Agenda

- Conditional Probability
- The law of Total probability

80 % → 20 %

*** Assignments

→ Sample space :

→ Event →

→ Set operations → union, intersection, complement

→ Probability

→ Mutually Exclusive

↓

$P(A \cap B) = 0$

Conditional Probability

Example :

How are you things the

X_1 → How

X_2 → second word

X_3 → third word

$\Rightarrow$ Given that $x_1 =$ "How" and $x_2 =$ "are" the

compute x_3 for every word in the dict

$$P(x_3 \mid x_1 = \text{"How"},\ x_2 = \text{"are"})$$

conditional probability

⇒ possibility of an event (or) outcome happening, based on the existence of a previous event (or) outcome.

Quiz

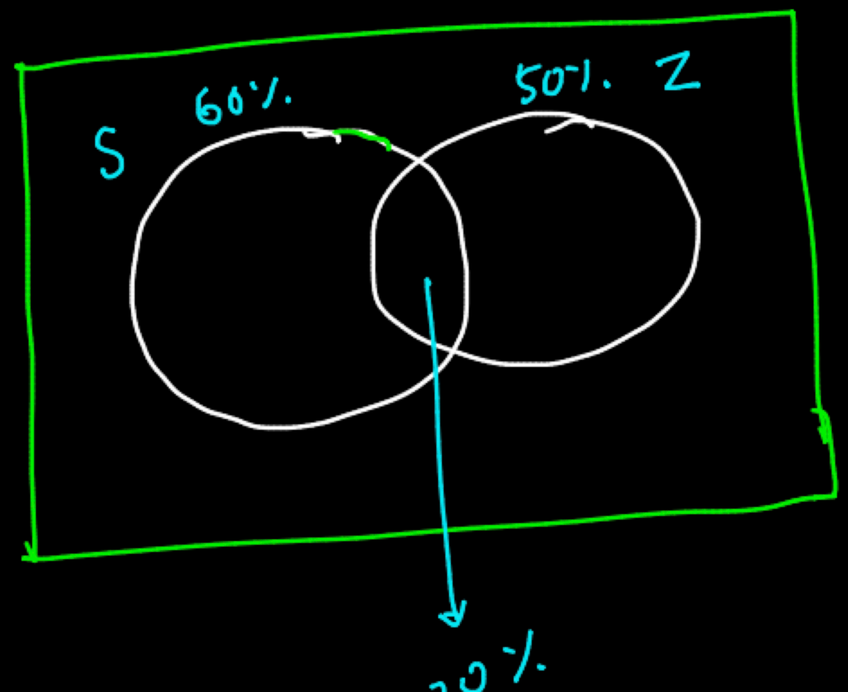
It is known that

60% people use Swiggy

50% " Zomato

20% " " both

Among those who use swiggy, what fraction also use zomato?



$\Rightarrow$ 100

60

20/60 = 1/3 | 50 | 20

Among 60 swiggy user, how many are zomato also

20 ✓

$$P(\text{Zomato} \mid \text{Swiggy}) = \frac{20}{60}$$

Swiggy → 60%

Zomato → 50%

Swiggy ∩ Zomato → 20%

$$P(\text{zomato} \mid \text{swiggy}) = \frac{P(\text{swiggy} \cap \text{Zomato})}{P(\text{swiggy})}$$

$$P(\text{swiggy} \mid \text{zomato}) = \frac{20}{50}$$

$$= \frac{P(\text{swiggy} \cap \text{zomato})}{P(\text{zomato})}$$

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)} \rightarrow \text{Conditional probability}$$

