Math 2300: Discrete Mathematics

Set Theory 3 - Set Operations Textbook Section

Terms, Concepts, and Examples

We can obtain new sets by performing operations on other sets. When performing set operations, it is often helpful to consider all of our sets as subsets of a universal set U.

- The **intersection** of A and B, $A \cap B = \{x \in U \mid x \in A \wedge \in B\}$, is the set that contains those elements that are in both A and B. (i.e. the elements the two sets have in common)

  Example: Let $A = \{1, 2, 3, 6\}$ and $B = \{2, 4, 6, 9\}$. Then $A \cap B = \{2, 6\}$.

  Video Example of Set Operations - Intersection

- The **union** of A and B, $A \cup B = \{x \in U \mid x \in A \vee \in B\}$, is the set that contains elements that are either in A or in B or in both. (i.e. elements that are in either set)

  Example: Let $A = \{1, 2, 3, 6\}$ and $B = \{2, 4, 6, 9\}$. Then $A \cup B = \{1, 2, 3, 4, 6, 9\}$.

  Video Example of Set Operations - Union

- Two sets are called **disjoint** if their intersection is empty. If A and B are disjoint, we write $A \cap B = \emptyset$

- The **set difference** of A and B, $A - B = \{x \in A \mid x \notin B\}$, is the set that contains the elements that are in A but not in B

  Example: Let $A = \{1, 2, 3, 5, 7\}$ and $B = \{1, 5, 6, 8\}$. Then $A - B = \{2, 3, 7\}$.

- The **complement** of A, $\overline{A} = \{x \in U \mid x \notin A\}$, contains all elements in the universe that are not in A

  Example: Let $A = \{1, 2, 3, 6\}$ and the universe $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. Then $\overline{A} = \{4, 5, 7, 8, 9\}$.

  Video Example of Set Operations - Set Difference and Complement

Practice Problems

1. Let $A = \{1, 2, 3, 4, 5\}$ and $B = \{0, 3, 6\}$ and the universe $U = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$. Find

   (a) $A \cup B$

   (b) $A - B$

   (c) $A \cap B$

   (d) $B - A$

   (e) $A \cap \overline{B}$

   (f) $\overline{A \cup B}$