COMSATS UNIVERSITY ISLAMABAD, ABBOTTABAD

Artificial Intelligence

Assignment # 02

Submitted by:

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Submitted to:

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(AI Class Assignment 2)

Q no 1.

Day	Outlook	Temp.	Humidity	Wind	Decision
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

Gini Index For Given Data

Step #01

Gini index for entire dataset

9 instances of 'Yes'

5 instances of 'NO'

$$Gini(D) = 1 - \left(\left(\frac{9}{14}\right)^2 + \left(\frac{5}{14}\right)^2\right)$$

$$= 1 - 0.54$$

$$= 0.46$$

Step #02

Gini index of each attribute

2.1 Outlook	Yes	No
◦ Sunny	2	3
◦ overcast	4	0
◦ Rainy	3	2

$$Gini(Sunny) = 1 - \left(\left(\frac{2}{5}\right)^2 + \left(\frac{3}{5}\right)^2\right)$$

$$= 0.48$$

$$Gini(overcast) = 1 - ((4/4)^2 - 0)$$

$$= 0.$$

$$Gini(Rain) = 1 - ((3/5)^2 + (2/5)^2)$$

$$= 0.48$$

Weighted Gini for outlook

$$= 5/14\,(0.48) + 4/14\,(0) + 5/14\,(0.48)$$

$$= 0.171 + 0 + 0.171$$

Gini(overcast) = 0.3428. ——— *

2.2 Temperature

	Yes	NO
○ Hot	2	2
○ Cool	3	1
○ Mild	4	2

$$Gini(hot) = 1 - ((2/4)^2 + (2/4)^2)$$

$$= 0.5$$

$$Gini(cool) = 1 - ((3/4)^2 + (1/4)^2)$$

$$= 0.37$$

Gini (Mild) = $1 - ((4/6)^2 + (2/6)^2)$

= 0.44

Weighted Gini of temperature

Gini (temp) = $0.5 \times \frac{4}{14} + 0.37 \times \frac{4}{14} + 0.44 \frac{6}{14}$

= 0.14 + 0.10 + 0.188

Gini (temp) = 0.428 ——— *

2.3 Humidity

	Yes	No
○ High	3	4
○ Normal	6	1

Gini (High) = $1 - ((3/7)^2 + (4/7)^2)$

= 0.48

Gini (Normal) = $1 - ((6/7)^2 + (1/7)^2)$

= 0.24

weighted Gini (Humidity) = $(0.48 \times 7/14) +$

$(0.\cancel{4}8 \times 7/14)$

Gini (Humidity) = 0.24 + 0.12

= 0.36 ——— *

2.4 Wind

	Yes	No
◦ Strong	3	3
◦ weak	6	2

Gini (weak) = $1 - ((6/8)^2 + (2/8)^2)$

= 0.37

Gini (strong) = $1 - ((3/6)^2 + (3/6)^2)$

= 0.5

weighted Gini of wind.

Gini (wind) = $(0.5 \times 6/14) + (0.37 \times 8/14)$

= 0.214 + 0.211

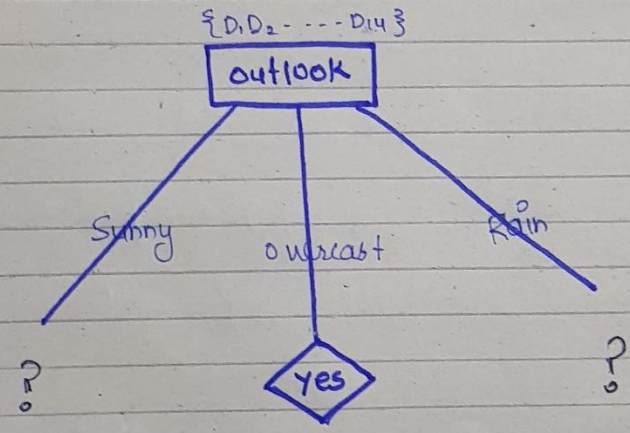
= 0.425 ——— *

Step #03

Compare the Gini index of features

Outlook	=	0.342
Temp	=	0.428
Humidity	=	0.36
Wind	=	0.425

As 0.342 is Lowest among all So outlook is selected as a root node.



