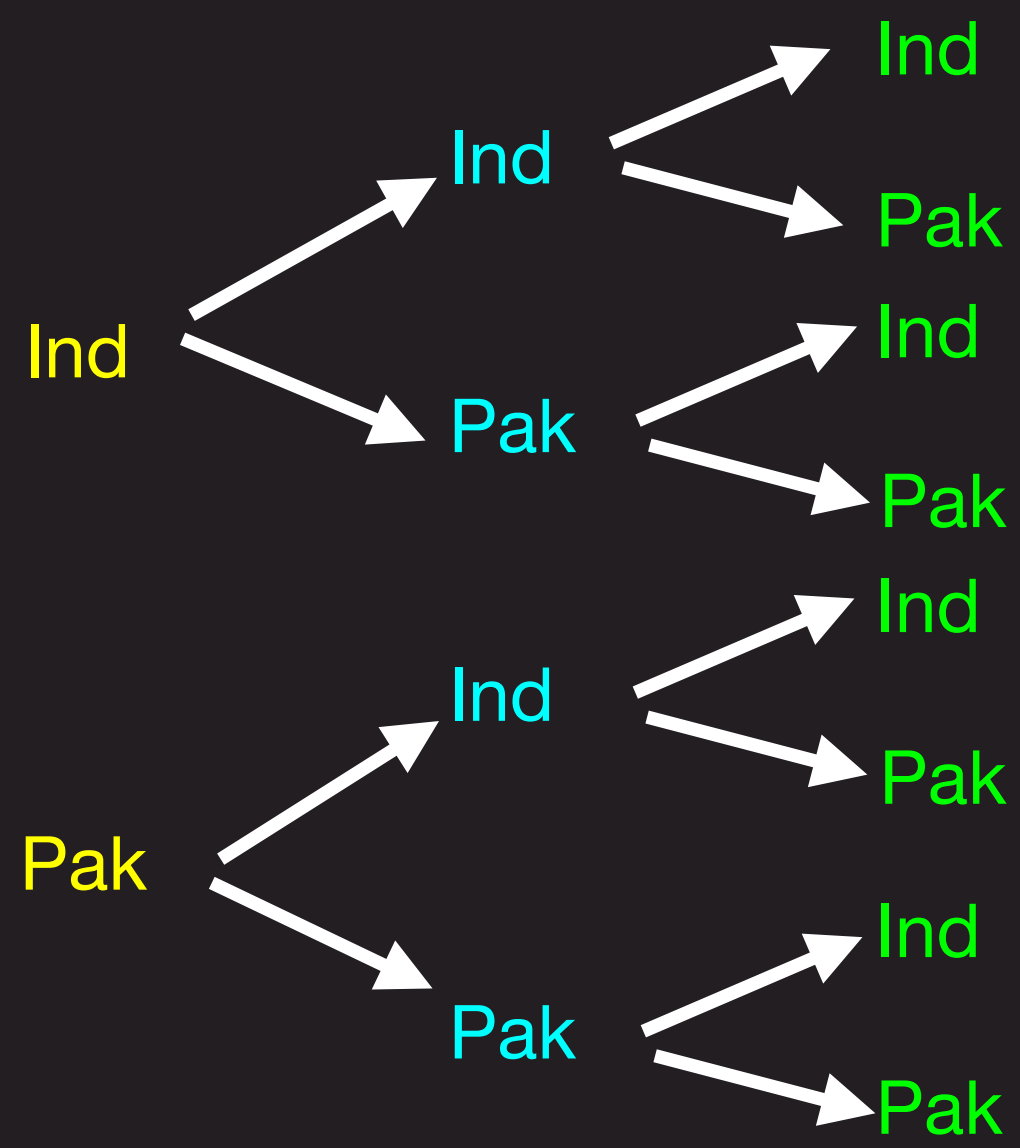
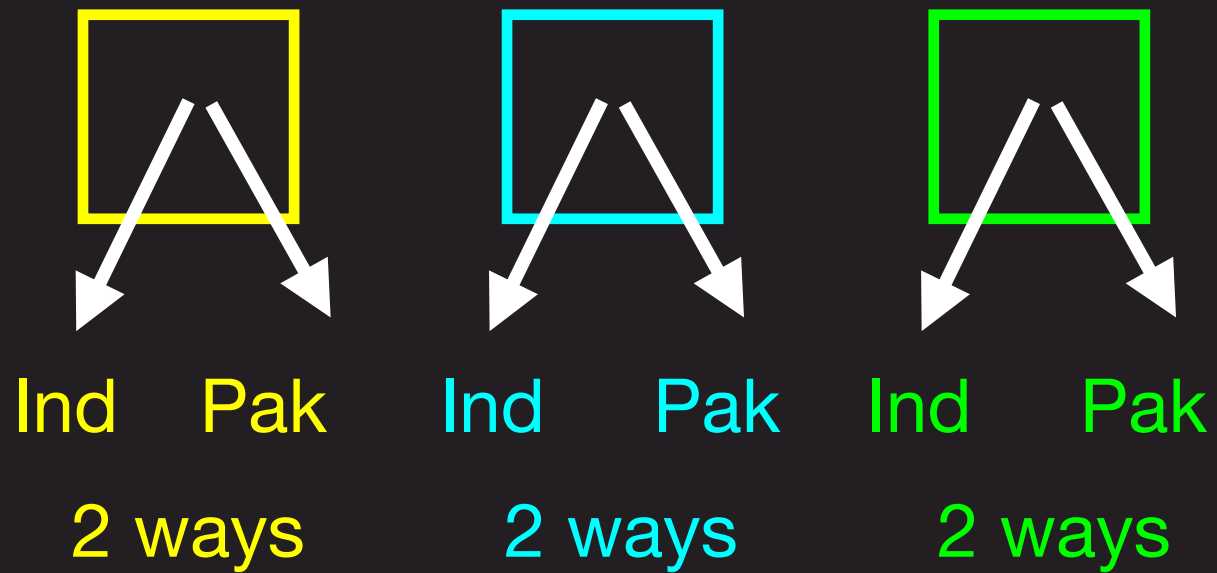


