Solutions to Prac Sheet - Intro to ML

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Exercise 5

- Recall Bayes rule, P(A | B) = P(B | A) P(A) / P(B)
- Show that we have also P(A | B,C) = P(B | A,C) P(A | C) / P(B | C)

We have

(1) P(A | B,C) = P(A,B,C) / P(B,C) by the product rule
and
(2) P(A,B,C) = P(B | A,C) P(A,C) by the same product rule

Substituting (2) in (1), we get

(3) P(A | B,C) = P(B | A,C) P(A,C) / P(B,C)

Using
P(B,C) = P(B|C) P(C) and P(A,C) = P(A|C) P(C)
and replacing in (3) , we finally get

P(A | B,C) = P(B | A,C) P(A | C) / P(B | C)

Exercise 6

- Suppose we want to fit a linear function $f_w(x) = wx$ where x is scalar to a data set $\{(x_1, y_1), \ldots, (x_n, y_n)\}$.
- Compute the derivative of the error $E = \sum_{i=1}^{n} (y_i - w x_i)^2$ with respect to w.

Let compute the derivative of E with respect to w.

$$\frac{\partial E}{\partial w} = \sum_n -2 x_i (y_i - w x_i)$$

The derivative becomes zero when

$$w = \frac{\sum_n x_i y_i}{\sum_n x_i^2}$$

- This is the most probable w.