CS & IT ENGINEERING

DISCRETE MATHS
COMBINATORICS
Basics of Combinatorics
Lecture No. 1

By- SATISH YADAV SIR

01 Sum Rule

02 Product Rule

03 Sum Rule & Product Rule

COMBINATORICS

Sum Rule/product Rule ✓

P/C → Reptn.

pigeonhole principle.

Inclusion-Exclusion.

Euler-ϕ-function ✓

* Generating function (2024)

Recurrence Relation.

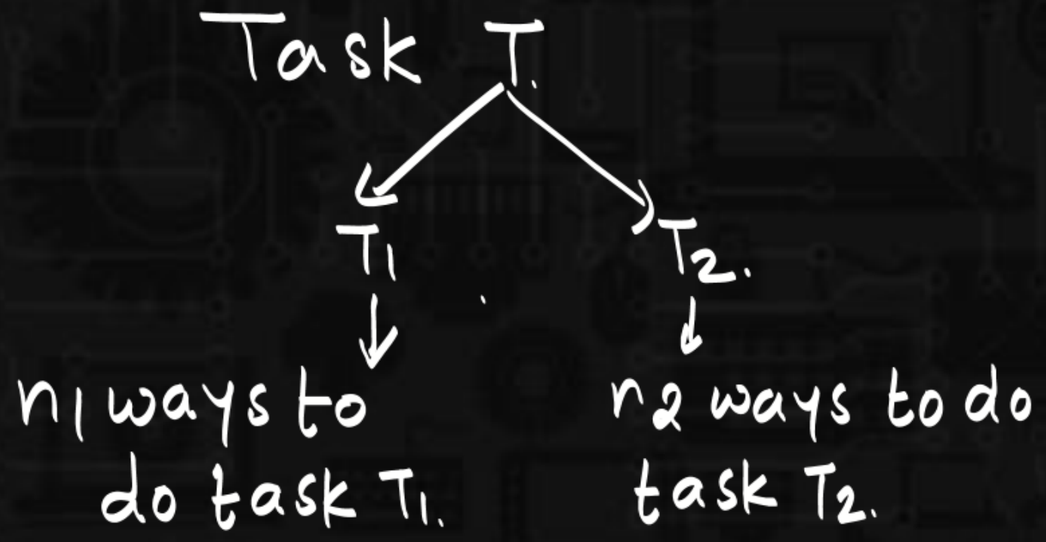
Derangement.

Binomial coefficient

Extended binomial coefficient

COMBINATORICS

Product Rule : (×)



* both tasks are happening simultaneously.
* for each of n1 ways we can perform n2.

Total ways = n1 * n2.

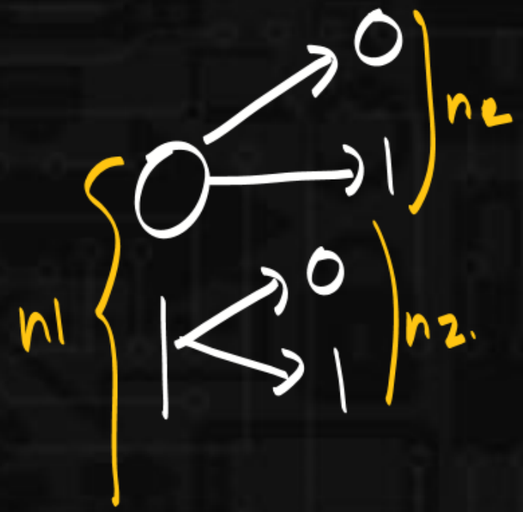
COMBINATORICS

T: how many ways we can generate signal if we have 2 bit code ?

2 ways → T_1 < 0, 1.

2 ways → T_2 < 0, 1.

Total ways = $2 \times 2 = 2^2 = 4$.



COMBINATORICS

$k = 0$

T { T_1: for $i = 1 \longrightarrow n_1$

T_2: for $j = 1 \longrightarrow n_2$.

$k = k + 1$.

$i = 1$ $j = 1 \longrightarrow n_2$.