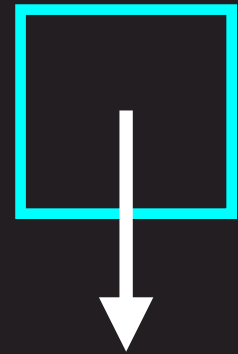
India and Pakistan play a 3-match series. How many results are possible?

Note that we consider (Ind, Ind, Pak) different from (Ind, Pak, Ind) etc.



Total number of ways = $2 * 2 * 2 = 8$

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 ways



3 ways

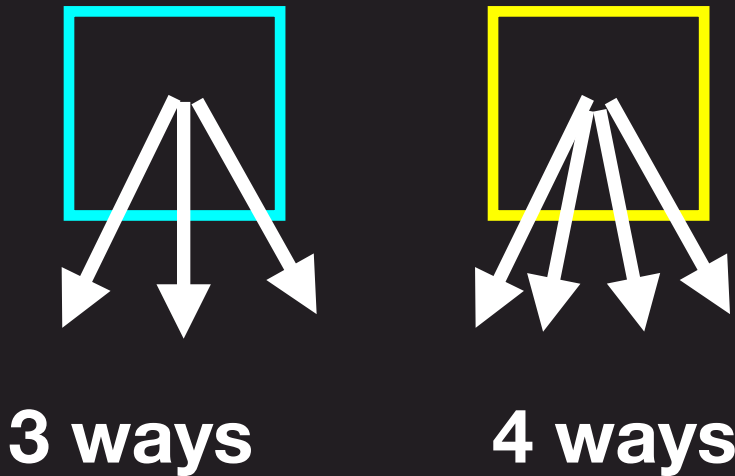
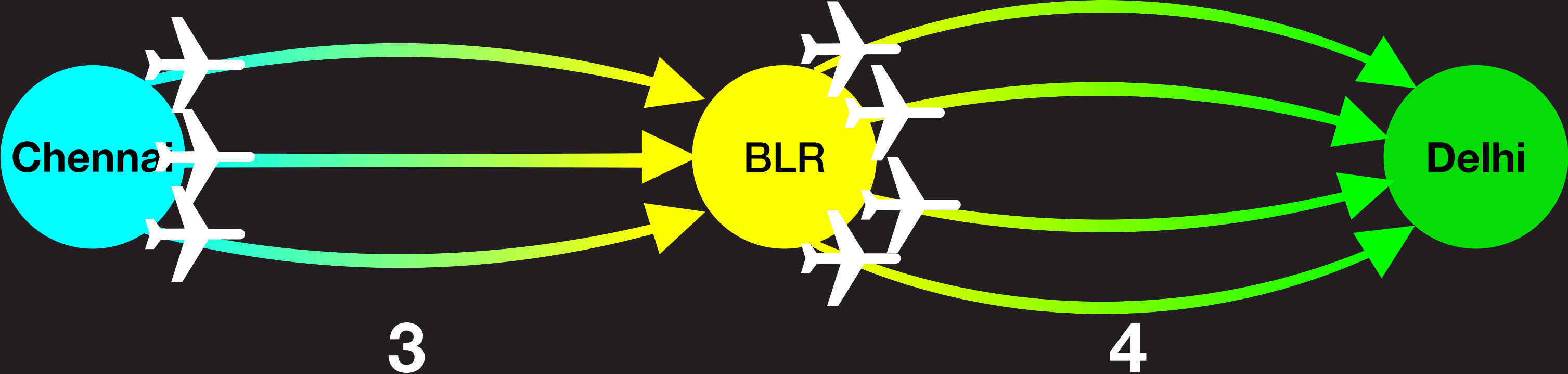
Total number of ways = $5 * 3 = 15$

