Supplementary material for Lesson 2

The simple form of Bayes Theorem involves two discrete events:

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(A)}{P(B|A)P(A) + P(B|A^c)P(A^c)}$$

When there are three possible outcomes A_1, A_2, and A_3 such that exactly one of these must happen, then Bayes Theorem expands to:

$$P(A_1|B) = \frac{P(B|A_1)P(A_1)}{P(B|A_1)P(A_1) + P(B|A_2)P(A_2) + P(B|A_3)P(A_3)}$$

If the events $A_1, \ldots, A_m$ form a partition of the space (exactly one of the A_i's must occur, i.e., the A_i's are mutually exclusive and $\sum\limits_{i=1}^{m} P(A_i) = 1$), then we can write Bayes Theorem as:

$$P(A_1|B) = \frac{P(B|A_1)P(A_1)}{\sum_{i=1}^{m} P(B|A_i)P(A_i)} \, .$$

For continuous distributions, the sum gets replaced with an integral, as we'll see in the next lesson.