Question 1)

Solution:

Given: After being tested positive, the patent tests positive in again for a second test.

- ⇨ To find: P(cancer| +,+)

We know from the previous problem that $P(\neg cancer) = 1 - P(cancer)$

$= 1 – 0.008$

$= 0.992$

$P(\neg cancer|+) = 1 – P(cancer|+)$

$= 1 – 0.21$

$= 0.79$

$P(+|\neg cancer) = 0.3$

Also, we found that $P(cancer|+) = 0.21$ { i.e, Probability of cancer given positive test results }

Now,

Since the first test has already returned positive, we only consider the cases where we are given that the test results are positive.

Therefore,

we substitute P(cancer|+) and P(¬cancer |+) for P(cancer) and P(¬cancer) respectively.

Thus, $$P(cancer|++) = \frac{P(+|cancer) \times P(cancer|+)}{\{ P(+|cancer) \times P(cancer|+) + P(+|\neg cancer) \times P(\neg cancer|+) \}}$$

$$= \frac{(0.98 \times 0.21)}{(.98 \times .21 + .03 \times .79)} = 0.91$$

Hence, after the second positive test, we are a lot more certain that the patient has cancer.

Question 2)

Solution:

Correct predictions = 85

=> mispredictions = 100 – 85 = 15

Thus, error = 0.15

For, 95% confidence interval for Error D(h) =

$$= \text{Error } D(h) \pm \left[1.96 \times \left\{ \sqrt{\text{Error } D(h) \times (1 - \text{Error } D(h))/n} \right\} \right]$$

$$= 0.15 \pm 1.96 \sqrt{(0.15*(1-0.15)/100}$$

$$= 0.15 \pm 0.0357$$

a, b → i/ps ; c → hidden layer unit ; d → o/p unit

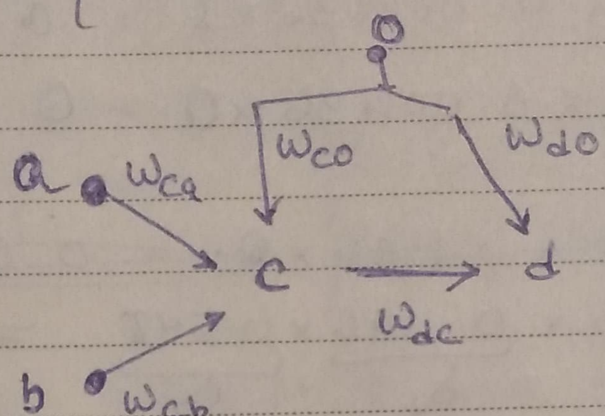
n/w has five weights (w_{ca}, w_{cb}, w_{c0}, w_{dc}, w_{d0})

a	b	d
1	0	1
0	1	0

w_{x0} = threshold weight for unit x.

initialize to (.1, .1, .1, .1, .1)

learning rate, $\eta = 0.3$; momentum $\alpha = 0.9$



$$\sigma(y) = \frac{1}{1+e^{-y}}$$

sigmoid f^n.

Training Example 1:

o/p of two neurons, for d = 1 ⇒ a = 1 & b = 0

$$O_c = \sigma(0.1 \times 1 + 0.1 \times 0 + \underbrace{0.1}_{w_{c0}} \times 1) = \sigma(0.2) = 0.5498$$

$$O_d = \sigma(0.1 \times \underline{0.5498} + 0.1 \times 1) = \sigma(0.15498) = 0.53867.$$

Error terms for the two neurons noting that d = 1.

$$\delta_d = 0.53867 \times (1 - 0.53867) \times (1 - 0.53867) = 0.1146 \quad \text{from ①}$$

$$\delta_c = 0.5498 \times (1 - 0.5498) \times \boxed{0.1}_{w_{dc}} \times 0.1146 \quad \text{from ②}$$

$$= 0.002836.$$

Now correction terms for $\eta = 0.3$, $a = 1$, $b = 0$

$\Delta w_{d0} = 0.3 \times 0.1146 \times 1 = 0.0342$

$\Delta w_{c0} = 0.3 \times 0.002836 \times 1 = 0.000849$.

$\Delta w_{ca} = 0.3 \times 0.002836 \times 1 = 0.000849$

$\Delta w_{cb} = 0.3 \times 0.002836 \times 0 = 0$.

$\Delta w_{dc} = \cancel{0.3 \times 0.1146 \times 0.6}$

$0.3 \times \underbrace{0.1146}_{\delta_d} \times \underbrace{0.548}_{O_c} = 0.0189$

New weights

$\therefore w'_{d0} = 0.1 + 0.0342 = 0.1342$

$w'_{dc} = 0.1 + 0.0189 = 0.1189$

$w'_{c0} = 0.1 + 0.000849 = 0.100849$

$w'_{ca} = 0.1 + 0.000849 = 0.100849$

$w'_{cb} = 0.1 + 0 = 0.1$.

Second Training Iteration :

$a = 0 \qquad b = 1 \qquad d = 0.$

$$O_c = \sigma(w_{c0} + w_{ca} \times a + w_{cb} \times b)$$

$$= \sigma(0.100849 + 0 + 0.1 \times 1) = \frac{1}{1 + e^{-0.200849}}$$

$$= \underline{0.55004}$$

$$O_d = \sigma(w_{d0} + w_{dc} \times c)$$

$$= \sigma(0.1342 + 0.1189 \times 0.55004) = \sigma(0.19965)$$

$$= 0.54974$$

$$\delta_d = O_d \times (1 - O_d)(d - o_d) = (0.54974)(1 - 0.54974)(-0.54974) \quad \because d = 0$$

$$= -0.136078552$$

$$\delta_c = O_c \times (1 - O_c)(W_{dc} \times \delta_d) = (0.55004)(1 - 0.55004)(.1189 \times (-0.136078552))$$

$$\cancel{\Delta w_{ca} = \eta\delta} \qquad = -0.0041$$

$$\Delta' W_{ca} = \eta \delta_c \times a + \alpha \Delta w_{ca}(2-1)$$

$$= 0.3(-0.0041) \times 0 + 0.9 \times 0.000849 \times 1$$

$$= 0.00076$$

$$\Delta' W_{cb} = \eta \delta_c \times b + \alpha W_{cb}(2-1) = 0.3(-0.0041) \times 1 + .9 \times 0$$

$$= -0.00123$$

IIIly, $\Delta' W_{c0} = 0.3 \times 0.004 \times 1 + 0.9 \times 0.000849 \times 1 = (-)0.00043$

$$\Delta' W_{dc} = 0.3 \times (-)0.136078 \times 0.55004 + 0.9 \times .0189$$

$$= -0.00543$$

Notes

$$\Delta' W_{do} = 0.3 \times -0.13607 \times 0 + 0.9 \times 0.03439$$
$$= -0.00987$$

Final weghts:

$$W_{ca} = W'_{ca} + \Delta' W_{ca} = 0.100849 + 0.00076$$
$$= 0.101609$$

$$W_{cb} = W'_{cb} + \Delta' W_{cb} = 0.1 + (-)0.00123$$
$$= \cancel{0.100}\ 0.09877.$$

$$W_{co} = W'_{co} + \Delta' W_{co} = 0.100849 - 0.0004$$
$$= 0.1004$$

$$W_{dc} = W'_{dc} + \Delta' W_{dc} = 0.1189 + (-)0.00543$$
$$= 0.11347$$

$$W_{do} = W'_{do} + \Delta' W_{do} = 0.1342 - 0.00987$$
$$= 0.12433$$