

MAT-207: Discrete Mathematics – Assignment 3

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1. Define set operations for the following sets

1.1. $\{x \mid x \in U \text{ and } x \notin A\}$

$$U \cap A^c$$

1.2. $\{x \mid x \in C \text{ and } x \notin A\}$

$$C \cap A^c$$

1.3. $\{x \mid x \in D \text{ and } x \notin B\}$

$$D \cap B$$

1.4. $\{x \mid x \in A \text{ or } x \notin B\}$

$$A \cup B$$

1.5. $\{\forall x \mid x \in D \Rightarrow x \in B\}$ and $\{\forall x \mid x \in B \Rightarrow x \in D\}$

$$(D \subset B) \cap (B \subset D)$$

2. Prove these statements using set operators.

2.1. $A \cup (B - A) = A \cup B$

$$= A \cup (B \cap A)^c$$

$$= (A \cup B) \cap (A \cup A^c)$$

$$= (A \cup B) \cap (U)$$

$$= A \cup B$$

2.2. $A \cap (B - A) = \emptyset$

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

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

x cannot be both in B and not in B - this can only mean that this is an empty set

$$= \emptyset$$

2.3. $(A - C) \cap (C - B) = \emptyset$

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

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

x cannot be both in C and not in C - this can only mean that this is an empty set

$$= \emptyset$$

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3. Let $A = \{a, b\}$, $B = \{x, z\}$ and $C = \{0, 1\}$. Find the Cartesian Product of the following:

3.1. $A \times B \times C$

$$A \times B = \{(a, x), (a, z), (b, x), (b, z)\}$$

$$(A \times B) \times C = \{(a, x, 0), (a, x, 1), (a, z, 0), (a, z, 1), (b, x, 0), (b, x, 1), (b, z, 0), (b, z, 1)\}$$

3.2. $C \times B \times A$

$$C \times B = \{(0, x), (0, z), (1, x), (1, z)\}$$

$$(C \times B) \times A = \{(0, x, a), (0, x, b), (0, z, a), (0, z, b), (1, x, a), (1, x, b), (1, z, a), (1, z, b)\}$$

3.3. $C \times C \times C$

$$C \times C = \{(0, 0), (0, 1), (1, 0), (1, 1)\}$$

$$(C \times C) \times C = \{(0, 0, 0), (0, 0, 1), (0, 1, 0), (0, 1, 1), (1, 0, 0), (1, 0, 1), (1, 1, 0), (1, 1, 1)\}$$