(B1, W1), (B2, W1), (B3, W1), (B4, W1), (B5, W1)

(B1, W2), (B2, W2), (B3, W2), (B4, W2), (B5, W2)

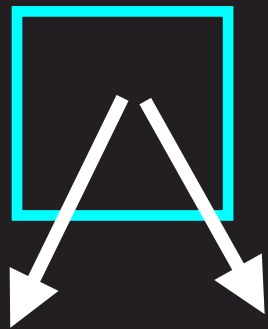
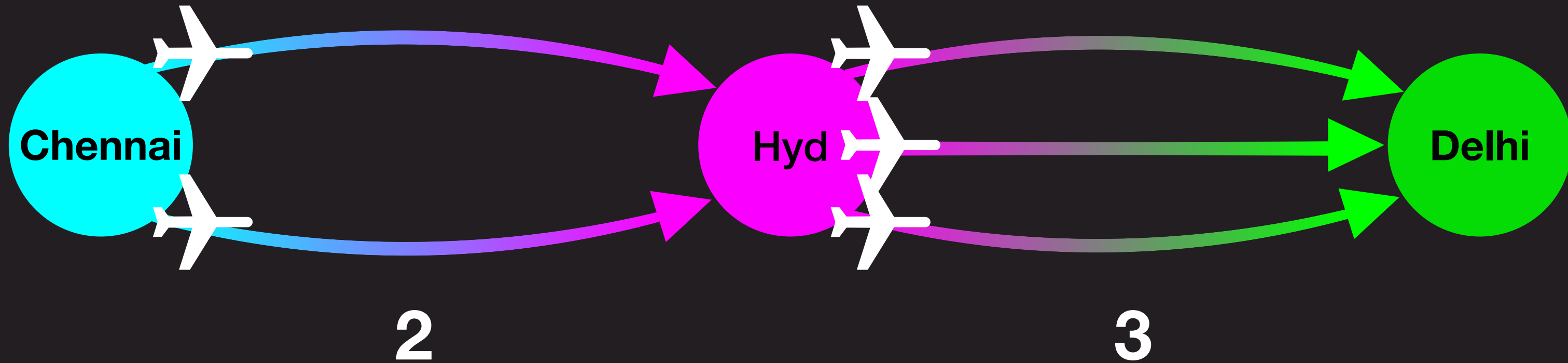
(B1, W3), (B2, W3), (B3, W3), (B4, W3), (B5, W3)

There are 3 ways to move from Chennai to Bangalore.
There are 4 ways to move from Bangalore to Delhi.
What are the total ways of moving from Chennai to Delhi?

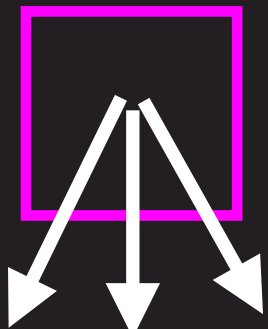


Total number of ways = $3 * 4 = 12$

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?