Step #04

Repeat the process for each Subset

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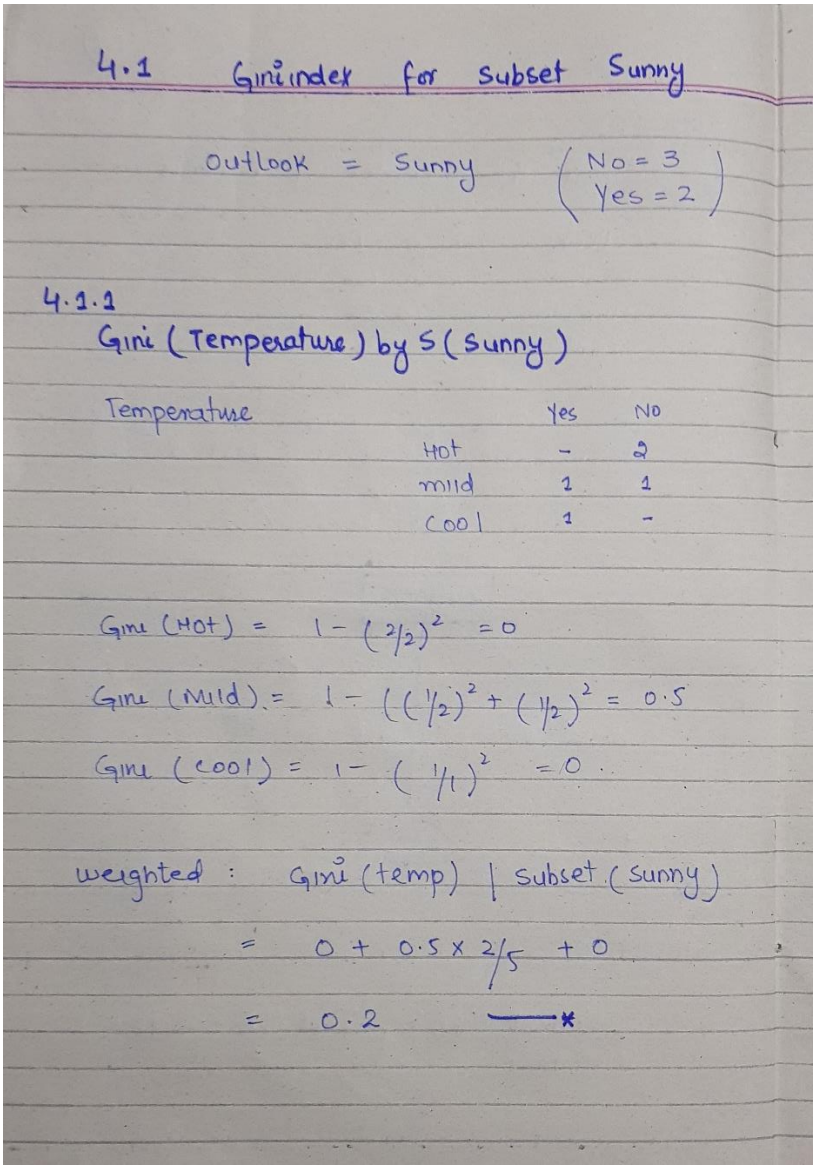
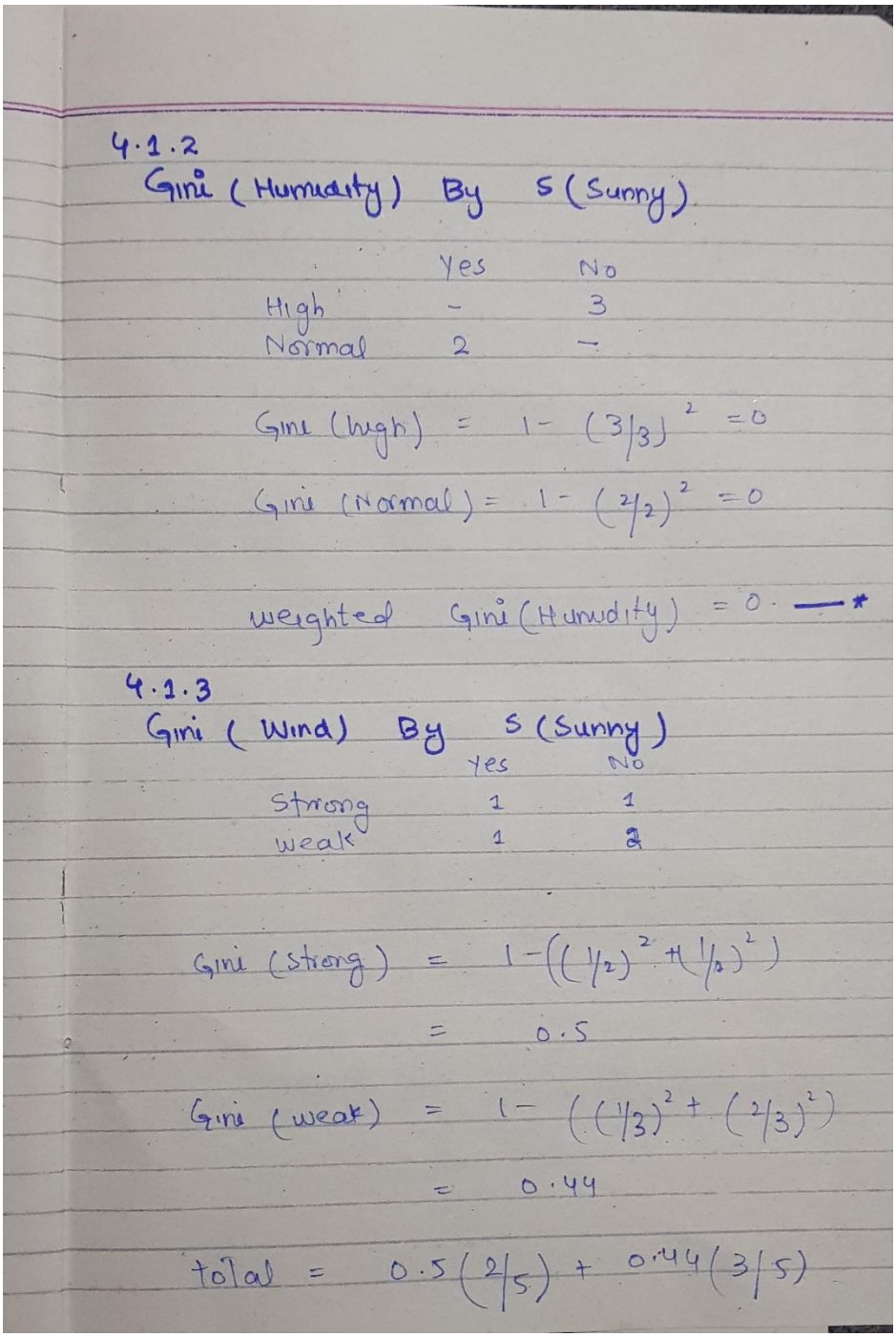
(AI Class Assignment 2)

