Math behind Naive Bayes

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Concept behind Naive Bayes

$$P(C_k \mid X) = \frac{P(X \mid C_k) * P(C_k)}{P(X)}$$

$$P(C_1 \mid x_1 \& x_2 \& x_3 \& x_4) = \frac{P(x_1 \cap x_2 \cap x_3 \cap x_4 \mid C_1) * P(C_1)}{P(x_1 \cap x_2 \cap x_3 \cap x_4)}$$

$$\boxed{P(C_1 \mid x_1 \& x_2 \& x_3 \& x_4) = \frac{P(x_1 \mid C_1) * P(x_2 \mid C_1) * P(x_3 \mid C_1) * P(x_4 \mid C_1) * P(C_1)}{P(x_1) * P(x_2) * P(x_3) * P(x_4)}}$$

Math behind Naive Bayes

$$P(C_k \mid X) = \frac{\mathbf{P(X \mid C_k)} * P(C_k)}{P(X)}$$

Conditional Probability:

$$P(E_1 \mid E_2) = \frac{P(E_1 \cap E_2)}{P(E_2)}$$

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Math behind Naive Bayes

$P(C_k \mid X) =$

$$\frac{\mathbf{P(X \mid C_k)} *}{P(C_k)}$$

$$\frac{\mathbf{P(X \cap C_k)}}{\mathbf{P(C_k)}} * P(C_k)$$

$\mathbf{P(X)}$

$$= \frac{\mathbf{P(C_k)}}{P(X)}$$

Conditional Probability:

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$$= \frac{\dfrac{\mathbf{P(X \cap C_k)}}{\cancel{\mathbf{P(C_k)}}} * \cancel{P(C_k)}}{P(X)} = \frac{P(X \cap C_k)}{P(X)}$$

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$$P(C_1 \mid x_1 \& x_2 \& x_3 \& x_4) = \frac{P(x_1 \cap x_2 \cap x_3 \cap x_4 \cap C_1)}{P(x_1 \& x_2 \& x_3 \& x_4)}$$

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$$P(\underbrace{x_1 \cap}_{E_1} \underbrace{x_2 \cap x_3 \cap x_4 \cap C_1)}_{E_2}$$

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$$P(C_1 \mid x_1 \& x_2 \& x_3 \& x_4) = \boxed{\frac{P(x_1 \cap x_2 \cap x_3 \cap x_4 \cap C_1)}{P(x_1 \& x_2 \& x_3 \& x_4)}}$$

$$P(\underbrace{x_1}_{E_1} \cap \underbrace{x_2 \cap x_3 \cap x_4 \cap C_1}_{E_2})$$

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$$P(\underbrace{x_2}_{E_1} \cap \underbrace{x_3 \cap x_4 \cap C_1}_{E_2})$$

Math behind Naive Bayes

$$P(C_1 | x_1 \& x_2 \& x_3 \& x_4) = \frac{P(x_1 | x_2 \cap x_3 \cap x_4 \cap C_1) * P(x_2 \cap x_3 \cap x_4 \cap C_1)}{P(x_1 \& x_2 \& x_3 \& x_4)}$$

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Math behind Naive Bayes

- For two events A and B, if A and B are independent

$$P(A \mid B) = P(A)$$

Math behind Naive Bayes

- For two events A and B, if A and B are independent

  $P(A \mid B) = P(A)$

- For three events A, B and C, is A and B are conditional

  independent

  $P(A \mid B, C) = P(A|C)$

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Math behind Naive Bayes

$$P(C_1 \mid x_1 \& x_2 \& x_3 \& x_4) = \frac{P(x_1 \mid x_2 \cap x_3 \cap x_4 \cap C_1) * P(x_2 \mid x_3 \cap x_4 \cap C_1) * \ldots\ldots\ P(x_4 \mid C_1) * P(C_1)}{P(x_1 \& x_2 \& x_3 \& x_4)}$$

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$$P(A \cap B) = P(A) * P(B), \quad \text{when A, B are independent}$$

$$\boxed{P(C_1 \mid x_1 \& x_2 \& x_3 \& x_4) = \frac{P(x_1 \mid C_1) * P(x_2 \mid C_1) * P(x_3 \mid C_1) * P(x_4 \mid C_1) * P(C_1)}{P(x_1) * P(x_2) * P(x_3) * P(x_4)}}$$