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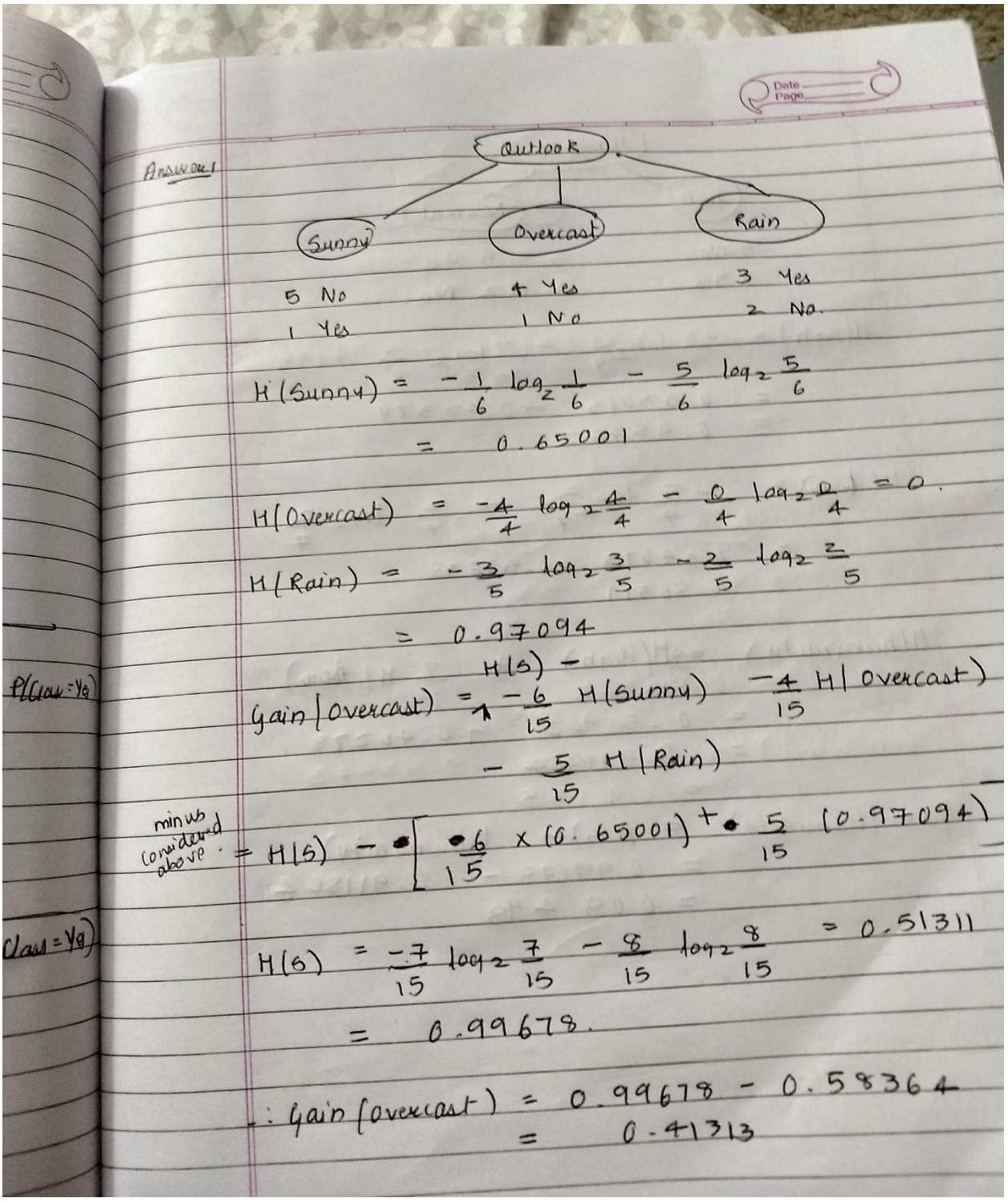
Homework 1

Answer 1:



Answer 1

$$H(\text{Sunny}) = -\frac{1}{6}\log_2\frac{1}{6} - \frac{5}{6}\log_2\frac{5}{6}$$

$$= 0.65001$$

$$H(\text{Overcast}) = -\frac{4}{4}\log_2\frac{4}{4} - \frac{0}{4}\log_2\frac{0}{4} = 0.$$

$$H(\text{Rain}) = -\frac{3}{5}\log_2\frac{3}{5} - \frac{2}{5}\log_2\frac{2}{5}$$

$$= 0.97094$$

$$\text{Gain}(\text{Overcast}) = H(S) - \frac{6}{15}H(\text{Sunny}) - \frac{4}{15}H(\text{Overcast}) - \frac{5}{15}H(\text{Rain})$$

minus considered above.

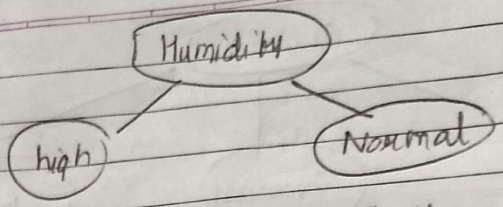
$$= H(S) - \left[\frac{6}{15} \times (0.65001) + \frac{5}{15}(0.97094)\right]$$

$$H(S) = -\frac{7}{15}\log_2\frac{7}{15} - \frac{8}{15}\log_2\frac{8}{15} = 0.51311$$

$$= 0.99678.$$

$$\therefore \text{Gain}(\text{Overcast}) = 0.99678 - 0.58364$$

$$= 0.41313$$



5 No
3 Yes

5 Yes
2 No.

$$H(\text{high}) = -\frac{3}{8}\log_2\frac{3}{8} - \frac{5}{8}\log_2\frac{5}{8}$$