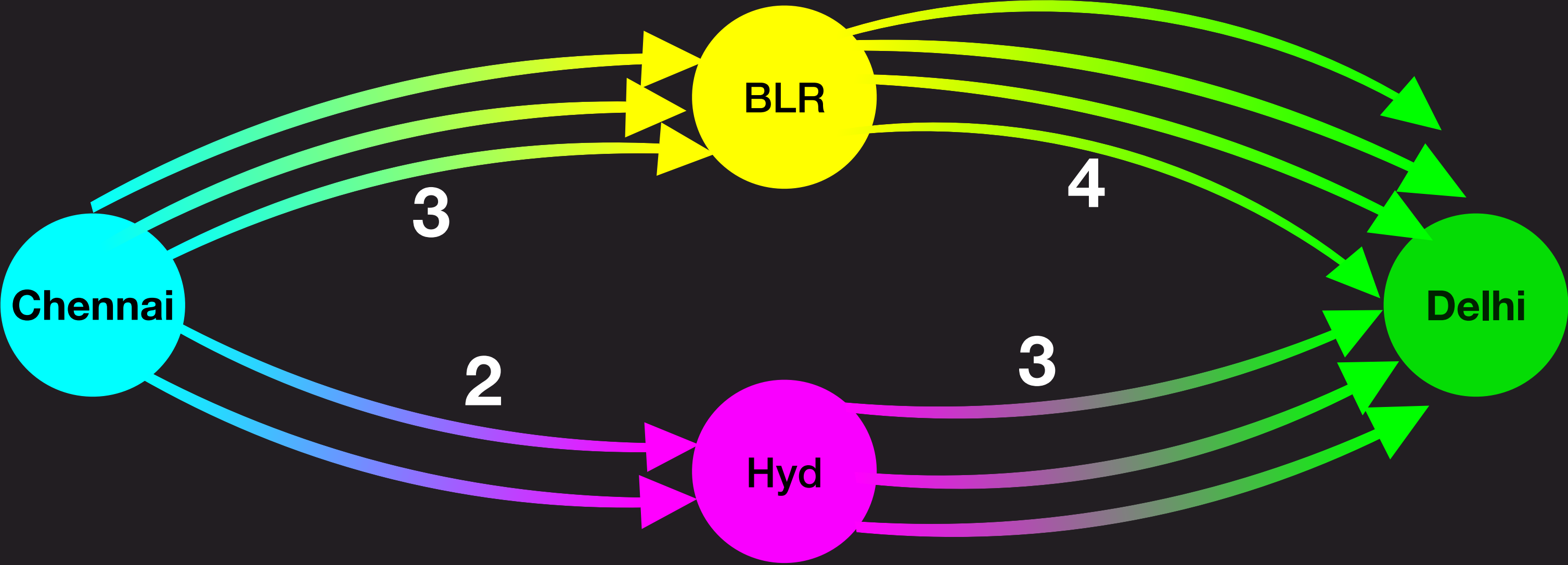
2 ways



3 ways

Total number of ways = $2 * 3 = 6$

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?

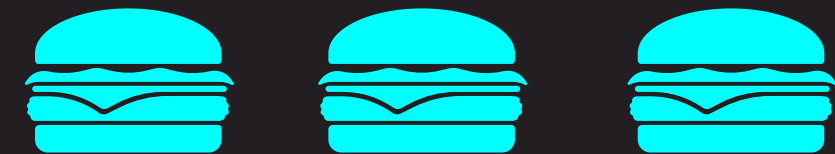


Via BLR $3 * 4 = 12$

Via Hyd $2 * 3 = 6$

Total = $12 + 6 = 18$

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



3 types of
Burgers



3 types of
Pizza



3 types of
Drinks



5 types of
Sandwiches



7 types of
Fruits

You can choose one of the following combos:

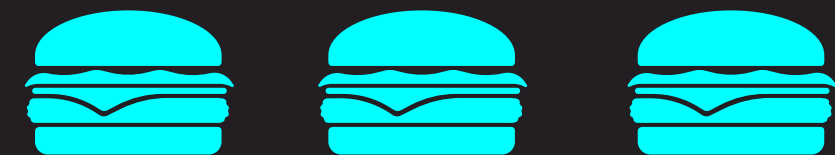
1 Burger and 1 Sandwich

1 Fruit and 1 Drink

1 Pizza

How many such combos can you make?

