1.2 Set Representation and Manipulation

Notebook:	Discrete Mathematics [CM1020]		
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Cornell Notes	**Topic:** 1.2 Set Representation and Manipulation	Course: BSc Computer Science Class: Discrete Mathematics-Lecture Date: October 14, 2019

Essential Question:

What is the visual representation of a set and on the other hand how can the said set be manipulated and partitioned?

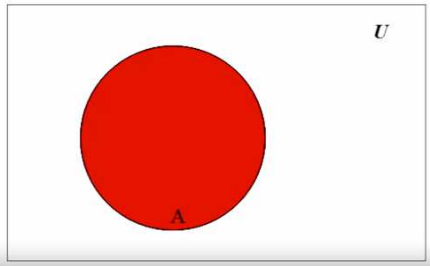
Questions/Cues:

- What is the universal set?
- What is a Venn Diagram?
- What is a compliment of a set?
- What is the union of a set and its complement?
- What is the Venn Diagram Representation of the union, intersection, set difference and symmetric difference of two sets?
- What are De Morgan's Laws?
- What is De Morgan's first and second law?
- What is the Set identity of Commutativity?
- What is the Set identity of Associativity?
- What is the set identity of Distributivity?
- What is the partition of an object?
- What are disjoint sets?
- What is the partition of a set?

Notes

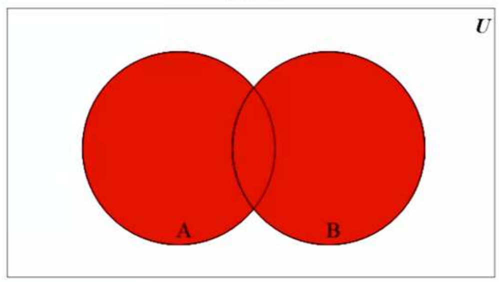
- Universal Set = set containing everything, denoted by ***U***
- Venn Diagram = to visualize possible relations among collection of sets

U is called the universal set and it contains everything.
A $\subseteq$ U (A is in red).

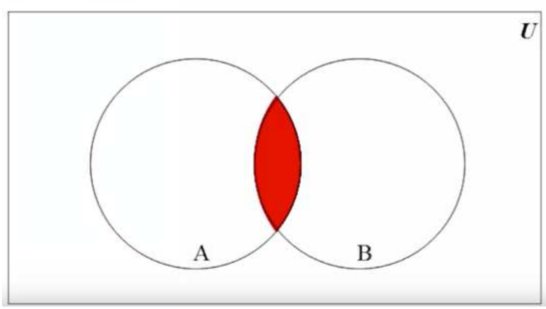


- Given A, Complement of $\overline{A}$ = contains all elem. in ***U***, not in A
    - $\overline{A}$ = U - A
- $\overline{A} \cup A = U$

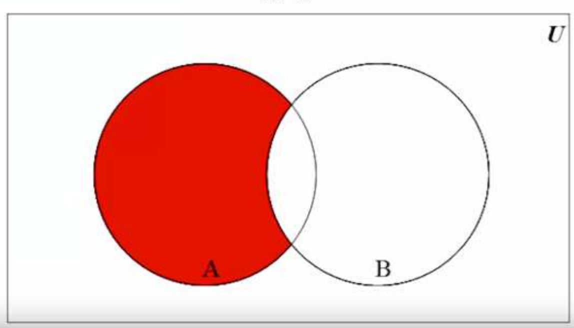
A ∪ B



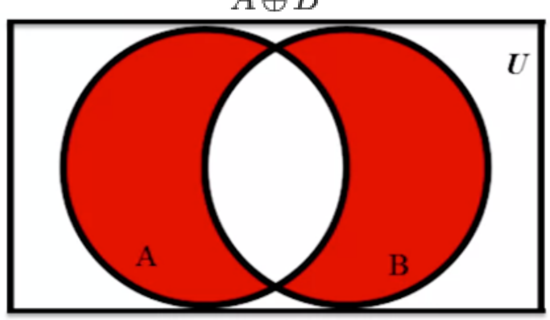
A ∩ B



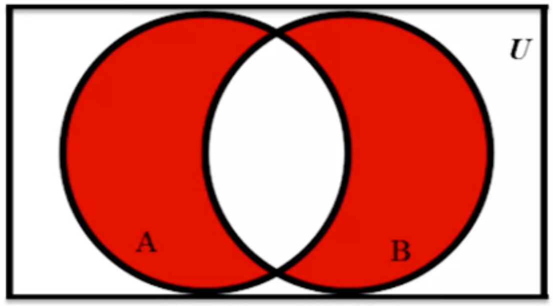
A−B



$A \oplus B$



$A \cup B - (A \cap B)$



- De Morgan's Laws = how math statements and concepts related through their opposites
    - In set theory, DMLs' relate to interaction and union of set through their complements

