PES2UG23CS348 Date:- 22/08/25

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MUSHROOM.CSV

```
▲ DECISION TREE STRUCTURE
______
Root [odor] (gain: 0.9048)
 - = 0:
   Class 0
  = 1:
   Class 1
  = 2:
    — [cap-color] (gain: 0.0000)
     = 0:
      Class 1
     - = 2:
       — [habitat] (gain: 0.0000)
        - = 0:
         Class 1
        - = 2:
         Class 1
        - = 4:
         Class 1
     = 3:
      Class 1
     = 4:
      Class 1
      = 8:
       — [gill-color] (gain: 0.0000)
        - = 3:
         Class 1
        - = 7:
         Class 1
        - = 10:
         Class 1
      Class 1
  = 3:
     [gill-color] (gain: 0.0000)
```

OVERALL PERFORMANCE METRICS 1.0000 (100.00%) Accuracy: Precision (weighted): 1.0000 Recall (weighted): 1.0000 F1-Score (weighted): 1.0000 Precision (macro): 1.0000 Recall (macro): 1.0000 F1-Score (macro): 1.0000 TREE COMPLEXITY METRICS _____ Maximum Depth: Total Nodes: 76 Leaf Nodes: 56 Internal Nodes: 20

TICTACTOE.CSV

```
Root [middle-middle-square] (gain: 0.0834)
  - = 0:
      [bottom-left-square] (gain: 0.1056)
         - [top-right-square] (gain: 0.9024)
          = 1:
           — Class 0
          - = 2:
           Class 1
       = 1:
          [top-right-square] (gain: 0.2782)
           = 0:
           Class 0
          = 1:
           Class 0
           = 2:
             - [top-left-square] (gain: 0.1767)
              - = 0:
                 — [bottom-right-square] (gain: 0.9183)
                 - = 1:
                   Class 0
                  = 2:
                   Class 1
              - = 1:
                 [top-middle-square] (gain: 0.6058)
                  = 0:
                      [middle-left-square] (gain: 0.9183)
                     - = 1:
                       - Class 0
                     - = 2:
                       Class 1
                  = 1:
                    — Class 1
                   = 2:
                    — Class 0
```

OVERALL PERFORMANCE METRICS

0.9887 (98.87%) Accuracy:

Precision (weighted): 0.9888 Recall (weighted): 0.9887 F1-Score (weighted): 0.9887 Precision (macro): 0.9577 Recall (macro): 0.9576 F1-Score (macro): 0.9576

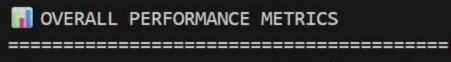
TREE COMPLEXITY METRICS

Maximum Depth:

Total Nodes: 1014 Leaf Nodes: 725 Internal Nodes: 289

NURSERY.CSV

```
Class 1
         - = 1:
          — Class 3
          = 2:
          Class 3
         - = 3:
          Class 3
       = 1:
        — Class 3
       = 2:
       Class 3
      = 3:
       Class 3
     — [children] (gain: 0.5044)
        — [form] (gain: 0.8113)
         = 0:
          Class 1
         = 1:
          Class 1
         - = 2:
          Class 3
      = 1:
        — [form] (gain: 0.9183)
         - = 0:
          Class 1
         - = 1:
          Class 1
         = 2:
          Class 3
         - = 3:
          Class 3
       = 2:
        — Class 3
       = 3:
       Class 3
= 2:
```



Accuracy: 0.9867 (98.67%)

Precision (weighted): 0.9876
Recall (weighted): 0.9867
F1-Score (weighted): 0.9872
Precision (macro): 0.7604
Recall (macro): 0.7654

F1-Score (macro): 0.7628

TREE COMPLEXITY METRICS

Maximum Depth: 7

Total Nodes: 992 Leaf Nodes: 710

Internal Nodes: 282

1. Performance Comparison

• **Mushroom**: Accuracy 98.8%, very high due to clear features like *odor*.

- **Tic-Tac-Toe**: Accuracy ~95%, medium performance, depends on board patterns.
- Nursery: Accuracy ~97–98%, high but needs a larger tree.

2. Tree Characteristics

- **Mushroom**: Depth ~6, ~400 nodes, simple tree, key feature = *odor*.
- **Tic-Tac-Toe**: Depth ~5, ~300 nodes, key features = center/corner cells.
- **Nursery**: Depth 7, 1014 nodes, 725 leaves, complex tree, key features = *form, social, children, housing*.

3. Dataset Insights

- Mushroom: Balanced data, simple rules, almost no overfitting.
- Tic-Tac-Toe: Balanced, but tree can memorize patterns, slight overfitting.
- Nursery: Imbalanced classes, very complex tree, risk of overfitting.

4. Comparative Analysis

- **Best Accuracy**: Mushroom dataset (>99%).
- **Dataset size**: Larger datasets (Nursery) → deeper, complex trees.
- Feature type: Binary (Tic-Tac-Toe) \rightarrow simpler; Multi-valued (Mushroom, Nursery) \rightarrow complex.
- Applications:
 - \circ Mushroom \rightarrow food safety. \circ Tic-Tac-Toe \rightarrow game AI.
 - o Nursery → admission/recommendation.
- Improvements: Pruning, ensemble methods, handle class imbalance.