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



3 types of
Burgers



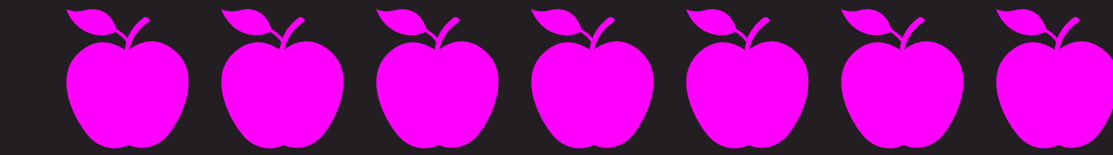
3 types of
Pizza



3 types of
Drinks



5 types of
Sandwiches



7 types of
Fruits

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?

1 Burger and 1 Sandwich $3 * 5 = 15$

1 Fruit and 1 Drink $7 * 3 = 21$

1 Pizza 3

Total = $15 + 21 + 3 = 39$

Permutations

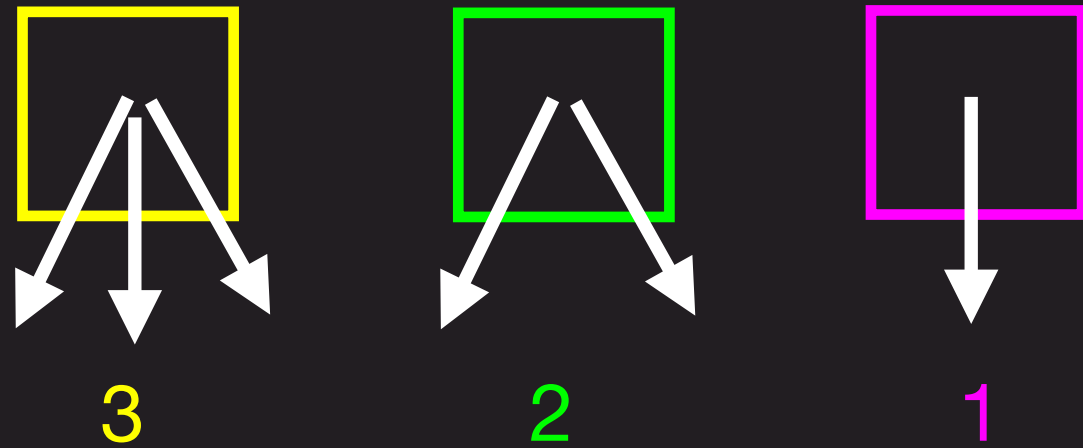
Arrangement of objects

Order matters!

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

$$a\ b \neq b\ a$$

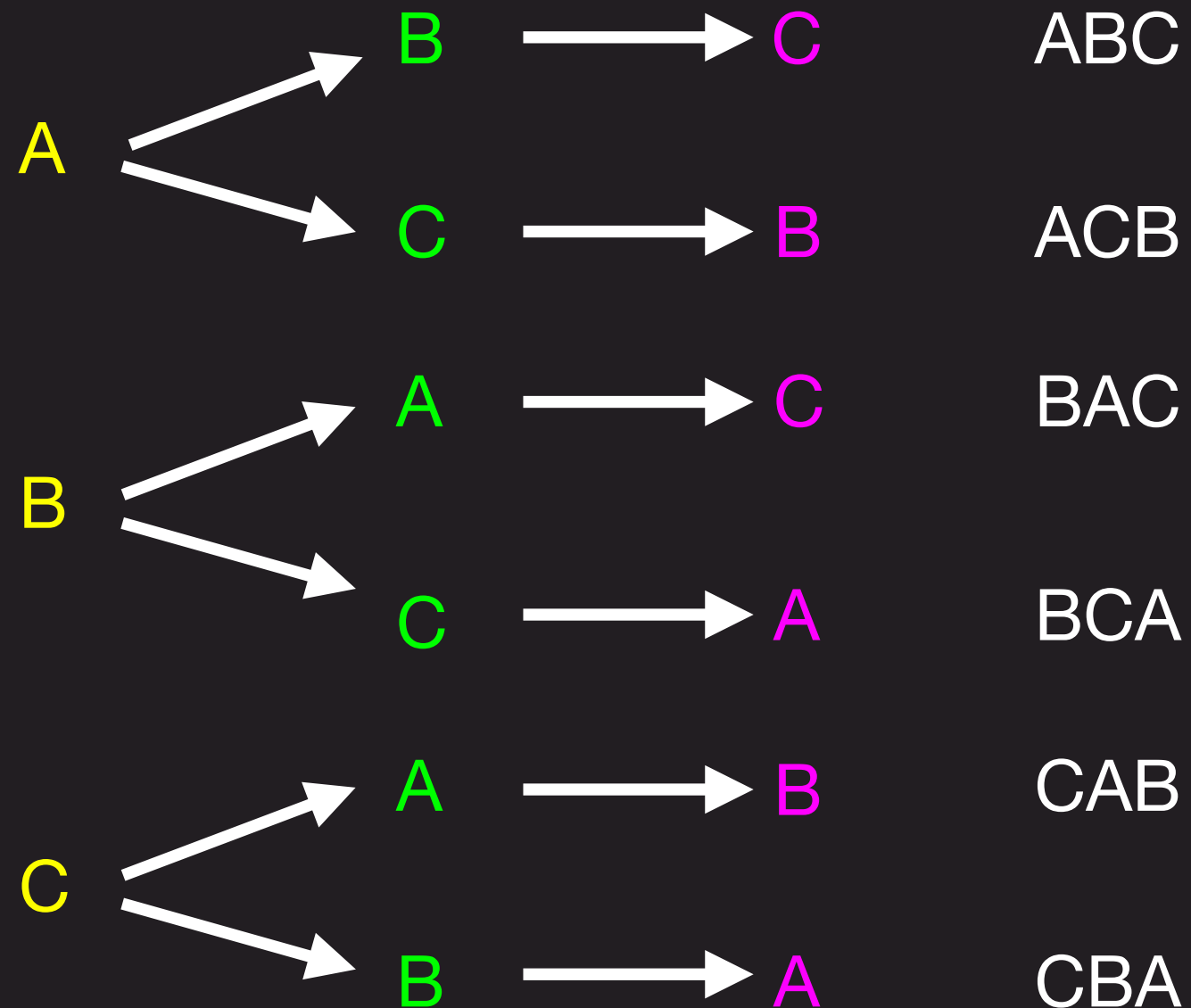
What is the number of ways of arranging 3 characters: A, B, C?



