Decision Tree vs. Random Forest

| Feature | Decision Tree | Random Forest | References |
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| **Concept** | Tree-like structure for classification/regression | Ensemble of multiple decision trees | <https://www.analyticsvidhya.com/blog/2021/10/an-introduction-to-random-forest-algorithm-for-beginners/>, <https://www.geeksforgeeks.org/decision-tree-algorithms/> |
| **Structure** | Single tree with nodes (features) and branches (values) | Forest of multiple decision trees | <https://en.wikipedia.org/wiki/Random_forest> |
| **Prediction** | Follows path based on feature values to reach leaf node (classification/regression) | Averages predictions (classification) or takes majority vote (regression) from all trees | <https://www.analyticsvidhya.com/blog/2020/05/decision-tree-vs-random-forest-algorithm/> |
| **Advantages** | - Interpretable: Easy to understand decision process | - Reduced Overfitting: Less prone to overfitting | <https://www.analyticsvidhya.com/blog/2020/05/decision-tree-vs-random-forest-algorithm/> |
|  | - Simple to implement and train | - Improved Accuracy: Often achieves higher accuracy |
|  | - No feature scaling needed | - Robustness: Handles missing data and outliers well |
| **Disadvantages** | - Prone to Overfitting: Can overfit training data | - Interpretability: Difficult to interpret logic |
|  | - Variance: Sensitive to data changes | - Complexity: More computationally expensive |
|  |  | - Feature Scaling: May benefit from scaling |
| **Best suited for** | - Interpretability is crucial | - Higher accuracy and overfitting reduction |
|  | - Smaller datasets | - Missing data and outliers present |
|  | - Simple models needed | - Complex datasets |
| **References** | <https://www.analyticsvidhya.com/blog/2021/10/an-introduction-to-random-forest-algorithm-for-beginners/>, <https://www.geeksforgeeks.org/decision-tree-algorithms/> | <https://www.analyticsvidhya.com/blog/2021/10/an-introduction-to-random-forest-algorithm-for-beginners/>, <https://towardsdatascience.com/decision-trees-and-random-forests-df0c3123f991> |

**Visualizations:**

* **Decision Tree:** Image of Decision Tree (Machine Learning): <https://en.wikipedia.org/wiki/Decision_tree>
* **Random Forest:** Image of Random Forest (Machine Learning): <https://simple.wikipedia.org/wiki/Random_forest>