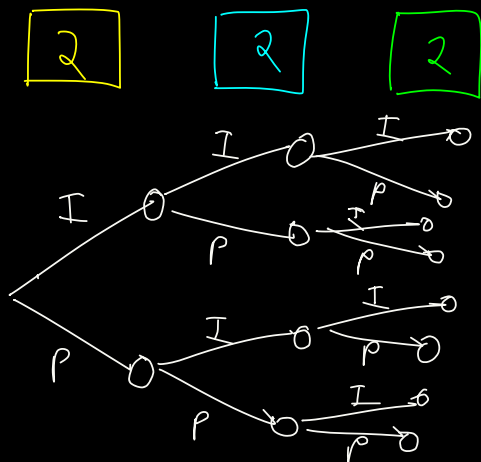


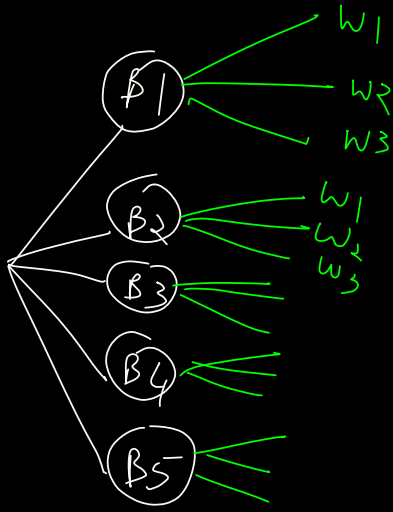
Combinatorics

India and Pakistan play a 3-match series. How many results are possible?
 Note that we consider (Ind, Ind, Pak) different from (Ind, Pak, Ind) etc.



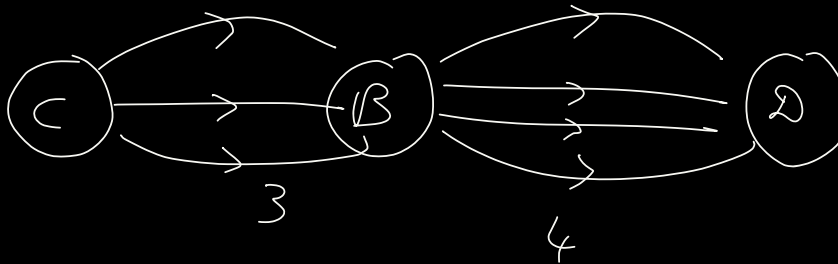
$$2 \times 2 \times 2 = 8$$

In a bowl-out, for a specific ball you have to choose a bowler and a wicket keeper.
Suppose you have 5 bowlers and 3 wicket keepers. How many ways can you select for a ball?



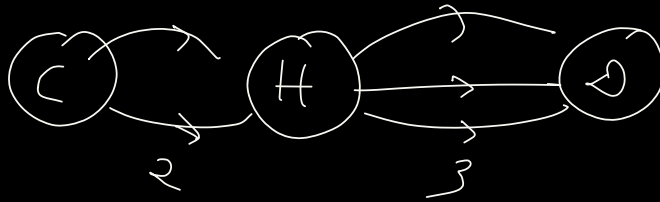
$$5 \times 3 = 15$$

There are 3 ways to move from Chennai to Bangalore.
There are 4 ways to move from Bangalore to Delhi.



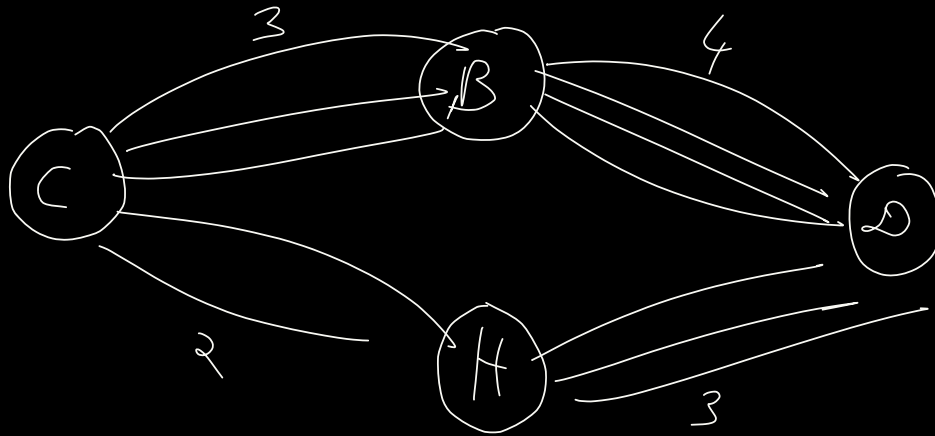
$$3 \times 4 = \underline{\underline{12}}$$

