* Combinatorics

→ Permutations (Arrangements)

→ Combinations. (selection / choosing)

* Permutations:

$$\underset{1}{A}\ \underset{2}{B} \overset{?}{\neq} B\ A$$

→ Arrangement / ordering matters.

* Combinations

$$A\ B = B\ A$$

(Q)

2 Quizes → T, F

Q1 AND Q2

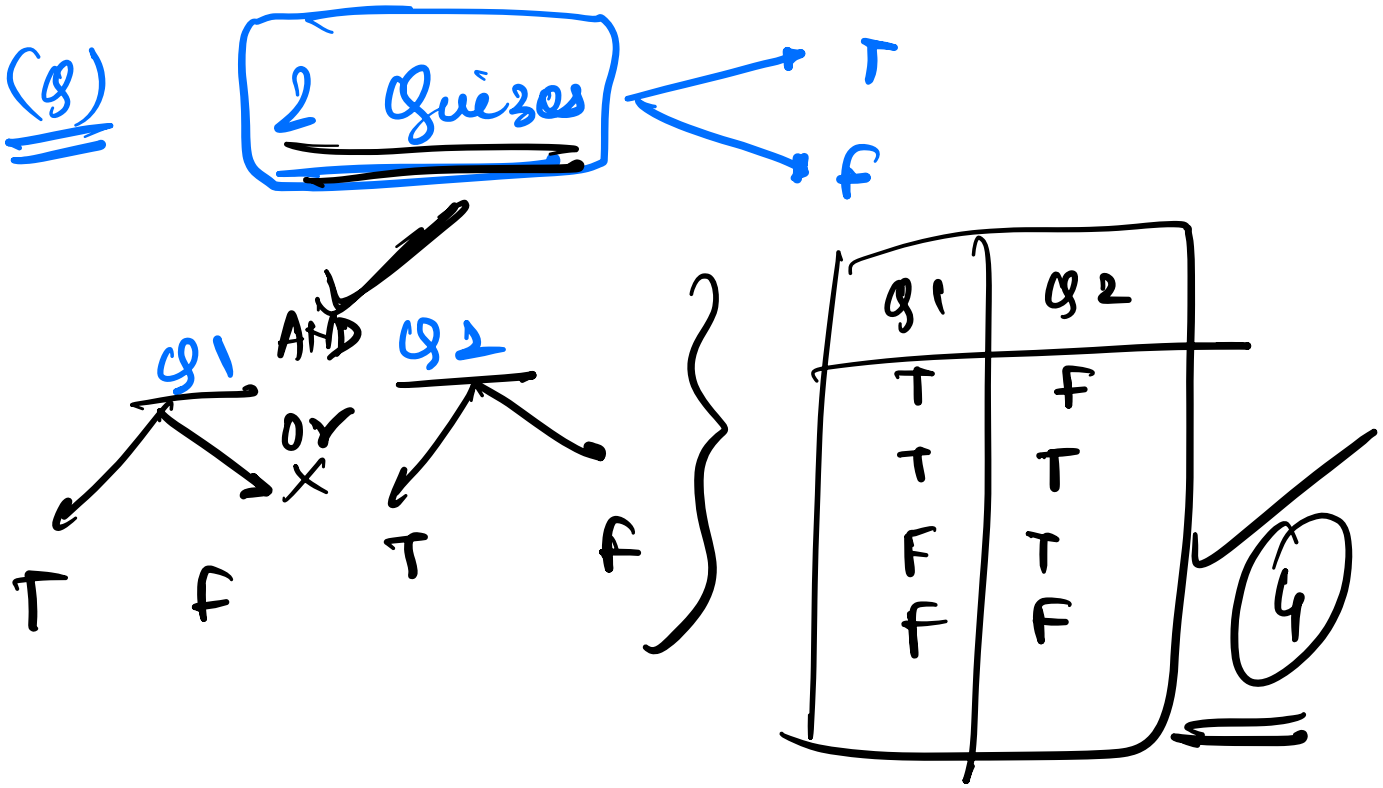
Q1 → T, F

Q2 → T, F

