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1  ┌────────────────── MODULE AdditionalSetOperators ───────────────────┐
    Copyright: https://www.learnltla.com/libraries/sets/
5  EXTENDS Naturals, TLC

    Pick an element from the set S.
10 Pick(S)  $\triangleq$  CHOOSE s  $\in$  S : TRUE

    Pick an element that is not in the set S.
15 PickNone(S)  $\triangleq$  CHOOSE s : s  $\notin$  S

17 RECURSIVE SetReduce( $-, -, -$ )
18 SetReduce(Op( $-, -$ ), S, value)  $\triangleq$ 
19   IF S = {}
20   THEN value
21   ELSE LET s  $\triangleq$  Pick(S)
22   IN   SetReduce(Op, S \ {s}, Op(s, value))

    This version will report an error if the operation applied is not commutative as required.
28 RECURSIVE SetReduceSafe( $-, -, -$ )
29 SetReduceSafe(Op( $-, -$ ), S, value)  $\triangleq$ 
30   IF S = {}
31   THEN value
32   ELSE LET s  $\triangleq$  Pick(S)
33   IN   IF Op(s, value) = Op(value, s)
34   THEN SetReduceSafe(Op, S \ {s}, Op(s, value))
35   ELSE Assert(FALSE, "Op is not commutative.")

37 Sum(S)  $\triangleq$ 
38   LET sum(a, b)  $\triangleq$  a + b
39   IN   SetReduce(sum, S, 0)

41 IsMin(set, min)  $\triangleq$ 
42    $\wedge$  min  $\in$  set
43    $\wedge$  ( $\forall x \in \text{set} : \text{min} \leq x$ )

45 IsMax(set, max)  $\triangleq$ 
46    $\wedge$  max  $\in$  set
47    $\wedge$  ( $\forall x \in \text{set} : \text{max} \geq x$ )

49 Min(set)  $\triangleq$  CHOOSE min  $\in$  set : ( $\forall x \in \text{set} : \text{min} \leq x$ )
51 Max(set)  $\triangleq$  CHOOSE max  $\in$  set : ( $\forall x \in \text{set} : \text{max} \geq x$ )
52 └────────────────────────────────────────────────────────────────────────┘

\ * Modification History
\ * Last modified Fri Jul 06 13:39:14 CST 2018 by hengxin
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