

EXTENDS *Naturals*

CONSTANTS N , NIL

$Nodes \triangleq 1 \dots N$

--fair algorithm *TortoiseAndHare*

variables

$start \in Nodes$,
 $succ \in [Nodes \rightarrow Nodes \cup \{NIL\}]$,
 $cycle, tortoise, hare, done$;

begin

$h0$: $tortoise := start$;

$hare := start$;

$done := FALSE$;

$h1$: **while** $\neg done$ **do**

$h2$: $tortoise := succ[tortoise]$;

$hare := LET\ hare1 \triangleq succ[hare] IN$

IF $hare1 \in DOMAIN\ succ$ THEN $succ[hare1]$ ELSE NIL ;

$h3$: **if** $tortoise = NIL \vee hare = NIL$ **then**

$cycle := FALSE$;

$done := TRUE$;

elseif $tortoise = hare$ **then**

$cycle := TRUE$;

$done := TRUE$;

end if;

end while;

end algorithm

BEGIN TRANSLATION

CONSTANT *defaultInitValue*

VARIABLES $start, succ, cycle, tortoise, hare, done, pc$

$vars \triangleq \langle start, succ, cycle, tortoise, hare, done, pc \rangle$

$Init \triangleq$ Global variables

$\wedge start \in Nodes$

$\wedge succ \in [Nodes \rightarrow Nodes \cup \{NIL\}]$

$\wedge cycle = defaultInitValue$

$\wedge tortoise = defaultInitValue$

$\wedge hare = defaultInitValue$

$\wedge done = defaultInitValue$

$\wedge pc = "h0"$

$$\begin{aligned}
h0 &\triangleq \wedge pc = \text{"h0"} \\
&\quad \wedge tortoise' = start \\
&\quad \wedge hare' = start \\
&\quad \wedge done' = FALSE \\
&\quad \wedge pc' = \text{"h1"} \\
&\quad \wedge \text{UNCHANGED } \langle start, succ, cycle \rangle \\
h1 &\triangleq \wedge pc = \text{"h1"} \\
&\quad \wedge \text{IF } \neg done \\
&\quad \quad \text{THEN } \wedge pc' = \text{"h2"} \\
&\quad \quad \text{ELSE } \wedge pc' = \text{"Done"} \\
&\quad \wedge \text{UNCHANGED } \langle start, succ, cycle, tortoise, hare, done \rangle \\
h2 &\triangleq \wedge pc = \text{"h2"} \\
&\quad \wedge tortoise' = succ[tortoise] \\
&\quad \wedge hare' = (\text{LET } hare1 \triangleq succ[hare] \text{ IN} \\
&\quad \quad \text{IF } hare1 \in \text{DOMAIN } succ \text{ THEN } succ[hare1] \text{ ELSE } NIL) \\
&\quad \wedge pc' = \text{"h3"} \\
&\quad \wedge \text{UNCHANGED } \langle start, succ, cycle, done \rangle \\
h3 &\triangleq \wedge pc = \text{"h3"} \\
&\quad \wedge \text{IF } tortoise = NIL \vee hare = NIL \\
&\quad \quad \text{THEN } \wedge cycle' = FALSE \\
&\quad \quad \quad \wedge done' = TRUE \\
&\quad \quad \text{ELSE } \wedge \text{IF } tortoise = hare \\
&\quad \quad \quad \quad \text{THEN } \wedge cycle' = TRUE \\
&\quad \quad \quad \quad \quad \wedge done' = TRUE \\
&\quad \quad \quad \quad \text{ELSE } \wedge TRUE \\
&\quad \quad \quad \quad \wedge \text{UNCHANGED } \langle cycle, done \rangle \\
&\quad \wedge pc' = \text{"h1"} \\
&\quad \wedge \text{UNCHANGED } \langle start, succ, tortoise, hare \rangle \\
Next &\triangleq h0 \vee h1 \vee h2 \vee h3 \\
&\quad \vee \text{Disjunct to prevent deadlock on termination} \\
&\quad (pc = \text{"Done"} \wedge \text{UNCHANGED } vars) \\
Spec &\triangleq \wedge Init \wedge \Box [Next]_{vars} \\
&\quad \wedge WF_{vars}(Next) \\
Termination &\triangleq \Diamond (pc = \text{"Done"})
\end{aligned}$$

END TRANSLATION

Transitive closure

From <https://github.com/tlaplus/Examples/blob/master/specifications/TransitiveClosure/TransitiveClosure.tla>

$$\begin{aligned}
TC(R) &\triangleq \\
&\quad \text{LET } Support(X) \triangleq \{r[1] : r \in X\} \cup \{r[2] : r \in X\}
\end{aligned}$$

$$\begin{aligned}
S &\triangleq \text{Support}(R) \\
\text{RECURSIVE } TCR(-) \\
TCR(T) &\triangleq \text{IF } T = \{\} \\
&\quad \text{THEN } R \\
&\quad \text{ELSE LET } r \triangleq \text{CHOOSE } s \in T : \text{TRUE} \\
&\quad \quad RR \triangleq TCR(T \setminus \{r\}) \\
&\quad \text{IN } RR \cup \{\langle s, t \rangle \in S \times S : \\
&\quad \quad \langle s, r \rangle \in RR \wedge \langle r, t \rangle \in RR\} \\
&\text{IN } TCR(S) \\
HasCycle(node) &\triangleq \text{LET } R \triangleq \{\langle s, t \rangle \in Nodes \times (Nodes \cup \{NIL\}) : succ[s] = t\} \\
&\quad \text{IN } \langle node, NIL \rangle \notin TC(R) \\
PartialCorrectness &\triangleq pc = \text{"Done"} \Rightarrow (cycle \equiv HasCycle(start))
\end{aligned}$$

\ * Modification History
\ * Last modified Sun Oct 15 19:33:20 PDT 2017 by lhochstein
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