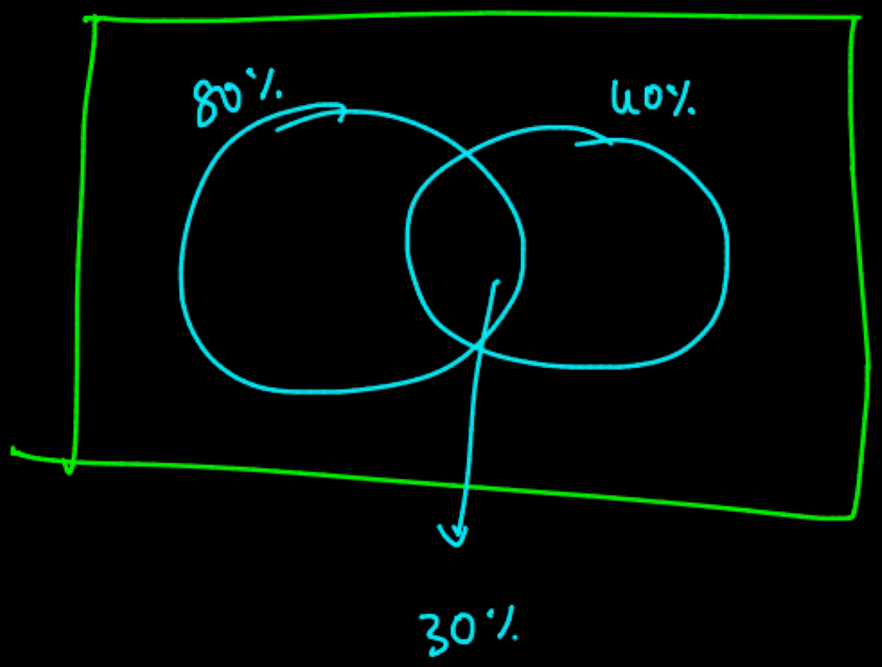
Quiz #2

80% people like cappuccino

40% " espresso

30% both

Among the people who like cappuccino, what fraction of people like espresso?



