then there are $\frac{n!}{(n-r)!}$ choices

Notation: $P(n;r) = \frac{n!}{(n-r)!}$

permutation

E.g. A professor is creating an exam of 9 questions from a test bank of 12 questions.

How many ways can he arrange the questions?

$P(12;9) = \frac{12!}{3!} = 79,833,600$

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Combinations

E.g. Choose 3 paintings out of 4 paintings to buy. (order doesn't matter). How many choices are there?

assume that the order does matter.

alter it so that order doesn't matter anymore.

$4 \times 3 \times 2 = 24$

Many of these choices are actually the same.

A B C C A B

A C B C B A

B A C

B C A

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$4 \times 3 \times 2 = \frac{4!}{(4-3)!} \cdot \frac{1}{3!}$

In general,

n things to choose from, choose r of them, no repetition, order doesn't matter.

$\frac{n!}{(n-r)!} \cdot \frac{1}{r!} = \frac{n!}{(n-r)!\,r!}$

Notation: $\boxed{C(n;r) = \frac{n!}{(n-r)!\,r!}}$

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\# of Subsets of a finite set

E.g. $S = \{1,2,3,4\}$

How many subsets does S have?

$\{1\}, \{2\}; \{3\}; \{4\}$

$\{1,2\}; \{1,3\}; \{1,4\}; \{2,3\}; \{2,4\}; \{3,4\}$

$\{1,2,3\}; \{1,2,4\}; \{1,3,4\}; \{2,3,4\}$

$\{1,2,3,4\}; \emptyset \longrightarrow$ empty set.

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How do we form a subset?

1 < In, Out

2 < In, Out

3 < In, Out

4 < In, Out

$2 \cdot 2 \cdot 2 \cdot 2 = 2^4$

If S has n elements, S has 2^n subsets.

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