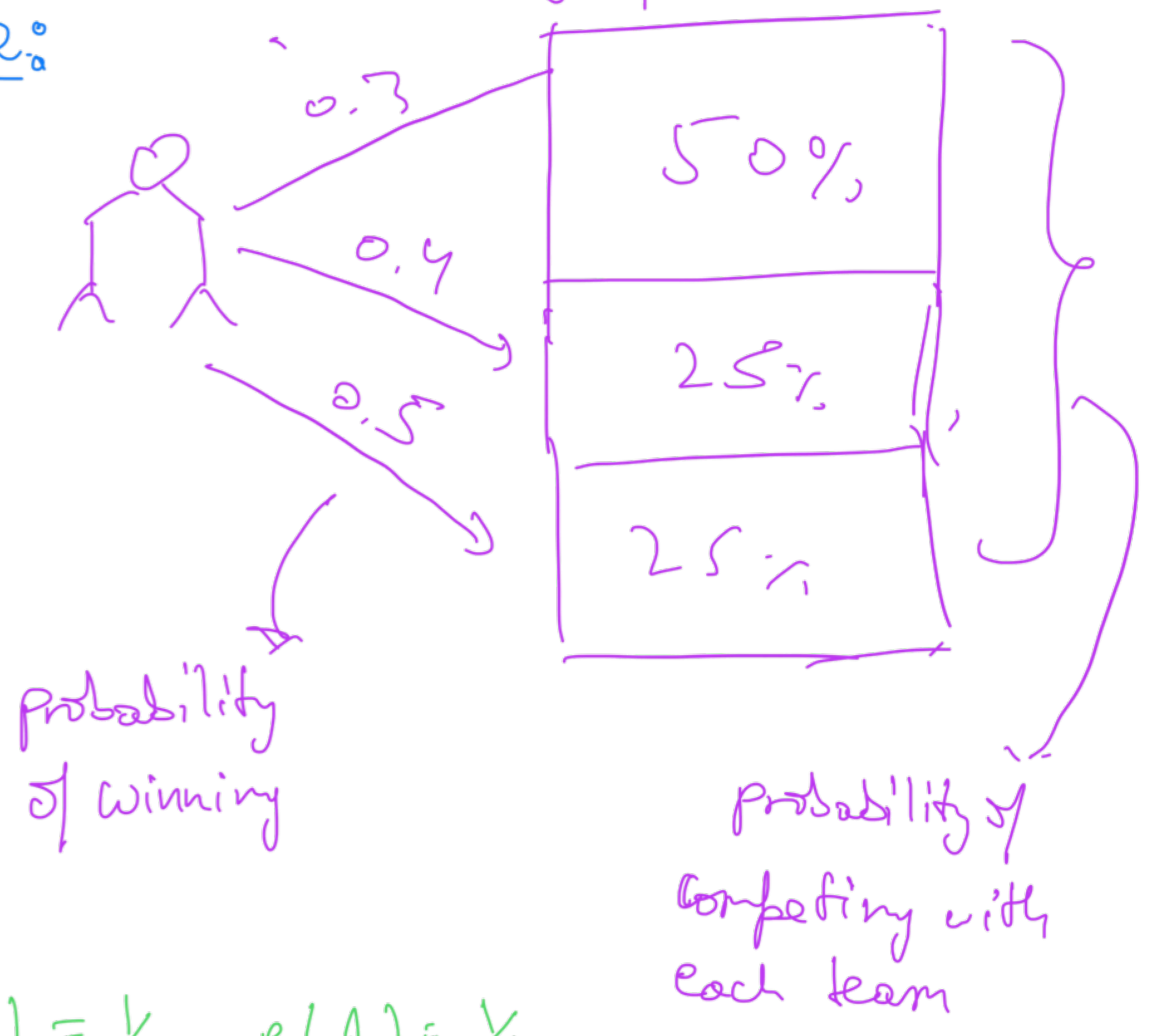
Example:

Find probability of winning



$P(A_1) = \frac{1}{2} \quad P(A_2) = \frac{1}{4}, \quad P(A_3) = \frac{1}{4}$

$$P(W) = P(A_1)\cdot P(W/A_1) + P(A_2)\cdot P(W/A_2) + P(A_3)\cdot P(W/A_3)$$

$$= \frac{1}{2} \times 0.3 + \frac{1}{4} \times 0.4 + \frac{1}{4} \times 0.5$$

$$= 0.15 + 0.1 + 0.125$$
$$0.375$$

$$\boxed{P(W) = 0.375}$$

Baye's Theorem : It is used for inference.

There are a no. of "Causes" that may result in certain effect. We observe the effect & we wish to infer the cause

Definition: Let $A_1, A_2 \ldots A_n$ be disjoint events that form a partition of three sample space & assume that $P(A_i) > 0$. Then, for any event B ($P(B) > 0$), we have:

$$\boxed{P(A_i/B) = \frac{P(A_i)\cdot P(B/A_i)}{P(B)} = \frac{P(A_i)\,P(B/A_i)}{P(A_1)\cdot P(B/A_1) + P(A_2)\cdot P(B/A_2) + \ldots + P(A_i)\,P(B/A_i)}}$$

Example: Take the example from before, calculate the probability that you played against Team A_1, suppose you win.

$$P(A_1/B) = \frac{P(A_1)\cdot P(B/A_1)}{P(A_1)\cdot P(B/A_1) + P(A_2)\cdot P(B/A_2) + P(A_3)\cdot P(B/A_3)}$$

$$= \frac{0.5 \times 0.3}{0.5 \times 0.3 + 0.4 \times 0.25 + 0.5 \times 0.25} = \frac{0.15}{0.375}$$

$$= \frac{\cancel{150}\ \cancel{30}\ \cancel{6}\ 2}{\cancel{375}\ \cancel{75}\ \cancel{15}\ 5} = \frac{2}{5}$$

$$\boxed{P(A_1/B) = \frac{2}{5}}$$