$i = 2$ $j = 1 \longrightarrow n_2$

$i = 3$ $j = 1 \longrightarrow n_2$.

$\vdots$

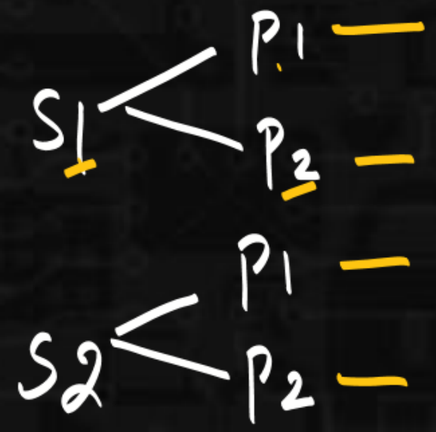
$i = n_1$

$K = n_1 \times n_2$.

COMBINATORICS

how many ways i can dress up if i have 2 shirts & 2 pants?.

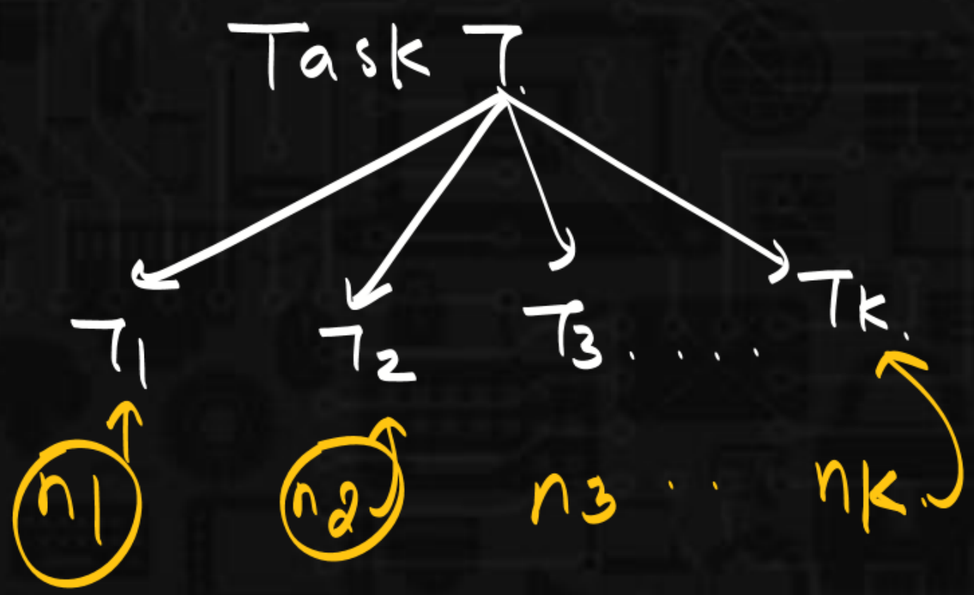
2	2
S_1	P_1
S_2	P_2



Total ways = 2.2 = 4

COMBINATORICS

Extended product Rule :



all tasks are happening Simultaneously.

Total ways

$= n_1 \times n_2 \times n_3 \ldots n_k$

COMBINATORICS

$k = 0$

for $i_1 = 1 \longrightarrow n_1$

for $i_2 = 1 \longrightarrow n_2$

for $i_3 = 1 \longrightarrow n_3$.

⋮

for $i_k = 1 \longrightarrow n_k$.

$k = k+1$.

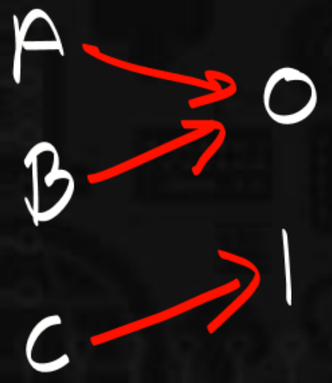
$K = n_1 \times n_2 \times \ldots n_k$.