Total number of ways = $3 * 2 * 1 = 6$

This number is called “3 factorial”

$$3! = 3 * 2 * 1$$



What is the number of ways of arranging 4 characters: A, B, C, D?



4

3

2

1

Total number of ways = $4! = 4 * 3 * 2 * 1 = 24$

4 factorial

What is the number of ways of arranging N distinct objects?

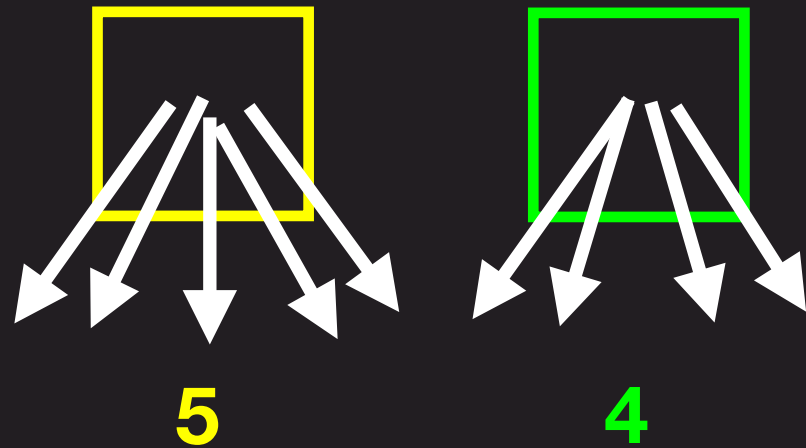
$$N * (N - 1) * (N - 2) * \dots * 3 * 2 * 1 = N!$$

N factorial

In how many ways can we arrange 0 distinct characters?

$$0! = 1$$

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



Total number of ways = $5 * 4 = 20$

$${}^5P_2 = 5 * 4 = \frac{5 * 4 * 3 * 2 * 1}{3 * 2 * 1} = \frac{5!}{3!}$$

Given “N” distinct objects, count the number of ways in which can we arrange them in 3 places.

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

Given “N” distinct objects, count the number of ways in which can we arrange them in 4 places.

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

Given “N” distinct objects, count the number of ways in which can we arrange them in “k” places.