There are 2 ways to move from Chennai to Hyderabad.
There are 3 ways to move from Hyderabad to Delhi.
What are the total ways of moving from Chennai to Delhi?



$$2 \times 3 = 6$$

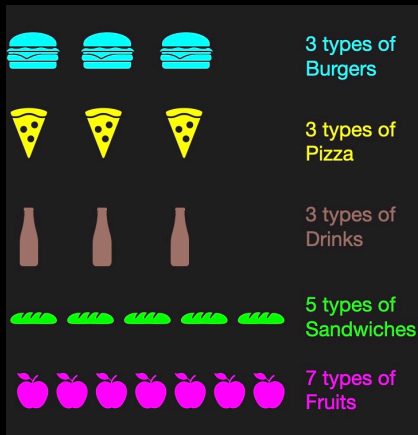
There are 3 ways to move from Chennai to Bangalore, and 4 ways to move from Bangalore to Delhi.
There are 2 ways to move from Chennai to Hyderabad, and 3 ways to move from Hyderabad to Delhi.
In how many ways can we move from Chennai to Delhi?



via BLR $\rightarrow 3 \times 4 = 12$
via Hyd $\rightarrow 2 \times 3 = 6$ } OR \rightarrow addition

$$\underline{\underline{12 + 6 = 18 \text{ ways}}}$$

A fast food outlet has the following types of items in their menu



You can choose one of the following combos:

1 Burger and 1 Sandwich

1 Fruit and 1 Drink

1 Pizza

How many such combos can you make?

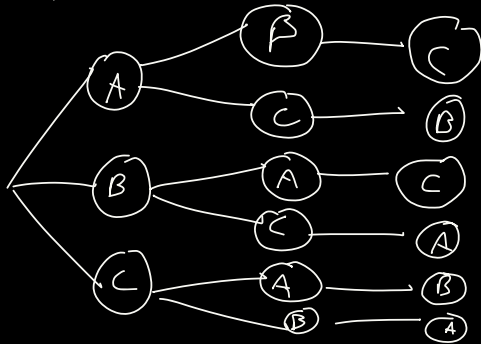
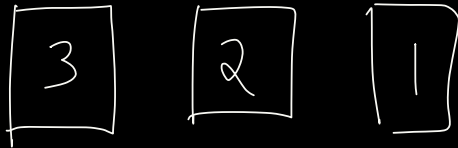
$$\begin{array}{lcl} 1B \& 1S & \rightarrow 3 \times 5 = 15 \\ 1F \& 1D & \rightarrow 7 \times 3 = 21 \\ 1\text{Pizza} & \rightarrow & 3 \end{array} \left. \vphantom{\begin{array}{l} 1B \& 1S \\ 1F \& 1D \\ 1\text{Pizza} \end{array}} \right\} \begin{array}{r} 15 \\ 21 \\ 3 \\ \hline 39 \end{array}$$

total

Permutation (Arrangement)

Order matters!

A B C



$$3 \times 2 \times 1 = 6$$

$3!$ "3 factorial"

A B C D



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

$4!$

Given 5 different characters, in how many ways can we arrange them in 2 places?

5

4

$$\underbrace{5 \times 4}_{2 \text{ terms}} = 20$$

$5P_2$

$$\frac{5 \times 4 \times 3 \times 2 \times 1}{3 \times 2 \times 1} = \frac{5!}{3!}$$

① "N" objects \rightarrow arrange in 3 slots

$${}^N P_3 = N(N-1)(N-2)$$

② "N" objects \rightarrow arrange in 4 slots

$${}^N P_4 = N(N-1)(N-2)(N-3)$$

③ "N" objects \rightarrow arrange in "k" slots $(k \leq N)$

$${}^N P_k = \frac{N(N-1)(N-2) \dots (N-k+1)(N-k)(N-k-1) \dots 3 \times 2 \times 1}{(N-k)(N-k-1) \dots 3 \times 2 \times 1}$$

$${}^N P_k = \frac{N!}{(N-k)!}$$

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

Combinations

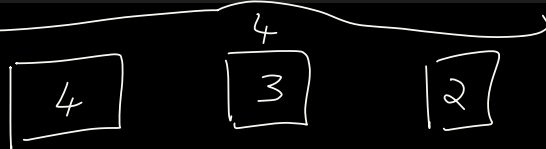
Top-order in cricket \rightarrow No 1, No 2, No 3

