Assignment 1
AI1110 : Probability and Random Variables

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Question:12.13.3.2: A bag contains 4 red and 4 black balls, another bag contains 2 red and 6 black balls. One of the two bags is selected at random and a ball is drawn from the bag which is found to be red. Find the probability that the ball is drawn from the first bag.

Solution:
B be the random variable of choosing a bag whose possible values are 1 and 2
R be the random variable of choosing a bag whose possible values are 0 and 1
Let B=1 be the event of selecting the first bag
B=2 be the event of selecting the second bag
R=1 be the event of drawing a red ball
R=0 be the event of drawing a white ball
Given,

$$\Pr(R=1|B=1) = \frac{4}{8} = \frac{1}{2}$$

$$\Pr(R=1|B=2) = \frac{2}{8} = \frac{1}{4}$$

$$\Pr(B=1) = \frac{1}{2}$$

$$\Pr(B=2) = \frac{1}{2}$$

$\Pr(B=1|R=1)$= probability of choosing bag 1 given that the ball is red

$$\Pr(B=1|R=1) = \frac{\Pr(R=1|B=1)\,.\,\Pr(B=1)}{\Pr(R=1|B=1)\,.\,\Pr(B=1) + \Pr(R=1|B=2)\,.\,\Pr(B=2)}$$

$$= \frac{\frac{1}{2}\cdot\frac{1}{2}}{\frac{1}{2}\cdot\frac{1}{2} + \frac{1}{4}\cdot\frac{1}{2}} = \frac{\frac{1}{4}}{\frac{1}{4}+\frac{1}{8}} = \frac{2}{3} \qquad (1)$$

Hence,

$$\Pr(B=1|R=1) = \frac{2}{3}$$

The probability that the ball is drawn from the first bag is $\frac{2}{3}$.