of drift occurs when the *relationship between input and output* changes?  
    A. Data drift  
    B. Concept drift  
    C. Label imbalance  
    D. Feature scaling drift  
    **Answer:** B
15. Data drift can occur when:  
    A. Model parameters are updated  
    B. The distribution of incoming data differs from training data  
    C. Training data is reduced  
    D. Batch size increases  
    **Answer:** B
16. What triggers can be used with AWS Lambda to automate model retraining?  
    A. S3 upload events and monitoring alerts  
    B. Manual console actions only  
    C. EC2 restarts  
    D. CloudFront updates  
    **Answer:** A
17. Which performance metric measures model prediction correctness?  
    A. Precision  
    B. Drift rate  
    C. F1-score  
    D. Both A and C  
    **Answer:** D
18. SageMaker Model Monitor saves reports and metrics in:  
    A. CloudFormation stacks  
    B. S3 buckets  
    C. EC2 instances  
    D. CloudTrail logs  
    **Answer:** B
19. A major challenge in model maintenance is:  
    A. Lack of new data  
    B. Changing real-world conditions causing model performance degradation  
    C. Too much hardware  
    D. Static environments  
    **Answer:** B
20. Which AWS tool can visualize model performance over time?  
    A. AWS Glue  
    B. CloudWatch dashboards  
    C. AWS CodeDeploy  
    D. AWS Step Functions  
    **Answer:** B