Math 140: Tuesday, Nov 5th, Day 18 Notes

Agenda for Tuseday, Nov 5th, 2024

Start new unit: Sets and Logic !!! **1**

Coming up

- ! Online HW 11 due today
- Priority registration for Spring 2025 is open!
- Written HWS due Thursday

Sets use capital letters A, B, C, N, Z

What is a set? A set is a collection of distinct objects called elements of the set. (or members)

ex H = { George, Kris, Jordan }

Example 1. Let A = The set of all whole numbers between 1 and 6.

- Word description: The set of all whole numbers between 1 and 6.
- Listing method: A = { 1, 2, 3, 4, 5, 6 }
- Set-builder notation: A = { x | condition to be an element of A }

A is the first 100 natural numbers

$A = \{x \mid 1 \le x \le 100, \text{ where } x \text{ is a natural number}\}$

such that

The set with no elements is called the empty set and it is denoted ∅ empty set or { }

B = set of students here above 8ft

To specify that an element belongs to a set we write

$1 \in A$ 1 is an element of A

Juliana $\notin$ B? not an element of B

S = solutions to $x^2 = -1$ is ∅.

{∅} not the empty set

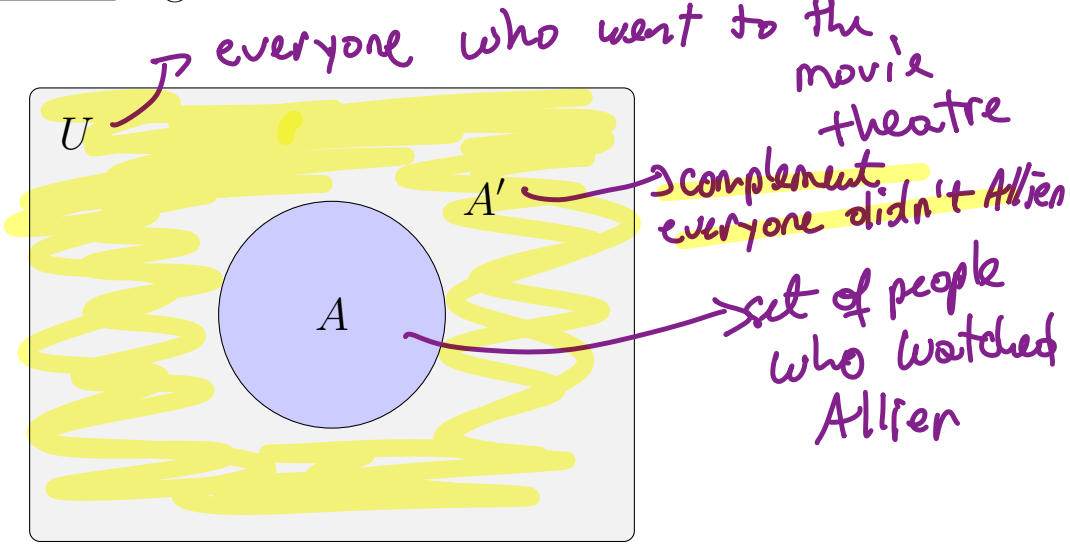
Cardinality: The number of elements in a set is called the cardinal number, or cardinality, of the set.
Symbol: $|A|$

$|A| = 6$ $\quad A = \{1, 2, 3, 4, 5, 6\}$

$|B| = 3$ $\quad B = \{G, O, K\}$

Universal set: In set theory, the universe of discourse is called the Universal Set, typically designated with the letter U.

Venn Diagrams: Venn diagrams were developed by the logician John Venn (1834 – 1923). In these diagrams, the universal set is represented by a rectangle and other sets of interest within the universal set are depicted as circular regions.



Complement of a set: The complement of a set A contains everything that is NOT in the set A. The complement is notated A' or A^c.

$B^c = \{C, M, S, \ldots\}$

$B = \{1, 3, 5, 7, 9\}$

Example 2. Example: Let $A = \{2, 4, 6\}$ and $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ Find A'.

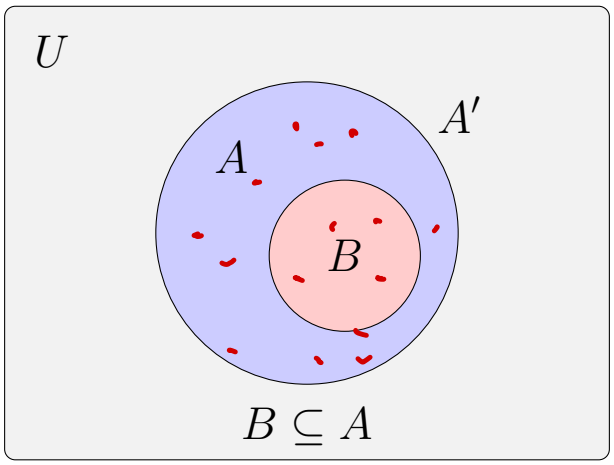
$A' = \{1, 3, 5, 7, 8, 9, 10\}$

$B^c = \{2, 4, 6, 8, 10\}$

Subset: Set B is a subset of set A if every element of B is also an element of A. In symbols this is written as $B \subseteq A$.

$2 \subseteq 3$ ✗

$3 \not\subseteq 2$ ✗

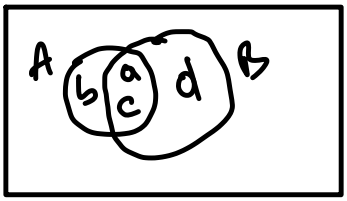


$A \subseteq B$? NO

Example 3. Fill in the blank with $\subseteq$ to make a true statement.

