MODULE *crackers7a*

EXTENDS *Naturals*, *FiniteSets*
CONSTANTS *Things*, *People*
VARIABLES *desires*, *holds*

$$Init \triangleq \land desires = [p \in People \mapsto \{\}] \quad \land holds = [p \in People \mapsto \{\}]$$

RECURSIVE $\_SetOrdinals(\_, \_)$

$$\_SetOrdinals(s, f) \triangleq \text{IF } s = \{\} \text{ THEN } f \text{ ELSE LET } e \triangleq \text{CHOOSE } x \in s : \text{TRUE IN } \_SetOrdinals(s \setminus \{e\}, [f \text{ EXCEPT } ![e] = Cardinality(s)])$$

$$SetOrdinals(S) \triangleq \_SetOrdinals(S, [x \in S \mapsto 0])$$

$$ResourceOrdinals \triangleq SetOrdinals(Things)$$

$$ChooseBefore(a, b) \triangleq ResourceOrdinals[a] < ResourceOrdinals[b]$$

$$Held(t) \triangleq \exists\, p \in People : t \in holds[p]$$

$$Desire(p) \triangleq \land holds[p] \neq \{\} \Rightarrow desires[p] \neq \{\} \land \exists\, t \in Things : \land t \notin desires[p] \land desires' = [desires \text{ EXCEPT } ![p] = desires[p] \cup \{t\}] \land \text{UNCHANGED } holds$$

$$Acquire(p) \triangleq \exists\, t \in desires[p] : \land \neg Held(t) \land \neg\exists\, t2 \in desires[p] : t2 \notin holds[p] \land ChooseBefore(t2, t) \land holds' = [holds \text{ EXCEPT } ![p] = holds[p] \cup \{t\}] \land \text{UNCHANGED } desires$$

$$Satiated(p) \triangleq \land desires[p] \neq \{\} \land \forall\, t \in desires[p] : t \in holds[p] \land desires' = [desires \text{ EXCEPT } ![p] = \{\}] \land \text{UNCHANGED } holds$$

$$TidyUp(p) \triangleq \land desires[p] = \{\} \land \exists\, t \in holds[p] : \land holds' = [holds \text{ EXCEPT } ![p] = holds[p] \setminus \{t\}] \land \text{UNCHANGED } desires$$

$$Relinquish(p) \triangleq \exists\, t \in desires[p] : \land t \notin holds[p] \land \exists\, t2 \in holds[p] : \land ChooseBefore(t, t2) \land holds' = [holds \text{ EXCEPT } ![p] = holds[p] \setminus \{t2\}]$$

$\wedge$ UNCHANGED $desires$

$$
\begin{array}{l}
Next \triangleq \exists\, p \in People : \\
\qquad \vee\ Desire(p) \\
\qquad \vee\ Acquire(p) \\
\qquad \vee\ Satiated(p) \\
\qquad \vee\ TidyUp(p) \\
\qquad \vee\ Relinquish(p)
\end{array}
$$

$$
\begin{array}{l}
TidiesUp \triangleq \neg\exists\, p \in People : \\
\qquad\qquad \wedge\ desires[p] \neq \{\} \\
\qquad\qquad \wedge \exists\, l \in holds[p] : l \notin desires[p]
\end{array}
$$

$$
Exclusivity \triangleq \neg\exists\, p,\ q \quad \in People : p \neq q \wedge (holds[p] \cap holds[q]) \neq \{\}
$$

$$
\begin{array}{l}
Ordering \triangleq \ \wedge \forall\, x,\ y,\ z \in Things : \\
\qquad\qquad ChooseBefore(x,\ y) \wedge ChooseBefore(y,\ z) \Rightarrow ChooseBefore(x,\ z) \\
\qquad\quad \wedge \forall\, x \in Things : \neg ChooseBefore(x,\ x)
\end{array}
$$

$$
Spec \triangleq Init \wedge \Box[Next]_{\langle desires,\, holds \rangle}
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