```
Code:
# lab.py
import torch
def get entropy of dataset(tensor: torch.Tensor) -> float:
    Calculate the entropy of the entire dataset.
    target = tensor[:, −1] # last column = target
    values, counts = torch.unique(target, return_counts=True)
    probs = counts.float() / counts.sum()
    entropy = -torch.sum(probs * torch.log2(probs))
    return float(entropy)
def get avg info of attribute(tensor: torch.Tensor, attribute:
int) -> float:
    .....
    Calculate the average information (weighted entropy) of an
attribute.
    target = tensor[:, -1]
    attr values = tensor[:, attribute]
    values, counts = torch.unique(attr values, return counts=True)
   total = len(attr values)
    avg info = 0.0
    for v, count in zip(values, counts):
        subset = tensor[attr_values == v]
        subset_entropy = get_entropy_of_dataset(subset)
       weight = count.item() / total
        avg info += weight * subset entropy
  return float(avg info)
def get information gain(tensor: torch.Tensor, attribute: int) ->
float:
    Calculate Information Gain for an attribute.
    total_entropy = get_entropy_of_dataset(tensor)
    avg info = get avg info of attribute(tensor, attribute)
    info_gain = total_entropy - avg_info
    return round(float(info gain), 4)
def get selected attribute(tensor: torch.Tensor):
```

```
Select the best attribute based on highest information gain.

Returns (dict of gains, best_attribute_index).

"""

n_attributes = tensor.shape[1] - 1  # exclude target column gains = {}

for attr in range(n_attributes):
    gains[attr] = get_information_gain(tensor, attr)

# get attribute with max info gain
best_attr = max(gains, key=gains.get)
return gains, best_attr
```

Output:

```
Running tests with PYTORCH framework
 target column: 'class' (last column)
Original dataset info:
Shape: (8124, 23)
Columns: ['cap-shape', 'cap-surface', 'cap-color', 'bruises', 'odor', 'gill-attachment', 'gill-spacing',
'gill-size', 'gill-color', 'stalk-shape', 'stalk-root', 'stalk-surface-above-ring', 'stalk-surface-below-ring', 'stalk-color-above-ring', 'stalk-color-below-ring', 'veil-type', 'veil-color', 'ring-number', 'ring-type',
'spore-print-color', 'population', 'habitat', 'class']
First few rows:
cap-shape: ['x' 'b' 's' 'f' 'k'] -> [5 0 4 2 3]
cap-surface: ['s' 'y' 'f' 'g'] -> [2 3 0 1]
cap-color: ['n' 'y' 'w' 'g' 'e'] -> [4 9 8 3 2]
class: ['p' 'e'] -> [1 0]
Processed dataset shape: torch.Size([8124, 23])
Number of features: 22
Features: ['cap-shape', 'cap-surface', 'cap-color',
'bruises', 'odor', 'gill-attachment', 'gill-spacing',
'gill-size', 'gill-color', 'stalk-shape', 'stalk-root', 'stalk-surface-above-ring', 'stalk-surface-below-ring', 'stalk-color-above-ring', 'stalk-color-below-ring', 'veil-type', 'veil-color', 'ring-number', 'ring-type',
'spore-print-color', 'population', 'habitat']
Target: class
Framework: PYTORCH
Data type: <class 'torch.Tensor'>
______
DECISION TREE CONSTRUCTION DEMO
```

===

Total samples: 8124

Training samples: 6499 Testing samples: 1625

Constructing decision tree using training data...

Decision tree construction completed using PYTORCH!

DECISION TREE STRUCTURE ______ Root [odor] (gain: 0.9083) -- = 0: ├─ Class 0 = 1: - Class 1 = 2: — Class 1 = 3: — Class 0 ÷ 4: — Class 1 = 5: - [spore-print-color] (gain: 0.1469) = 0: ├─ Class 0 = 1: — Class 0 = 2: — Class 0 = 3: – Class 0 = 4: — Class 0 = 5: — Class 1 ÷ 7: - [habitat] (gain: 0.2217) - [gill-size] (gain: 0.7642) = 0: - Class 0 1: Class 1

```
— Class 0
        ÷ 2:
           - [cap-color] (gain: 0.7300)
             = 1:
              — Class 0
             = 4:
                – Class 0
             = 8:
               - Class 1
             = 9:
               – Class 1
           - Class 0
        = 6:
           – Class 0
    = 8:
      — Class 0
= 6:
  Class 1
= 7:
  - Class 1
= 8:
  — Class 1
```

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: 4 Total Nodes: 29 Leaf Nodes: 24 Internal Nodes: 5

Running tests with PYTORCH framework

target column: 'Class' (last column)

Original dataset info:

Shape: (958, 10)

Columns: ['top-left-square', 'top-middle-square', 'top-right-square', 'middle-left-square', 'middle-middle-square', 'middle-right-square', 'bottom-left-square', 'bottom-middle-square', 'bottom-right-square', 'Class']

First few rows:

top-left-square: ['x' 'o' 'b'] -> [2 1 0]

top-middle-square: ['x' 'o' 'b'] -> [2 1 0]

top-right-square: ['x' 'o' 'b'] -> [2 1 0]

Class: ['positive' 'negative'] -> [1 0]

Processed dataset shape: torch.Size([958, 10])

Number of features: 9

Features: ['top-left-square', 'top-middle-square', 'top-right-square', 'middle-left-square', 'middle-middle-square', 'middle-right-square', 'bottom-left-square',

'bottom-middle-square', 'bottom-right-square']

Target: Class

Framework: PYTORCH

Data type: <class 'torch.Tensor'>

===

DECISION TREE CONSTRUCTION DEMO

===

Total samples: 958
Training samples: 766
Testing samples: 192

Constructing decision tree using training data...

Decision tree construction completed using PYTORCH!

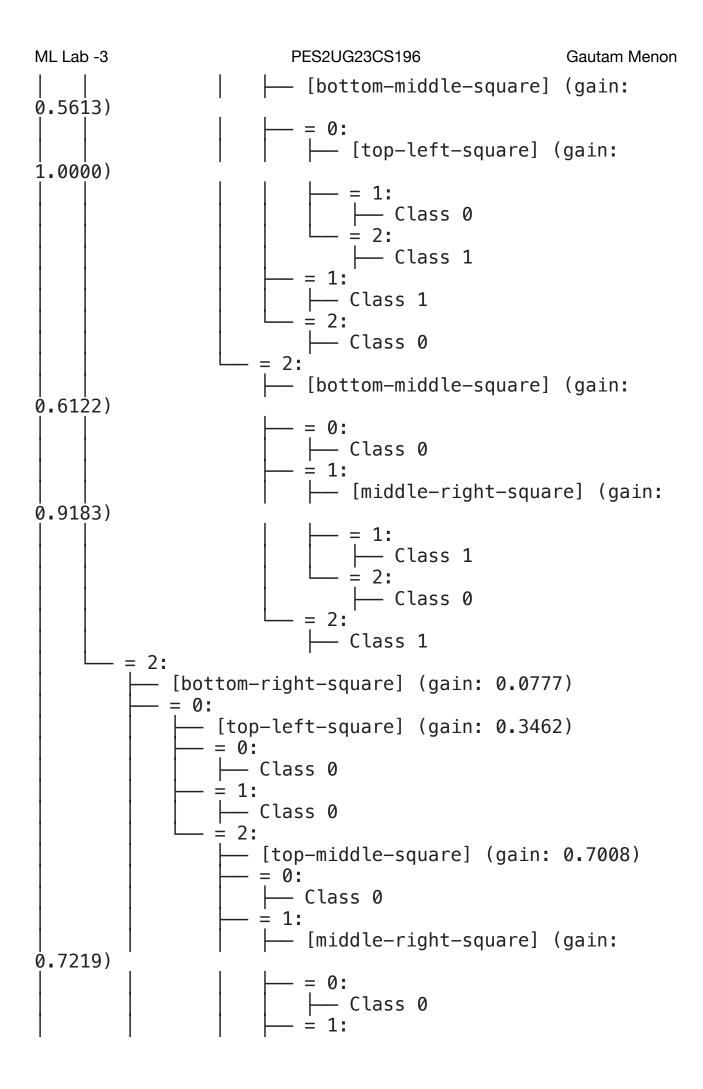


DECISION TREE STRUCTURE

```
Root [middle-middle-square] (gain: 0.0834)
  - = 0:
      — [bottom-left-square] (gain: 0.1056)
           - [top-right-square] (gain: 0.9024)
               - Class 0
            = 2:
              — Class 1
        = 1:
            [top-right-square] (gain: 0.2782)
               - Class 0
            = 1:
               – Class 0
            = 2:
              — [top-left-square] (gain: 0.1767)
                   - [bottom-right-square] (gain: 0.9183)
                       - Class 0
                     = 2:
                     ├─ Class 1
                = 1:
                    - [top-middle-square] (gain: 0.6058)
                       - [middle-left-square] (gain:
0.9183)
                         = 1:
                           – Class 0
                         ÷ 2:
                           — Class 1
                      1:
                       – Class 1
                    = 2:
                     ├─ Class 0
                 = 2:
                   - [top-middle-square] (gain: 0.3393)
                     = 0:
                       - [middle-left-square] (gain:
0.9183)
                        = 0:
                           – Class 0
                           – Class 1
```