$\overline{A \cup B} = \overline{A} \cap \overline{B}$
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$\overline{A \cap B} = \overline{A} \cup \overline{B}$
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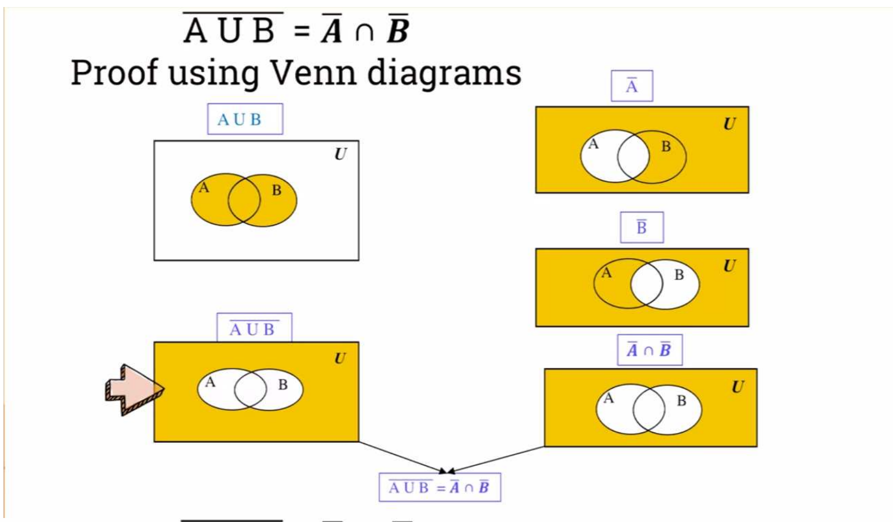

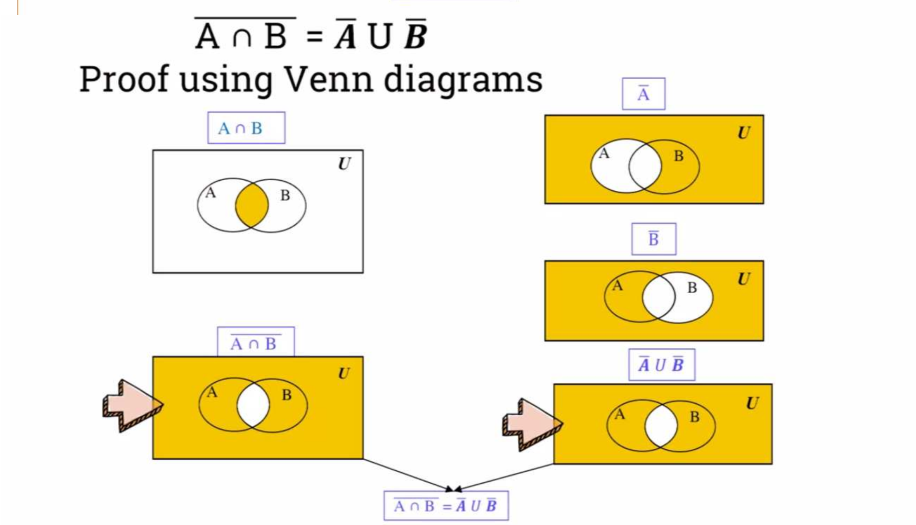

- Commutativity = operation in which order of element doesn't affect result
    - $A \cup B = B \cup A$
    - $A \cap B = B \cap A$
    - $A \oplus B = B \oplus A$
    - Set difference is **NOT** commutative, $A - B \neq B - A$

- Associativity = grouping of elements in operation, where the grouping doesn't effect the result
    - $(A \cup B) \cup C = A \cup (B \cup C)$
    - $(A \cap B) \cap C = A \cap (B \cap C)$
    - $(A \oplus B) \oplus C = A \oplus (B \oplus C)$
    - Set difference is **NOT** associative, $(A - B) - C \neq A - (B - C)$
- Distributivity = multiplying a sum by number gives same result as multiplying each # and adding the products together
    - $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
    - $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

Union	Name	Intersection
$A \cup B = B \cup A$	commutative	$A \cap B = B \cap A$
$(A \cup) B \cup C = A \cup (B \cup C)$	associative	$(A \cap) B \cap C = A \cap (B \cap C)$
$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$	distributive	$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$
$\overline{A \cup B} = \overline{A} \cap \overline{B}$	De Morgan's laws	$\overline{A \cap B} = \overline{A} \cup \overline{B}$
$A \cup \emptyset = A$ $A \cup U = U$	identities	$A \cap \emptyset = \emptyset$ $A \cap U = A$
$A \cup \overline{A} = U$ $\overline{U} = \emptyset$	complement	$A \cap \overline{A} = \emptyset$ $\overline{\emptyset} = U$
$\overline{\overline{A}} = A$	double complement	
$A \cup (A \cap B) = A$	absorption	$A \cap (A \cup B) = A$
$A - B = A \cap \overline{B}$	set difference	

Show that: $\overline{(A \cap B) \cup \overline{B}} = B \cap \overline{A}$

$\overline{(A \cap B) \cup \overline{B}} = \overline{(A \cap B)} \cap \overline{\overline{B}}$ De Morgan's law

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

$= (\overline{A} \cup \overline{B}) \cap B$ De Morgan's law

$= B \cap (\overline{A} \cup \overline{B})$ commutative

$= (B \cap \overline{A}) \cup (B \cap \overline{B})$ distributive

$= (B \cap \overline{A}) \cup \emptyset$

$= B \cap \overline{A}$

- Partition of an obj = a subdivision of obj into parts, so that parts are completely separated from each other, yet together they form whole object
- Dis-joint sets = A and B are disjoint $\leftrightarrow A \cap B = \emptyset$
- Partition of Set = Partit. of A is set of subsets A_i of A
    - all subsets A_i are disjointed

- the union of all subsets A_i = A

Summary

In this week, we learned that sets can be visually represented by Venn Diagrams, manipulated by set identities to be simplified and subdivided into partitions to represent segments of a whole set.