4 players who are good at top-order

Sachin / Sehwag / Kohli / Rohit

24 top-order

P1, P2, P3	P1, P2, P4	P1, P3, P4	P2, P3, P4
P1, P3, P2	P1, P4, P2	P1, P4, P3	P2, P4, P3
P2, P1, P3	P2, P1, P4	P3, P1, P4	P3, P2, P4
P2, P3, P1	P2, P4, P1	P3, P4, P1	P3, P4, P2
P3, P1, P2	P4, P1, P2	P4, P1, P3	P4, P2, P3
P3, P2, P1	P4, P2, P1	P4, P3, P1	P4, P3, P2



$$4 \times 3 \times 2 = 24$$

$${}^4P_3 = 4 \times 3 \times 2 = 24$$

Don't care about order $\rightarrow \frac{24}{6} = 4$

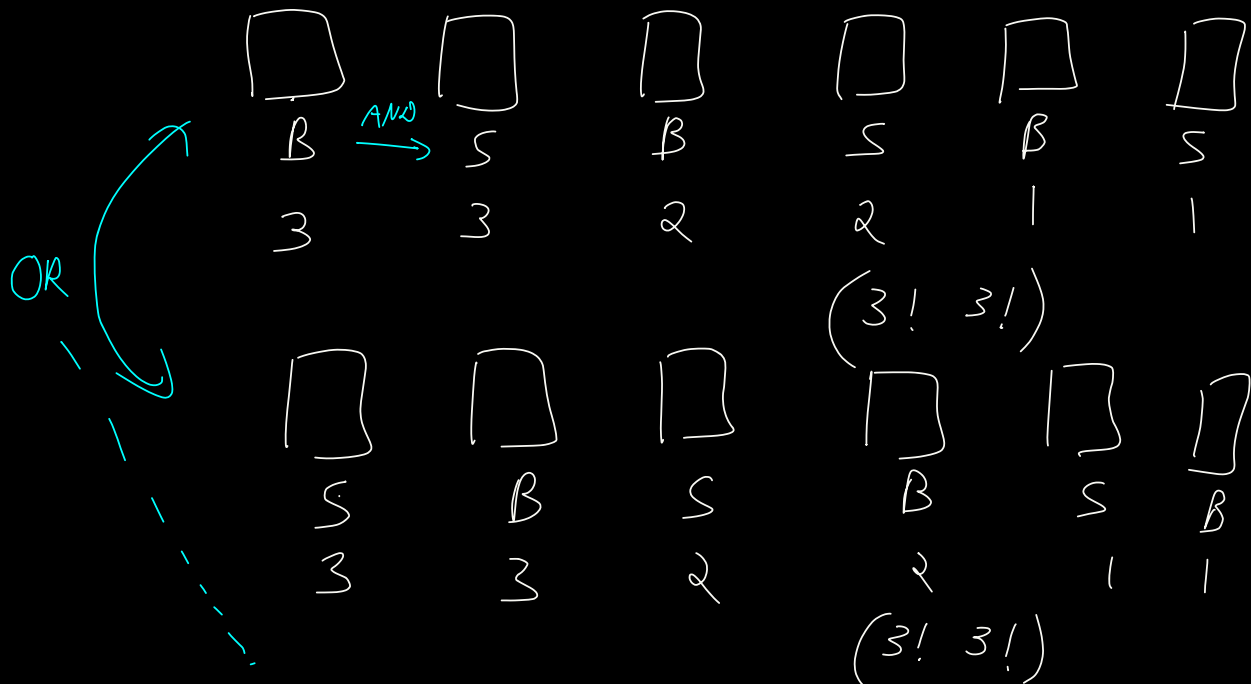
$${}^4C_3 = \frac{{}^4P_3}{3!} = 4$$

$C \rightarrow$ Combinations / Selection

$${}^nC_k = \frac{{}^nP_k}{k!}$$

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

A Maruti Showroom has 3 colours in their "Baleno" model and 3 colours in the "Swift" model. In how many ways can they place it such that Baleno and Swift are kept in alternate slots?



Calculation of total ways:

$$3!3! + 3!3! = 72$$