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 $ListUptoLen(len) \triangleq$ UNION $\{[1 .. m \rightarrow Char] : m \in 0 .. len\}$ including the empty list $\langle \rangle$
13 ├───

The set of all operations.

17 $Rd \triangleq [type : \{\text{"Rd"}\}]$ a read specifies no arguments
18 $Ins \triangleq [type : \{\text{"Del"}\}, pos : PosInt]$ a deletion specifies a position, indexed from 1
19 $Del \triangleq [type : \{\text{"Ins"}\}, pos : PosInt, ch : Char, pr : PosInt]$ an insertion also specifies a character and a priority

21 $Op \triangleq Ins \cup Del$ Now we focus on "Ins" and "Del".
22 $Nop \triangleq PickNone(Op)$ *Nop*: an operation representing "doing nothing"
23 ├───

Some operations for test.

27 $Del1 \triangleq [type \mapsto \text{"Del"}, pos \mapsto 1]$
28 $Del2 \triangleq [type \mapsto \text{"Del"}, pos \mapsto 2]$
29 $Del3 \triangleq [type \mapsto \text{"Del"}, pos \mapsto 3]$
30 $Del4 \triangleq [type \mapsto \text{"Del"}, pos \mapsto 4]$
31 $Ins1 \triangleq [type \mapsto \text{"Ins"}, pos \mapsto 1, ch \mapsto \text{"a"}, pr \mapsto 1]$
32 $Ins2 \triangleq [type \mapsto \text{"Ins"}, pos \mapsto 2, ch \mapsto \text{"b"}, pr \mapsto 2]$
33 $Ins3 \triangleq [type \mapsto \text{"Ins"}, pos \mapsto 3, ch \mapsto \text{"c"}, pr \mapsto 3]$
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.

44 $Apply(op, l) \triangleq$ CASE $op = Nop \rightarrow l$
45   □ $op.type = \text{"Rd"} \rightarrow l$
46   □ $op.type = \text{"Del"} \rightarrow DeleteElement(l, op.pos)$
47   □ $op.type = \text{"Ins"} \rightarrow InsertElement(l, op.ch, op.pos)$

The "*ApplyOps*" operator which applies an operation sequence *ops* on the list *l*.

53 RECURSIVE $ApplyOps(\_, \_)$
54 $ApplyOps(ops, l) \triangleq$
55   IF $ops = \langle \rangle$
56   THEN l
57   ELSE $Apply(Last(ops), ApplyOps(AllButLast(ops), l))$
58 └───

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