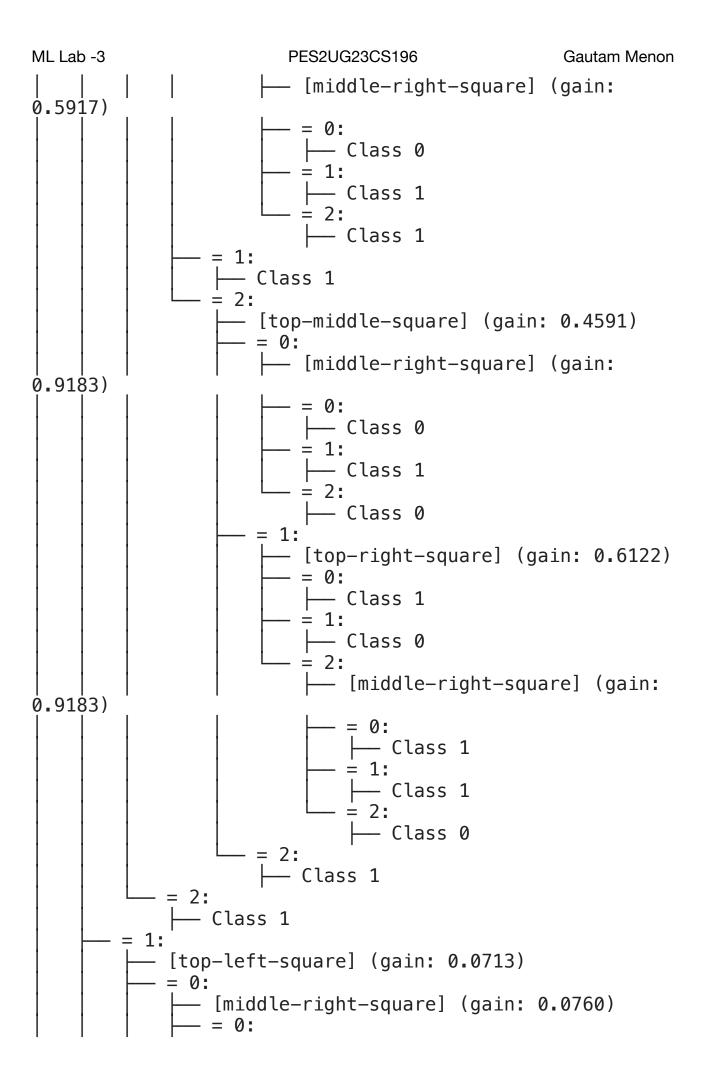
```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                     └── = 2:
                         ├─ Class 0
                     = 1:
                       — [middle-left-square] (gain:
0.9183)
                         = 0:
                           — Class 1
                         = 1:
                           – Class 1
                         = 2:
                           — Class 0
                     — Class 1
       - = 2:
          - [top-right-square] (gain: 0.1225)
            = 0:
              — Class 1
                 [middle-right-square] (gain: 0.1682)
                = 0:
                   - Class 1
                     [bottom-right-square] (gain: 0.9403)
                     = 0:
                       - Class 1
                     = 1:
                     ├─ Class 0
                    - = 2:
                     ├─ Class 1
                 = 2:
                   - [top-left-square] (gain: 0.9183)
                     = 0:
                       — Class 1
                     = 1:
                       - Class 0
                     = 2:
                       — Class 1
            = 2:
              — Class 1
      — [top-right-square] (gain: 0.0223)
       - = 0:
           - [bottom-left-square] (gain: 0.2247)
              — Class 0
```

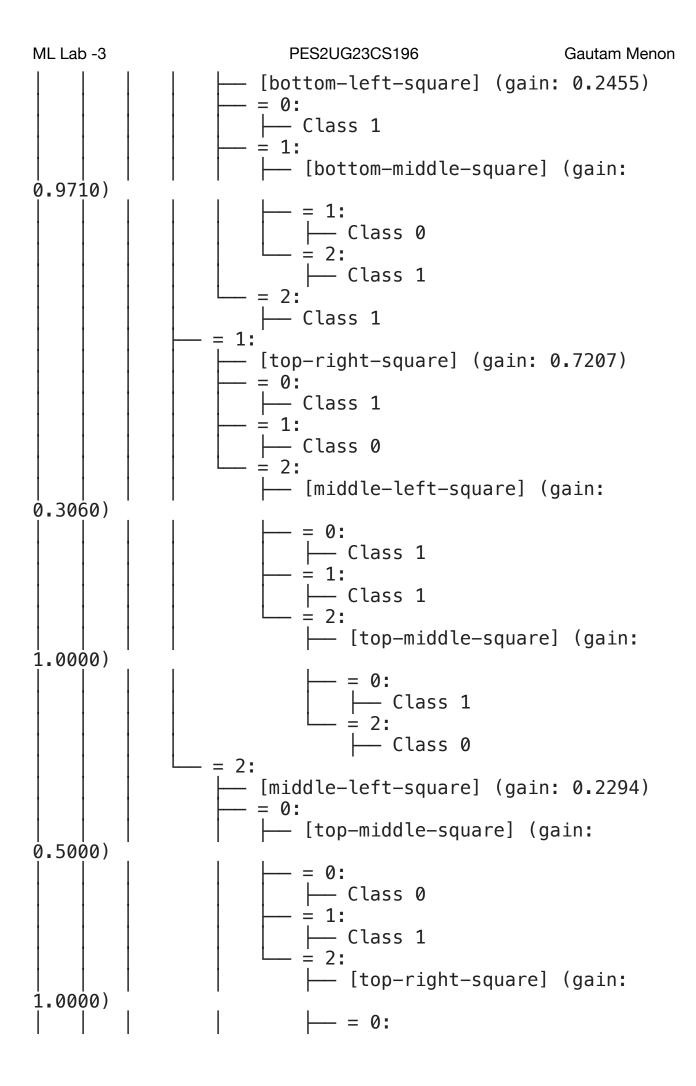
```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
            = 1:
               - Class 0
            = 2:
               - [middle-right-square] (gain: 0.1159)
                   - [top-left-square] (gain: 0.1771)
                     = 0:
                       — [middle-left-square] (gain:
0.9183)
                         = 0:
                           – Class 1
                           1:
                            Class 1
                         = 2:
                          — Class 0
                     = 1:
                       - [bottom-right-square] (gain:
0.9710
                            – Class 0
                           — Class 1
                     = 2:
                     ├─ Class 1
                 = 1:
                     [middle-left-square] (gain: 0.9887)
                     = 0:
                       - Class 1
                     = 1:
                        - Class 0
                     ÷ 2:
                      — Class 1
                 = 2:
                   - [bottom-middle-square] (gain: 0.2400)
                     = 0:
                       - [top-left-square] (gain: 1.0000)
                         = 1:
                           — Class 0
                         = 2:
                         ├─ Class 1
                     = 1:
                       — Class 0
                     = 2:
                       — [bottom-right-square] (gain:
0.9710
```

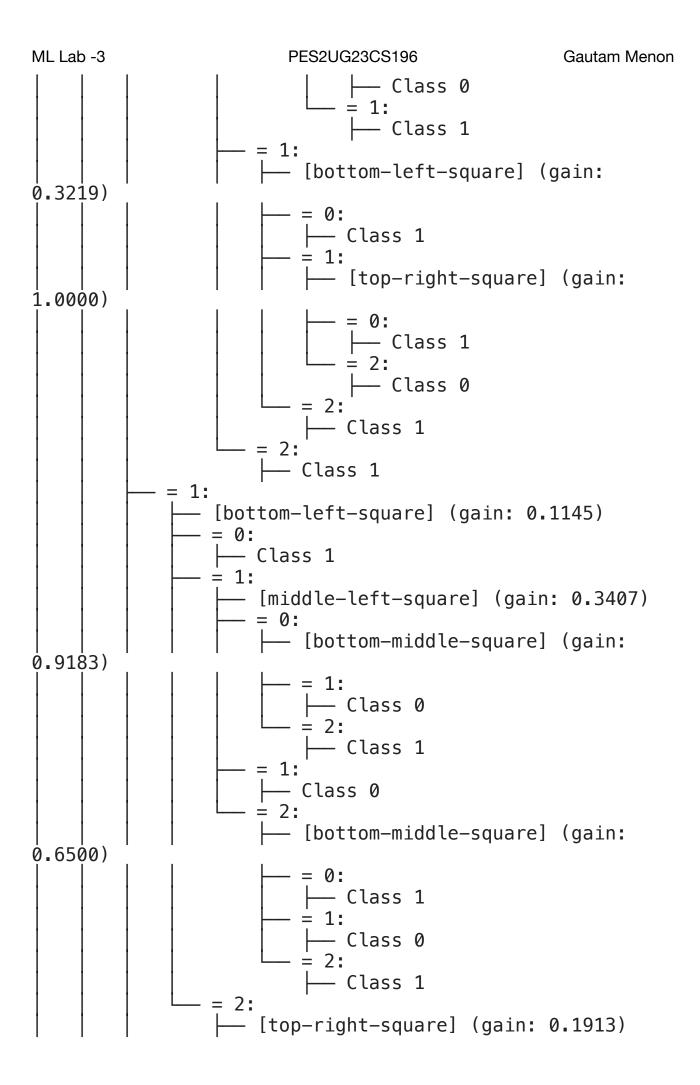


```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                           – Class 1
                         = 2:
                         ├─ Class 0
                     = 2:
                     — Class 1
            = 1:
               - [top-left-square] (gain: 0.5439)
                 = 0:
                   – Class 0
                 = 1:
                   – Class 0
                 = 2:
                   - [top-middle-square] (gain: 0.4687)
                     = 0:
                       — [bottom-middle-square] (gain:
0.9183)
                         = 0:
                           — Class 1
                           1:
                           – Class 0
                        · = 2:
                         — Class 0
                     = 1:
                       - [middle-right-square] (gain:
0.9183)
                         = 0:
                           – Class 1
                         = 1:
                           Class 1
                         = 2:
                          — Class 0
                     = 2:
                     — Class 1
            = 2:
               - [middle-right-square] (gain: 0.4731)
                    - [top-middle-square] (gain: 0.6464)
                     = 0:
                       - Class 1
                     = 1:
                       – Class 0
                       - [top-left-square] (gain: 0.8113)
                           — Class 0
```