$\Rightarrow \frac{30}{80}$

$P(C) = 0.8$

$P(E) = 0.4$

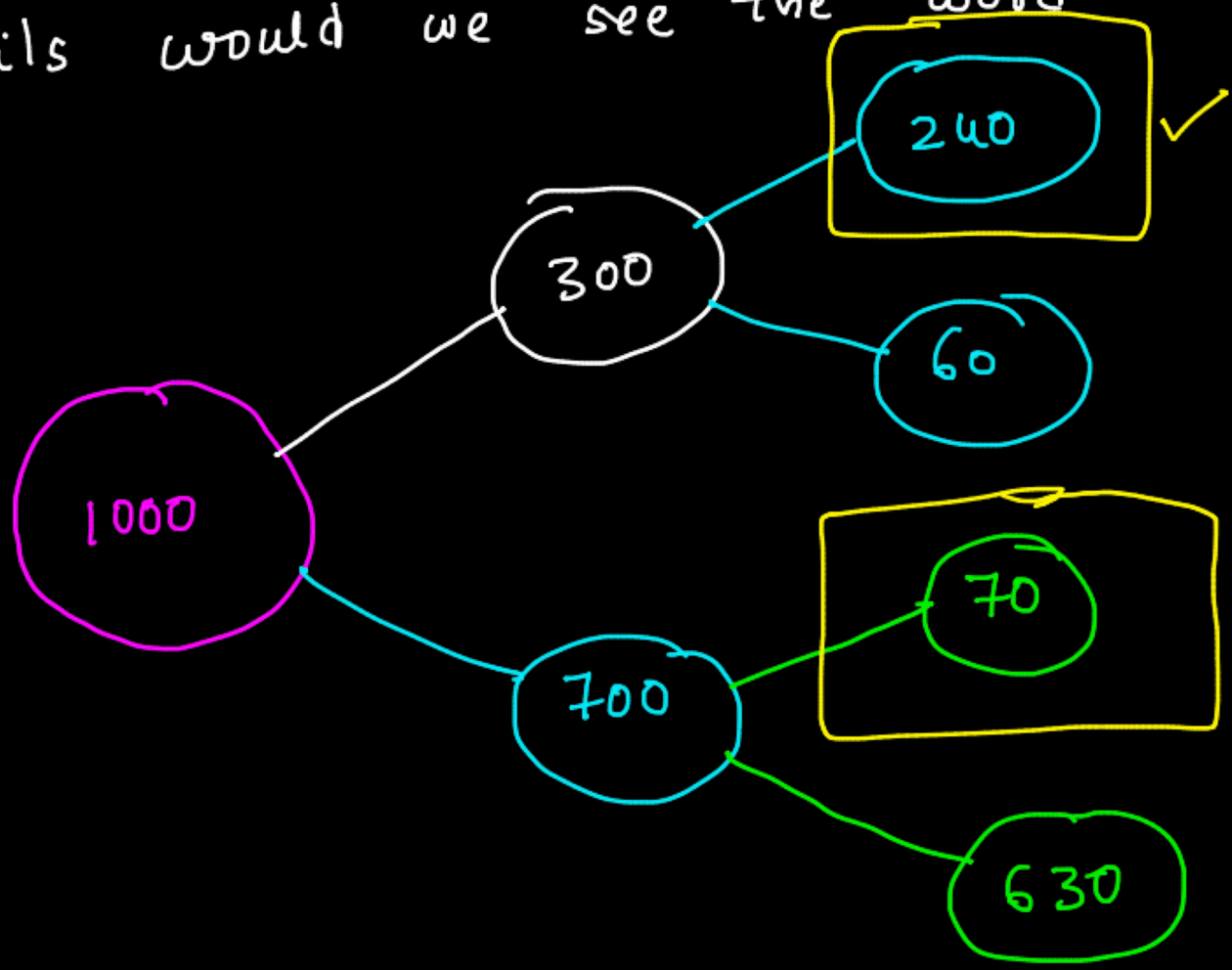
$P(C \cap E) = 0.3$

$$P(E \mid C) = \frac{P(E \cap C)}{P(C)} = \frac{0.3}{0.8} = \frac{3}{8}$$

Quiz #4

30% of emails are spam, 70% are not spam, the word "purchase" occurs in 80% of spam emails. It also occurs in 10% of non-spam emails. Overall, in what % of emails would we see the word "purchase"?

⇒



⇒ 310/1000

⇒ 31%

Quiz

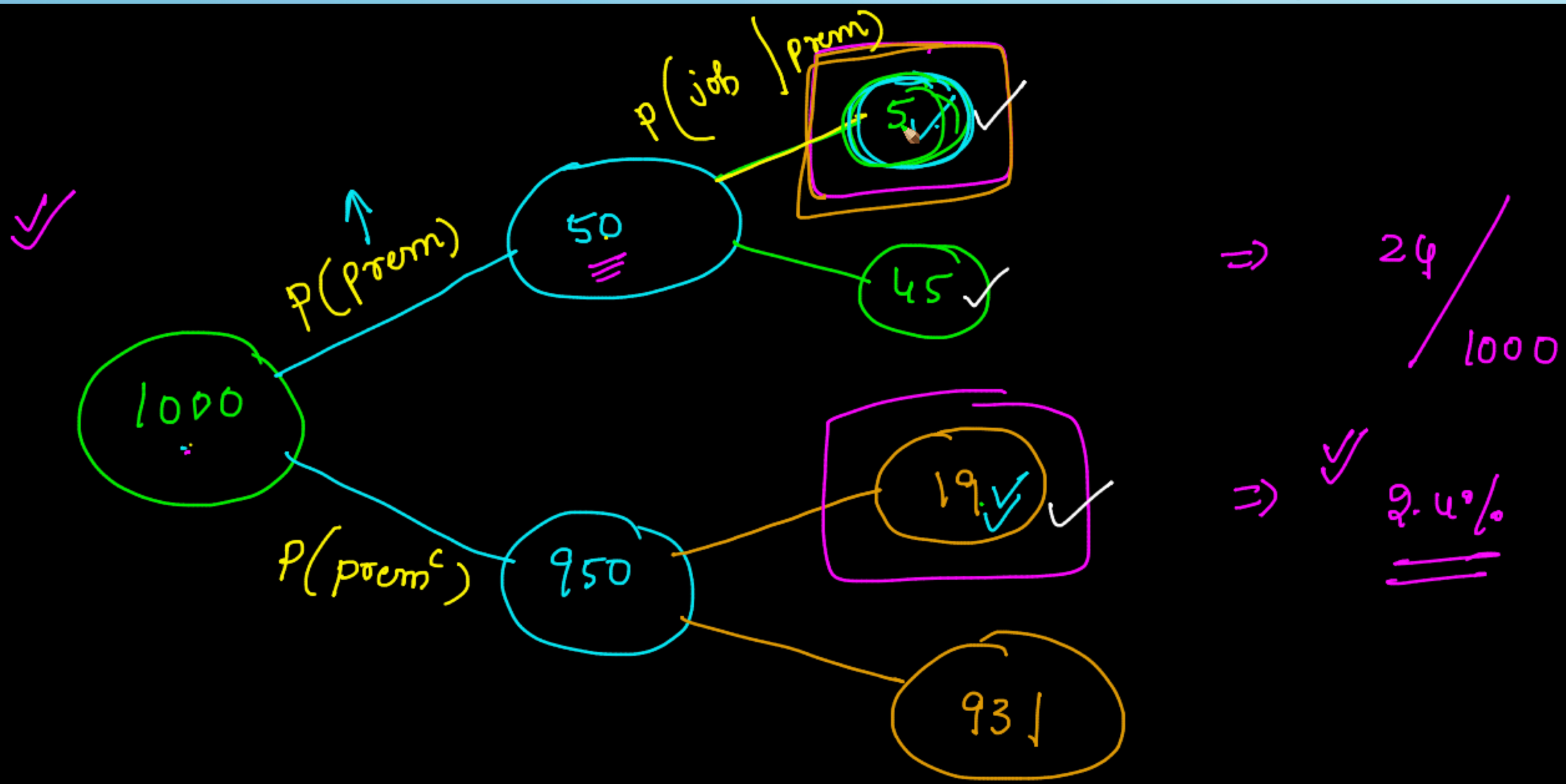
→ 5% of all LinkedIn users are premium users

