

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

Agenda for Tuesday, Nov 5th, 2024

Start new unit: Sets and Logic !!!

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Coming up

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

Sets use capital letters to denote sets: A, B, C

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

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: $A = \{x \mid \text{condition that } x \text{ needs to satisfy to be in } A\}$
such that

ex: $A = \{x \mid x \text{ is a whole number between 1 and 6}\}$
 $B = \{x \mid 0 \leq x \leq 15\}$

The set with no elements is called the empty set and it is denoted

$\{\}$ or $\emptyset$ empty set
empty box.

~~$\{ \emptyset \}$ empty box with empty box in it~~
 $\{ \emptyset \}$ is a set containing the empty set as an element.

To specify that an element belongs to a set we write

$$1 \in A$$

↳ means belongs

$7 \notin A$ is not an element of A .

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

$\emptyset \notin A$?

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

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

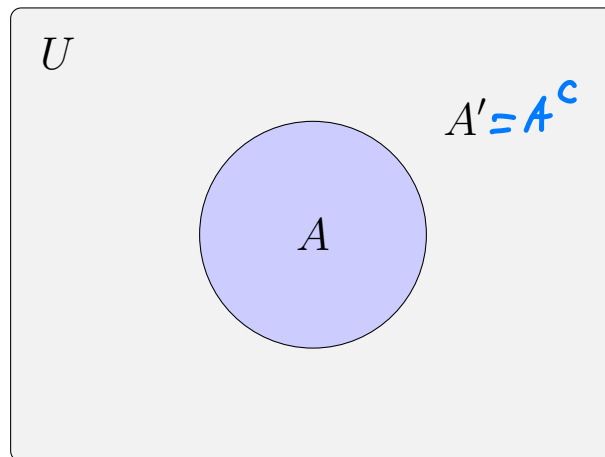
Symbol: $|A|$ or $n(A)$

$$|A| = 6$$

$$|\phi| = 0$$

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

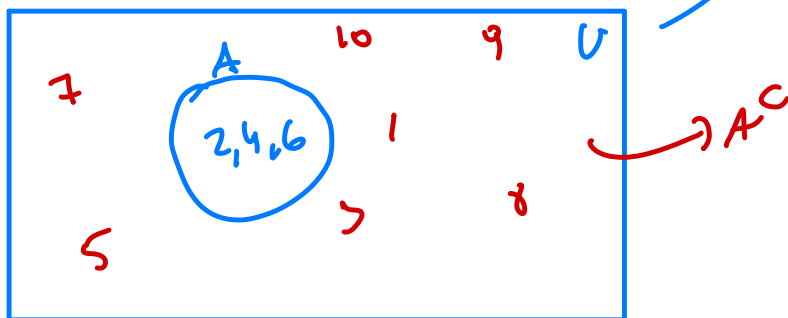
Venn Diagrams: Venn diagrams were developed by the logician John Venn (1834 – 1923). In these diagrams, the universal set is represented by a rectangle and other sets of interest within the universal set are depicted as circular regions.



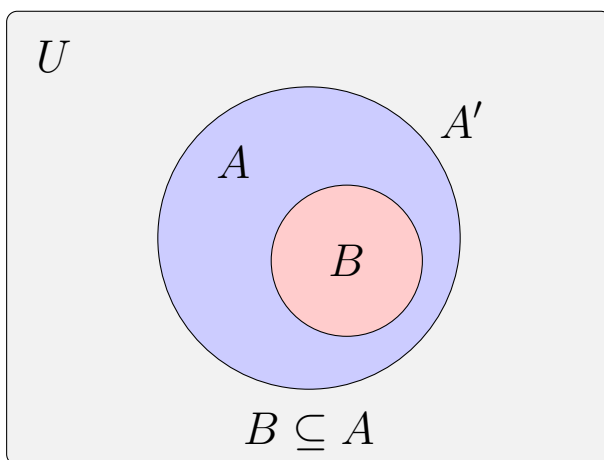
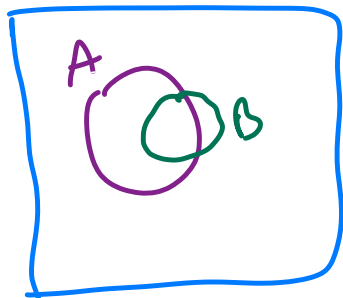
Complement of a set: The complement of a set A contains everything that is NOT in the set A . The complement is notated A' or A^c .

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

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



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 $B \subseteq A$.

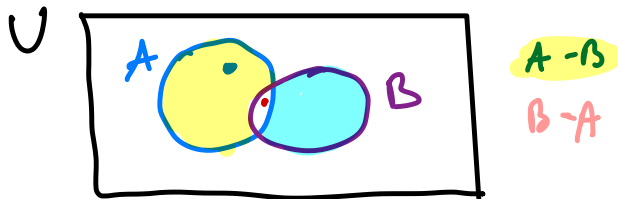


$A \not\subseteq B$
 A is not a subset of B .

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

- $\{a, \underline{b}, c\} \not\subseteq \{a, \underline{c}, d\}$ bc. b is in first set but not in second
- $\{1, 2, 3, 4\} \subseteq \{1, 2, 3, 4, 5, 6\}$

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 .