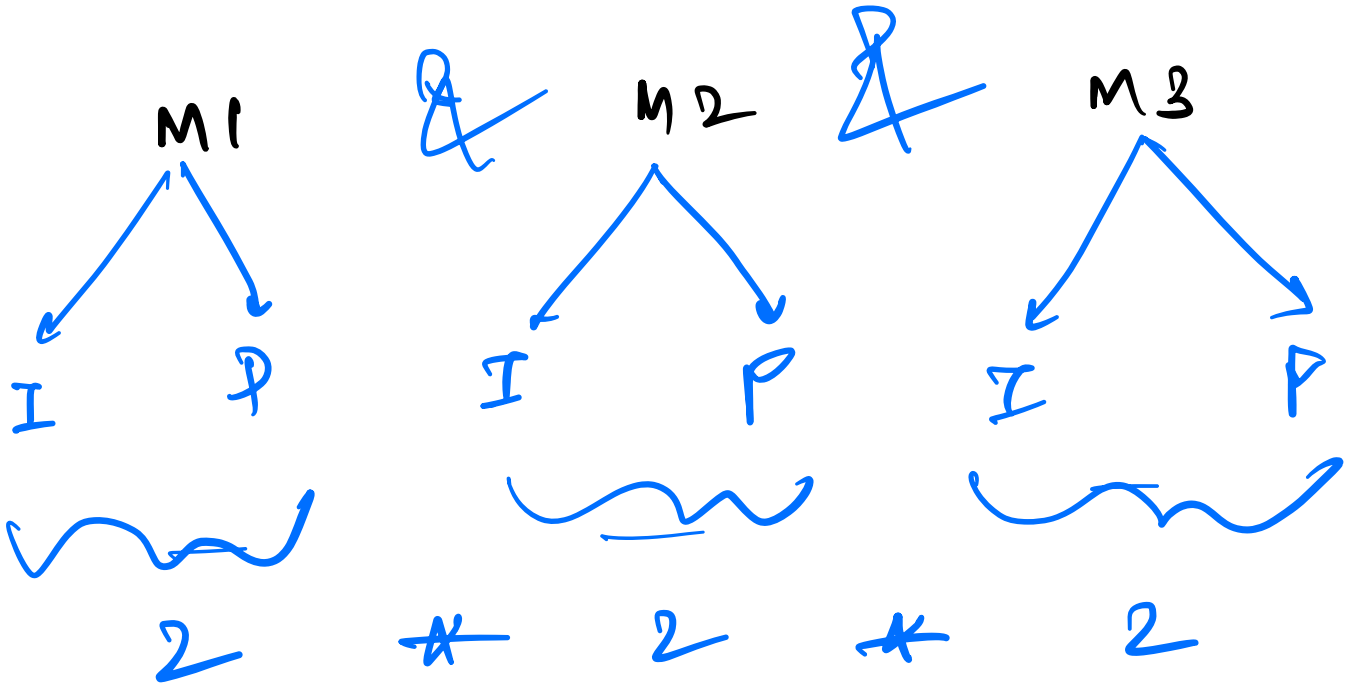
OR ✗

Q1	Q2
T	F
T	T
F	T
F	F

4

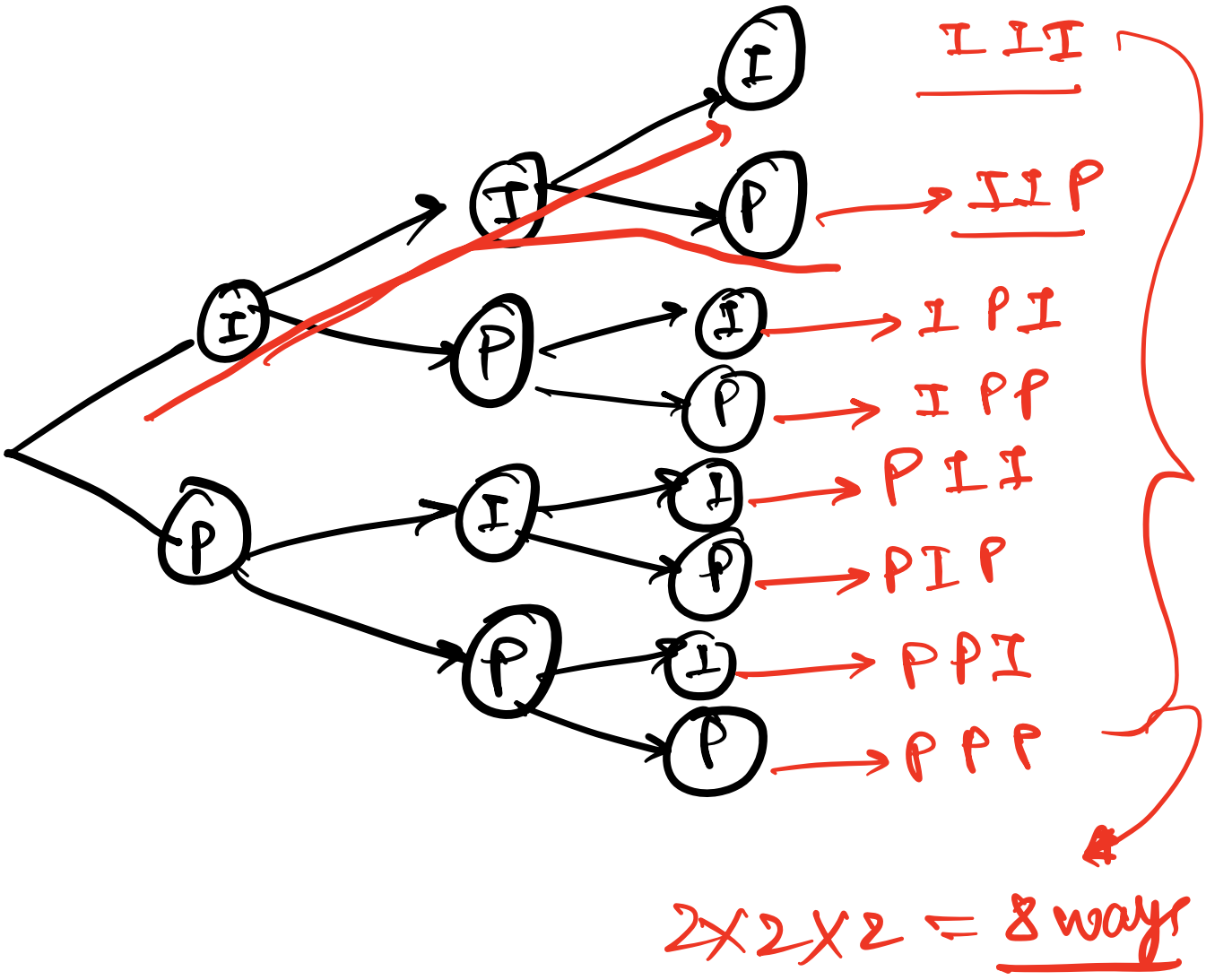


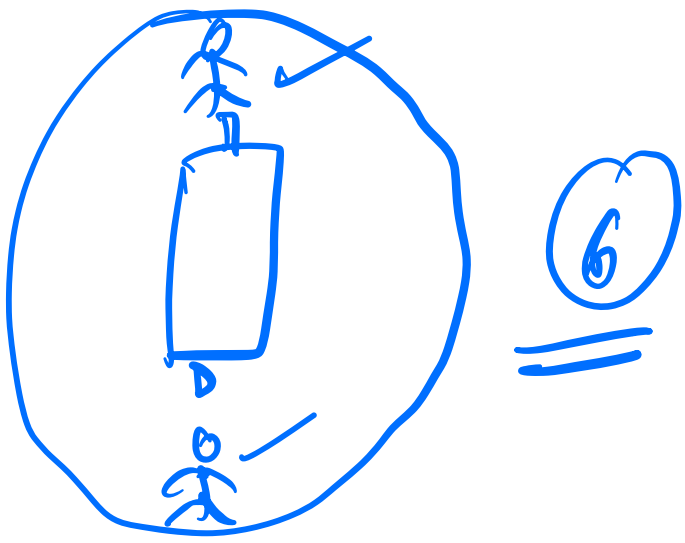
Quiz 1:



