

# Lecture 1

Monday, May 2, 2022 13:41

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Graph Theory Updated  
↳ Check learn

Grading: 10 Assignments, Midterm, Exam

Office Hrs: 1-2 pm & Tuesdays, Online

## Basic Principles of Enumeration

e.g. Given 2 finite sets,  $(A, B)$ ,

1) How many pairs  $(a, b)$  are there s.t.  $a \in A, b \in B$ ?

2) How many elements are either in  $A$  or  $B$ ?  
↳ Not exclusive

1) # of pairs =  $|A \times B| = |A| \times |B|$  [Cartesian Product]

2)  $|A \cup B| = \# \{x : x \in A \text{ or } x \in B\} \Rightarrow$

$$|A \cup B| = |A| + |B| - |A \cap B|$$

↳ Subtract extras that are in both, (Inclusion/Exclusion)  
↳ Double-counting

e.g. Given finite set, how many subsets of  $S$ ?

$2^n$ , since (IN/OUT)  $\forall$  elements  $\in S$ . [ $2^n - 1$  proper subsets]

↳ (Also # of binary strings)

↳ We could biject subsets  $\rightarrow$  binary strings (natural correspondence)  
↳ 011 = OUT/IN/IN

## Lists & Sets

Set: Unordered  $\rightarrow n \rightarrow \binom{n}{k}$  of size  $k$  (groups)

list: Ordered (Permutations)  $\Rightarrow n \rightarrow n!$  list

↳ Each element shows up once

Factorial:

$$n! = n \times (n-1) \times \dots \times 2 \times 1$$

$$[0! = 1]$$