Day	Outlook	Temp.	Humidity	Wind	Decision
D3	Overcast	Hot	High	Weak	Yes
D7	Overcast	Cool	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes





4.1.2

Gini (Humidity) By S (Sunny)

	Yes	No
High	-	3
Normal	2	-

$Gini(High) = 1 - (3/3)^2 = 0$

$Gini(Normal) = 1 - (2/2)^2 = 0$

Weighted Gini (Humidity) $= 0$ ——*

4.1.3

Gini (Wind) By S (Sunny)

	Yes	No
Strong	1	1
Weak	1	2

$Gini(Strong) = 1 - ((1/2)^2 + (1/2)^2)$

$= 0.5$

$Gini(Weak) = 1 - ((1/3)^2 + (2/3)^2)$

$= 0.44$

$total = 0.5(2/5) + 0.44(3/5)$

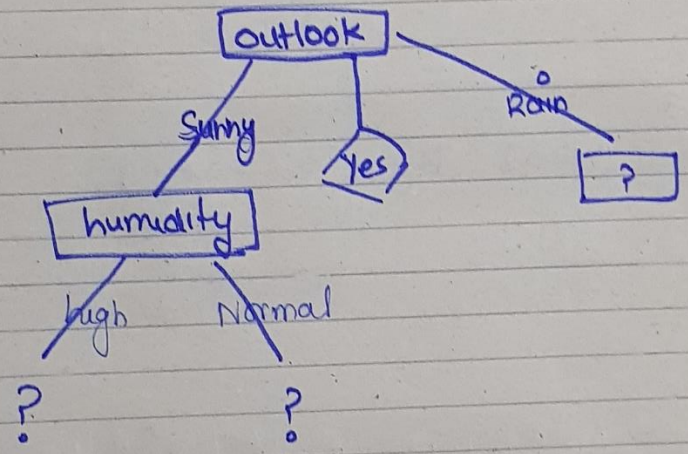
Compare Results

Gini (S$_{sunny}$, temp) = 0.2

Gini (S$_{sunny}$, humidity) = 0

Gini (S$_{sunny}$, wind) = 0.44

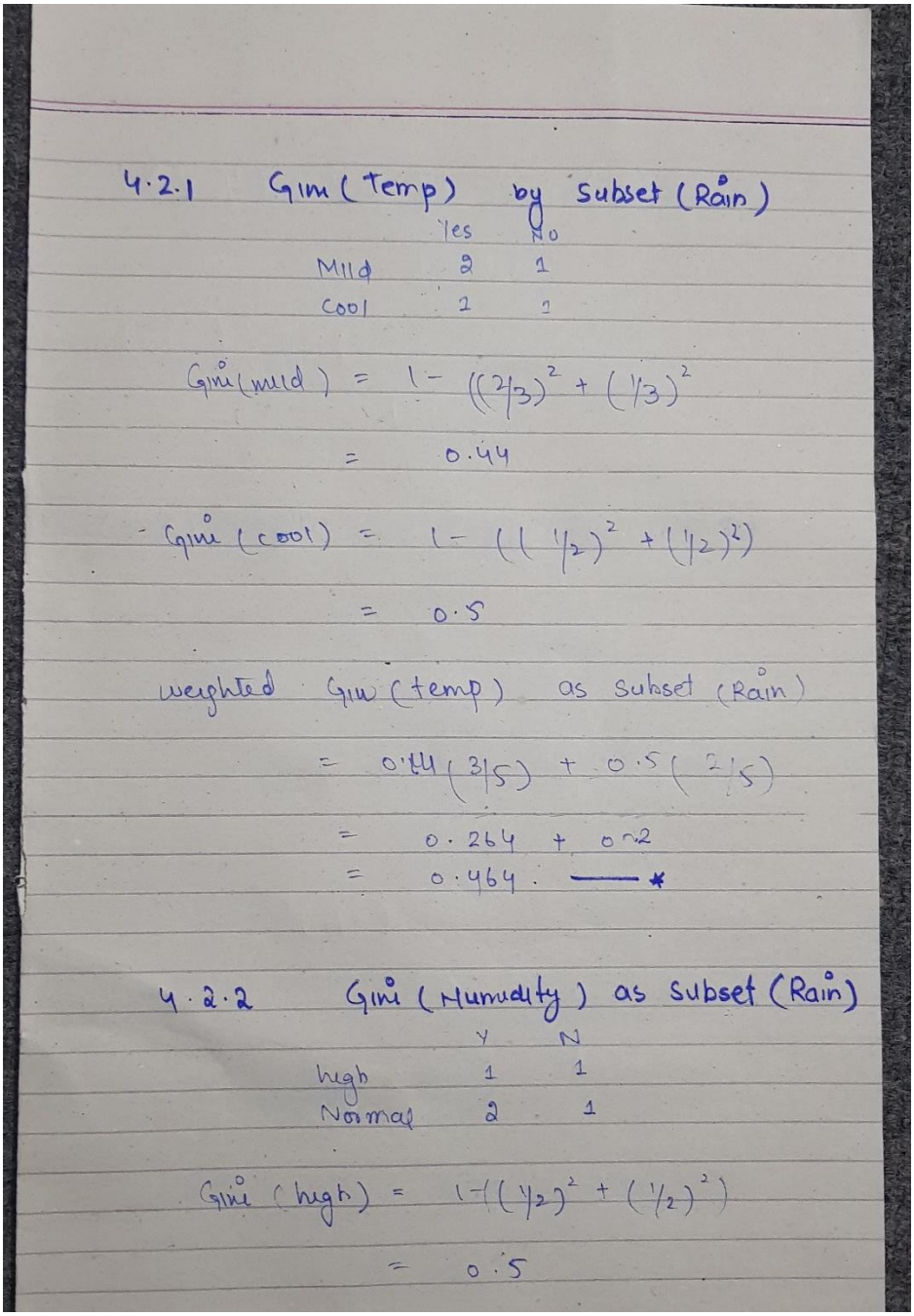
Lowest value would be selected



4.2 Gini index for Rain Subset

Yes = 3 NO = 2

D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D10	Rain	Mild	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No



4.2.1 Gini (Temp) by Subset (Rain)

	Yes	No
Mild	2	1
Cool	1	1

$Gini(mild) = 1 - ((2/3)^2 + (1/3)^2$

$= 0.44$

$Gini(cool) = 1 - ((1/2)^2 + (1/2)^2)$

$= 0.5$

weighted Gini (temp) as subset (Rain)