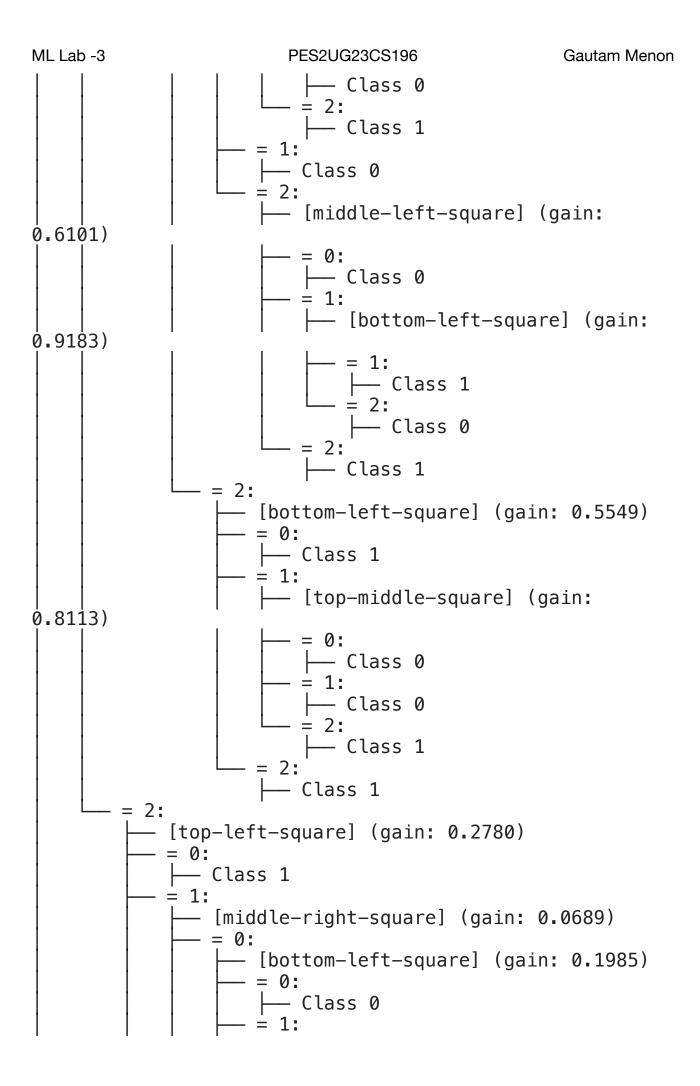
```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                     └── = 2:
                         — Class 1
                = 1:
                   - [middle-left-square] (gain: 0.3995)
                       - [bottom-middle-square] (gain:
0.8113)
                           – Class 1
                         = 1:
                           – Class 0
                           2:
                          — Class 1
                     = 1:
                       Class 0
                     = 2:
                       — [top-middle-square] (gain:
0.8113)
                           – Class 0
                           — Class 1
                = 2:
                 — Class 1
    = 2:
      — [bottom-right-square] (gain: 0.0269)
        = 0:
            [top-left-square] (gain: 0.1239)
            = 0:
               - Class 1
            = 1:
                [bottom-middle-square] (gain: 0.1033)
                   - [middle-left-square] (gain: 0.1605)
                     = 0:
                       — Class 1
                       - [bottom-left-square] (gain:
1.0000)
                           – Class 0
                           — Class 1
```

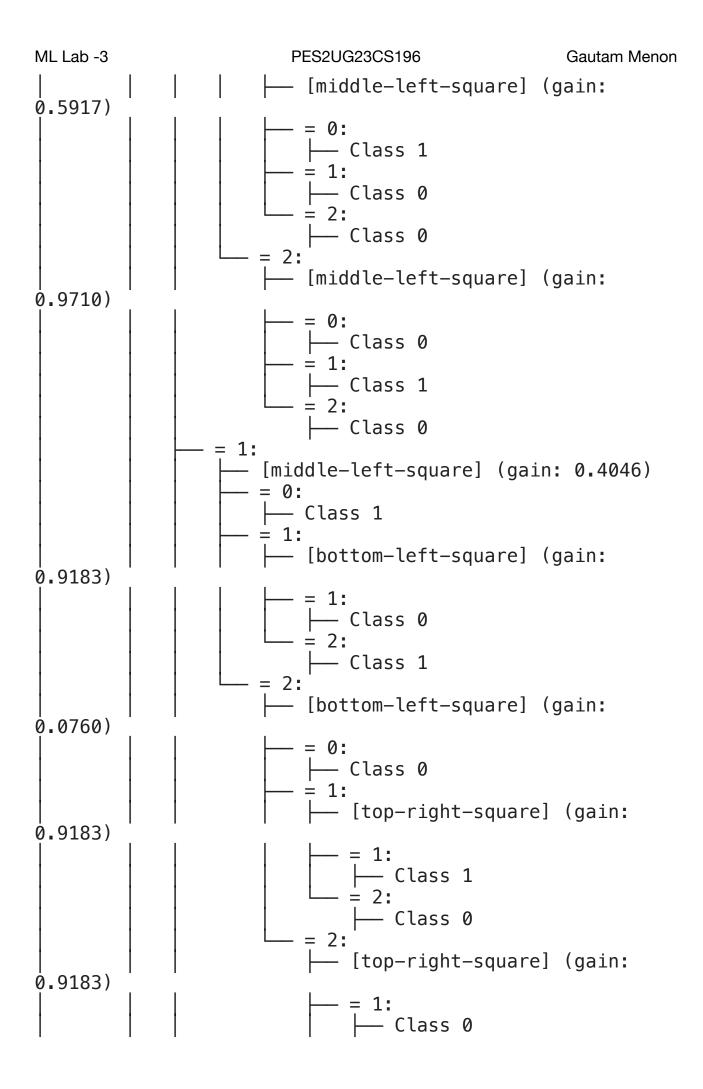


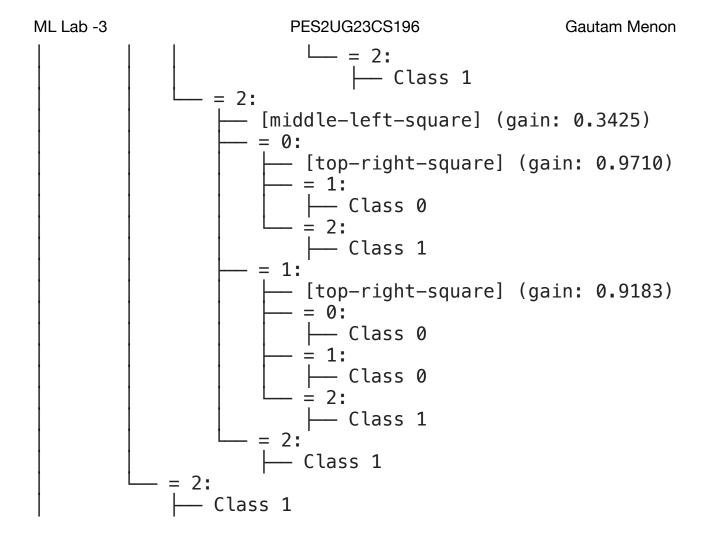




```
ML Lab -3
                        PES2UG23CS196
                                                   Gautam Menon
                       — Class 1
                     = 1:
                        - [top-middle-square] (gain:
0.3774)
                          = 0:
                            – Class 1
                          = 1:
                           — Class 0
                          = 2:
                            - [middle-right-square] (gain:
0.8113)
                              = 0:
                                - Class 1
                              = 1:
                                – Class 0
                              ÷ 2:
                                — Class 1
                     = 2:
                       — Class 1
            = 2:
               - [top-right-square] (gain: 0.0822)
                     [bottom-left-square] (gain: 0.3436)
                     = 0:
                       - Class 1
                         [bottom-middle-square] (gain:
0.9852)
                          = 0:
                            - Class 1
                            1:
                            – Class 0
                          = 2:
                            - Class 1
                     = 2:
                       — Class 1
                 = 1:
                   - [middle-right-square] (gain: 0.4301)
                        - [bottom-middle-square] (gain:
0.9183)
                            - Class 1
```







OVERALL PERFORMANCE METRICS

Accuracy: 0.8730 (87.30%)

Precision (weighted): 0.8741
Recall (weighted): 0.8730
F1-Score (weighted): 0.8734
Precision (macro): 0.8590
Recall (macro): 0.8638
F1-Score (macro): 0.8613

TREE COMPLEXITY METRICS

Maximum Depth: 7
Total Nodes: 281
Leaf Nodes: 180
Internal Nodes: 101

Running tests with PYTORCH framework

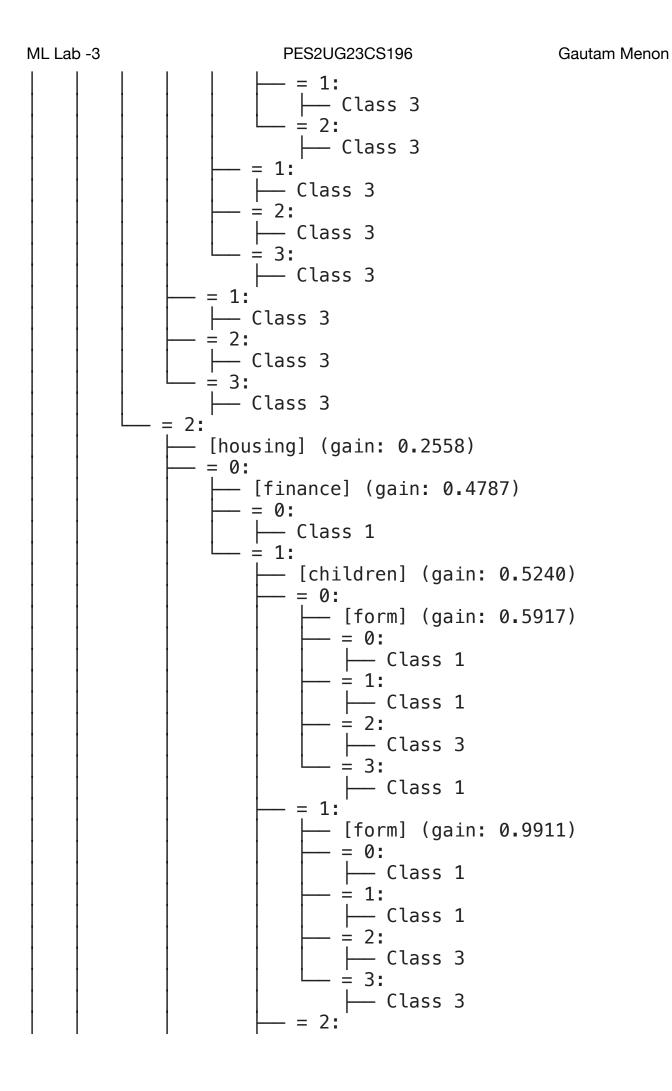
===

target column: 'class' (last column)

```
Original dataset info:
Shape: (12960, 9)
Columns: ['parents', 'has_nurs', 'form', 'children',
'housing', 'finance', 'social', 'health', 'class']
First few rows:
parents: ['usual' 'pretentious' 'great_pret'] -> [2 1 0]
has_nurs: ['proper' 'less_proper' 'improper' 'critical'
'very crit'] -> [3 2 1 0 4]
form: ['complete' 'completed' 'incomplete' 'foster'] ->
[0 1 3 2]
class: ['recommend' 'priority' 'not recom' 'very recom'
'spec_prior'] -> [2 1 0 4 3]
Processed dataset shape: torch.Size([12960, 9])
Number of features: 8
Features: ['parents', 'has_nurs', 'form', 'children',
'housing', 'finance', 'social', 'health']
Target: class
Framework: PYTORCH
Data type: <class 'torch.Tensor'>
===
DECISION TREE CONSTRUCTION DEMO
______
Total samples: 12960
Training samples: 10368
Testing samples: 2592
Constructing decision tree using training data...
Decision tree construction completed using PYTORCH!
DECISION TREE STRUCTURE
Root [health] (gain: 0.9595)
```

