

## Set Operations

Learning Objectives: Upon completion, you should be able to:

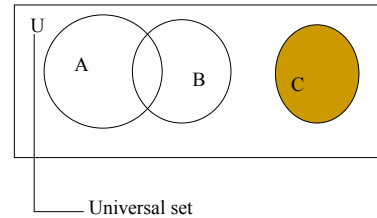
Perform the following set operations:

- Union
- Intersection
- Complement
- Difference
- Cross product

## Set Operations

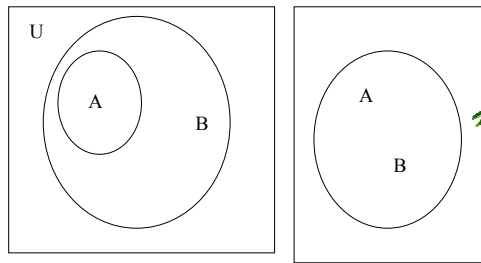
### Venn Diagrams

Uses a closed region in the plane to represent sets



## Set Operations

### Venn Diagrams



$$A \subseteq B$$

$$A = B$$

## Set Operations

### UNION

$$A \cup B = \{x \mid x \in A \text{ or } x \in B\}$$

The union of two sets is a set consisting of all elements belonging to either sets.

## Set Operations

### UNION

Example:

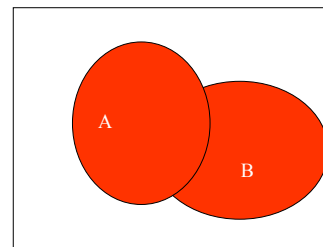
$$A = \{I, LOVE, YOU\}$$

$$B = \{I, HATE, YOU\}$$

$$\text{Then } A \cup B = \{I, LOVE, HATE, YOU\}$$

## Set Operations

### UNION



$$A \cup B$$

## Set Operations

### INTERSECTION

$$A \cap B = \{x \mid x \in A \text{ and } x \in B\}$$

The intersection of two sets is a set whose elements are those that are common to the two sets.

## Set Operations

### INTERSECTION

Example:

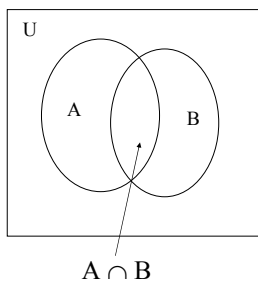
If  $A = \{2, 4, 6, 8, \dots\}$  and  $B = \{3, 6, 12, \dots\}$

$$A \cap B = \{6, 12, 18, \dots\}$$

Describe  $A \cap B$  using rule method.

## Set Operations

### INTERSECTION



## Set Operations

### COMPLEMENT

$$A' = \{x \mid x \in U \text{ but } x \notin A\}$$

The complement of a set is a set whose elements are in the Universal set but not in the set.

## Set Operations

### COMPLEMENT

Example:

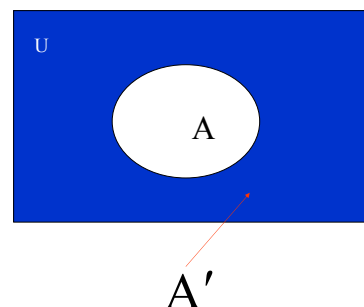
Let A be the set consonants in the English alphabet. Then

$A'$  is the set of vowels.

What is U in this case?

## Set Operations

### COMPLEMENT



## Set Operations

### DIFFERENCE

$$A - B = \{x \mid x \in A \text{ but } x \notin B\}$$

Describe in words the difference of two sets.

## Set Operations

### DIFFERENCE

Example:

Let  $A = \{2, 3, 5, 7, 11, 13, 15\}$

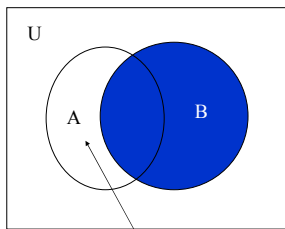
and  $B = \{3, 5, 13\}$

Then  $A - B = \{2, 7, 11, 15\}$ .

What is  $B - A$  ?

## Set Operations

### DIFFERENCE



$A - B$

## Set Operations

### CROSS PRODUCT

$$A \times B = \{(a, b) \mid a \in A \text{ and } b \in B\}$$

The elements of  $A \times B$  are called **ordered pairs**.

## Set Operations

### CROSS PRODUCT

Example:

Let  $A = \{1, 2, 3\}$  and  $B = \{a, b\}$

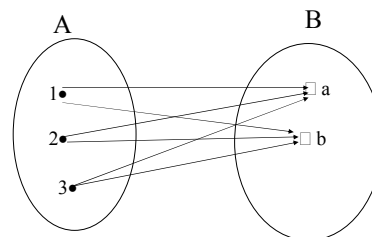
Then  $A \times B =$

$\{(1,a), (1,b), (2,a), (2,b), (3,a), (3,b)\}$

What is  $B \times A$  ?

## Set Operations

### CROSS PRODUCT



$A \times B$

## Set Operations

In this section, we learned how to perform the following set operations:

- Union
- Intersection
- Complement
- Difference
- Cross product