$= 0.44(3/5) + 0.5(2/5)$

$= 0.264 + 0.2$

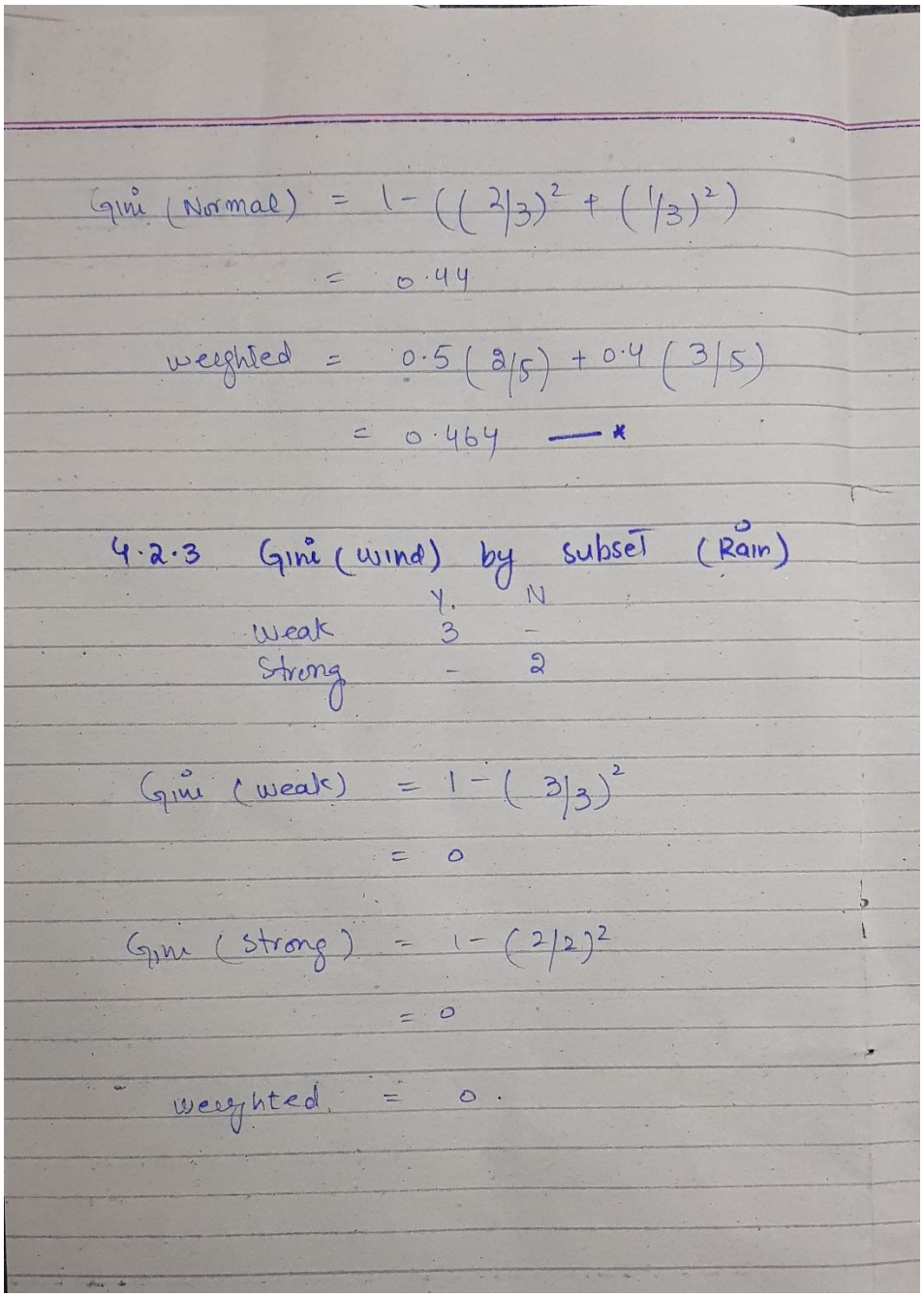
$= 0.464$ ——*

4.2.2 Gini (Humidity) as subset (Rain)

	Y	N
high	1	1
Normal	2	1

$Gini(high) = 1 - ((1/2)^2 + (1/2)^2)$

$= 0.5$



Gini (Normal) $= 1 - ((2/3)^2 + (1/3)^2)$

$= 0.44$

weighted $= 0.5(2/5) + 0.4(3/5)$

$= 0.464$ —*

4.2.3 Gini (wind) by subset (Rain)

	Y.	N
weak	3	-