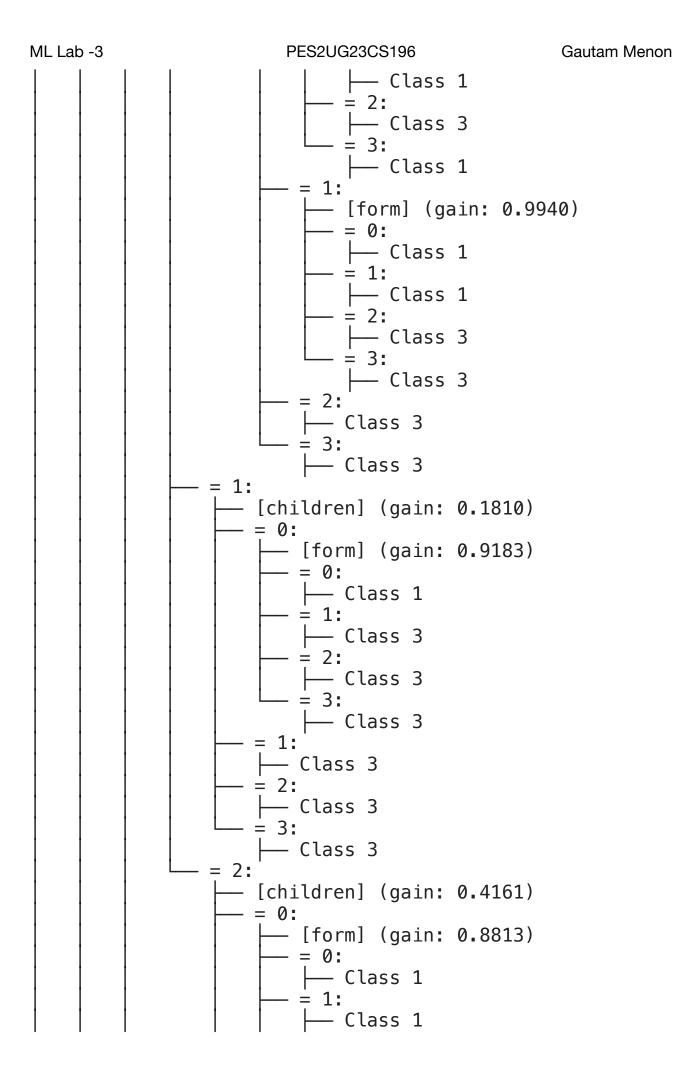
├── = 0:

```
— Class 0
= 1:
  - [has_nurs] (gain: 0.3555)
    = 0:
      — [parents] (gain: 0.1673)
       - = 0:
           - [form] (gain: 0.0171)
               - [children] (gain: 0.0662)
                 = 0:
                   - [housing] (gain: 0.2401)
                         [finance] (gain: 0.9710)
                         = 0:
                            - Class 1
                         = 1:
                           — Class 3
                     = 1:
                      — Class 3
                     = 2:
                     — Class 3
                 = 1:
                   - Class 3
                 = 2:
                   - Class 3
                 = 3:
                 ├─ Class 3
            = 1:
               - Class 3
            = 2:
              — Class 3
            = 3:
             — Class 3
        = 1:
           - [form] (gain: 0.0269)
            = 0:
               - [children] (gain: 0.1080)
                 = 0:
                   - [housing] (gain: 0.3219)
                       - [finance] (gain: 1.0000)
                        - = 0:
                           – Class 1
                         = 1:
                           — Class 3
```

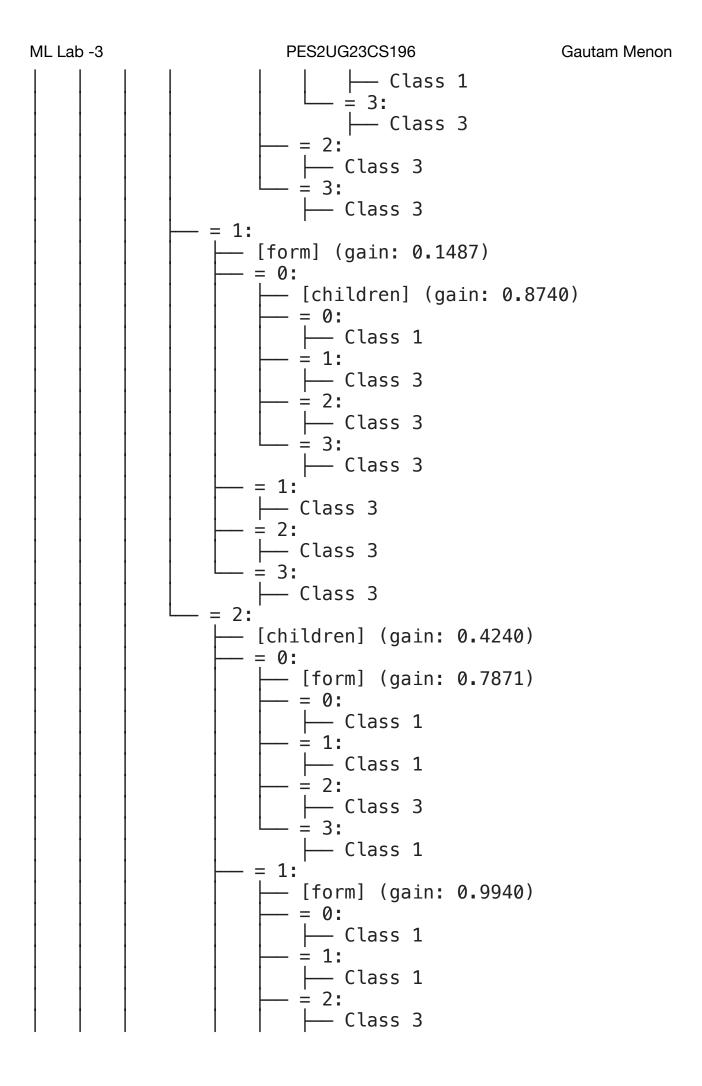


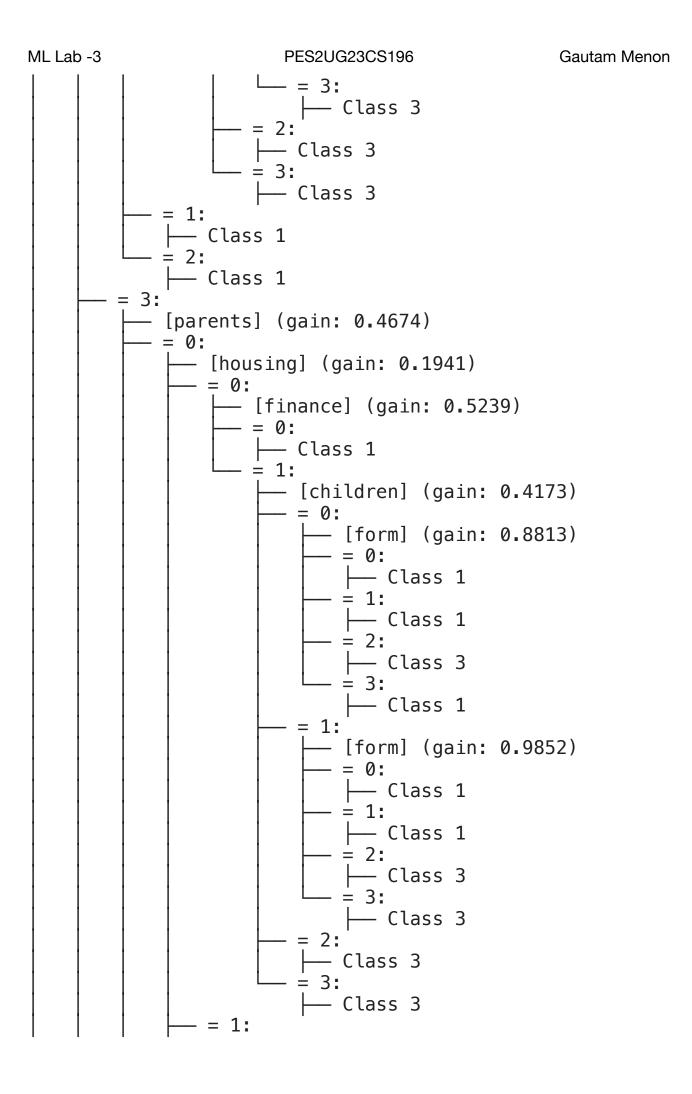
```
ML Lab -3
                        PES2UG23CS196
                                                   Gautam Menon
                          — Class 3
                         = 3:
                          — Class 3
                = 1:
                   — [children] (gain: 0.1214)
                     = 0:
                        - [form] (gain: 0.7871)
                         = 0:
                          — Class 1
                          — Class 3
                          <u>-</u> 2:
                          ├─ Class 3
                        - <del>-</del> 3:
                          — Class 3
                     = 1:
                       — Class 3
                     <u>-</u> 2:
                       — Class 3
                     = 3:
                      — Class 3
                 = 2:
                    - [children] (gain: 0.4000)
                     = 0:
                        - [form] (gain: 0.8740)
                          = 0:
                          ├─ Class 1
                         — Class 1
                          = 2:
                          — Class 3
                        - = 3:
                          — Class 1
                     = 1:
                        - [form] (gain: 0.9911)
                          = 0:
                            — Class 1
                          = 1:
                           — Class 1
                          = 2:
                        ├— Class 3
- = 3:
                          — Class 3
                     = 2:
                       — Class 3
```

```
ML Lab -3
                        PES2UG23CS196
                                                   Gautam Menon
                 L— = 3:
                     — Class 3
        = 1:
          - [parents] (gain: 0.6347)
            = 0:
               - [form] (gain: 0.0262)
                 = 0:
                   — [children] (gain: 0.1127)
                     = 0:
                       — [housing] (gain: 0.3210)
                         = 0:
                           — [finance] (gain: 1.0000)
                             \cdot = 0:
                                 - Class 1
                              = 1:
                              ├─ Class 3
                          = 1:
                            – Class 3
                          = 2:
                          ├─ Class 3
                     = 1:
                        - Class 3
                     = 2:
                       — Class 3
                     ÷ 3:
                      — Class 3
                 = 1:
                    – Class 3
                 = 2:
                   - Class 3
                 = 3:
                 — Class 3
             = 1:
               - [housing] (gain: 0.1945)
                 = 0:
                   — [finance] (gain: 0.4975)
                    = 0:
                       — Class 1
                     = 1:
                        - [children] (gain: 0.4013)
                         \cdot = 0:
                            - [form] (gain: 0.9183)
                              = 0:
                                 - Class 1
                              = 1:
```



```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                         = 2:
                          — Class 3
                         ÷ 3:
                          — Class 1
                     = 1:
                         [form] (gain: 0.9940)
                         = 0:
                          ├─ Class 1
                         = 1:
                           — Class 1
                         ÷ 2:
                          ├─ Class 3
                         = 3:
                          — Class 3
                     = 2:
                       — Class 3
                     = 3:
                       — Class 3
           - = 2:
             — Class 1
        = 2:
          — [parents] (gain: 0.4605)
            = 0:
              — [housing] (gain: 0.2382)
                 = 0:
                   — [finance] (gain: 0.4152)
                    \cdot = 0:
                        - Class 1
                     = 1:
                        - [children] (gain: 0.5697)
                         = 0:
                            — [form] (gain: 0.7219)
                              = 0:
                                - Class 1
                              = 1:
                                – Class 1
                              = 2:
                              — Class 3
                            - = 3:
                              ├─ Class 1
                         = 1:
                            - [form] (gain: 0.8631)
                              = 0:
                                - Class 1
                              = 1:
```