$= 2 \times 2 \times 2$

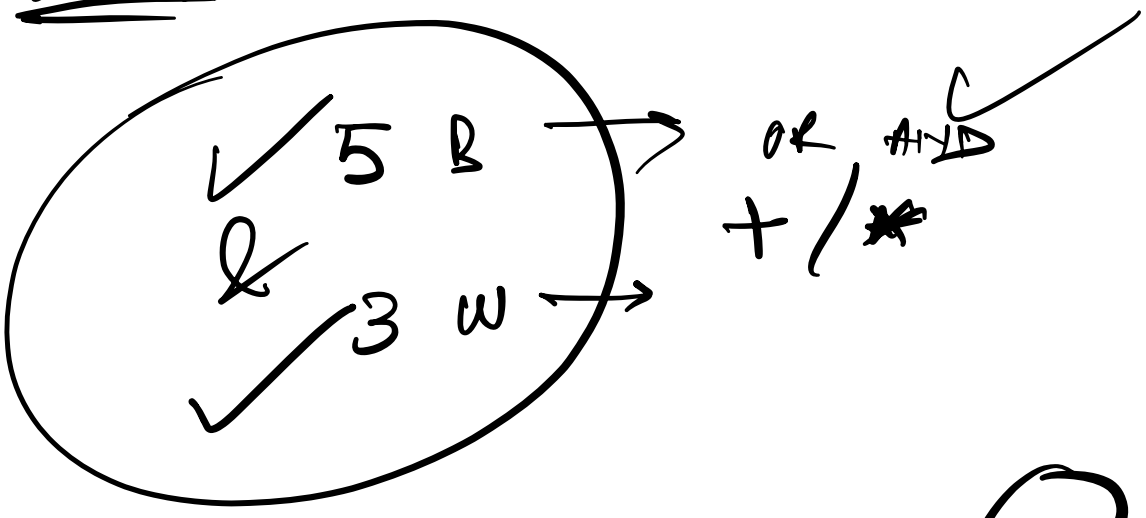
$= \underline{8 \text{ ways}}$



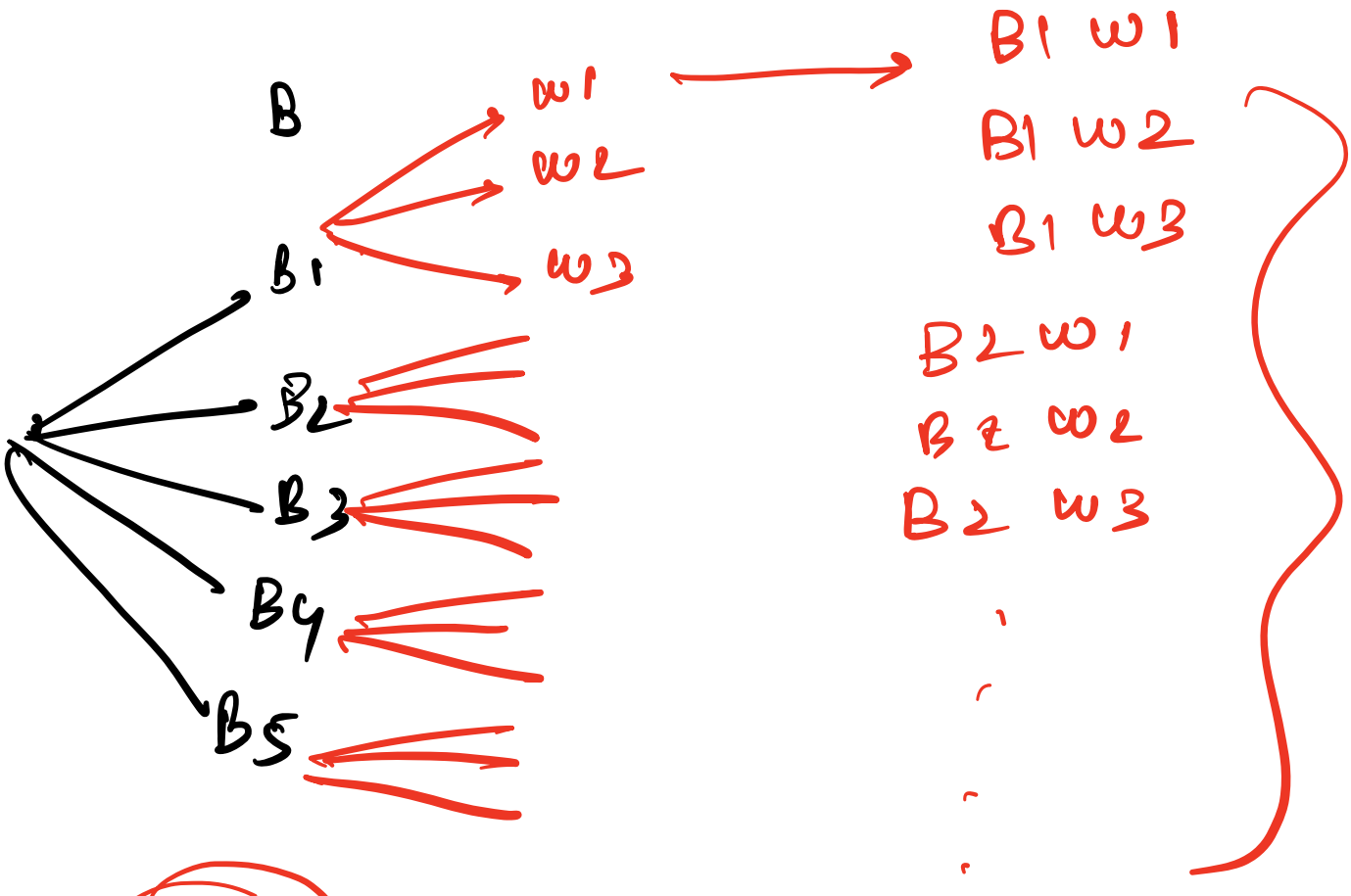


6

Quiz 2 :