$$= 0.53063 + 0.42379$$

$$= 0.95442$$

$$H(\text{low}) = -\frac{5}{7}\log_2\frac{5}{7} - \frac{2}{7}\log_2\frac{2}{7}$$

$$= 0.34673 + 0.51638$$

$$= 0.86311$$

$$H(\text{humidity}) = \frac{8}{15}H(\text{High}) + \frac{7}{15}H(\text{low})$$

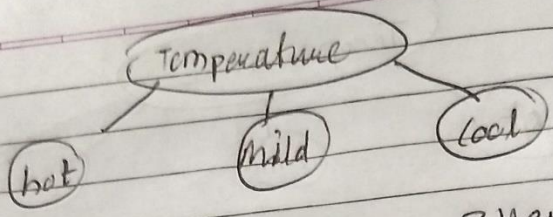
$$= 0.50902 + 0.40278$$

$$= 0.911804$$

$$\text{Gain (humidity)} = H(S) - H(\text{humidity})$$

$$= 0.99679 - 0.911804$$

$$= 0.08498$$

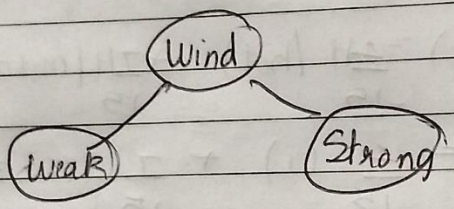


2 Yes
2 No

3 Yes
4 No

3 Yes
1 No.

Gain [Temperature] = 0.99678 − 0.94178
= 0.055



6 Yes
2 No.

5 No
2 Yes

H [wind] = 0.83543

Gain [wind] = 0.99678 − 0.83543
= 0.16135

Answer 3)

$$P(\text{Class} = \text{yes} \mid x_1 = 20, x_2 = 10) = \frac{P(x_1 = 20, x_2 = 10 \mid \text{Class} = \text{yes})\ P(\text{Class} = \text{Yes})}{P(x_1 = 20, x_2\ 10 \mid \text{Class} = \text{yes})\ P(\text{Class} = \text{yes}) + P(x_1 = 20, x_2 = 10 \mid \text{Class} = \text{No}) \times P(\text{Class} = \text{No})}$$

$P(\text{Class} = \text{Yes}) = 4/6 = 2/3$ ... From data.

$P(\text{Class} = \text{No}) = 2/6 = 1/3$ ... From data.

$P(x_1 = 20, x_2 = 10 \mid \text{Class} = \text{Yes}) = P(x_1 = 20 \mid \text{Class} = \text{Yes}) \times P(x_2 = 10 \mid \text{Class} = \text{Yes})$

$P(x_1 = 20, x_2 = 10 \mid \text{Class} = \text{No}) = P(x_1 = 20 \mid \text{Class} = \text{No}) \times P(x_2 = 10 \mid \text{Class} = \text{No})$

$\mu_{x1,\text{Yes}} = 11.25$ $\quad \mu_{x1,\text{No}} = 15.0$

$\sigma_{x1,\text{Yes}} = 29.6875$ $\quad \sigma_{x2,\text{No}} = 25.0$

$\mu_{x2,\text{Yes}} = 12.5$ $\quad \mu_{x2,\text{No}} = 15.0$

$\sigma_{x2,\text{Yes}} = 18.75$ $\quad \sigma_{x2,\text{No}} = 25.0$

$$P(x_1 = 20 \mid \text{Class} = \text{Yes}) = \frac{1}{\sqrt{2\pi}\,\sigma_{x1,\text{Yes}}} \exp -\frac{1}{2}\left(\frac{(20 - \mu_{x1,\text{Yes}})}{\sigma_{x1,\text{Yes}}^2}\right)^2$$

$$P(x_2 = 10, \text{Class} = \text{Yes}) = \frac{1}{\sqrt{2\pi}\,\sigma_{x2,\text{Yes}}} \exp -\frac{1}{2}\left(\frac{(10 - \mu_{x2,\text{Yes}})^2}{(\sigma_{x2,\text{Yes}})^2}\right)$$

$$P(X_1 = 20, \text{class} = No) =$$

$$\frac{1}{\sqrt{2\pi}\,\sigma_{X_1, No}} \exp -\frac{1}{2}\left(\frac{(30 - \mu_{X_1, No})^2}{(\sigma_{X_1, No})^2}\right)$$

$$P(X_2 = 10, \text{class} = No) =$$

$$\frac{1}{\sqrt{2\pi}\,\sigma_{X_2, No}} \exp -\frac{1}{2}\left(\frac{(10 - \mu_{X_2, No})^2}{(\sigma_{X_2, No})^2}\right)$$

$$P(\text{Class} = No \mid X_1 = 20, X_2 = 10) =$$

$$P(X_1 = 20, X_2 = 10 \mid \text{Class} = No)\, P(\text{Class} = No)$$

$$P(X_1 = 20, X_2 = 10 \mid \text{class} = No)\, P(\text{class} = No) + P(X_1 = 20, X_2 = 10 \mid \text{class} = Yes)\, P(\text{class} = Yes)$$

$$P(\text{Class} = Yes \mid X_1 = 20, X_2 = 10) =$$

$$P(X_1 = 20, X_2 = 10 \mid \text{Class} = Yes)\, P(\text{Class} = Yes)$$

$$P(X_1 = 20, X_2 = 10 \mid \text{Class} = Yes)\, P(\text{Class} = Yes) + P(X_1 = 20, X_2 = 10 \mid \text{Class} = Yes)\, P(\text{Class} = Yes)$$