Question 4

Probability of picking the red box is 60% hence,

$$p(Box = red) = \frac{6}{10}$$
$$p(Box = blue) = \frac{4}{10}$$

Now, Finding the conditional probabilities,

Given that the box is red, proability of fruit being apple:

$$p(Fruit = apple|Box = red) := \frac{Number\ of\ apples\ in\ Red\ box}{Totalnumber\ of\ fruits\ in\ red\ box}$$
$$p(Fruit = apple|Box = red) := \frac{2}{8}$$

Given that the box is red, proability of fruit being apple:

$$p(Fruit = orange|Box = red) := \frac{Number\ of\ oranges\ in\ Red\ box}{Total\ number\ of\ fruits\ in\ the\ red\ box}$$
$$p(Fruit = orange|Box = red) := \frac{6}{8}$$

Given that the box is blue, proability of fruit being apple:

$$p(Fruit = apple|Box = blue) := \frac{Number\ of\ apples\ in\ blue\ box}{Total\ number\ of\ fruits\ in\ the\ blue\ box}$$
$$p(Fruit = apple|Box = blue) := \frac{3}{4}$$

Given that the box is blue, proability of fruit being orange:

$$p(Fruit = orange|Box = blue) := \frac{Number\ of\ oranges\ in\ blue\ box}{Total\ number\ fruits\ in\ the\ blue\ box}$$
$$p(Fruit = orange|Box = blue) := \frac{1}{4}$$

Question : What is the probability that it was picked from the blue box, given that the fruit is an orange ?

$$p(Box = blue|Fruit = orange) = \frac{p(Fruit = orange|Box = blue) * P(Box = blue)}{p(Fruit = orange)}$$
$$p(Fruit = orange) = [p(Fruit = orange|Box = red) * p(Box = red)] + [p(Fruit = orange|Box =$$
$$p(Fruit = orange) = \frac{6}{10} * \frac{3}{4} + \frac{4}{10} * \frac{1}{4}$$
$$p(Fruit = orange) = 0.55$$

Hence

$$p(Box = blue|Fruit = orange) = \frac{p(Fruit = orange|Box = blue) * P(Box = blue)}{p(Fruit = orange)}$$
$$p(Box = blue|Fruit = orange) = \frac{0.4 * 0.25}{0.55}$$
$$p(Box = blue|Fruit = orange) = 0.181818$$

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Question 5

L2 Regularisation error function

- In L2, penalty lambda term is added, which is squares of magnitude of parameters,

$$E(W) = \frac{1}{2}\sum_{n=1}^{N}(t_n - w.\,\phi(x_n))^2 + \frac{\lambda\sum_{j=0}^{M-1} w_j^2}{2}$$

so $\frac{\partial E(w)}{\partial w}$ is :

$$\frac{\partial E(w)}{\partial w} = \frac{\partial(\frac{1}{2}\sum_{n=1}^{N}(t_n - w.\,\phi(x_n))^2 + \frac{\lambda\sum_{j=0}^{M-1} w_j^2}{2})}{\partial w}$$

Hence,

$$\frac{\partial E(w)}{\partial w} = -\sum_{n=1}^{N}(t_n - w.\,\phi(x_n))\phi(x_n) + \lambda\sum_{j=0}^{M-1} w_j$$

> **Updating weight steps for SGD and BGD :**

**** For BGD***

$$w = w^{(k-1)} - \eta' \bigtriangledown E(w^{(k-1)})$$

Substitute $\bigtriangledown E(w)$ from L2 regularisation gives weight of BGD

Hence,

$$w = w^{(k-1)} + \eta' \sum_{n=1}^{N}(t_n - w^{(k-1)}.\,\phi(x_n))\phi(x_n) - \eta'\lambda\sum_{j=0}^{M-1} w_j^{(k-1)}$$

**** For SGD***

$$w^{\tau} = w^{(\tau-1)} - \eta' \bigtriangledown E_n(w^{(\tau-1)})$$

Substitute $\bigtriangledown E(w)$ from L2 regularisation gives weight of SGD

Hence,

$$w^{\tau} = w^{(\tau-1)} + \eta' \sum_{n=1}^{N}(t_n - w^{(\tau-1)}.\,\phi(x_n))\phi(x_n) - \eta'\lambda\sum_{j=0}^{M-1} w_j^{(\tau-1)}$$