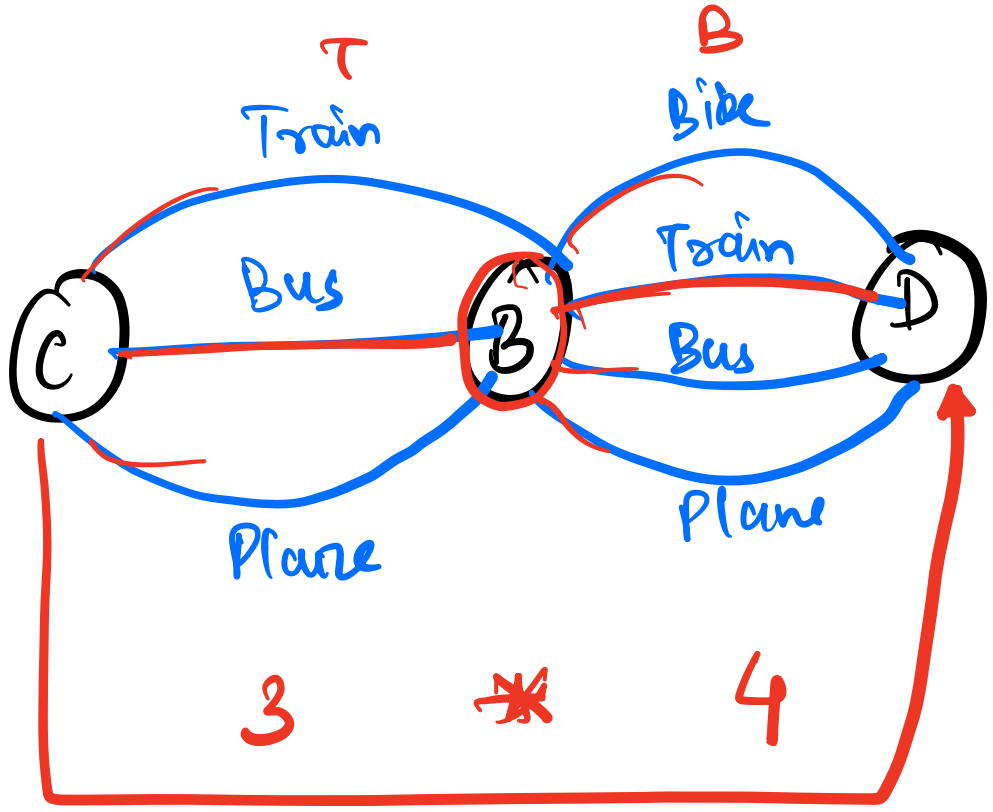
5 * 3 → 15



B1 W1
W1 B1
Same

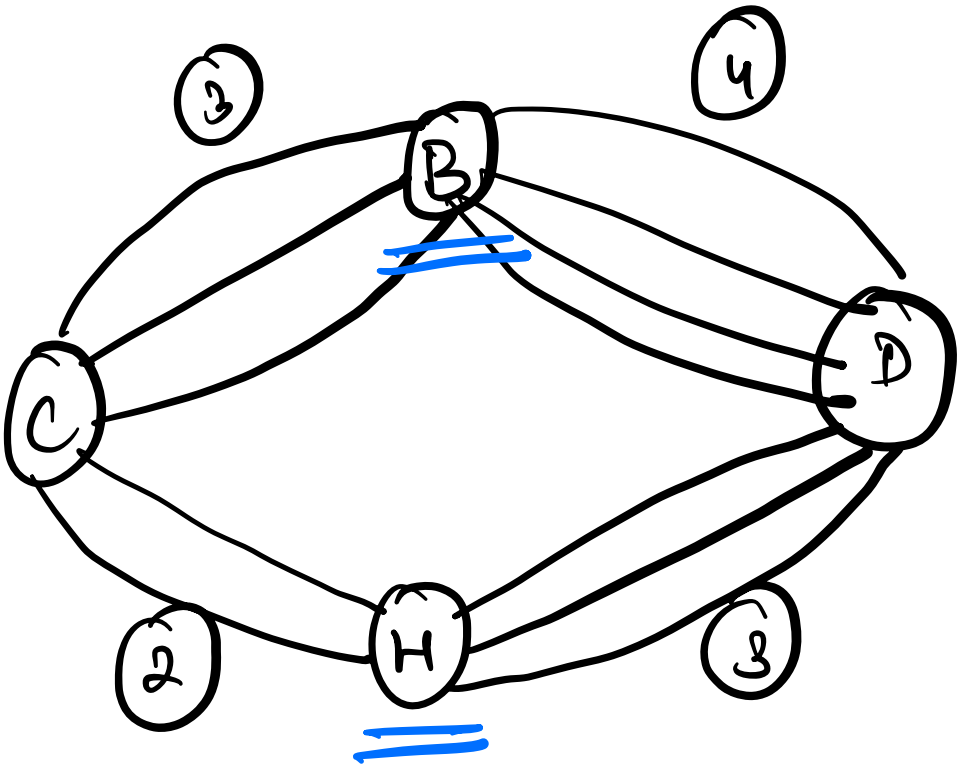
5 X 3 = 15 ways

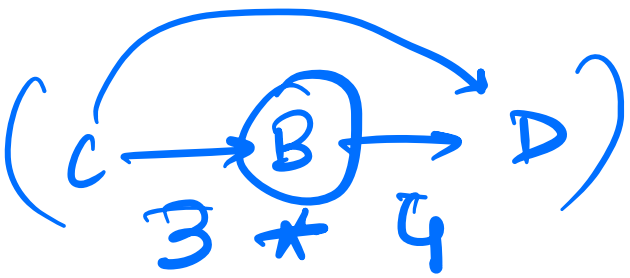
Quiz3 :



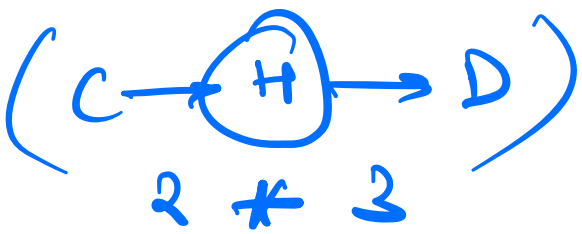
= 12 ways

Quiz 4 :-





or



= 12 ways

= 6 ways

12 + 6 = **18 ways**

Quiz 5:

