VIVEKANAND COLLEGE,KOLHAPUR (AUTONOMOUS)

DEPARTMENT OF BCA

SUBJECT – COMPUTER MATHEMATICS

CHAPTER 1- SETS

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What is a Set?

- A *set* is a well-defined collection of distinct objects.
- The objects in a set are called the *elements* or *members* of the set.
- Capital letters *A,B,C,…* usually denote sets.
- Lowercase letters *a,b,c*,… denote the elements of a set.

Examples

- The collection of the vowels in the word “probability”.
- The collection of real numbers that satisfy the equation $x^2 - 9 = 0$.
- The collection of two-digit positive integers divisible by 5.
- The collection of great football players in the National Football League.
- The collection of intelligent members of the United States Congress.

The Empty Set

- The set with no elements.
- Also called *the null set*.
- Denoted by the symbol ϕ.
- Example: The set of real numbers *x* that satisfy the equation

$$x^2 + 1 = 0$$

Finite and Infinite Sets

- A finite set is one which can be counted.
- Example: The set of two-digit positive integers has 90 elements.
- An infinite set is one which cannot be counted.
- Example: The set of integer multiples of the number 5.

The Cardinality of a Set

- Notation: $n(A)$
- For finite sets A, $n(A)$ is the number of elements of A.
- For infinite sets A, write $n(A)=\infty$.

Specifying a Set

- List the elements explicitly, e.g.,

$$C = \{\, a, o, i \,\}$$

- List the elements implicitly, e.g.,

$$K = \{\, 10, 15, 20, 25, \ldots., 95 \,\}$$

- Use set builder notation, e.g.,

$$Q = \{\; x \mid x = p/q \quad \text{where } p \text{ and } q \text{ are integers and } q \neq 0 \,\}$$

The Universal Set

- A set U that includes all of the elements under consideration in a particular discussion.
- Depends on the context.
- Examples: The set of Latin letters, the set of natural numbers, the set of points on a line.

The Membership Relation

- Let *A* be a set and let *x* be some object.
- Notation: $x \in A$
- Meaning: *x* is a member of *A*, or *x* is an element of *A*, or *x* belongs to *A*.
- Negated by writing $x \notin A$
- Example: $V = \{a, e, i, o, u\}$ $e \in V$ $b \notin V$

Equality of Sets

- Two sets A and B are equal, denoted $A=B$, if they have the same elements.
- Otherwise, $A \neq B$.
- Example: The set A of odd positive integers is not equal to the set B of prime numbers.
- Example: The set of odd integers between 4 and 8 is equal to the set of prime numbers between 4 and 8.

Subsets

- *A* is a <u>subset</u> of *B* if every element of *A* is an element of *B*.
- Notation: $A \subseteq B$
- For each set *A*, $A \subseteq A$
- For each set *B*, $\emptyset \subseteq B$
- *A* is <u>proper</u> subset of *B* if $A \subseteq B$ and $A \neq B$

Unions

- The union of two sets *A* and *B* is

$$A \cup B = \left\{ x \,\middle|\, x \in A \text{ or } x \in B \right\}$$

- The word "or" is inclusive.

Intersections

- The intersection of *A* and *B* is

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

- <u>Example</u>: Let *A* be the set of even positive integers and *B* the set of prime positive integers. Then

