4. Create an ADT, Boolean. The minimal operations are And, Or, Not, XOR, Equivalent and Implies.

Soln: ADT Boolean

Objects: The variables can only either take up the value True or False.

Functions: &&, ||, ! are the standard logical operations.

- Boolean And$(x,y) ::=$ ~~if (x) if (y)~~ return$(x \&\& y)$
- Boolean OR$(x,y) ::=$ return$(x || y)$
- Boolean Not$(x) ::= !x$ return
- Boolean Xor$(x,y) ::= p =$ ~~or~~ $OR($ AND$(x, Not(y))$, AND$(Not(x), y))$ return $\wedge p$
- Boolean Equivalent$(x,y) ::= p = Or($ AND(x,y), AND$(Not(x), Not(y)))$ return p
- Boolean Implies$(x,y) ::= Or(Not(x), y)$

2. Create an ADT, Set. Use the standard mathematics definition and include the following operations: Create, Insert, Remove, IsIn, Union, Intersection, Difference.

Soln: ADT Set

Objects: A collection of distinct elements drawn from some universe U. Each element is either in the set or not in the set.

Functions:
- Create$() \rightarrow$ Set : Returns a new empty set.
- Insert$(S: Set, x: Element) \rightarrow$ Set : Returns a new set that contains all the elements of S, and also the element x (if x is not already in S)
- Remove$(S: Set, x: Element) \rightarrow$ Set : Returns a new set that contains all the elements of S except x (if x was in S; otherwise S is unchanged)
- Is-In$(S: Set, x: Element) \rightarrow$ Boolean : Returns TRUE if x is an element of S, False o.w.