→ 10% of premium users are actively seeking new job opportunities

→ only 2% of non-premium users are actively seeking new job opportunities

→ Overall, what % of people are actively seeking new job opportunities.

a. 2%
b 2.4%
c 3.7%
d. 5%

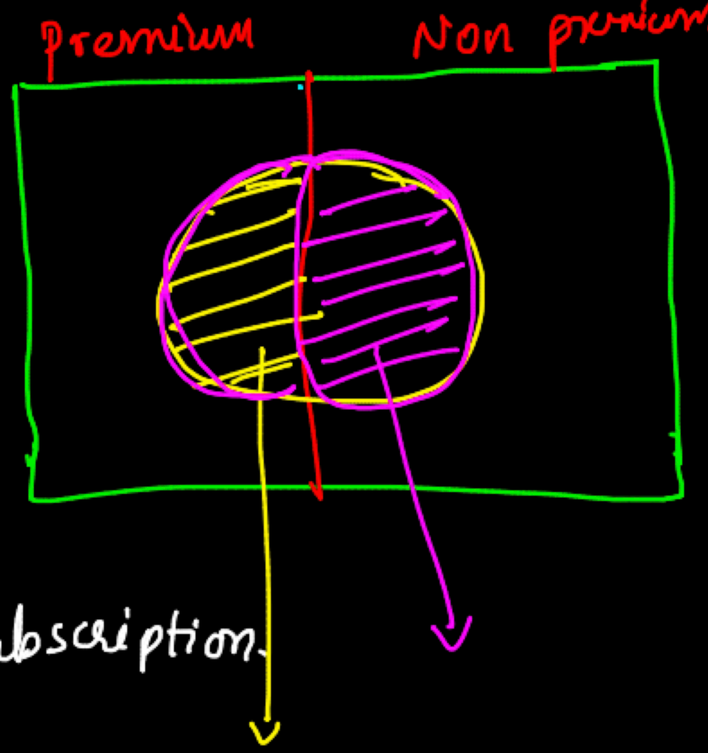


$1000 * 0.05 * 0.1$

$1000 * 0.005 \Rightarrow 5$

(1) $P(\text{premium}) = 0.05$

(2) $P(\text{non premium}) = 0.95$



(3) How many people are there who are seeking a job and have premium

(4) $P(\text{not prem} \cap \text{seeking a job}) = \frac{19}{1000} = 0.019$

(5) $P(\text{premium} \cap \text{not job}) = \frac{45}{1000} = 0.045$

(6) $P(\text{non premium} \cap \text{not job}) = \frac{931}{1000} = 0.931$

** (7) $P(\text{seeking a job} \mid \text{premium}) = 0.1$

(8) $P(\text{seeking a job} \mid \text{not premium}) = 0.02$

(9) $P(\text{not seeking job} \mid \text{premium}) = 0.9$

(10) $P(\text{not seeking job} \mid \text{non premium}) = 0.98$

$$P(\text{Seeking a job}) = \frac{24}{1000} = 0.024$$

$$P(\text{premium} \cap \text{Seeking job}) =$$

$$P(\text{prem}) * P(\text{Seeking} \mid \text{prem})$$

$$= 0.05 * 0.1 \Rightarrow 0.005$$

$$P(\text{non prem} \cap \text{seeking a job}) =$$

$$P(\text{non prem}) * P(\text{job} \mid \text{non prem})$$

$$= 0.95 * 0.02 \Rightarrow 0.019$$

$$P(\text{seeking job}) = \underbrace{P(\text{prem}) * P(\text{job} \mid \text{prem}) + P(\text{non prem}) * P(\text{job} \mid \text{non prem})}_{\text{total law of probability}}$$

