MODULE *InsertTree*

EXTENDS *Integers*, *Sequences*, *Naturals*, *TLC*

CONSTANT *Char*, *Charnum*

$node \triangleq [ch : Char,\ time : Int,\ father : Char \cup \{\text{“o”}\}]$

$nodechar \triangleq \langle \text{“o”} \rangle$

RECURSIVE $Readtree2set(\_)$

$$Readtree2set(T) \triangleq \text{IF } T = \{\} \text{ THEN } \{\} \text{ ELSE LET } t \triangleq \text{CHOOSE } x \in T : \text{TRUE IN } \{t.ch\} \cup Readtree2set(T \setminus \{t\})$$

RECURSIVE $Createtree(\_, \_)$

$$Createtree(num, tree) \triangleq \text{IF } num = 0 \text{ THEN } tree \text{ ELSE LET } i \triangleq \text{CHOOSE } x \in node : x.time = Charnum - num + 1 \wedge x.father \in Re \text{ IN } Createtree(num - 1,\ tree \cup \{i\})$$

RECURSIVE $max(\_, \_, \_, \_)$

$$\begin{array}{l} max(T, root, curmax, readchar) \triangleq \\ \quad \text{CASE } \exists\, i \in T : i.father = root \wedge i.time > curmax \wedge \neg i.ch \in readchar \rightarrow \\ \qquad \text{LET } i \triangleq \text{CHOOSE } x \in T : \ x.father = root \wedge x.time > curmax \wedge \neg x.ch \in readchar \\ \qquad\quad \text{IN } max(T \setminus \{i\},\ root,\ i.time,\ readchar) \\ \quad \square \quad \exists\, i \in T : i.father = root \wedge i.time \leq curmax \wedge \neg i.ch \in readchar \rightarrow \\ \qquad \text{LET } i \triangleq \text{CHOOSE } x \in T : \ x.father = root \wedge x.time \leq curmax \wedge \neg x.ch \in readchar \\ \qquad\quad \text{IN } max(T \setminus \{i\},\ root,\ curmax,\ readchar) \\ \quad \square \text{OTHER } \rightarrow curmax \end{array}$$

RECURSIVE $Readtree2list(\_, \_, \_, \_)$

$$\begin{array}{l} Readtree2list(T, root, tomb, readchar) \triangleq \\ \quad \text{IF } \exists\, x \in T : x.father = root \wedge \neg x.ch \in tomb \\ \qquad\qquad \wedge x.time = max(T, root, 0, readchar) \quad \wedge \neg x.ch \in readchar \\ \qquad \text{THEN LET } i \triangleq \text{CHOOSE } x \in T : x.father = root \wedge \neg x.ch \in tomb \\ \qquad\qquad\qquad \wedge \ x.time = max(T, root, 0, readchar) \wedge \neg x.ch \in readchar \\ \qquad\quad \text{IN } \langle i.ch \rangle \circ Readtree2list(T, i.ch, tomb, readchar \cup \{i.ch\}) \\ \qquad \text{ELSE IF } \exists\, x \in T : x.father = root \wedge x.ch \in tomb \\ \qquad\qquad \wedge x.time = max(T, root, 0, readchar) \wedge \neg x.ch \in readchar \\ \qquad\quad \text{THEN LET } i \triangleq \text{CHOOSE } x \in T : x.father = root \wedge \ x.ch \in tomb \\ \qquad\qquad\qquad \wedge x.time = max(T, root, 0, readchar) \wedge \neg x.ch \in readchar \\ \qquad\qquad \text{IN } Readtree2list(T, i.ch, tomb, readchar \cup \{i.ch\}) \\ \qquad \text{ELSE IF } \exists\, x \in T : root = x.ch \\ \qquad\quad \text{THEN LET } i \triangleq \text{CHOOSE } x \in T : root = x.ch \\ \qquad\qquad \text{IN } Readtree2list(T, i.father, tomb, readchar) \\ \qquad \text{ELSE } \langle\rangle \end{array}$$

$Readtree2list(Createtree(3, \{\}), \text{“o”}, \{\}, \{\})$

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