COMBINATORICS

$f: A \to B$

$|A| = 3 \quad |B| = 2$

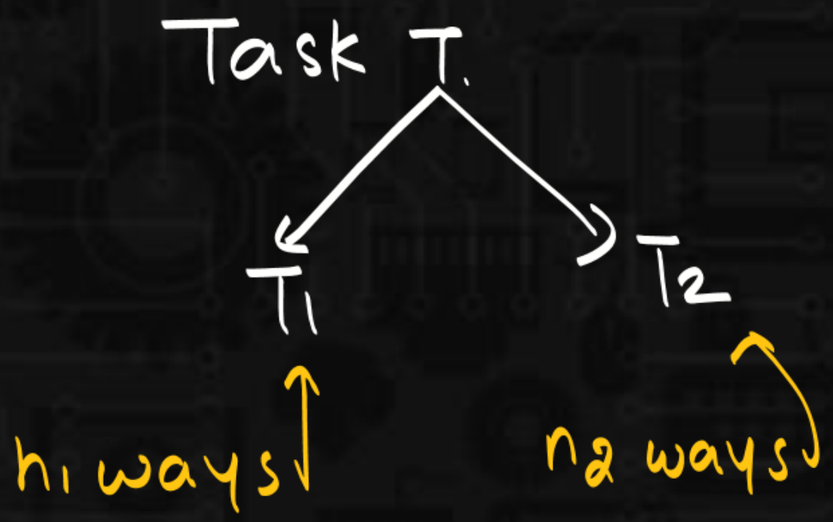
Total no. of functions $= (R.S)^{LS} = 2^3$



$\frac{A}{2.} \quad \frac{B}{2} \quad \frac{C}{2.} = 2^3$

COMBINATORICS

Sum Rule.



* both the tasks are not happening simultaneously.

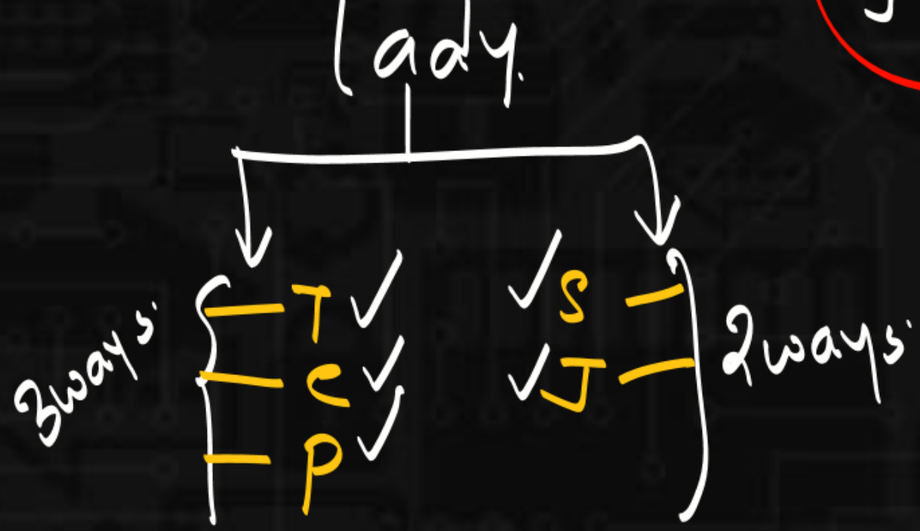
Total ways = $n_1 + n_2$.

COMBINATORICS

Babitaji is going for shopping.