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

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

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

Let us see the same for 5 objects in 2 places

$${}^5 P_2 = 5 * 4 = \frac{5 * 4 * 3 * 2 * 1}{3 * 2 * 1} = \frac{5!}{3!}$$

$$N = 5 \quad k = 2 \quad N - k = 3$$

$$\frac{N!}{(N - k)!} = \frac{5!}{(5 - 2)!} = \frac{5!}{3!}$$

There are 4 players P1, P2, P3, and P4 who can play in the top-order positions of 1, 2, and 3.

How many arrangements of top-order can we make from 3 of these 4 players?

- | | | | |
|------------|------------|------------|------------|
| 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 |

Sachin, Sehwag, Kohli, Rohit

Examples of top-order

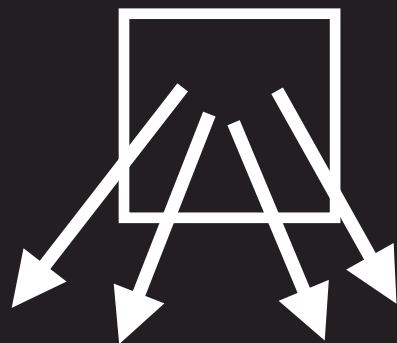
Sachin, Sehwag, Kohli

Sehwag, Sachin, Kohli

Sachin, Rohit, Kohli

Sachin, Kohli, Sehwag

How many more like this?



4



3



2

$$24 = 4 * 3 * 2$$

$4P_3$

Sachin, Sehwag, Kohli, Rohit

Suppose we have to select 3 players out of 4 players in our team.

In how many ways can we do this?

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

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

$$24 = 4 * 3 * 2$$
$4P_3$

$$\frac{24}{6} = 4$$

6 → 3!

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

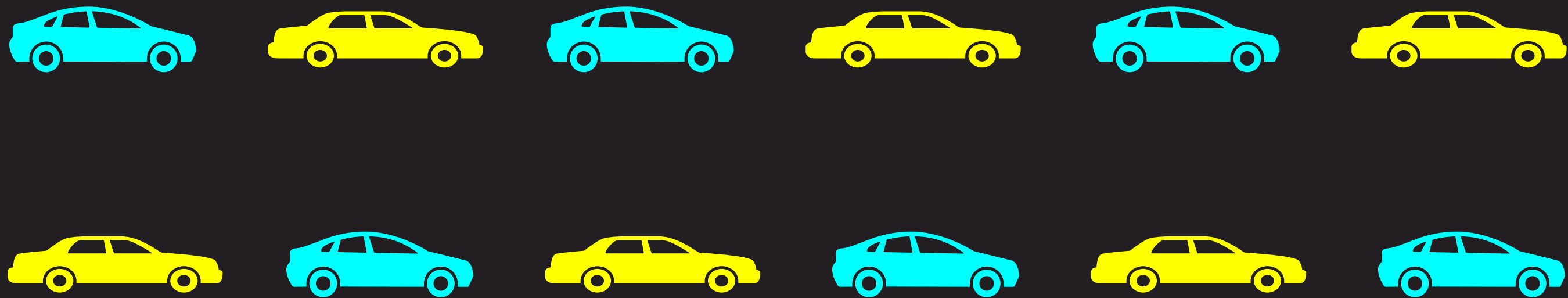
$${}^nC_k = \frac{{}^nP_k}{k!}$$

Suppose we have to select 2 players out of 5 players in our team.
In how many ways can we do this?

$${}^5C_2 = \frac{5 * 4}{2 * 1} = 10$$

A Honda Showroom has 3 colours in their “Jazz” model and 3 colours in the “Amaze” model.

In how many ways can they place it such that Jazz and Amaze are kept in alternate slots?