Burgers (B) → 3 → B1, B2, B3

Pizzas (P) → 3 → P1, P2, P3

Drinks (D) → 3

Sandwiches (S) → 5

Fruits (F) → 7

C1 → B (3) & S (5) } → 3×5 → 15

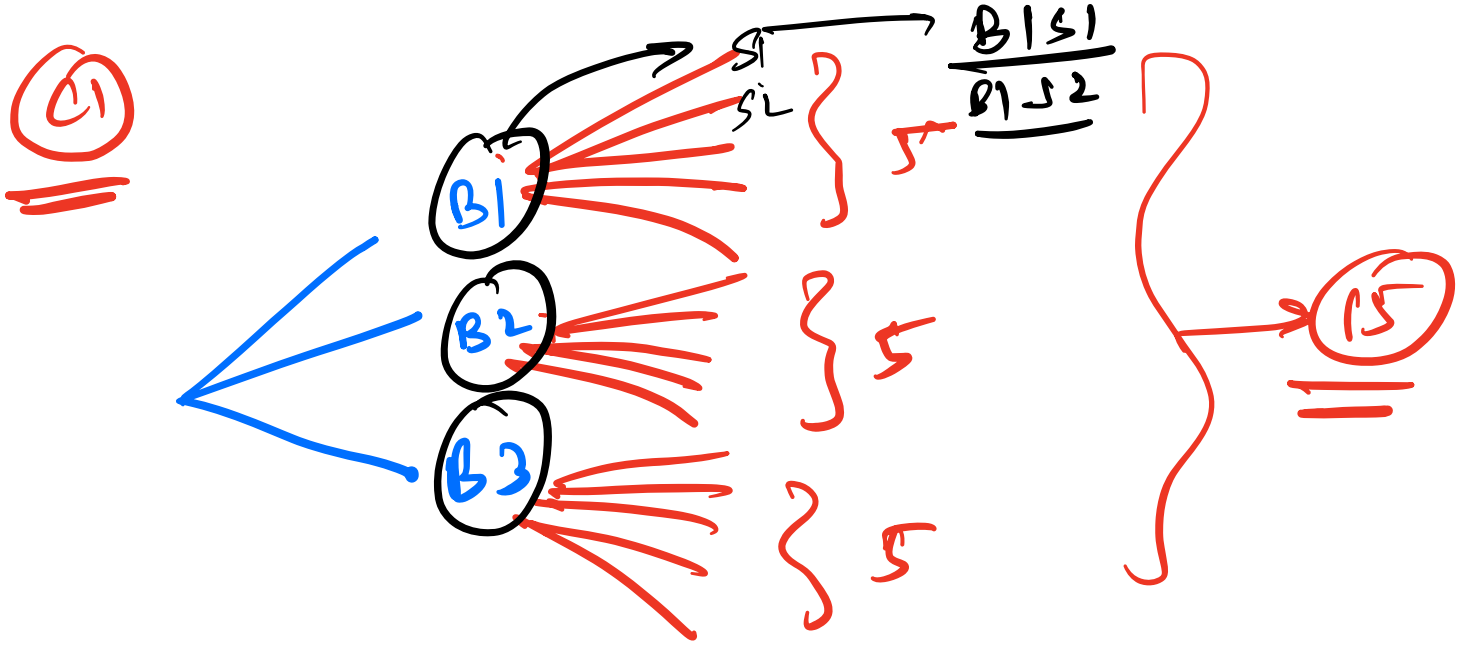
OR

C2 → F (7) & D (3) } → 7×3 → 21

OR

C3 → P (3) } → 3 → 3

Ans ⇒ 15 + 21 + 3 = 39


C1
B1
B2
B3
S1
S2
B1S1
B1S2
5
5
5
15

Permutation , Combination

* Permutation → Arrangement of objects

↓

order

$(i, j) \neq (j, i)$

* Combinations → order doesn't matter

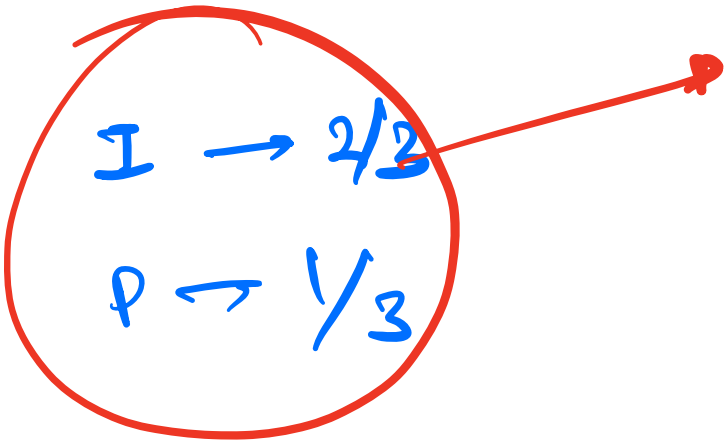
$(i, j) = (j, i)$

eg

3M → series

M1 M2 M3

I/P I/P I/P



Case

India win 2/3 the series

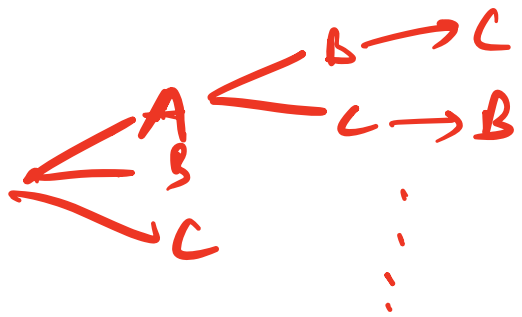
I I P
I P I
P I I

I : 2
P : 1

Permutation : IIP ≠ PII

Quiz 6 :

Case 1 : Repetition NOT allowed



A/B/C B/C C

3 × 2 × 1 = 6 ways

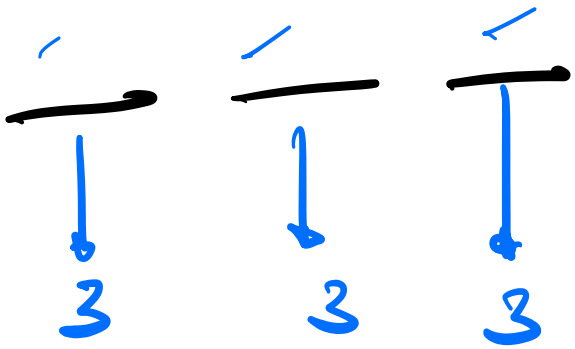
3!