$$P(\text{job}) = P(P \cap \text{job}) + P(\text{non}P \cap \text{job})$$

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

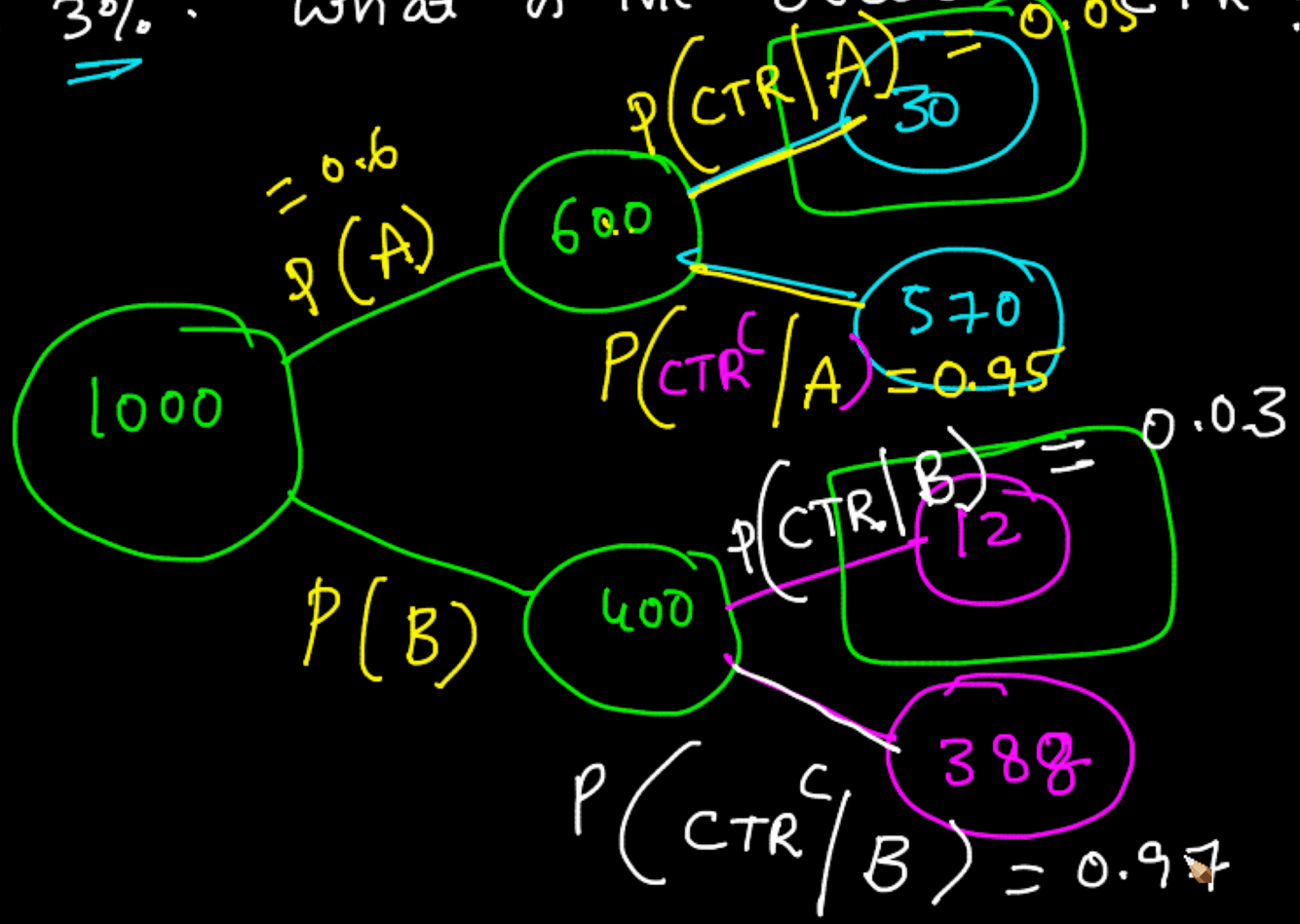
$$P(A \cap B) = P(B) * P(A \mid B)$$

Quiz

A e-commerce website shows 2 types of ads: Type A & Type B

60% of the visitors see Type A ads, and 40% visitors see type B

The CTR for type A ads is 5% while the CTR for type B ads is 3%. What is the overall CTR?