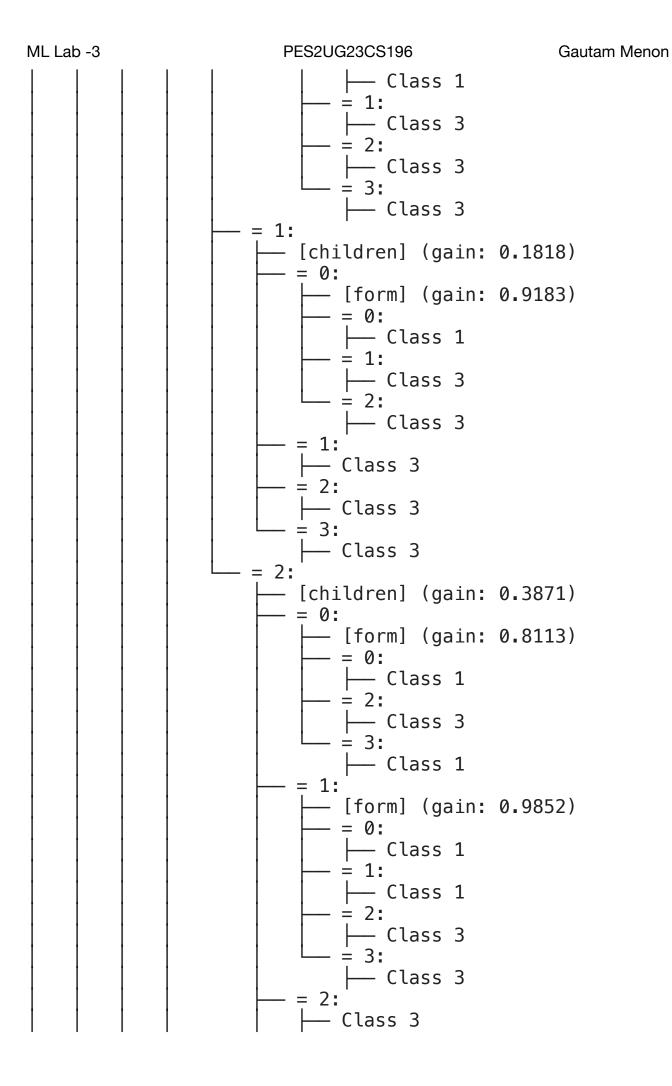




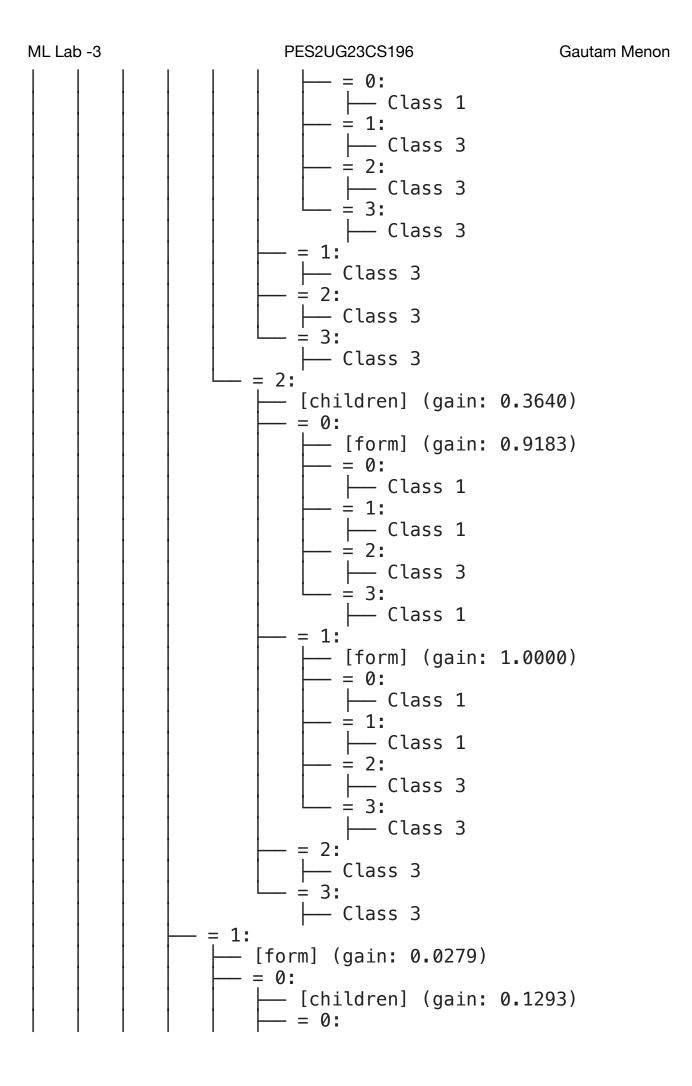
```
PES2UG23CS196
ML Lab -3
                                                    Gautam Menon
                     [form] (gain: 0.1462)
                      = 0:
                        - [children] (gain: 0.8524)
                          = 0:
                            — Class 1
                          = 1:
                            – Class 3
                          = 2:
                            — Class 3
                          = 3:
                          — Class 3
                      = 1:
                        – Class 3
                      = 2:
                        - Class 3
                      = 3:
                      — Class 3
                 = 2:
                   — [children] (gain: 0.3591)
                     = 0:
                        - [form] (gain: 0.9183)
                          = 0:
                            — Class 1
                          = 1:
                            — Class 1
                          ÷ 2:
                          ├─ Class 3
                         - <del>-</del> 3:
                          — Class 1
                      = 1:
                        - [form] (gain: 0.9940)
                         = 0:
                           — Class 1
                          = 1:
                             - Class 1
                          = 2:
                            — Class 3
                          ÷ 3:
                           — Class 3
                      = 2:
                        – Class 3
                    - = 3:
                        — Class 3
               — Class 1
```

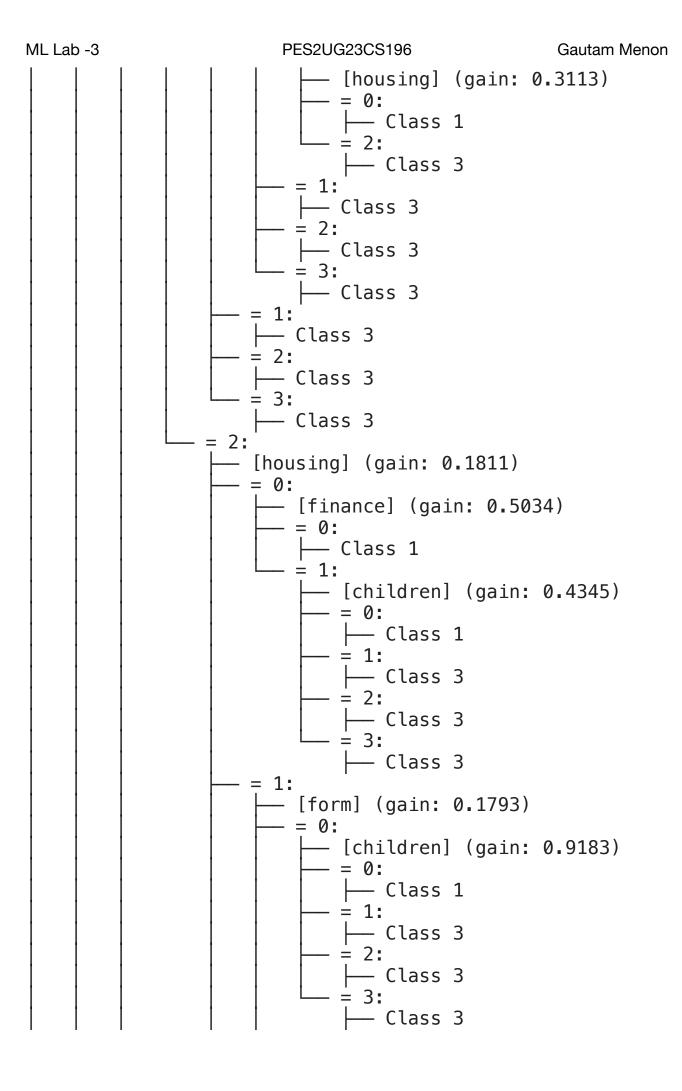
= 1:

- [children] (gain: 0.2536)