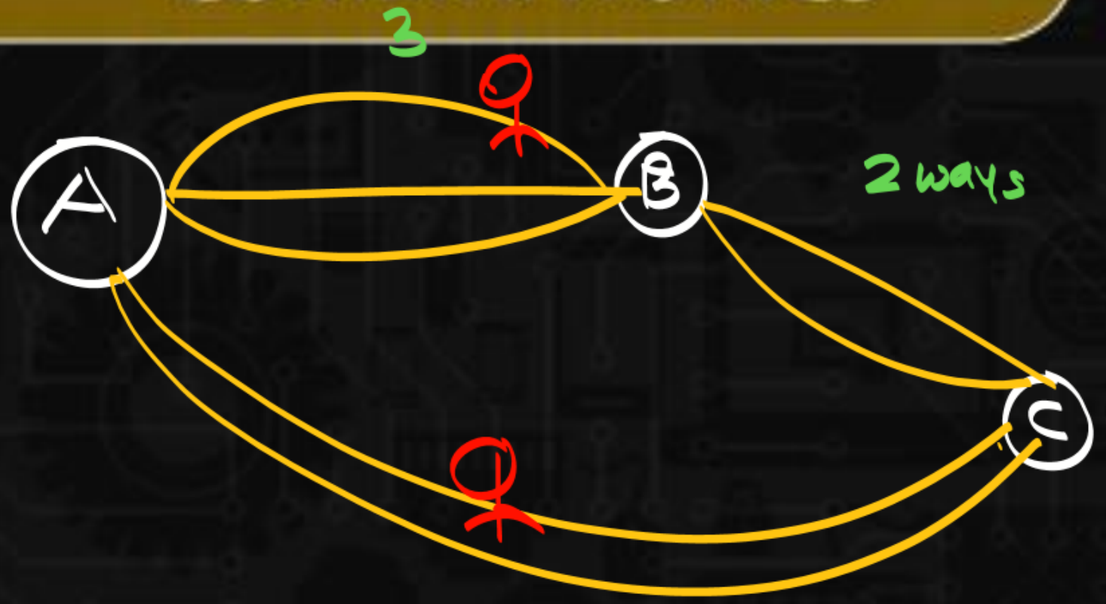
if she does the shopping in Delhi, she can buy Table Chair Pen. 3 ways.

She does shopping in mumbai she buys Saree Jeans. 2 ways.



Total ways = 3 + 2
= 5 ways.

COMBINATORICS



1. A — B — C

3×2 ways.

2. A — C

via B: 3×2 + without B: 2 ways.

