**ML Categories**

* Supervised Learning -Learn mapping from input to output (Linear Regression, Decision Trees, SVM)
* Unsupervised Learning -Find patterns without labels (K-Means, PCA, Hierarchical Clustering)
* Semi-Supervised Learning -Mix of labeled & unlabeled data (Self-training, Label propagation)
* Reinforcement Learning -Learn via rewards from environment (Q-Learning, Deep Q-Networks)

**Assumptions**

* Model assumptions -Conditions under which the algorithm works best (Linearity -Linear Regression, Independence -Naive Bayes, Stationarity -Time Series)

**Problem Formulation / Equations**

* Core equations -General formulation of the model (Regression )

**Loss / Objective Functions**

* Regression -Measures prediction error (MSE, MAE, Huber Loss)
* Classification -Measures misclassification (Cross-Entropy, Hinge Loss, Log Loss)

**Optimization / Training Methods**

* Optimization / Training -How model parameters are learned (Gradient Descent, Stochastic GD, Newton-Raphson, EM algorithm)

**Hyperparameters**

* Tuning parameters -Set before training to control model (Learning rate, max depth -trees, C -SVM, number of neighbors -kNN)

**Regularization / Overfitting Prevention**

* Techniques -Prevent overfitting and improve generalization (L1/Lasso, L2/Ridge, ElasticNet, Dropout -DL, Early Stopping, Pruning)

**Evaluation Metrics**

* Regression Metrics -Measure prediction accuracy for continuous targets (RMSE, MAE, R²)
* Classification Metrics -Measure accuracy for discrete targets (Accuracy, Precision, Recall, F1-score, ROC-AUC)
* Clustering / Unsupervised -Evaluate structure or similarity (Silhouette score, Davies-Bouldin index, Calinski-Harabasz index)

**Feature Importance / Interpretability**

* Techniques -Understand model decisions (Coefficients -Linear models, Feature importance -Trees, SHAP, LIME)

**Computational Complexity**

* Training / Prediction Cost -Resource requirements (O(n²) -SVM, O(n·d) -Linear regression, O(n·k·i) -k-means)

**Advantages / Strengths**

* When to use -Key benefits of the algorithm (SVM -high-dimensional data, Trees -interpretability, kNN -simple & non-parametric)

**Limitations / Weaknesses**

* When to avoid -Common failure cases (Sensitive to outliers, overfitting, slow prediction on large datasets)

**Typical Use Cases / Applications**

* Real-world scenarios -Problems each algorithm is good for (Fraud detection, Image classification, Customer segmentation)