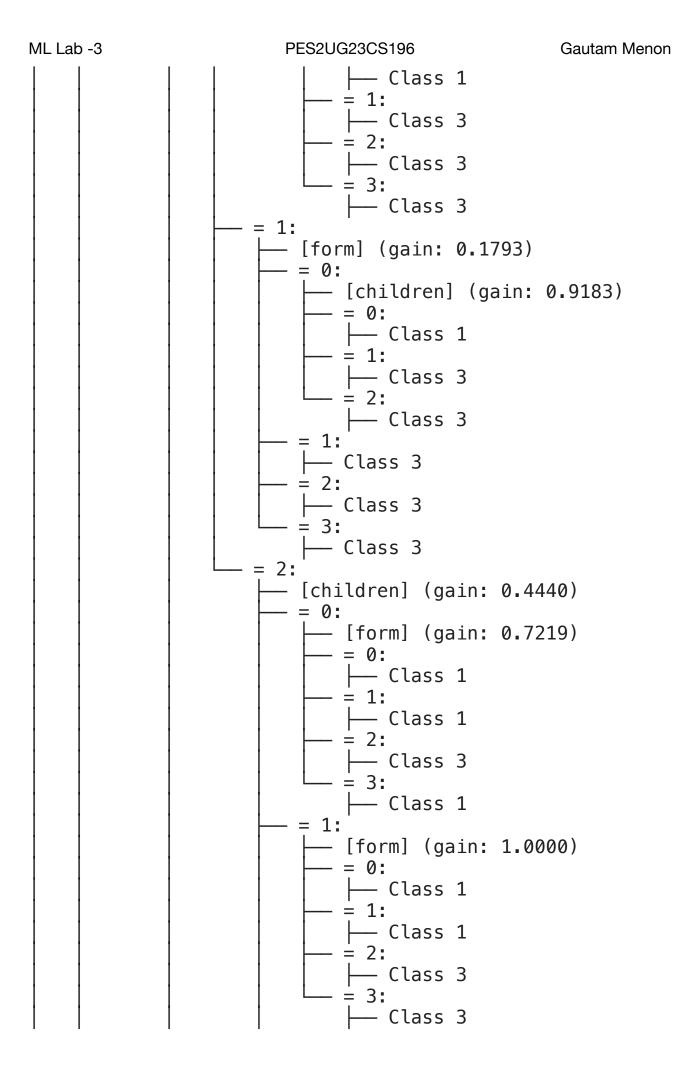


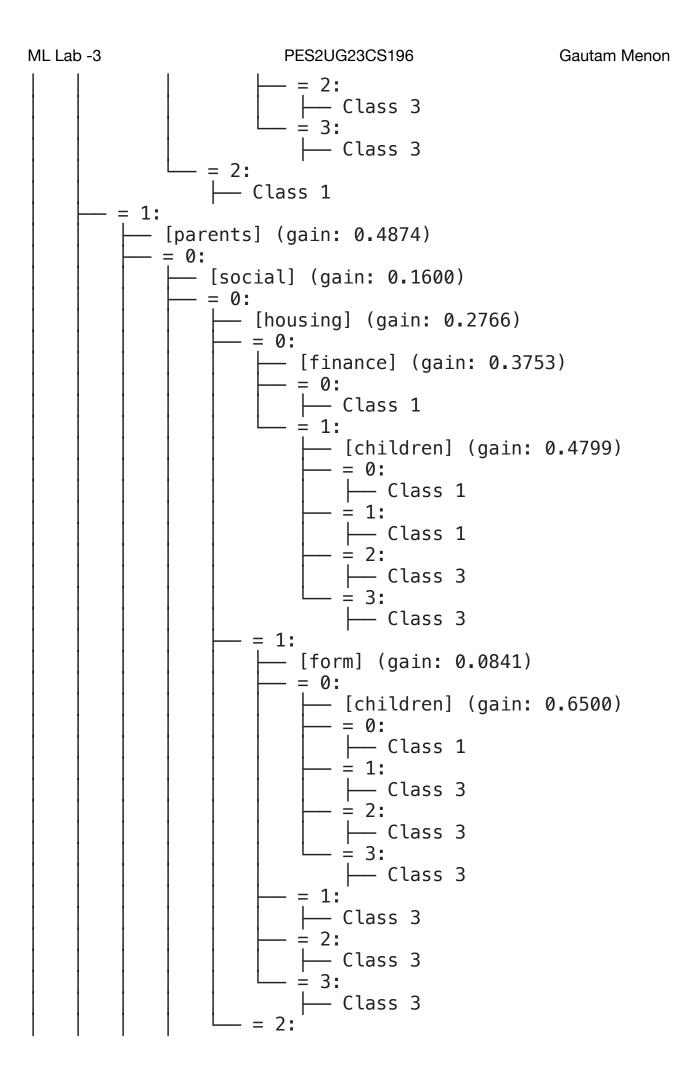
```
ML Lab -3
                        PES2UG23CS196
                                                 Gautam Menon
                         [children] (gain: 0.4667)
                         = 0:
                           - [form] (gain: 0.9183)
                             = 1:
                               — Class 1
                             = 2:
                               — Class 3
                             = 3:
                             — Class 1
                         = 1:
                           - [form] (gain: 0.9183)
                             = 0:
                             ├─ Class 1
                             = 1:
                               – Class 1
                             = 2:
                               — Class 3
                            ÷ 3:
                             ├─ Class 3
                         = 2:
                          — Class 3
                         ÷ 3:
                         — Class 3
           - = 1:
              - [social] (gain: 0.1315)
                = 0:
                  — [housing] (gain: 0.1639)
                    = 0:
                       — [finance] (gain: 0.5716)
                         = 0:
                          — Class 1
                         = 1:
                           - [children] (gain: 0.3178)
                            = 0:
                               – Class 1
                             = 1:
                               – Class 1
                             = 2:
                             — Class 3
                             = 3:
                             — Class 3
                   - = 1:
                       - [form] (gain: 0.1842)
                           - [children] (gain: 0.9183)
```

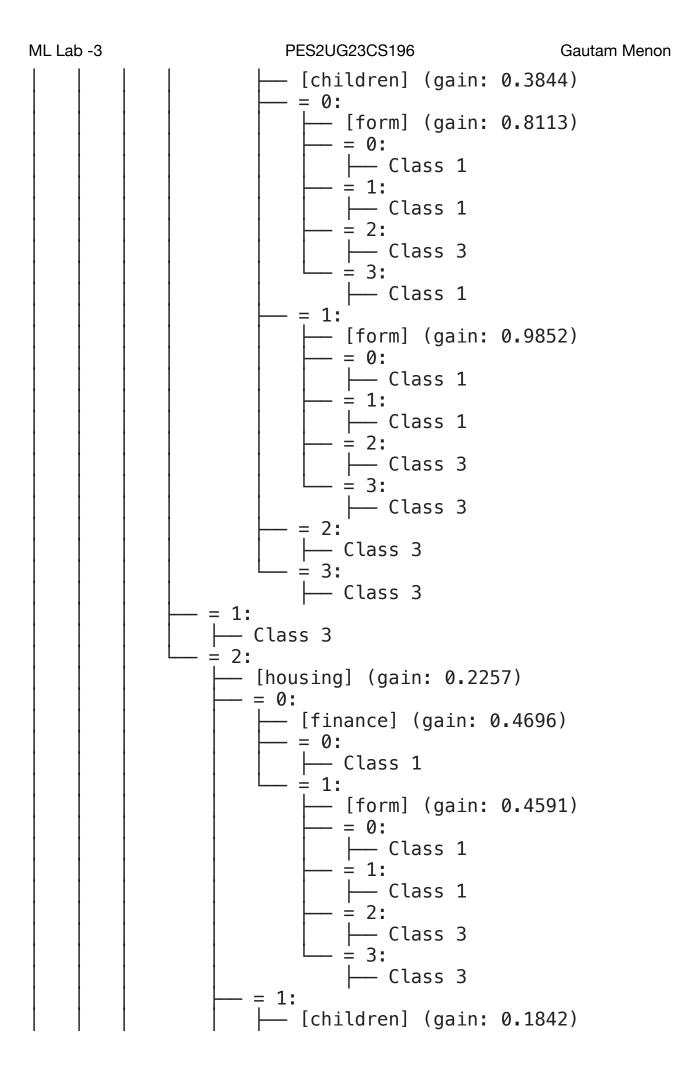




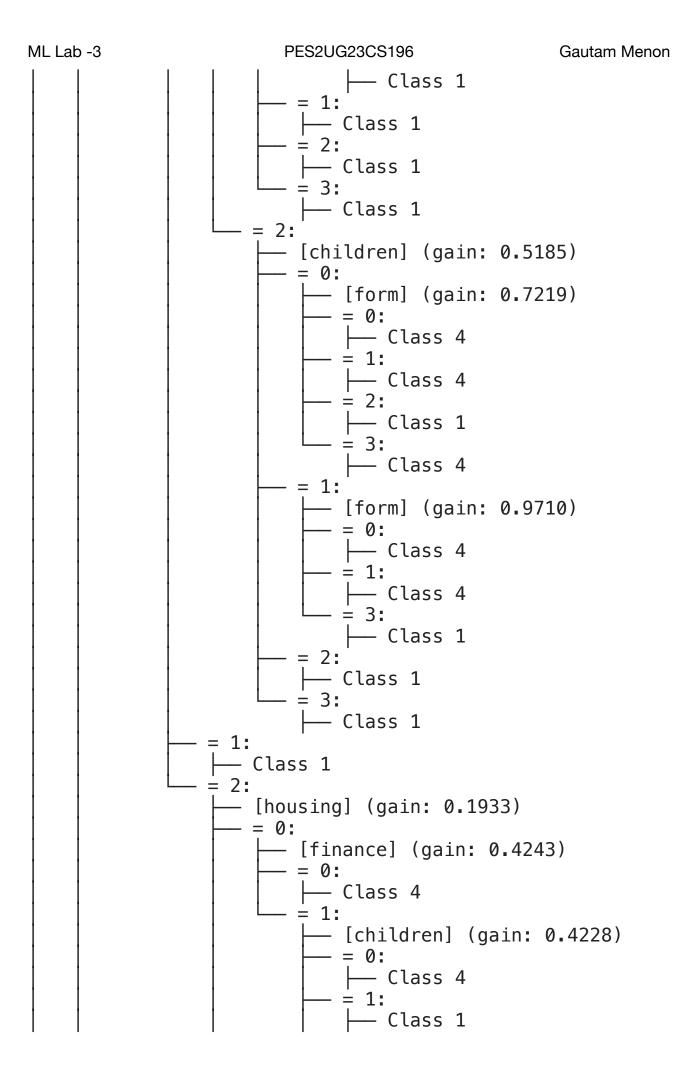
```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                         = 1:
                           — Class 3
                         ÷ 2:
                           — Class 3
                         = 3:
                         — Class 3
                     = 2:
                       - [children] (gain: 0.5445)
                         = 0:
                           — [form] (gain: 0.5917)
                            = 0:
                              — Class 1
                             = 1:
                               - Class 1
                             = 2:
                             — Class 3
                             ÷ 3:
                             — Class 1
                         = 1:
                            - [form] (gain: 0.9710)
                             = 0:
                               — Class 1
                             = 1:
                               — Class 1
                             ÷ 2:
                              — Class 3
                             = 3:
                             — Class 3
                         = 2:
                           — Class 3
                         ÷ 3:
                          — Class 3
            = 2:
              - [social] (gain: 0.4394)
               - = 0:
                  — Class 1
                = 1:
                   - [housing] (gain: 0.2023)
                   - = 0:
                       — [finance] (gain: 0.4895)
                        - = 0:
                         ├─ Class 1
                         = 1:
                           - [children] (gain: 0.4290)
                            - = 0:
```



