

```

1 |----- MODULE Op -----|
  |Model checking basic operations on strings (i.e., list of characters).|
6 | EXTENDS Naturals, Sequences,
7   | AdditionalMathOperators, AdditionalSetOperators, AdditionalSequenceOperators
8 |-----|
9 | CONSTANTS   Char   | set of characters allowed
11 | List  $\triangleq$  Seq(Char) | all possible lists/strings
12 |-----|
  |The set of all operations.
16 | Rd  $\triangleq$  [type : { "Rd" }] | a read specifies no arguments
17 | Ins  $\triangleq$  [type : { "Del" }, pos : 1 .. PosInt] | a deletion specifies a position, indexed from 1
18 | Del  $\triangleq$  [type : { "Ins" }, pos : 1 .. PosInt, ch : Char, pr : 1 .. PosInt] | an insertion also specifies a character and a position
20 | Op  $\triangleq$  Ins  $\cup$  Del | Now we focus on "Ins" and "Del".
22 | Nop  $\triangleq$  PickNone(Op) | Nop: an operation representing "doing nothing"
23 |-----|
  |Some operations for test.
27 | Del1  $\triangleq$  [type  $\mapsto$  "Del", pos  $\mapsto$  1]
28 | Del2  $\triangleq$  [type  $\mapsto$  "Del", pos  $\mapsto$  2]
29 | Del3  $\triangleq$  [type  $\mapsto$  "Del", pos  $\mapsto$  3]
30 | Del4  $\triangleq$  [type  $\mapsto$  "Del", pos  $\mapsto$  4]
31 | Ins1  $\triangleq$  [type  $\mapsto$  "Ins", pos  $\mapsto$  1, ch  $\mapsto$  "a", pr  $\mapsto$  1]
32 | Ins2  $\triangleq$  [type  $\mapsto$  "Ins", pos  $\mapsto$  2, ch  $\mapsto$  "b", pr  $\mapsto$  2]
33 | Ins3  $\triangleq$  [type  $\mapsto$  "Ins", pos  $\mapsto$  3, ch  $\mapsto$  "c", pr  $\mapsto$  3]
34 | Ops  $\triangleq$   $\langle$  Ins2, Del3, Ins1, Del2, Ins3, Del1  $\rangle$ 
35 |-----|
  |The "Apply" operator which applies an operation op on the list l. Del: If pos > Len(l), the last
  |element of l is deleted.
  |This is realized by the DeleteElement operator.
  |Ins: If pos > Len(l), the new element is appended to l. This is realized by the InsertElement
  |operator.
43 | Apply(op, l)  $\triangleq$  CASE op = Nop  $\rightarrow$  l
44 |   | op.type = "Del"  $\rightarrow$  DeleteElement(l, op.pos)
45 |   | op.type = "Ins"  $\rightarrow$  InsertElement(l, op.ch, op.pos)

  |The "ApplyOps" operator which applies an operation sequence ops on the list l.
51 | RECURSIVE ApplyOps(ops, l)
52 |   | ApplyOps(ops, l)  $\triangleq$ 
53 |     | IF ops =  $\langle$ 
54 |       | THEN l
55 |       | ELSE Apply(Last(ops), ApplyOps(AllButLast(ops), l))
56 |-----|
  | \ * Modification History
  | \ * Last modified Sat Jul 07 10:59:03 CST 2018 by hengxin

```

* Created Sat Jun 23 20:56:53 CST 2018 by *hengxin*