

Date _____

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"NAIVE BAYES CLASSIFIER"

Bayes Theorem:

$$P(A|B) = \frac{P(A) \cdot P(B|A)}{P(B)}$$

Annotations:

- $P(A)$: prior probab
- $P(B|A)$: prob of hypothesis
- $P(A|B)$: posterior
- $P(B)$: marginal prob / prior
- $P(B)$: prob of evidence
- $P(A|B)$: posterior probab

→ Naive Bayes assumes that features are independent. The presence of one does not affect others.

Generative learning:

It is a machine learning approach where the model learns how data is generated for each class.

↳ Learn the joint probability $P(x, y)$ — how inputs x & labels y occur together

↳ Once we know $P(x, y)$, we can compute the posterior prob $P(y|x)$ using Bayes theorem

→ Estimating $P(y)$ & $P(x|y)$ is called generative learning

→ Naive Bayes has High Bias and Low Variance

Application :

- Sentiment Analysis
- Spam Detection
- Lang Identification

→ Page Exercise

[Sunny, Cool, High, Strong] = ?

- Calculation For "Yes"

$$P(\text{Yes}) = 9/14$$

$$P(\text{Yes} / \text{Sunny, Cool, High, Strong}) = P(\text{Yes}) * P(\text{Sunny} / \text{Yes}) * \\ P(\text{Cool} / \text{Yes}) * P(\text{High} / \text{Yes}) * \\ P(\text{Strong} / \text{Yes}) \rightarrow (i)$$

$$P(\text{Sunny} / \text{Yes}) = 2/9$$

$$P(\text{Cool} / \text{Yes}) = 3/9$$

$$P(\text{High} / \text{Yes}) = 3/9$$

$$P(\text{Strong} / \text{Yes}) = 3/9$$

$$\text{eq (i)} \Rightarrow P(\text{Yes} / \text{---}) = 9/14 * 2/9 * 3/9 * 3/9 * 3/9 \\ = 0.0053$$

- Calculation For "No"

$$P(\text{No}) = 5/14$$

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$$P(\text{No} / \text{Sunny, Cool, High, Strong}) = \frac{P(\text{No}) \times P(\text{Sun} / \text{No}) \times P(\text{High} / \text{No}) \times P(\text{Cool} / \text{No}) \times P(\text{Strong} / \text{No})}{P(\text{Cool} / \text{No}) \times P(\text{Strong} / \text{No})} \rightarrow \text{eq (2)}$$

$$P(\text{Sunny} / \text{No}) = 3/5$$

$$P(\text{Cool} / \text{No}) = 1/5$$

$$P(\text{High} / \text{No}) = 4/5$$

$$P(\text{Strong} / \text{No}) = 3/5$$

$$\text{eq (2)} \Rightarrow P(\text{No} / \text{---}) = 5/11 \times 3/5 \times 1/5 \times 4/5 \times 3/5 \\ = 0.0205$$

→ scaling the values

$$P(\text{No}) = \frac{P(\text{No})}{P(\text{Yes}) + P(\text{No})} = 0.794 \quad \checkmark$$

$$P(\text{Yes}) = \frac{P(\text{Yes})}{P(\text{Yes}) + P(\text{No})} = 0.2054$$

$$P(\text{Sun, High, Green, Teeth} / \text{Parrot}) = ? \quad P(\text{Parrot}) \times P(\text{---})$$