

How many different
Subway sandwiches
are possible?

How would we figure this out?

Breads
Lengths
Protein ← no
Sauces/Seasonings
Topping ← veg
Toasted
cheese

Subway™ Alaska has limited
options due to late shipments.

they have 3 types of

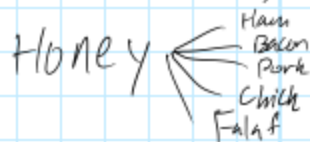
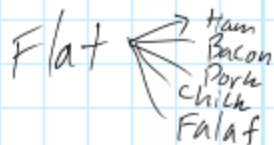
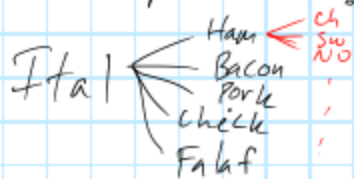
Bread (Italian, Flat, HoneyOat),

5 different protein options

(ham, bacon, pork, chicken, falafel).

But that's it...

a) How many different sandwiches are possible?



← Tree diagram

15 total options

= 3 breads

x 5 protein

b) Next time, they have 2 types of cheese (cheddar, swiss), or no cheese. How many?

3 breads x 5 protein x 3 cheese

(ch, sw, no)

= 45

Fundamental Counting Principle

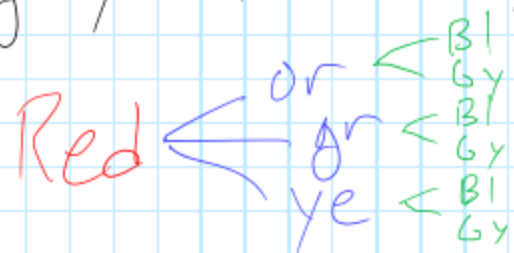
If a combination has multiple different parts, where Part #1 has "a" choices, **and** Part #2 has "b" choices, **and** Part #3 has "c" choices, ...

then the total number of combinations is $= a \times b \times c \times \dots$

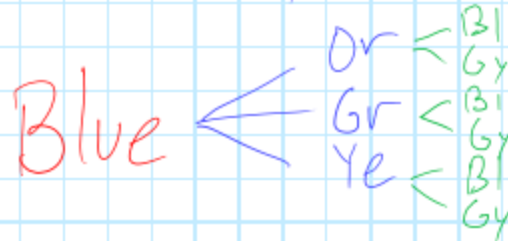
NOTE: **AND** \Rightarrow \times multiply

this only works if for each part we can only choose 1 option.

Ex 2 Mr. Jack is designing new uniforms. The shirt can be blue or red, and have stripes that are orange, green, or yellow and shorts that are black or grey. How many options are there?



12 options



2 shirts

(X) 3 stripes

(X) 2 shorts

12 options

Ex 3

A math quiz has 6

Multiple choice questions (A, B, C, D).

How many different ways can you guess the quiz?

ABCD

$$\begin{array}{cccccccc} \textcircled{4} & \times & \textcircled{4} & \times & \textcircled{4} & \times & \textcircled{4} & \times & \textcircled{4} & \times & \textcircled{4} \\ \hline \text{Q1} & \textcircled{\text{AND}} & \text{Q2} & \textcircled{\text{AND}} & \text{Q3} & \textcircled{\text{AND}} & \text{Q4} & \textcircled{\text{AND}} & \text{Q5} & \textcircled{\text{AND}} & \text{Q6} \end{array}$$

$$= 4096$$

Ex 4 You want to choose a PIN for your credit card, but the last number needs to be odd (because you're weird).

a) How many options?

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

$$\frac{10}{1^{\text{st}}} \times \frac{10}{2^{\text{nd}}} \times \frac{10}{3^{\text{rd}}} \times \frac{5}{4^{\text{th}}}$$

$$= 5000$$

b) Zero at the start is weird. How many options?

9 10 10 5

$$= 4500$$

c) No repeats. How many?

no 0
diff from 4th → 8 8 7 5

diff 4th and 1st diff from 1st 2nd 4th ← odd

1st and 2nd and 3rd and 4th

$$= 2240$$

1-7

Pg 6.8