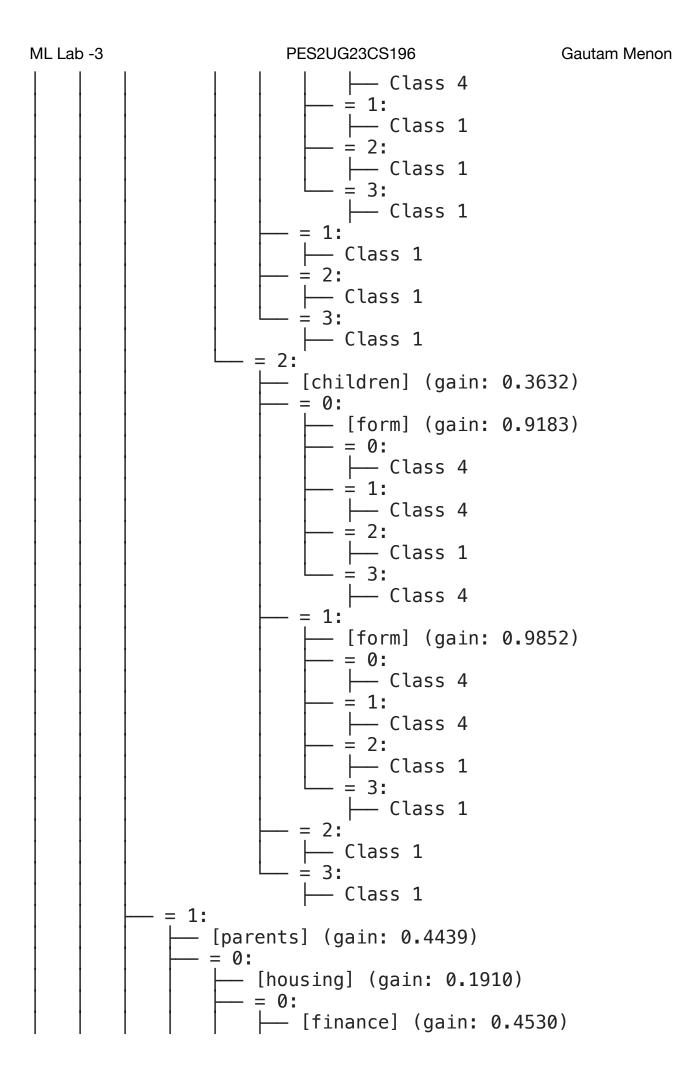


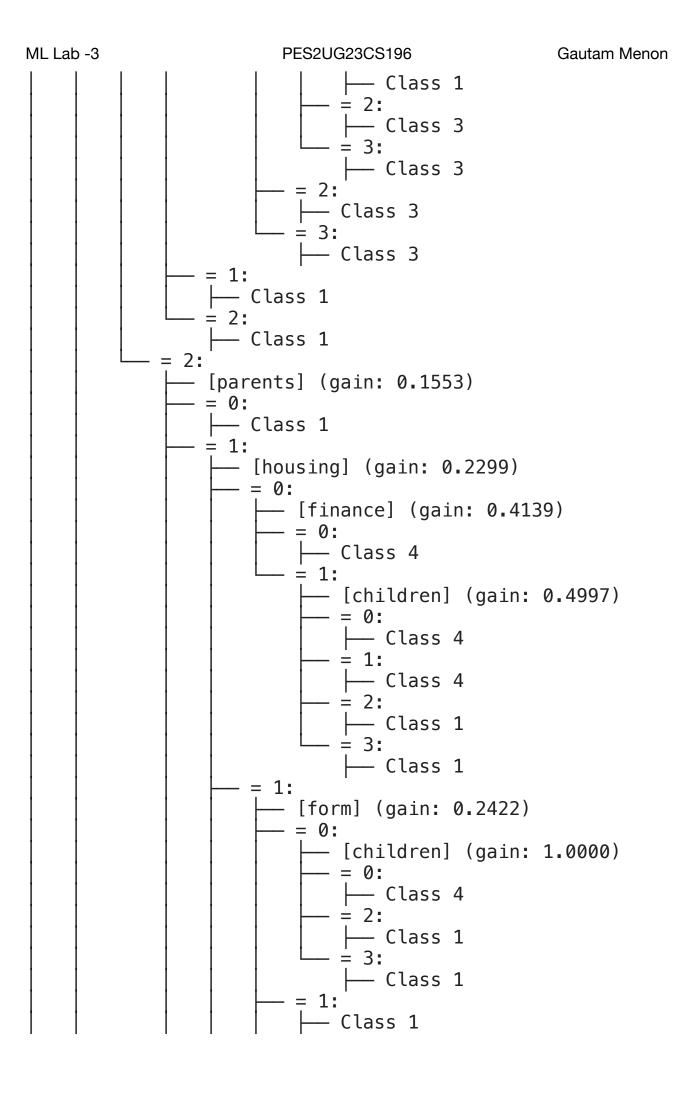


```
ML Lab -3
                       PES2UG23CS196
                                                 Gautam Menon
                        = 1:
                           - [form] (gain: 0.9183)
                             = 0:
                               – Class 1
                             Class 1
                             = 2:
                               - Class 3
                           - = 3:
                             — Class 3
                        = 2:
                         ├─ Class 3
                        = 3:
                          — Class 3
                = 2:
                — Class 1
            = 2:
              — [social] (gain: 0.1579)
                = 0:
                  - [housing] (gain: 0.1963)
                    = 0:
                      — [finance] (gain: 0.4934)
                        = 0:
                          — Class 4
                        - [form] (gain: 0.6058)
                           - = 0:
                               - Class 4
                             = 1:
                               — Class 4
                            ÷ 2:
                             ├─ Class 1
                            = 3:
                             — Class 1
                    = 1:
                      — [form] (gain: 0.1555)
                        = 0:
                           - [children] (gain: 0.8631)
                            = 0:
                              — Class 4
                            = 1:
                               – Class 1
                             = 2:
                               — Class 1
                             = 3:
```

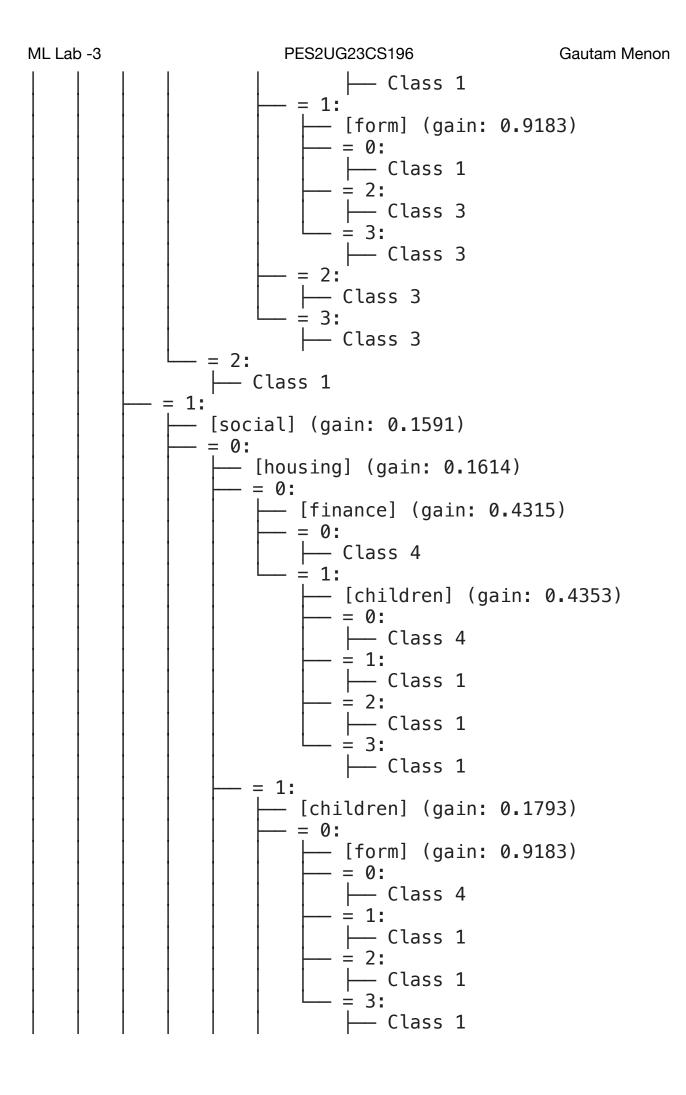


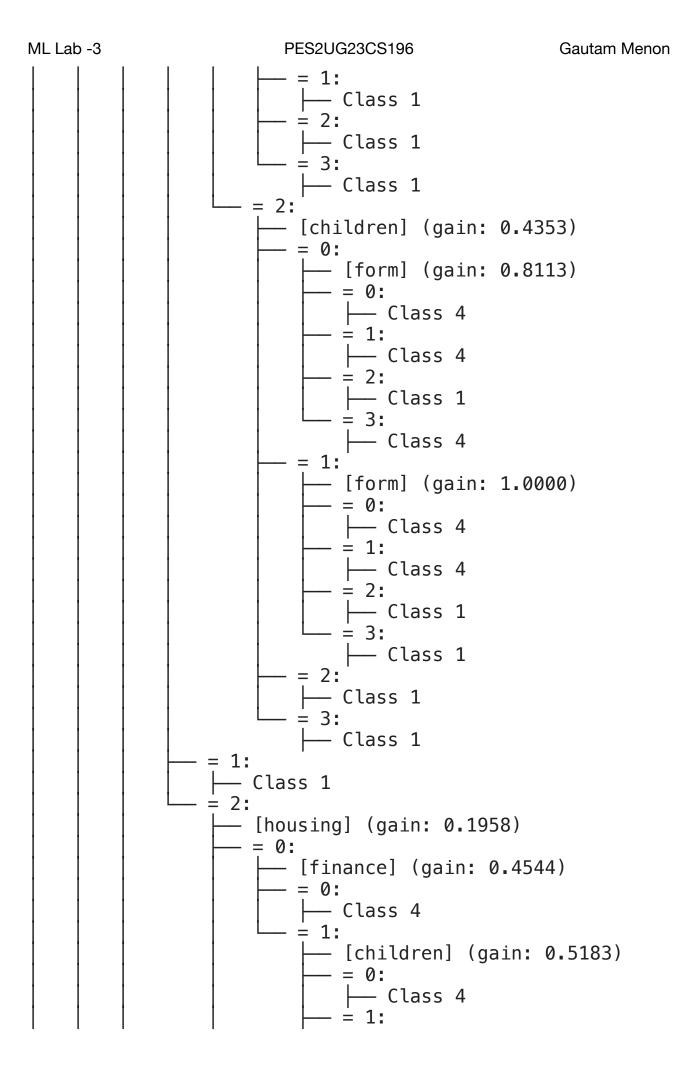
```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                           — Class 1
                        = 3:
                         — Class 1
        = 2:
         — [social] (gain: 0.1983)
            = 0:
               - [parents] (gain: 0.1465)
                = 0:
                   – Class 1
                = 1:
                   - [housing] (gain: 0.2147)
                     = 0:
                        [finance] (gain: 0.4408)
                         = 0:
                           — Class 4
                         = 1:
                           — [children] (gain: 0.4353)
                            = 0:
                             ├─ Class 4
                             = 1:
                               – Class 1
                             = 2:
                               — Class 1
                             = 3:
                             — Class 1
                     = 1:
                       - [form] (gain: 0.0948)
                        = 0:
                           - [children] (gain: 0.7219)
                             = 0:
                               — Class 4
                             = 1:
                               — Class 1
                             = 2:
                               Class 1
                             = 3:
                             ├─ Class 1
                         = 1:
                           – Class 1
                         = 2:
                           – Class 1
                        - = 3:
                          — Class 1
                     = 2:
                      — [children] (gain: 0.4054)
```