Jazz in first slot

$$\frac{3!3!}{6!}$$

Amaze in first slot

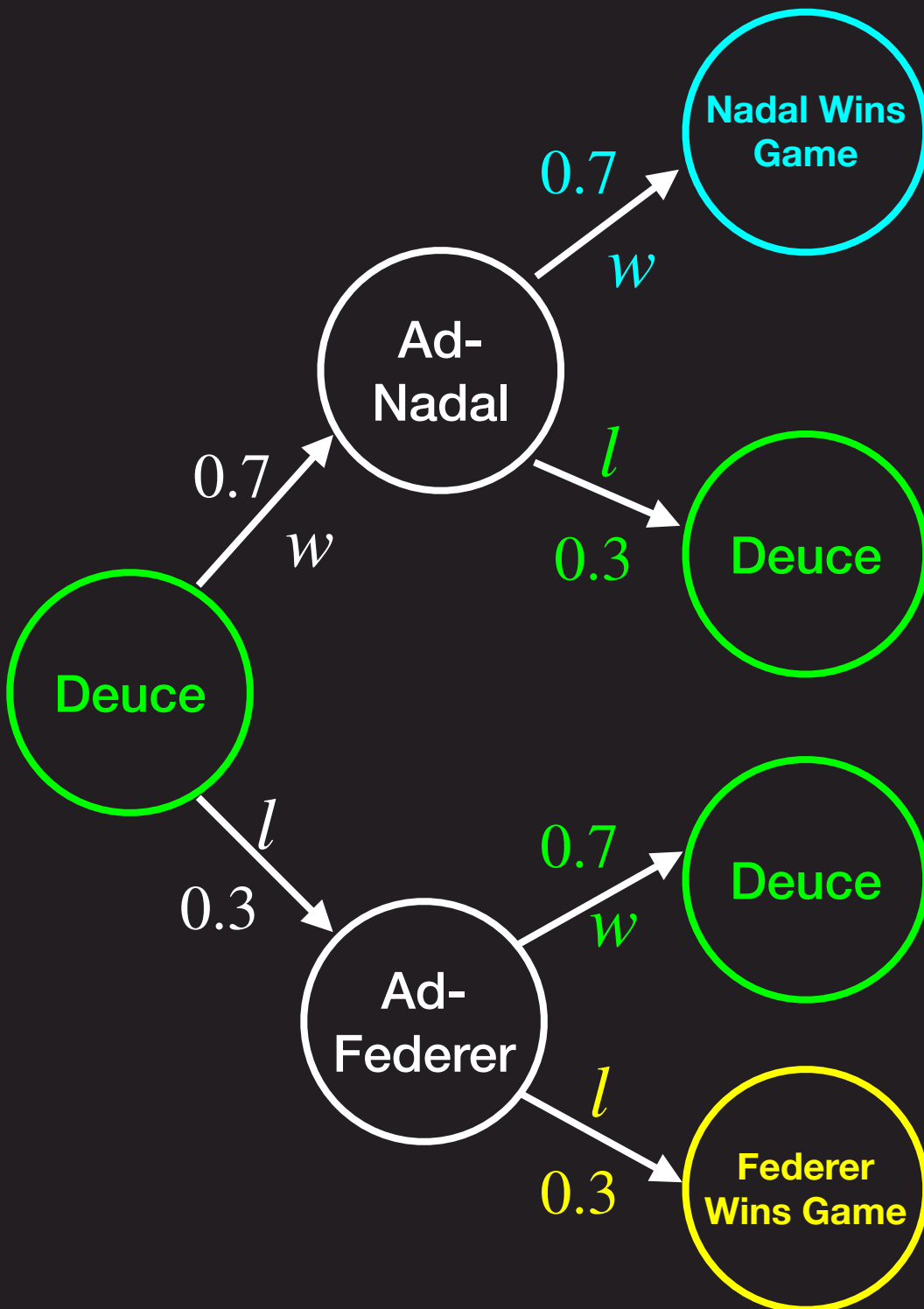
$$\frac{3!3!}{6!}$$

Total:

$$(2)\frac{3!3!}{6!}$$

Nadal Vs Federer on Clay

Nadal wins 70% of the points he plays against Federer on clay
Suppose a tennis game between Nadal and Federer is on Deuce.
What is the probability of Nadal winning the game?



Let $P[N]$ denote the probability that Nadal won the game

$$P[N] = P[N|ww]P[ww] + P[N|wl]P[wl] + P[N|lw]P[lw] + P[N|ll]P[ll]$$

$$P[N|ww] = 1 \quad P[ww] = 0.7 * 0.7$$

$$P[N|ll] = 0 \quad P[ll] = 0.3 * 0.3$$

$$P[N|wl] = P[N] \quad P[wl] = 0.7 * 0.3$$

$$P[N|lw] = P[N] \quad P[lw] = 0.3 * 0.7$$

$$P[N] = (1)(0.7 * 0.7) + P[N](0.7 * 0.3) + P[N](0.3 * 0.7) + (0)(0.3 * 0.3)$$

$$P[N](1 - 2 * 0.7 * 0.3) = 0.7 * 0.7$$

$$P[N] = \frac{0.7 * 0.7}{1 - 2 * 0.7 * 0.3} = 0.84$$