$$A \cap B = \{2\}$$

- <u>Definition</u>: *A* and *B* are <u>disjoint</u> if

$$A \cap B = \varnothing$$

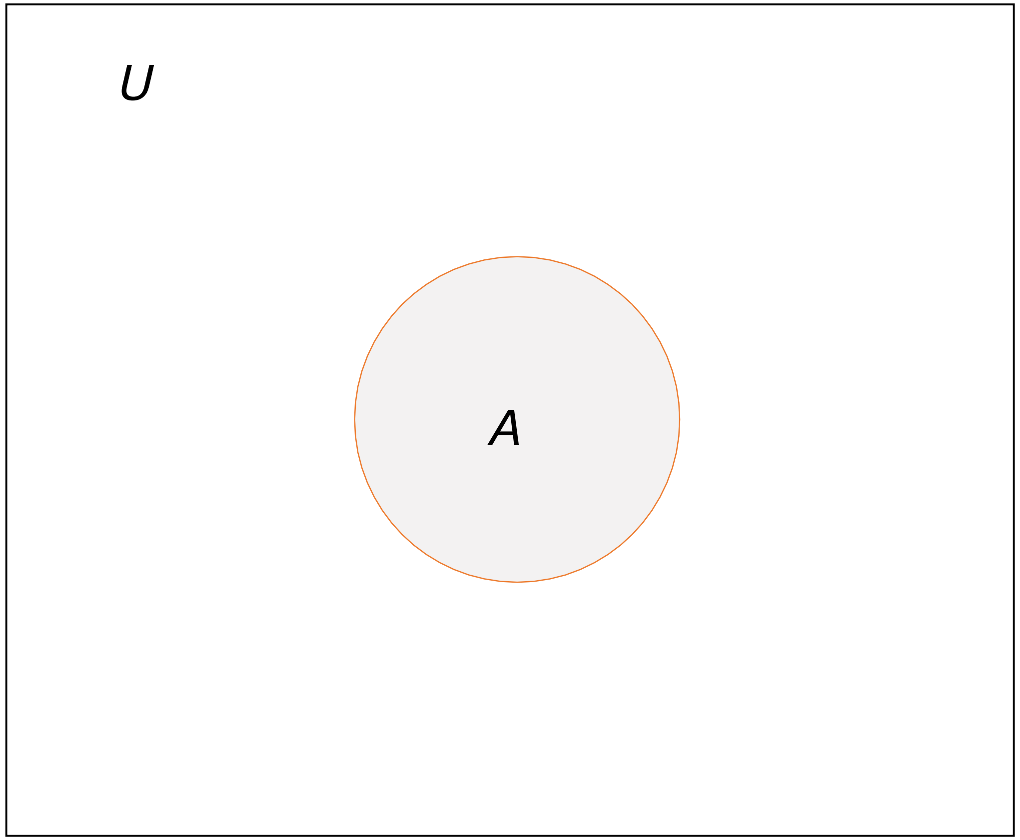
Complements

- If A is a subset of the universal set U, then the <u>complement</u> of A is the set

$$A^c = \left\{ x \in U \;\middle|\; x \notin A \right\}$$

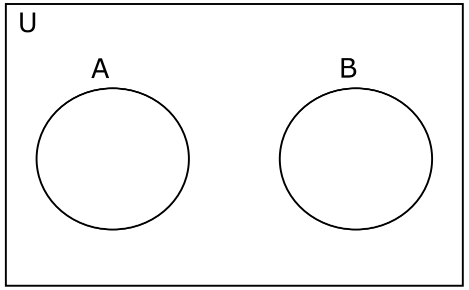
- Note: $A \cap A^c = \Phi$ $\quad A \cup A^c = U$

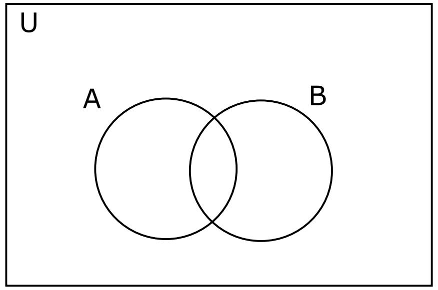
Venn Diagrams

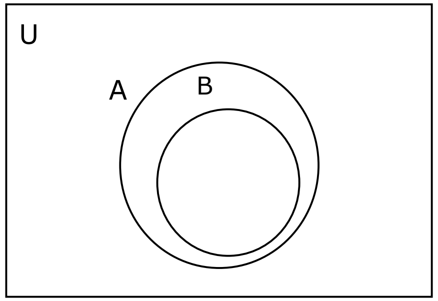


Set A represented as a disk inside a rectangular region representing U.