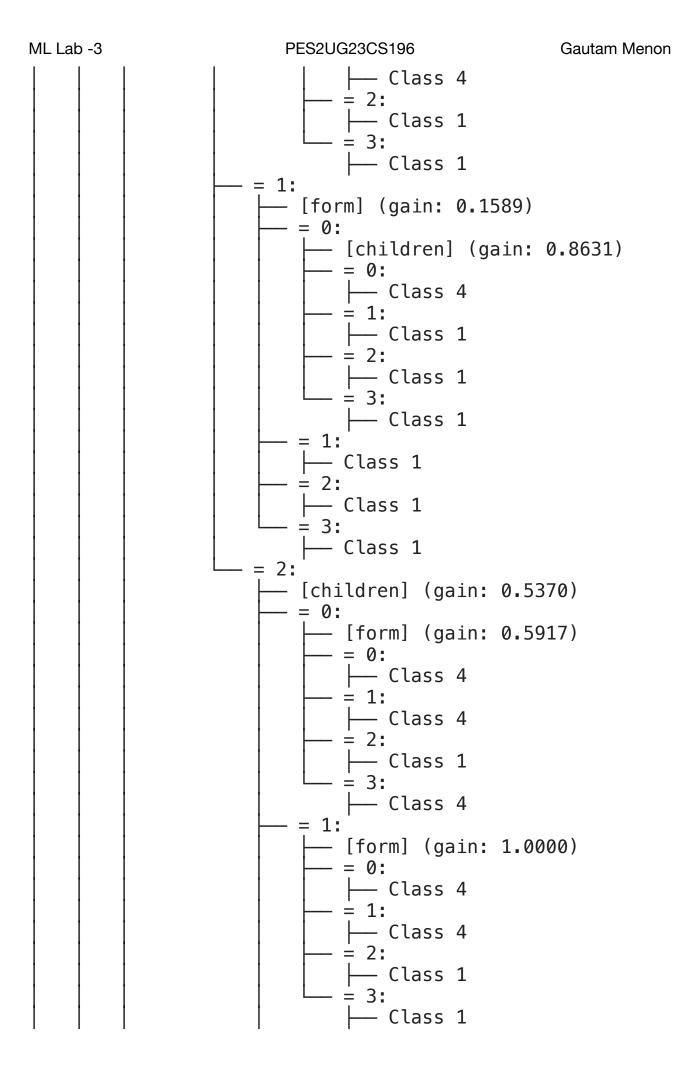


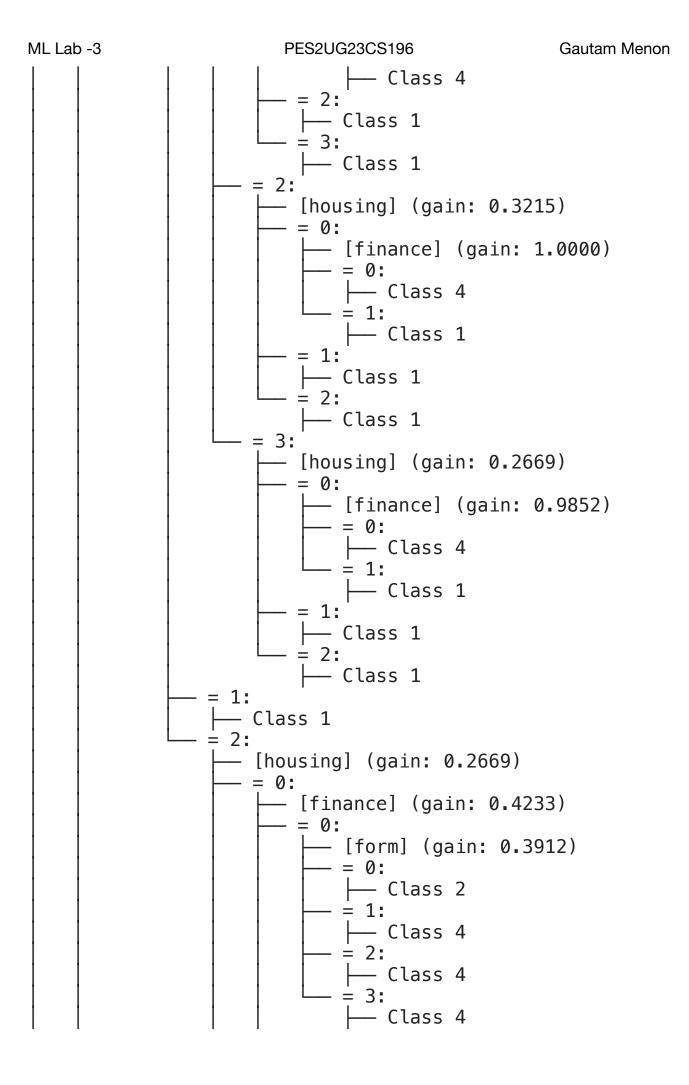


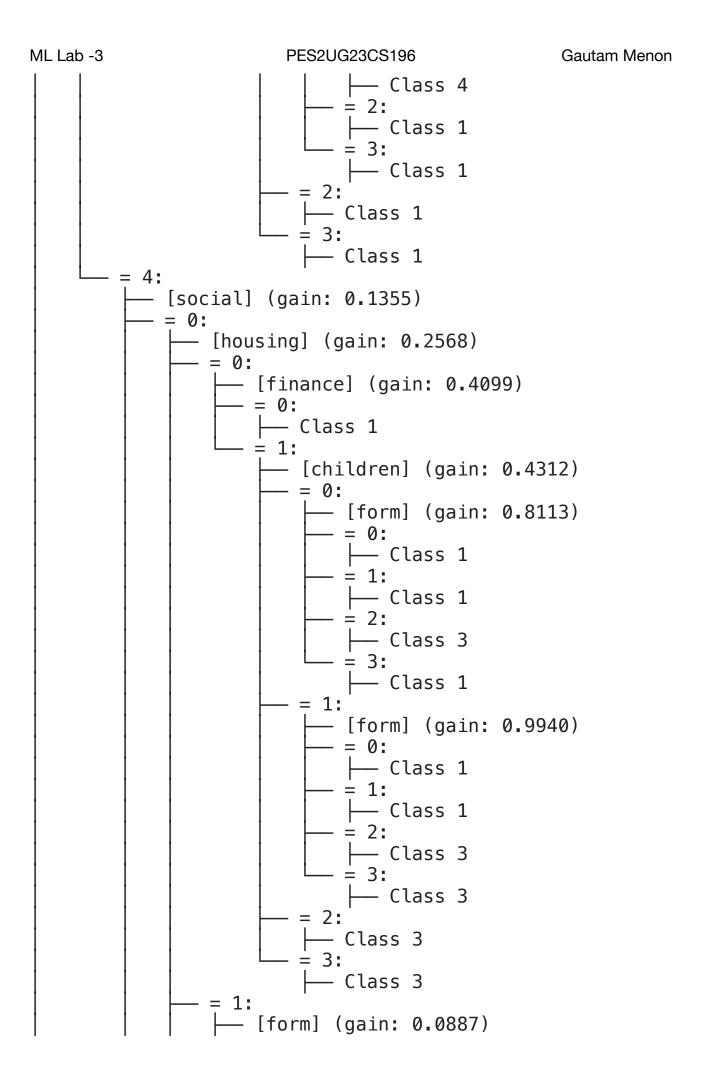
```
ML Lab -3
                        PES2UG23CS196
                                                  Gautam Menon
                         [form] (gain: 0.1555)
                         = 0:
                           - [children] (gain: 0.8631)
                             = 0:
                               — Class 4
                             = 1:
                               — Class 1
                             = 2:
                               — Class 1
                             ÷ 3:
                             — Class 1
                         = 1:
                           Class 1
                         ÷ 2:
                           – Class 1
                         = 3:
                         — Class 1
                     = 2:
                       — [children] (gain: 0.4323)
                         = 0:
                           - [form] (gain: 0.8113)
                             = 0:
                               – Class 4
                             = 1:
                               — Class 4
                             ÷ 2:
                             ├─ Class 1
                            - = 3:
                             — Class 4
                         = 1:
                           — [form] (gain: 0.9183)
                            - = 0:
                              ├── Class 4
                             = 2:
                               - Class 1
                             = 3:
                             ├─ Class 1
                         = 2:
                           — Class 1
                         = 3:
                          — Class 1
       - = 3:
          — [parents] (gain: 0.2121)
              — [social] (gain: 0.4863)
```

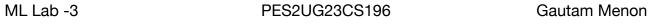


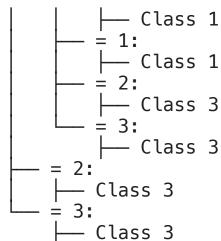












OVERALL PERFORMANCE METRICS

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: 952
Leaf Nodes: 680
Internal Nodes: 272