A	B	C
A	C	B
B	A	C
B	C	A
C	A	B
C	B	A

$1 \times 2 \times 3 \cdots \times n \rightarrow n!$

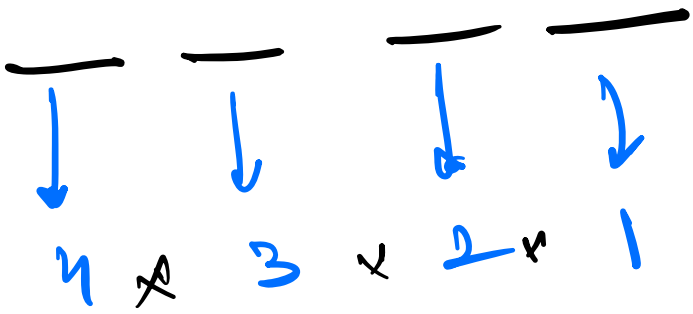
$[\because 0! = 1]$

Case 2 :- Repetition allowed :-



$\Rightarrow 3 \times 3 \times 3 = 27$

Quiz 7: without rep



→ 4! = 24 ways

Quiz 8 :

$${}^5P_2$$

A/B/C/D/E

5 → 4

$5 \times 4 = 20$

$$\Rightarrow \frac{5 \times 4 \times (3 \times 2 \times 1)}{(3 \times 2 \times 1)}$$

$$= \frac{5!}{3!} \Rightarrow {}^5P_2 = \frac{5!}{(5-2)!}$$

Generic formula:- Permutation

N obj into 3 slots

$$NP_3 = N(N-1)(N-2)$$

$$NP_4 = N(N-1)(N-2)(N-3)$$

$$NP_K = N \cdot (N-1) \cdot (N-2) \cdots (N-(K-1))$$

$$= N(N-1)(N-2) \cdots (N-K+1)$$

$$5 \times 4 \times 3 \times 2 \times 1$$

$$= N(N-1)(N-2)\cdots(N-K+1) \times$$

$$(N-K)(N-K-1)\cdots\times 1$$

$$(N-K)(N-K-1)\cdots\times 1$$

$$= \frac{N!}{(N-K)!}$$

$$\boxed{{}^{N}P_{K} = \frac{N!}{(N-K)!}}$$

Quiz 9 :

$$_4P_3 = \frac{4!}{(4-3)!} = \frac{4!}{1!} = \boxed{24}$$

Permutation

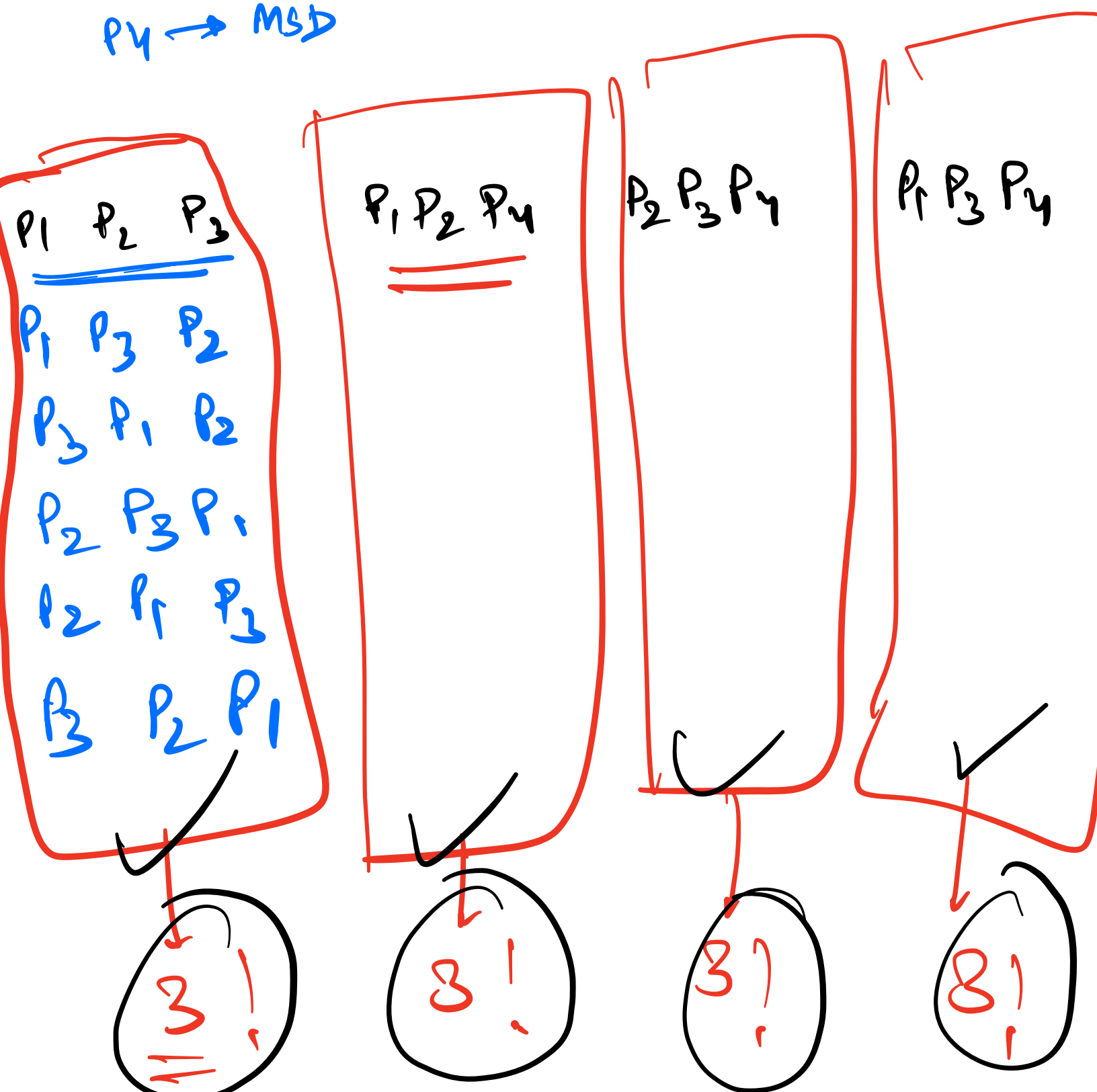
Combinations : In how many ways you can select a team of 3 Players.

