

Naïve Bayes - Homework 3

Using the Bayes rule to classify the new data entry given bellow:

Give Birth	Can Fly	Lives in Water	Has Legs	Class
Yes	No	Yes	No	?

$$\text{Bayes Rule: } P(c | x) = \frac{P(x|c) P(c)}{P(x)}$$

$$\text{Laplace Smoothing: } P(x | c) = \frac{\text{count}(x = v | c) + 1}{\text{count}(c) + \text{Values}}$$

Calculating P(c) (Priors)

There are 20 entries in the table and 8 of those are mammals, so the priors P(c) are P(mammals) = 8/20 and P(not-mammals) = 12/20

Calculating P(x | c) for each attribute x using Laplace Smoothing (Likelihood)

For each of these attributes, we will find the probability that some animal is a mammal given that the attribute matches with the unknown data entry.

Gives Birth: Since there are 7 animals who do give birth and are mammals, P(Gives Birth | Mammals) = 7+1 / 8+(1*2) = 8/10. Since there are 0 animals who do give birth and are non-mammals, P(Gives Birth | non-mammals) = 0+1 / 12+(1*2) = 1/14

Can Fly: Since there are 7 animals who do not fly and are mammals, P(Can **not** fly | Mammals) = 7+1 / 8+(1*2) = 8/10. Since there are 9 animals who do not fly and are non-mammals, P(Can **not** fly | non-mammals) = 9+1 / 12+(1*2) = 10/14

Lives in Water: Since there are 4 animals who live in water and are mammals, P(Lives in water | Mammals) = 4+1 / 8+(1*3) = 5/11. Since there are 3 animals who live in water and are non-mammals, P(Lives in water | non-mammals) = 3+1 / 12+(1*3) = 4/15

Has Legs: Since there are 3 animals who do **not** have legs and are mammals, P(Has **no** Legs | Mammals) = 3+1 / 8+(1*2) = 4/10. Since there are 3 animals who do **not** have legs and are non-mammals, P(Has **no** legs | non-mammals) = 3+1 / 12+(1*2) = 4/14

$$P(x | \text{mammals}) = 8/10 * 8/10 * 5/11 * 4/10 = \underline{\underline{0.116363636}}$$

$$P(x | \text{non-mammals}) = 1/14 * 10/14 * 4/15 * 4/14 = \underline{\underline{0.003887269}}$$

Calculating P(x) (Evidence)

$$P(x) = P(\text{mammal}) * P(x | \text{mammal}) + P(\text{non-mammal}) * P(x | \text{non-mammal})$$

$$P(x) = 0.4 * 0.116363636 + 0.6 * 0.003887269 = \underline{\underline{0.048877816}}$$

Calculating P(c | x) (Posterior)

$$P(\text{mammal} | x) = (0.4 * 0.116363636) / 0.048877816 = \underline{\underline{0.952281796}}$$

$$P(\text{non-mammal} | x) = (0.6 * 0.003887269) / 0.048877816 = \underline{\underline{0.0477182}}$$

This unknown animal has a %95.228 probability of being a mammal and a %4.772 probability of being a non-mammal. This means that we would classify the animal as being a **mammal**.