**5. Supervised Learning Algorithms - Decision Trees:** Implement decision trees considering a data

set of your choice.

1. Create an ID3 Decision Tree. Write the inference
2. Hardcode the Entropy and Information Gain calculation.

**(OR)**

Handcode the Gini Index Calculation.

1. Do not use a pre-defined sklearn library for (b) or (c ) above.
2. Separate out the predicting and predictor attributes.
3. Print the values of Entropy and Information Gain at each step.

**(OR)**

Print the values of Gini Index at each step.

1. Be verbose and print out the count of occurrence of predictor attributes at each step.

**OUTPUT & ANALYSIS**

**Entropy of given PlayTennis Data Set: 0.9402859586706309**

**Info-gain for Outlook is :0.2467498197744391**

**Info-gain for Humidity is: 0.15183550136234136**

**Info-gain for Wind is:0.04812703040826927**

**Info-gain for Temperature is:0.029222565658954647**

**List of Attributes:['id', 'outlook', 'temperature', 'humidity', 'wind', 'play']**

**Predicting Attributes:['outlook', 'temperature', 'humidity', 'wind']**

**The Resultant Decision Tree is :**

**{'outlook': {'overcast': 'yes',**

**'rainy': {'wind': {'strong': 'no', 'weak': 'yes'}},**

**'sunny': {'humidity': {'high': 'no', 'normal': 'yes'}}}}**

**DETAILED OUTPUT IS:**

**ATTRIBUTE outlook , VALUE overcast**

id outlook temperature humidity wind play

2 3 overcast hot high weak yes

6 7 overcast cool normal strong yes

11 12 overcast mild high strong yes

12 13 overcast hot normal weak yes

No and Yes Classes: play Counter({'yes': 4})

No and Yes Classes: play Counter({'yes': 3, 'no': 2})

No and Yes Classes: play Counter({'no': 3, 'yes': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**ATTRIBUTE outlook , VALUE rainy**

id outlook temperature humidity wind play

3 4 rainy mild high weak yes

4 5 rainy cool normal weak yes

5 6 rainy cool normal strong no

9 10 rainy mild normal weak yes

13 14 rainy mild high strong no

No and Yes Classes: play Counter({'yes': 4})

No and Yes Classes: play Counter({'yes': 3, 'no': 2})

No and Yes Classes: play Counter({'no': 3, 'yes': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**ATTRIBUTE outlook , VALUE sunny**

id outlook temperature humidity wind play

0 1 sunny hot high weak no

1 2 sunny hot high strong no

7 8 sunny mild high weak no

8 9 sunny cool normal weak yes

10 11 sunny mild normal strong yes

No and Yes Classes: play Counter({'yes': 4})

No and Yes Classes: play Counter({'yes': 3, 'no': 2})

No and Yes Classes: play Counter({'no': 3, 'yes': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**Info-gain for Outlook is :0.2467498197744391**

**ATTRIBUTE humidity , VALUE high**

id outlook temperature humidity wind play

0 1 sunny hot high weak no

1 2 sunny hot high strong no

2 3 overcast hot high weak yes

3 4 rainy mild high weak yes

7 8 sunny mild high weak no

11 12 overcast mild high strong yes

13 14 rainy mild high strong no

No and Yes Classes: play Counter({'no': 4, 'yes': 3})

No and Yes Classes: play Counter({'yes': 6, 'no': 1})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**ATTRIBUTE humidity , VALUE normal**

id outlook temperature humidity wind play

4 5 rainy cool normal weak yes

5 6 rainy cool normal strong no

6 7 overcast cool normal strong yes

8 9 sunny cool normal weak yes

9 10 rainy mild normal weak yes

10 11 sunny mild normal strong yes

12 13 overcast hot normal weak yes

No and Yes Classes: play Counter({'no': 4, 'yes': 3})

No and Yes Classes: play Counter({'yes': 6, 'no': 1})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**Info-gain for Humidity is: 0.15183550136234136**

**ATTRIBUTE Wind , VALUE strong**

id outlook temperature humidity wind play

1 2 sunny hot high strong no

5 6 rainy cool normal strong no

6 7 overcast cool normal strong yes

10 11 sunny mild normal strong yes

11 12 overcast mild high strong yes

13 14 rainy mild high strong no

No and Yes Classes: play Counter({'no': 3, 'yes': 3})

No and Yes Classes: play Counter({'yes': 6, 'no': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**ATTRIBUTE Wind , VALUE weak**

id outlook temperature humidity wind play

0 1 sunny hot high weak no

2 3 overcast hot high weak yes

3 4 rainy mild high weak yes

4 5 rainy cool normal weak yes

7 8 sunny mild high weak no

8 9 sunny cool normal weak yes

9 10 rainy mild normal weak yes

12 13 overcast hot normal weak yes

No and Yes Classes: play Counter({'no': 3, 'yes': 3})

No and Yes Classes: play Counter({'yes': 6, 'no': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**Info-gain for Wind is:0.04812703040826927**

**ATTRIBUTE Temperature , VALUE cool**

id outlook temperature humidity wind play

4 5 rainy cool normal weak yes

5 6 rainy cool normal strong no

6 7 overcast cool normal strong yes

8 9 sunny cool normal weak yes

No and Yes Classes: play Counter({'yes': 3, 'no': 1})

No and Yes Classes: play Counter({'no': 2, 'yes': 2})

No and Yes Classes: play Counter({'yes': 4, 'no': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**ATTRIBUTE Temperature , VALUE hot**

id outlook temperature humidity wind play

0 1 sunny hot high weak no

1 2 sunny hot high strong no

2 3 overcast hot high weak yes

12 13 overcast hot normal weak yes

No and Yes Classes: play Counter({'yes': 3, 'no': 1})

No and Yes Classes: play Counter({'no': 2, 'yes': 2})

No and Yes Classes: play Counter({'yes': 4, 'no': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**ATTRIBUTE Temperature , VALUE mild**

id outlook temperature humidity wind play

3 4 rainy mild high weak yes

7 8 sunny mild high weak no

9 10 rainy mild normal weak yes

10 11 sunny mild normal strong yes

11 12 overcast mild high strong yes

13 14 rainy mild high strong no

No and Yes Classes: play Counter({'yes': 3, 'no': 1})

No and Yes Classes: play Counter({'no': 2, 'yes': 2})

No and Yes Classes: play Counter({'yes': 4, 'no': 2})

No and Yes Classes: play Counter({'yes': 9, 'no': 5})

**Info-gain for Temperature is:0.029222565658954647**

**The Resultant Decision Tree is :**

**{'outlook': {'overcast': 'yes',**

**'rainy': {'wind': {'strong': 'no', 'weak': 'yes'}},**

**'sunny': {'humidity': {'high': 'no', 'normal': 'yes'}}}}**