

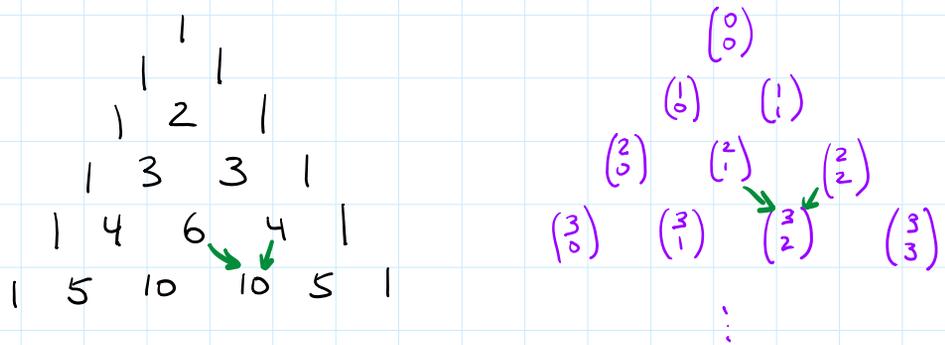
# BINOMIAL COEFFICIENTS:

We've said  $\binom{n}{k}$  is "n choose k" — the number of ways of selecting k items from n possibilities (without replacement, order unimportant).  
**COMBINATIONS**

$$\begin{aligned} \text{Consider: } (a+b)^3 &= (a+b)(a+b)(a+b) = \binom{3}{3}a^3 + \binom{3}{2}a^2b + \binom{3}{1}ab^2 + \binom{3}{0}b^3 \\ &= 1a^3 + 3a^2b + 3ab^2 + 1b^3 \end{aligned}$$

$$\text{Similarly, } (a+b)^n = \binom{n}{n}a^n + \binom{n}{n-1}a^{n-1}b + \dots + \binom{n}{0}b^n$$

They also occur in Pascal's triangle:



$$\text{Why? } \binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$$

Selecting  $k$  items  
out of  $n$

	ORDER IMPORTANT	ORDER NOT IMPORTANT
WITH REPLACEMENT	$n^k$	$\binom{k+n-1}{k} = \frac{(k+n-1)!}{(n-1)! k!}$
WITHOUT REPLACEMENT	$\frac{n!}{(n-k)!}$ permutation	$\binom{n}{k} = \frac{n!}{(n-k)! k!}$ combination