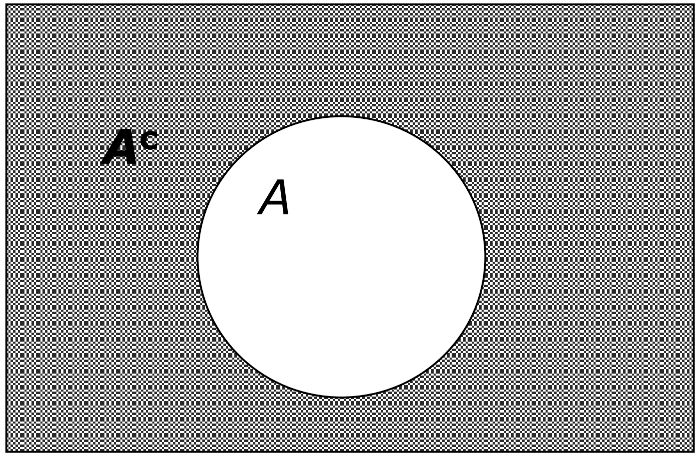
Possible Venn Diagrams for Two Sets





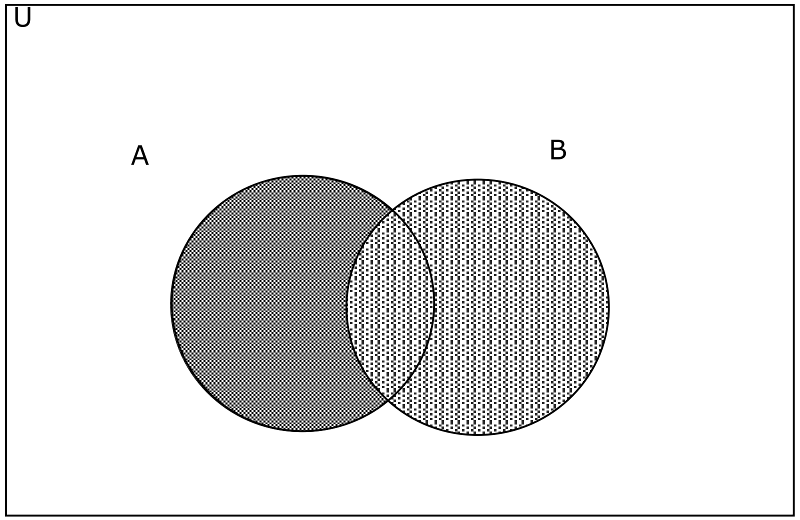


The Complement of a Set

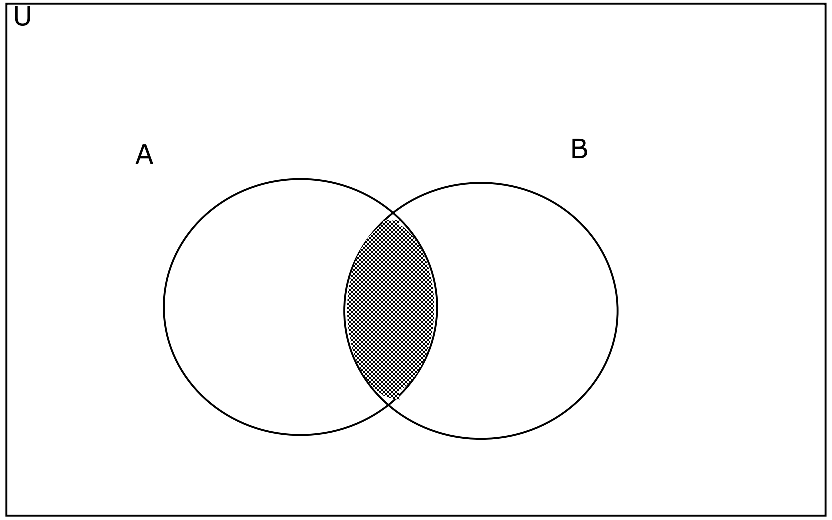


The shaded region represents the complement of the set *A*

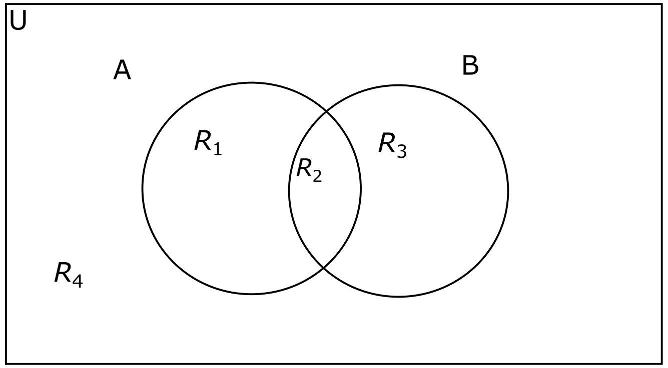
The Union of Two Sets



The Intersection of Two Sets



Sets Formed by Two Sets



- $R_1 = A \cap B^c$
- $R_2 = A \cap B$
- $R_3 = A^c \cap B$
- $R_4 = A^c \cap B^c$

Two Basic Counting Rules

If *A* and *B* are finite sets,

1. $$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

2. $$n(A \cap B^c) = n(A) - n(A \cap B)$$

See the preceding Venn diagram.