3. A — C — A (via B, via B.)

4. A — C — A.

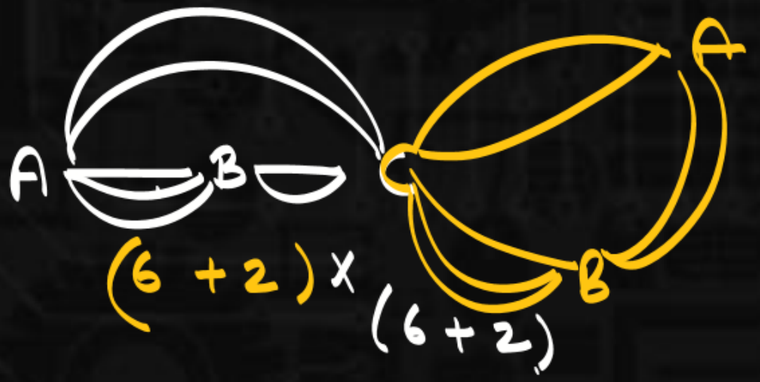
COMBINATORICS

8. A —(via AB)— C —(via AB)— A

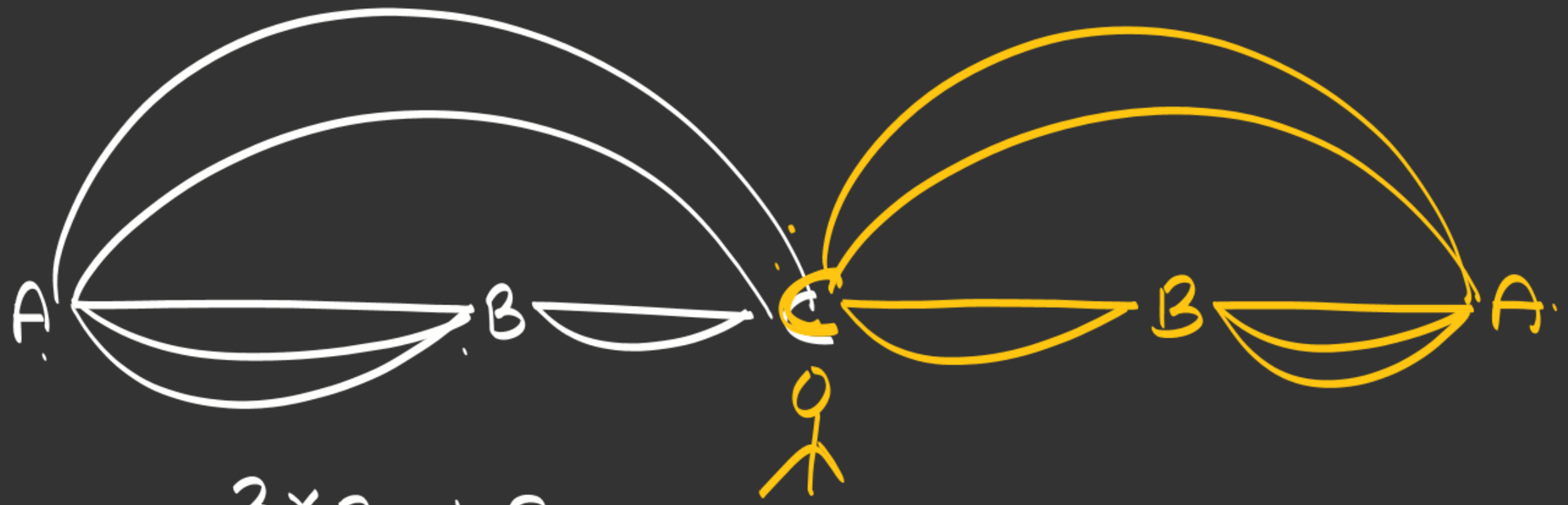
8ways × 2ways × 2ways × 3ways.

= 36 ways.

Q.4.



8 × 8 = 64 ways.



$3 \times 2 + 2$

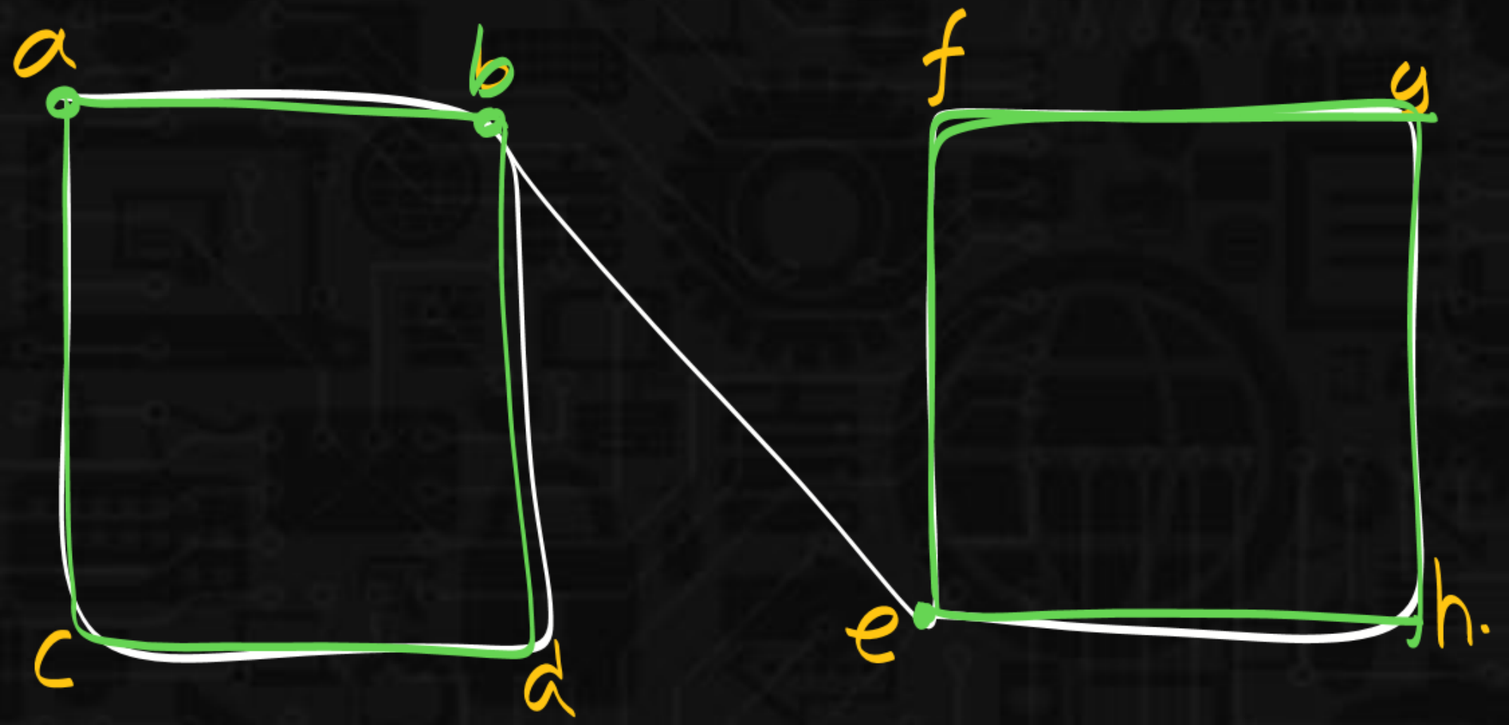
= 8 ways $\times$ 6 ways + 8 ways $\times$ 2 ways