1. $\{a, b, c\} \not\subseteq \{a, c, d\}$ bc. b is in the first set but not second

2. $\{1, 2, 3, 4\} \subseteq \{1, 2, 3, 4, 5, 6\}$ yes



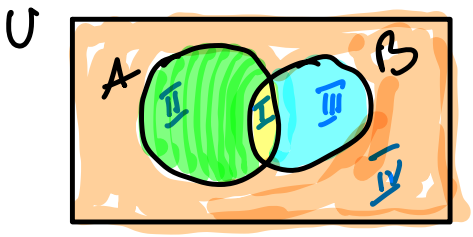
Difference of Sets: The difference of sets A and B, written $A - B$ is the set of elements belonging to set A and not to set B.

Example 4. Find $A - B$ if $A = \{1, 2, 3\}$ and $B = \{2, 3, 4\}$

$A - B = \{1\}$ $\quad B - A = \{4\}$

Intersection: The intersection of sets A and B, written $A \cap B$ is the set of elements common to both A and B.

ex 4: $A \cap B = \{2, 3\}$



4 Regions

I $A \cap B$
II $A - B$
III $B - A$
IV $(A \cup B)^c$

Union: The union of sets A and B, written $A \cup B$ is the set of elements belonging to either of the sets.
This is the "inclusive or". It means one or the other or both.

$A \cup B \rightarrow$ I & II & III

Example 5. Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$A = \{1, 3, 5, 7, 9\}$

$B = \{2, 4, 6\}$ $B' = \{1, 3, 5, 7, 8, 9, 10\}$

$C = \{1, 2, 3\}$

Find the following:

a) $A \cap C$

b) $A - C$

c) $A \cup B$

d) $B \cap B' = \phi$

e) $C \cap \emptyset = \phi$ $\{1,2,3\} \cap \phi = \phi$

f) $C \cup \emptyset = C$ $\{1,2,3\} \cup \phi = \{1,2,3\}$

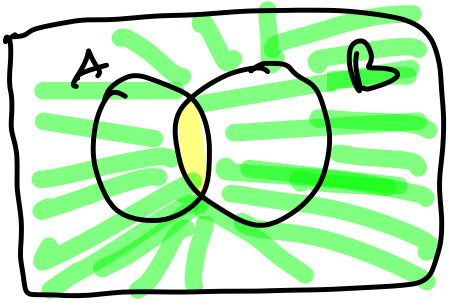
g) $(A \cup B) \cap C$ $= \{1,2,3,4,5,6,7,9\} \cap \{1,2,3\} = \{1,2,3\}$

h) $(B \cup A)'$ $= \{1,2,3,4,5,6,7,9\}^C = \{8, 10\}$

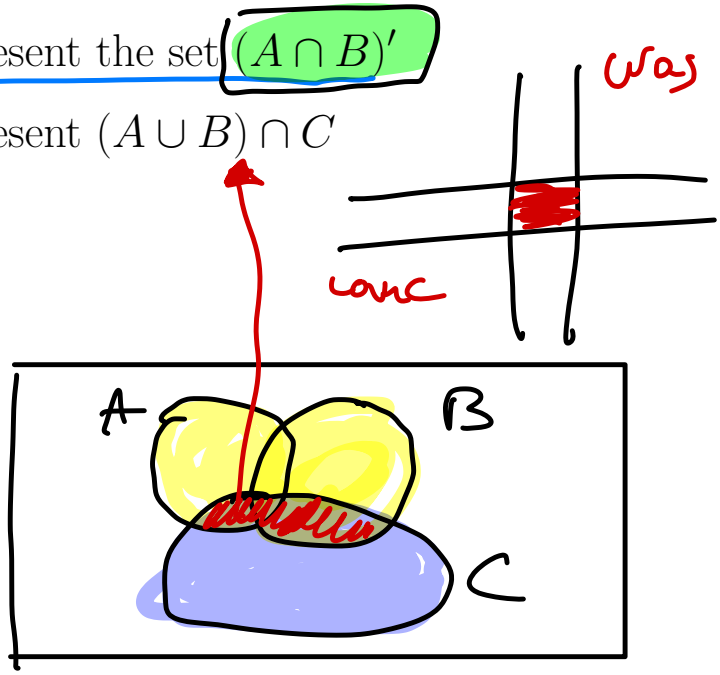
Examples with Venn Diagram

1. Draw a Venn Diagram to represent the set $(A \cap B)'$
2. Draw a Venn Diagram to represent $(A \cup B) \cap C$

(1)



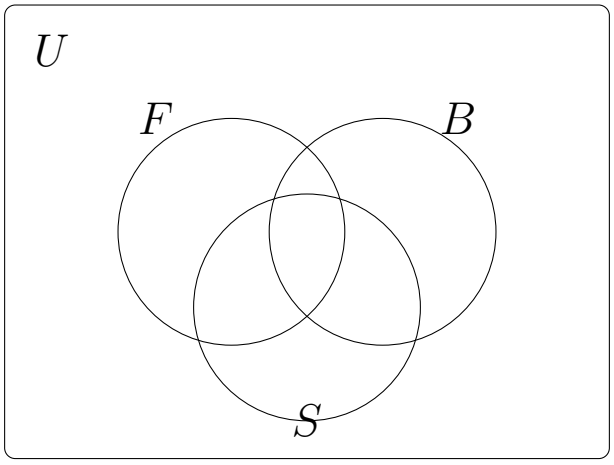
(2)



Example with 3 Venn Diagrams

Example 6. Suppose that a group of 140 people were questioned about particular sports that they watch regularly and the following information was produced.

- 93 like watching football
- 70 like watching baseball
- 40 like watching soccer
- 40 like watching football and baseball
- 25 like watching baseball and soccer
- 28 like watching football and soccer
- 20 like watching all three



Questions:

a. How many people like watching only football?

b. How many people don't like watching any of these sports?