SET THEORY

❖ Intersection of Sets :

- The **intersection** of two or more sets contains all the elements that are in all sets.
- For sets A, B, their ***intersection*** $A \cap B$ is the set containing all elements that are simultaneously in A **and ("$\wedge$") in** B.
- Formally, $\forall A, B$: $A \cap B \equiv \{x \mid x \in A \wedge x \in B\}$.
- Note that $A \cap B$ is a subset of A **and** it is a subset of B:
  $\forall A, B$: $(A \cap B \subseteq A) \wedge (A \cap B \subseteq B)$.
- Formal definition for the intersection of two sets:
  $A \cap B = \{ x \mid x \in A$ **and** $x \in B \}$.
- **Further Examples**
  - $\{1, 2, 3\} \cap \{3, 4, 5\} = \{3\}$.
  - {New York, Washington} $\cap \{3, 4\} = \varnothing$.
    No elements in common
  - $\{1, 2\} \cap \varnothing = \varnothing$
    Any set intersection with the empty set yields the empty set

- **Properties of the intersection operation**

  - $A \cap U = A$ — **Identity law**
  - $A \cap \varnothing = \varnothing$ — **Domination law**
  - $A \cap A = A$ — **Idempotent law**
  - $A \cap B = B \cap A$ — **Commutative law**
  - $A \cap (B \cap C) = (A \cap B) \cap C$ — **Associative law**

❖ Disjoint of Sets:

- Two sets are disjoint if they have **NO** elements in common

- Formally, two sets are disjoint if their intersection is the empty set

- **Formal definition for disjoint sets:**
  Two sets are disjoint if their intersection is the Empty set.

- **Further Examples**

  - {1, 2, 3} and {3, 4, 5} are not disjoint

  - {New York, Washington} and {3, 4} are disjoint

  - {1, 2} and ∅ are disjoint

- Their intersection is the empty set ∅ **and** ∅ are disjoint!
  Their intersection is the empty set

- Two sets ***A***, ***B*** are called ***disjoint*** (*i.e.*, enjoined)
  if their intersection is empty. **(*A* ∩ *B* = ∅)**

- Example: the set of even integers is disjoint with the set of odd integers.