8 ways (6 + 2)

= 64

COMBINATORICS

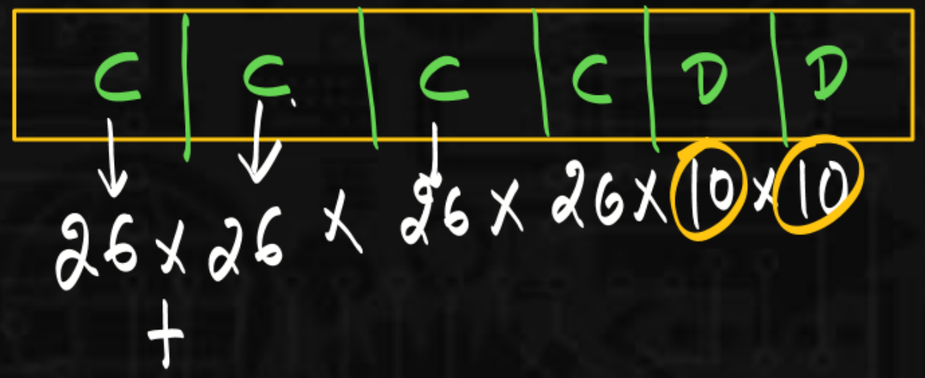
paths are there from a to h.



COMBINATORICS

how many number plates we can generate if 4 characters followed by 2 digit ?

$= 26^4 \times 10^2$



COMBINATORICS

how many number plates we can generate if 4 characters followed by 2 digit or 3 or 4 digit ?

$$26^4 10^2 + 26^4 \cdot 10^3 + 26^4 \cdot 10^4$$

$$= 26^4 (10^2 + 10^3 + 10^4)$$

C	C	C C	D D

$26^4 \cdot 10^2$ (D: 0 to 10)

$+$ C C C C D D D $+$ C C C C D D D D

$26^4 \cdot 10^3$ $+ 26^4 \cdot 10^4$

COMBINATORICS

how many number plates we can generate if 1 OR 2 OR 3 OR 4 characters followed by 1 OR 2 OR 3 OR 4 Digit ?

$$(26 + 26^2 + 26^3 + 26^4)(10 + 10^2 + 10^3 + 10^4)$$

COMBINATORICS

how many 4 digit integers are there with digit 0 appearing exactly once?

Ans: 2187

$|S| = n$

how many ways we can choose subsets P and Q

$P \cap Q = \phi$

A) 2^n

b) $3^n - 1$

c) $3^n + 1$

d) 3^n

COMBINATORICS

how many integers

{ 1, 2, 3 . . . . . 1,00,000 }

Ans: 12600

contains exactly one 3, exactly one 4, exactly one 5 ?

in decimal representation ?


THANK YOU GW
SOLDIERS !