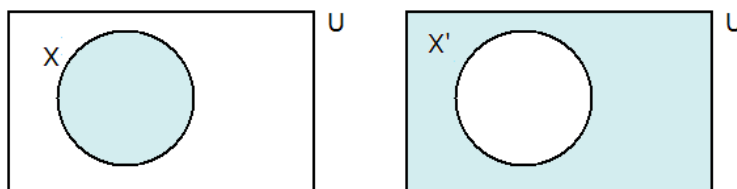


You have probably noticed that when sets are given, usually they are all included in a larger set, usually denoted by U . This is the universal set, the "universe" in the context of the problem. The universal set becomes truly essential for the definition of a new operation, **taking the complement of a set**.

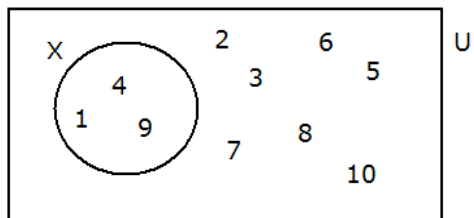
Definition 1 Let X be a set. Then the complement of X , denoted by X' is the set defined by

$$\text{for all } a, \quad a \in X' \text{ if and only if } a \notin X$$

The elements of the complement of X are "everything but" X . Sort of like the negative of a picture.



Example 1 Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ and $X = \{1, 4, 9\}$. Then $X' = \{2, 3, 5, 6, 7, 8, 10\}$.



Example 2 Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $A = \{1, 7, 8, 9\}$, and $B = \{2, 4, 6, 8, 10\}$. Then

1. $A' = \{2, 3, 4, 5, 6, 10\}$
2. $B' = \{1, 3, 5, 7, 9\}$
3. $A' \cap B' = \{2, 3, 4, 5, 6, 10\} \cap \{1, 3, 5, 7, 9\} = \{3, 5\}$
4. $(A \cap B)' = (\{1, 7, 8, 9\} \cap \{2, 4, 6, 8, 10\})' = (\{8\})' = \{1, 2, 3, 4, 5, 6, 7, 9, 10\}$
5. $A \cap A' = \emptyset$ (true for all sets)
6. $A \cap B' = \{1, 7, 8, 9\} \cap \{1, 3, 5, 7, 9\} = \{1, 7, 9\}$