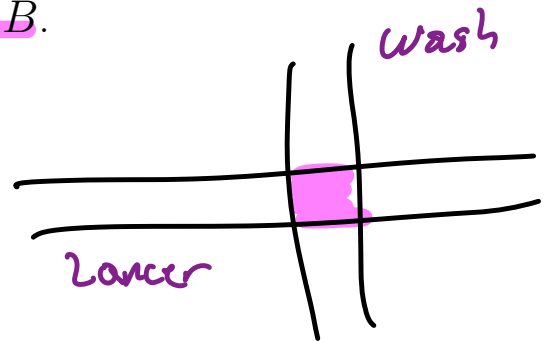
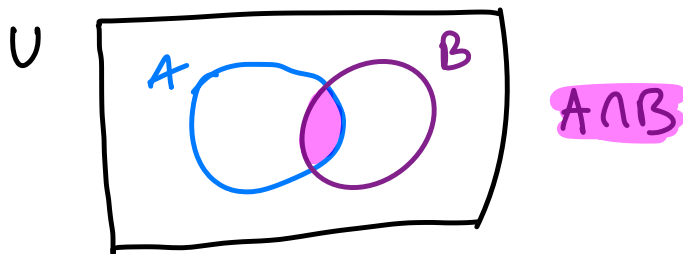


Example 4. Find $A - B$ if $A = \{1, 2, 3\}$ and $B = \{2, 3, 4\}$

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

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

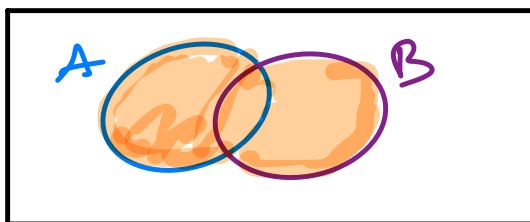
Intersection: The intersection of sets A and B , written $A \cap B$ is the set of elements common to both A and B .



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

Union: The union of sets A and B , written $A \cup B$ is the set of elements belonging to either of the sets.

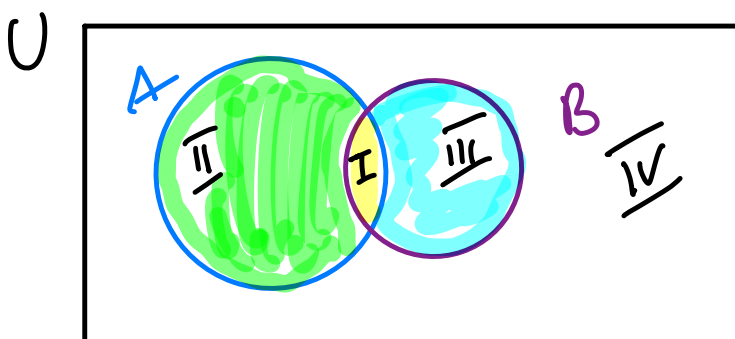
This is the "inclusive or". It means one or the other or both.



$$A \cup B$$

$$A \cup B = \{1, 2, 3, 4\}$$

ex 4:



Region

$$\text{I: } A \cap B$$

$$\text{II: } A - B$$

$$\text{III: } B - A$$

$$\text{IV: } (A \cup B)^c$$

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

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

$$B = \{2, 4, 6\}$$

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

Find the following:

a) $A \cap C$

b) $A - C$

c) $A \cup B$

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

e) $C \cap \emptyset = \emptyset$

f) $C \cup \emptyset = C$

g) $(A \cup B) \cap C = \{1, 2, 3\} = C$

h) $(B \cup A)' = \text{complement} = \{8, 10\}$

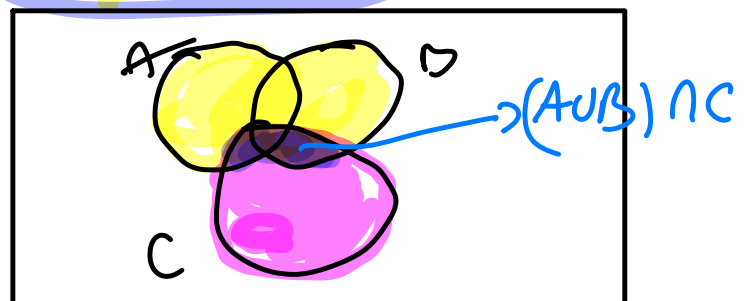
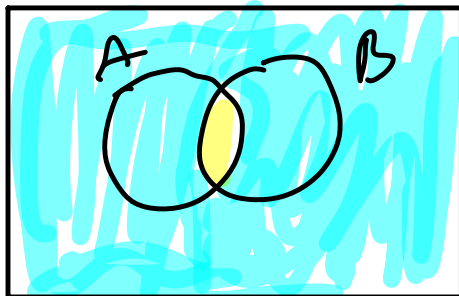
$$\{1, 2, 3, 4, 5, 6, 7, 9\}$$

$$B' = B^c = \{1, 3, 5, 7, 8, 9, 10\}$$

Examples with Venn Diagram

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

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

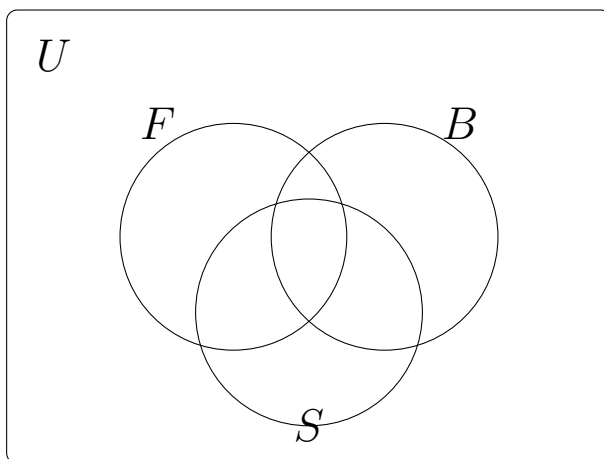


Example with 3 Venn Diagrams

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

*next
class*



Questions:

- a. How many people like watching only football?
- b. How many people don't like watching any of these sports?