$\Rightarrow \frac{42}{1000}$

$\Rightarrow$ 4.2%

$$P(CTR) = P(A) * P(CTR|A) + P(B) * P(CTR|B)$$

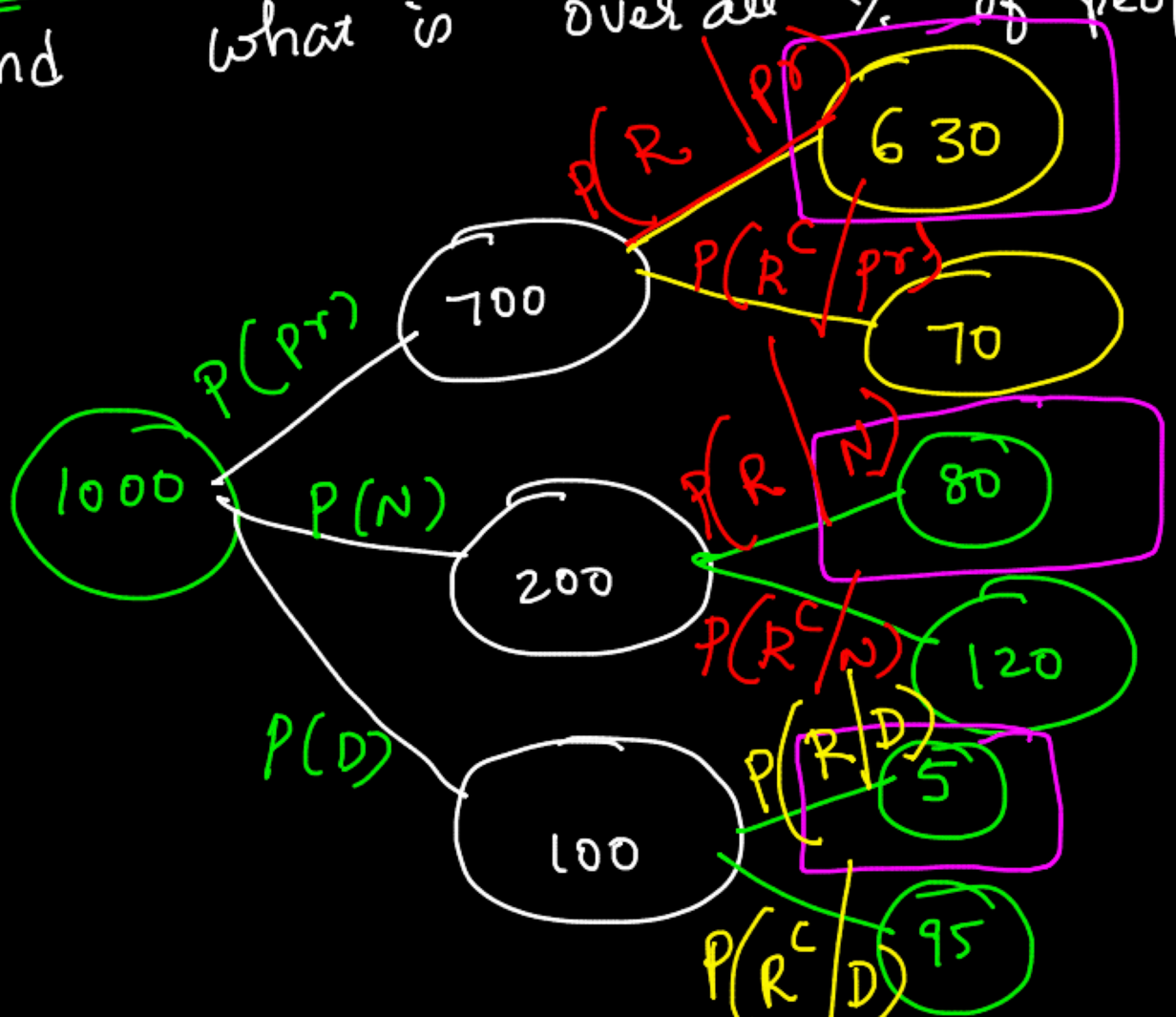
⇒ Total law of probability

$$= 0.6 * 0.05 + 0.4 * 0.03$$

$$= 0.03 + 0.012$$

$$\Rightarrow 0.042$$

⇒ NPS Survey - it is seen that 70% are promoters. 20% are neutral, 10% are detractors, 90% of promoters, 40% of neutral and 5% of detractors recommend the product to a friend what is overall % of people recommend the product.



$$\Rightarrow \frac{630+80+5}{1000}$$

$$\Rightarrow \frac{715}{1000}$$

$$= 71.5\%$$

$$P(\text{Recomm}) = P(Pr \cap R) + P(N \cap R) + P(D \cap R)$$

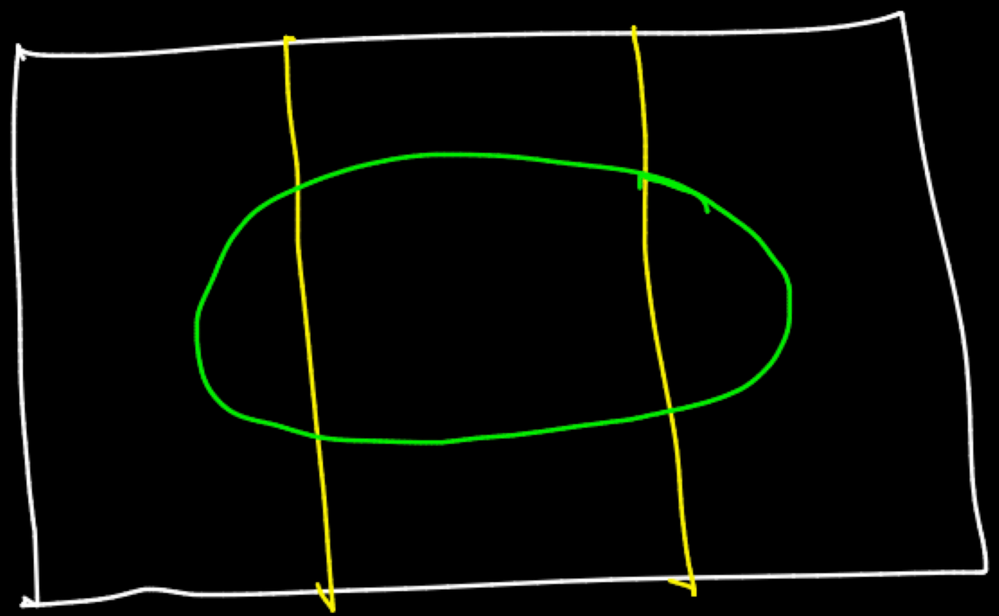
$$= P(Pr) * P(R/Pr) + P(N) * P(R/N) + P(D) * P(R/D)$$

$$= 0.7 * 0.9 + 0.2 * 0.4 + 0.1 * 0.05$$

$$= 0.63 + 0.08 + 0.05$$

$$= 0.715 \Rightarrow 71.5\%$$

✓



$\Rightarrow$ mutually Exclusive and exhaustive

$A_1 \quad A_2 \quad A_3 \quad --- \quad A_n$

$$P(A_1) + P(A_2) + P(A_3) + \text{---} + P(A_n) = 1$$

$$P(A_1 \cup A_2 \cup \cdots \cup A_n) =$$

$$P(A_1) + P(A_2) + \cdots + P(A_n) = 1$$

$$P(A_1 \cap A_2) \cap A_3 \cap A_4 \cdots) = 0$$

Mutually Exclusive events

Summary

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

Multiplication Rule

$$P(A \cap B) = P(A \mid B) * P(B)$$

Total law of Probability

$$P(A) = \sum_{i=1}^{n} P(A \mid B_i) * P(B_i)$$