11.1 Factorial & Fundametal Counting Principal

Factorial - if you have n items to arrange in a particular order, there are $n!$ ways to do it. $(n \times (n-1) \times (n-2) \times \ldots \times 1)$

ex) How many ways can 8 people stand in a line?

$$8! = 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 40{,}320$$

This is known as a permutation...arranging n items in a particular order.

Evaluate $\frac{100!}{98!} = \frac{100 \times 99 \times 98 \times \ldots \times 3 \times 2 \times 1}{98 \times \ldots \times 3 \times 2 \times 1} = 9900$

Fundamental Counting Principle

How many different Happy Meals are possible if there are 4 sandwiches, 3 sides, 2 desserts, and 6 beverages to choose from? You must choose exactly 1 item from each group.

$4 \times 3 \times 2 \times 6 = 144$ possible "meals"

If you have 7 hats, 3 shirts, 4 pants & 2 shoes to choose from, how many different outfits are possible? $7 \times 3 \times 4 \times 2 = 168$ outfits.

What if a hat isn't necessary?

$8 \times 3 \times 4 \times 2$ or $7 \times (3 \times 4 \times 2) + (3 \times 4 \times 2) = 192$

What if one item in each group is black, and you won't wear 2 black items together?

7 3 4 2

No black hat & shirt together — 8 outfits omitted — $1 \times 1 \times 4 \times 2$
" " & pants " — 6 outfits omitted — $1 \times 3 \times 1 \times 2$
" " & shoes " — 12 outfits omitted — $1 \times 3 \times 4 \times 1$
⋮

Can you come up with a strategy?

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#1, 3, 4, 6, 12-15, 17, 20, 21, 25, 26