Naive Bayes Classification

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Homework 6, Question 3

You need to categorize vehicles into the following categories: truck, suv, and sedan using 5 features. Perform a naïve Bayes classification with the following probabilities. Show your work.

Table 1

c	TRUCK	SUV	SEDAN
$P(c)$	0.35	0.4	0.25
$P(f_1\|c)$	0.2	0.01	0.2
$P(f_2\|c)$	0.01	0.1	0.05
$P(f_3\|c)$	0.1	0.001	0.005
$P(f_4\|c)$	0.001	0.2	0.005
$P(f_5\|c)$	0.005	0.008	0.01

Bayes' Theorem

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

$P(f_i)$ can be solved for with,

$$P(f_i) = \sum_{c \in C} P(f_i|c)$$

$$C = \{\text{TRUCK, SUV, SEDAN}\}$$

$P(f_1)$	0.41
$P(f_2)$	0.16
$P(f_3)$	0.106
$P(f_4)$	0.206
$P(f_5)$	0.023

Question 3.a

a. What category would you assign to the vehicle (f1, f2, f3)?

$$P(c|f_1 \cap f_2 \cap f_3) = \frac{P(c)P(f_1|c)P(f_2|c)P(f_3|c)}{P(f_1)P(f_2)P(f_3)}$$

$$P(\text{TRUCK}|f_1 \cap f_2 \cap f_3) = \frac{0.35 * 0.2 * 0.01 * 0.1}{0.41 * 0.16 * 0.106} \approx 0.0101$$

$$P(\text{SUV}|f_1 \cap f_2 \cap f_3) \approx 0.0005$$

$$P(\text{SEDAN}|f_1 \cap f_2 \cap f_3) \approx 0.0018$$

Answer for question 3.a is TRUCK.

Question 3.b

b. What category would you assign to the vehicle (f1, f2, f4, f5)?

$$P(\text{TRUCK}|f_1 \cap f_2 \cap f_4 \cap f_5) \approx 0.0001$$

$$P(\text{SUV}|f_1 \cap f_2 \cap f_4 \cap f_5) \approx 0.0021$$

$$P(\text{SEDAN}|f_1 \cap f_2 \cap f_4 \cap f_5) \approx 0.0004$$

Answer for question 3.b is SUV.