

# Counting Rules

## Sum Rule

If you are choosing one thing between  $n$  options in one group and  $m$  in another group with no overlap, the total number of options is:  $n + m$ .

## Product Rule




If you have a sequential process, where step 1 has  $n_1$  options, step 2 has  $n_2$  options, ..., step  $k$  has  $n_k$  options, and you choose one from each step, the total number of possibilities is  $n_1 \cdot n_2 \cdots n_k$

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# Farming Outfits



The farmer has three hats (cowboy, straw, mushroom)   



Three shirts (classic overalls, night sky, light blue)   

And three pairs of pants (farmer, dinosaur, relaxed fit)   

How many outfits are there (consisting of one hat, shirt, and pair of pants) if

the classic overalls shirt cannot be worn with dinosaur pants,  

the night sky shirt cannot be worn with relaxed fit pants,  

and the light blue shirt cannot be worn with farmer pants.  

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## Assigning Books

We have 5 books to split to 3 people (Leo, Jas, and Vincent)

Every book goes to exactly one person, but each person could end up with no books (or all of them, or something in between).

Attempt 1: We're choosing subsets!

Leo could get any of the  $2^5 = 32$  subsets of the books.

Jas could get any of the  $2^5 = 32$  subsets of the books.

Vincent could get any of the  $2^5 = 32$  subsets of the books.

Total is product of those three steps  $32 \cdot 32 \cdot 32 = 32768$

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## Strings

How many strings of length 5 are there over the alphabet  $\{A, B, C, \dots, Z\}$ ? (repeated characters allowed)

$$26^5$$

How many binary strings of length  $n$  are there?

$$2^n$$

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