

$$1. P(A|B) = P(A \cap B) / P(B)$$

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

$$P(A \cap B) = P(B|A) P(A)$$

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

Bayes Theorem helps w/ conditional probabilities. It helps to confirm data and accurate predictions in machine learning.

2.

$$P(\text{cancer} | \oplus, \oplus) = \frac{(.98^2)(.008)}{(.98^2)(.008) + (1-.98)^2(1-.008)} = .951$$

$$P(\neg \text{cancer} | \oplus, \oplus) = \frac{(.02^2)(.992)}{(.02^2)(.992) + (1-.02)^2(1-.992)} = .049$$

3.

$$P(\text{yes}) = 8/12$$

$$P(\text{no}) = 4/12$$

$$P(\text{sun} | \text{yes}) = 2/8$$

$$P(\text{sun} | \text{no}) = 3/4$$

$$P(\text{cool} | \text{yes}) = 3/8$$

$$P(\text{cool} | \text{no}) = 1/4$$

$$P(\text{high} | \text{yes}) = 3/8$$

$$P(\text{high} | \text{no}) = 3/4$$

$$P(\text{strong} | \text{yes}) = 3/8$$

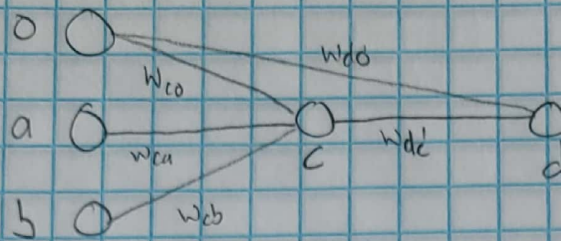
$$P(\text{strong} | \text{no}) = 2/4$$

$$\text{yes} = \left(\frac{8}{12}\right) \left(\frac{2}{8}\right) \left(\frac{3}{8}\right) \left(\frac{3}{8}\right) \left(\frac{3}{8}\right) = .0088$$

$$\text{no} = \left(\frac{4}{12}\right) \left(\frac{3}{4}\right) \left(\frac{1}{4}\right) \left(\frac{3}{4}\right) \left(\frac{2}{4}\right) = .023$$

predicts no

4.



$$\sigma = \frac{1}{1 + e^{-x}}$$

$$\sigma_c((.1)(1) + (.1)(0) + (.1)(1)) = .55$$

$$\sigma_d((.1)(.55) + (.1)(1)) = .54$$

$$\text{err}_d = (.54)(1 - .54)(1 - .54) = .115$$

$$\text{err}_c = (.55)(1 - .55)(.1)(.115) = .0028$$

$$\Delta w_{db} = (.3)(.1146)(1) = .0342 \quad w_{db} = .1342$$

$$\Delta w_{dc} = (.3)(.1146)(.55) = .0189 \quad w_{dc} = .1189$$

$$\Delta w_{da} = (.3)(.0028)(1) = .000849 \quad w_{da} = .100849$$

$$\Delta w_{ca} = (.3)(.0028)(1) = .000849 \quad w_{ca} = .100849$$

$$\Delta w_{cb} = (.3)(.0028)(0) = 0 \quad w_{cb} = .1$$

$$\sigma_c((.100849)(0) + (.1)(1) + (.100849)(1)) = .55$$

$$\sigma_d((.1189)(.55) + (.1342)(1)) = .5497$$

$$\Delta w_{db} = (.3)(-.1361)(1) + .9(.0342) = -.01 \quad w_{db} = .1242$$

$$\Delta w_{dc} = (.3)(-.1361)(.55) + .9(.0189) = -.0055 \quad w_{dc} = .1134$$

$$\Delta w_{da} = (.3)(-.004)(1) + .9(.000849) = -.0004 \quad w_{da} = .100849$$

$$\Delta w_{ca} = (.3)(-.004)(0) + .9(.000849) = -.0005 \quad w_{ca} = .1014$$

$$\Delta w_{cb} = (.3)(-.004)(1) + .9(0) = -.0012 \quad w_{cb} = .0988$$