Discrete II Notes

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February 15, 2017

Set Theory Review

Sets are collections of unique elements.

Complement

Everything that's not in the set. Denoted by A', A^C, or $\overline{A}$

Intersection

An operation that takes two sets, and returns the common elements between them. Denoted by $A \cap B$

Union

An operation that takes two sets, and returns a all the elements that are in A, B, and $A \cap B$. Denoted by $A \cup B$.

De Morgan's Laws

$$(A \cup B)^C = A^C \cap B^C$$
$$(A \cap B)^C = A^C \cup B^C$$

Disjoint Sets

Disjoint sets or **Mutually Exclusive** sets, are sets that have no elements in common. More formally: $(A \cup B) = \emptyset$

Intro to Probability

Sample Space of an experiment is the set of all possible outcomes of that experiment. An **event** is any collection (subset) of outcomes contained in the sample space S. An event is said to be **simple** if it consists of exactly one outcome and **compound** if it consists of more than one outcome.

Counting

For an ordered pair defined by (x, y) where x can be selected in n_1 ways, and y can be selected in n_2 ways, the number of pairs is $n_1 n_2$. Can be extended to k dimensions. This is known as the **Multiplication rule**.

Permutations

For k selections made **with replacement** on n distinct elements, there are n^k possible outcomes.
Without replacement however, there are n options for the first selection, $n-1$ choices for the next selection, and $n-k+1$ choice(s) for the k^{th} selection. This yeilds.

$${}_nP_k = n(n-1)(n-2)\ldots(n-k+1)$$

Combinations

Given n distinct objects, the number of **unordered** subsets of size k is given by ${}_nC_k$, or $\binom{n}{k}$ (n choose k).

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

Overcounting

Overcounting with Groups

Bose Einstein