ECE 302: Lecture 1.5 Combinatorics

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Outline

- 1.1 Infinite Series
  - 1.1.1. Geometric Series
  - 1.1.2. Binomial Series
- 1.2 Approximations
  - 1.2.1. Taylor Approximation
  - 1.2.2. Exponential Series
  - 1.2.3. Logarithmic Approximation
- 1.3 Integration
  - 1.3.1. Odd and Even Functions
  - 1.3.2. Fundamental Theorem of Calculus
- 1.4 Linear Algebra (Optional)
  - 1.4.1. Inner Products (Optional)
  - 1.4.2. Matrix Calculus (Optional)
  - 1.4.3. Matrix Inversion (Optional)
- 1.5 Combinatorics
  - 1.5.1. Permutation
  - 1.5.2. Combination

Permutation

- You have n balls.
- All different color.
- Pick k balls.
- Without replacement.
- How many **configurations** can you have?
- Order matters. a-b-c is different from b-a-c

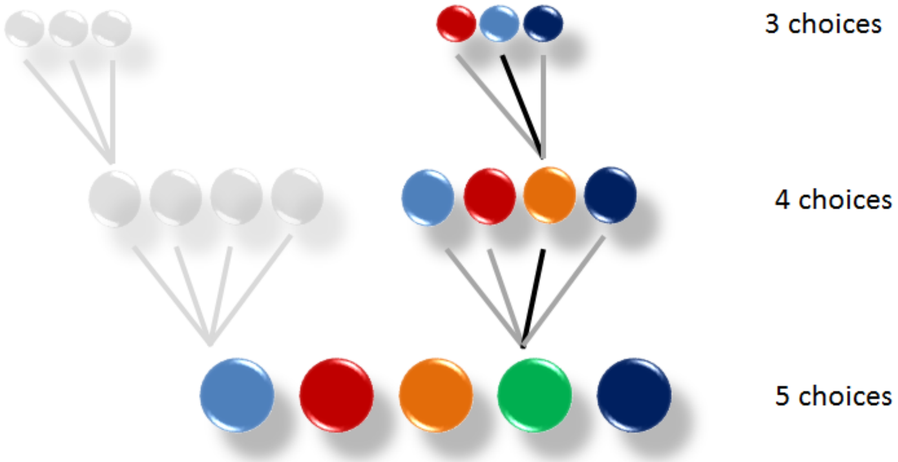
Theorem

The number of permutations of choosing k out of n is

$$\frac{n!}{(n-k)!}$$

where $n! = n(n-1)(n-2)\ldots 3 \cdot 2 \cdot 1.$

Visualize Permutation



Example

Consider a set of 4 balls $\{1, 2, 3, 4\}$. We want to pick 2 balls at random without replacement. The ordering matters. How many permutations can we obtain?

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Permutation

- You have n balls.
- All different color.
- Pick k balls.
- Without replacement.
- How many **combinations** can you have?
- Order does not matter. a-b-c the same as b-a-c

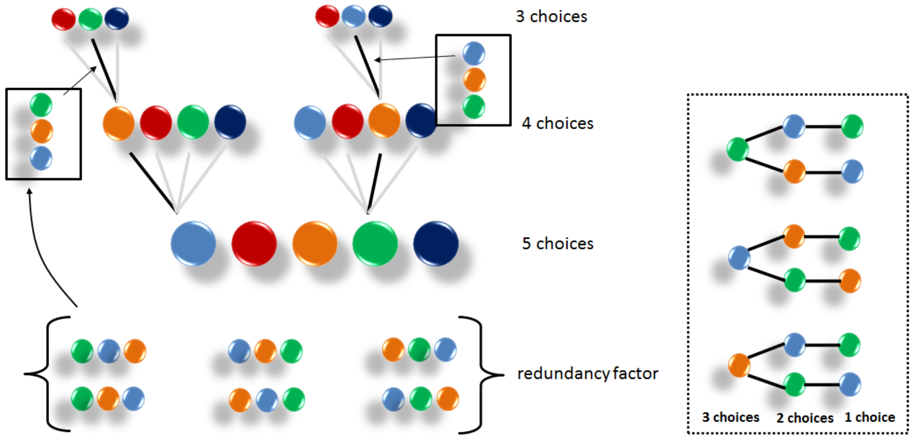
Theorem

The number of combinations of choosing k out of n is

$$\frac{n!}{k!(n-k)!}$$

where $n! = n(n-1)(n-2)\ldots 3 \cdot 2 \cdot 1$.

Visualize Combination



Example

Consider a set of 4 balls $\{1, 2, 3, 4\}$. We want to pick 2 balls at random without replacement. The ordering does not matter. How many combinations can we obtain?

More Examples

Example 1

A collection of letters, a-z, is mixed in a jar. Two letters are drawn at random, one after the other. What is the probability of drawing a vowel (a,e,i,o,u) and a consonant in either order?

Example 2

There are 50 students in a classroom. What is the probability that there is at least one pair of students having the same birthday?

Questions?