$P_1 \rightarrow$ VK

$P_2 \rightarrow$ RS

$P_3 \rightarrow$ HP

$P_4 \rightarrow$ MSD



✓ ✓ ✓ ✓

C ← 4 Teams

P ← 24 Batting orders

$$^{4}C_{3} = \frac{^{4}P_{3}}{3!} = \frac{24}{6} = \boxed{4}$$

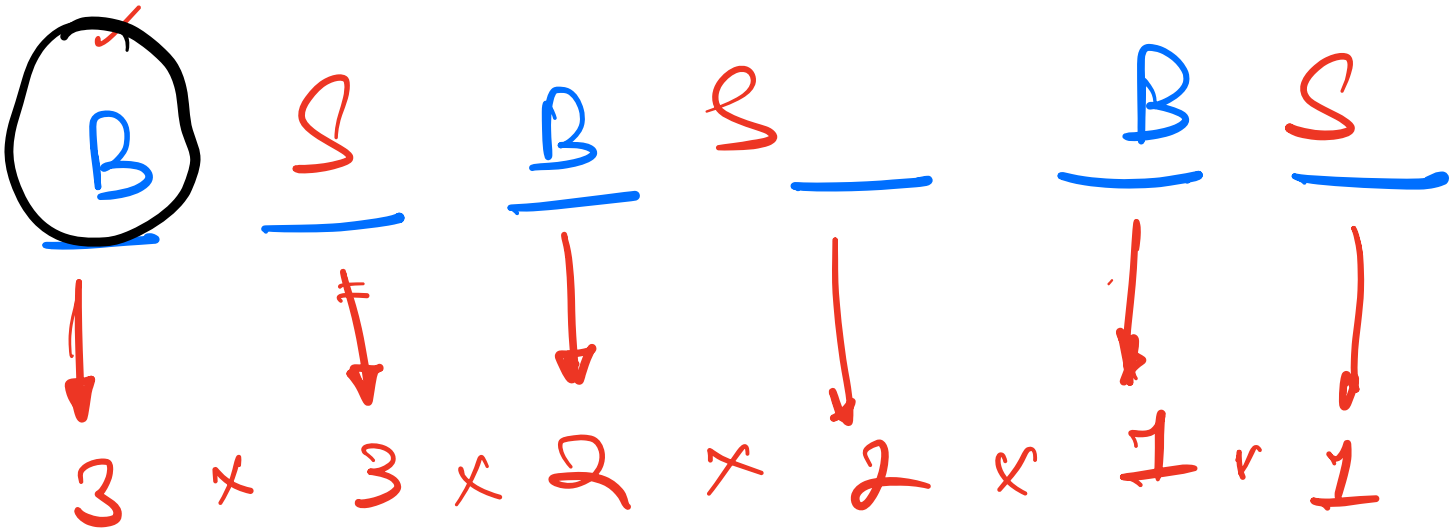
$$
{}^{n}C_{k} = \frac{{}^{n}P_{k}}{k!} = \frac{n!}{(n-k)!} \times \frac{1}{k!}
$$

$$
= \frac{n!}{k! * (n-k)!}
$$

Quiz 10 :-

B ⟶ 3

S ⟶ 3



= 36 ways of arranging the cars.

$3! \times 3!$

S _ B _ S _ B _ S _ B

$3 \times 3 \times 2 \times 2 \times 1 \times 1$

$= 36$ ways

B first ⟶ 36

+

or S first ⟶ 36

} 72 ways

Applications :-

1. Feature Engg
2. Data Sampling
3. ML feature selection