Strong	-	2

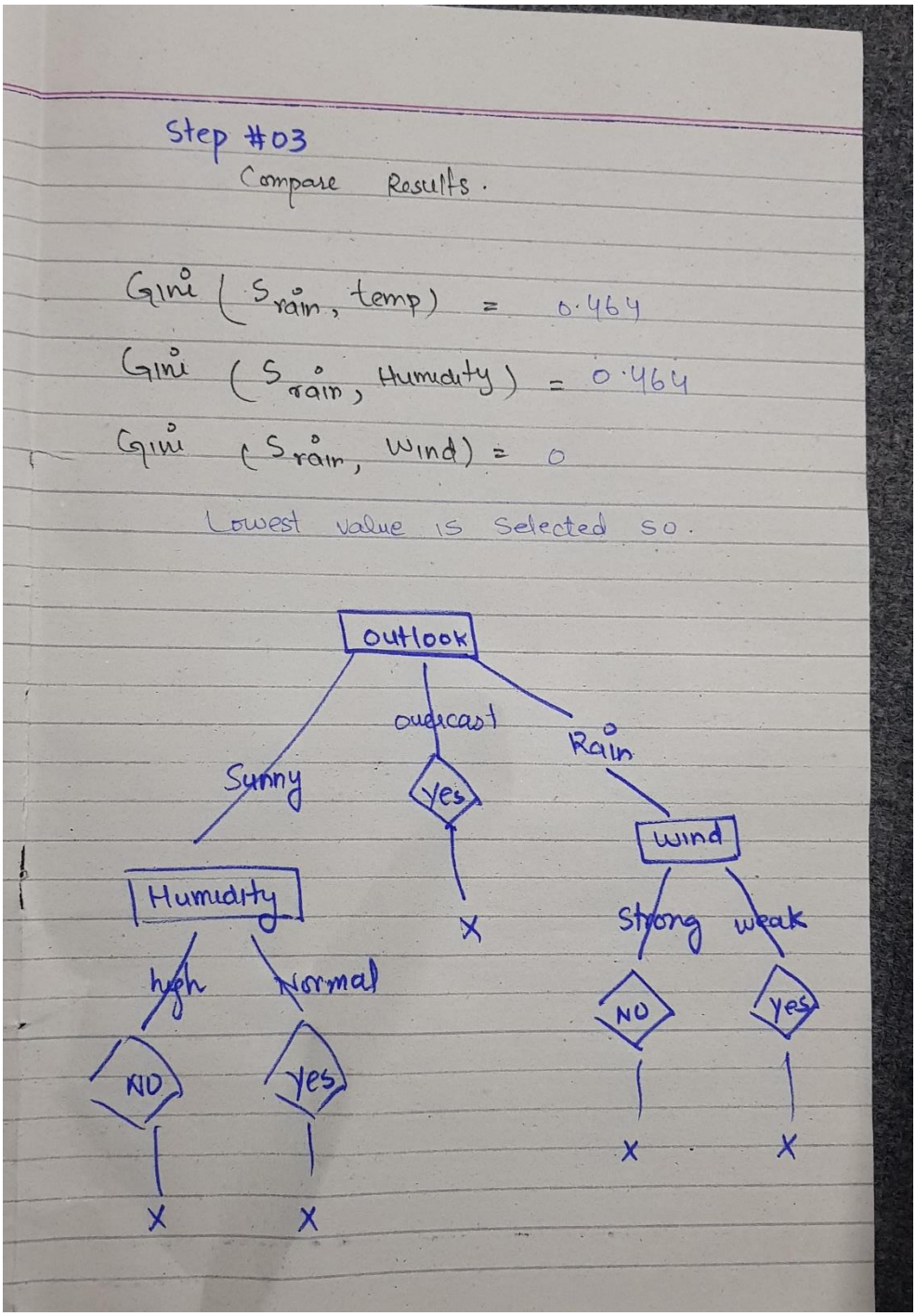
Gini (weak) $= 1 - (3/3)^2$

$= 0$

Gini (strong) $= 1 - (2/2)^2$

$= 0$

weighted $= 0.$


Step #03
Compare Results.
Gini (S rain, temp) = 0.464
Gini (S rain, Humidity) = 0.464
Gini (S rain, Wind) = 0
Lowest value is selected so.
Outlook
Sunny
Overcast
Rain
Yes
Humidity
Wind
X
high
Normal
Strong
weak
NO
yes
NO
Yes
X
X
X
X