MODULE $3state$

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EXTENDS *Integers*, *FiniteSets*
CONSTANT N
ASSUME $N \in Nat \setminus \{0, 1\}$
$Procs \triangleq 1 \,..\, (N-1)$

$Numberize(S) \triangleq$ IF $S =$ TRUE THEN 1 ELSE 0

Dijkstra's 3 state

```
--algorithm 3state{
  variable c = [i ∈ 0 .. N ↦ Numberize(i = 0)] ;
    variable c =  [i ∈ 0 .. N ↦ ((i + 1)%3)];
  fair process ( i ∈ {0} )
  {   I0: c[0] := 1 ;
      I1: while ( TRUE )
          {
            await (((c[0] + 1)%3) = c[1]) ;
            c[0] := (c[1]   + 1)%3 ;
          }
   }
  fair process ( n ∈ {N} )
  {
      N1: while ( TRUE )
          {
            await ((c[(N − 1)] = c[0]) ∧ (c[N] ≠ ((c[N − 1] + 1)%3))) ;
            c[N] := (c[(N − 1)] + 1)%3 ;
          }
   }
  fair process ( j ∈ Procs )
  {
       J1: while ( TRUE )
       {
            either
               {
                  await (((c[self] + 1)%3) = c[(self − 1)]) ;
                  c[self] := c[(self − 1)] ;
               }
            or
               {
                  await (((c[self] + 1)%3) = c[(self + 1)]) ;
                  c[self] := c[(self + 1)] ;
```

```
            }
        }
    }
}
```

BEGIN TRANSLATION

VARIABLES c, pc

$vars \triangleq \langle c, pc \rangle$

$ProcSet \triangleq (\{0\}) \cup (\{N\}) \cup (Procs)$

$Init \triangleq$ Global variables
$\land c = [i \in 0 \,..\, N \mapsto Numberize(i = 0)]$
$\land pc = [self \in ProcSet \mapsto \text{CASE } self \in \{0\} \rightarrow \text{“I0”}$
$\square \quad self \in \{N\} \rightarrow \text{“N1”}$
$\square \quad self \in Procs \rightarrow \text{“J1”}]$

$I0(self) \triangleq \land pc[self] = \text{“I0”}$
$\land c' = [c \text{ EXCEPT } ![0] = 1]$
$\land pc' = [pc \text{ EXCEPT } ![self] = \text{“I1”}]$

$I1(self) \triangleq \land pc[self] = \text{“I1”}$
$\land (((c[0] + 1)\%3) = c[1])$
$\land c' = [c \text{ EXCEPT } ![0] = (c[1] + 1)\%3]$
$\land pc' = [pc \text{ EXCEPT } ![self] = \text{“I1”}]$

$i(self) \triangleq I0(self) \lor I1(self)$

$N1(self) \triangleq \land pc[self] = \text{“N1”}$
$\land ((c[(N-1)] = c[0]) \land (c[N] \neq ((c[N-1] + 1)\%3)))$
$\land c' = [c \text{ EXCEPT } ![N] = (c[(N-1)] + 1)\%3]$
$\land pc' = [pc \text{ EXCEPT } ![self] = \text{“N1”}]$

$n(self) \triangleq N1(self)$

$J1(self) \triangleq \land pc[self] = \text{“J1”}$
$\land \lor \land (((c[self] + 1)\%3) = c[(self - 1)])$
$\land c' = [c \text{ EXCEPT } ![self] = c[(self - 1)]]$
$\lor \land (((c[self] + 1)\%3) = c[(self + 1)])$
$\land c' = [c \text{ EXCEPT } ![self] = c[(self + 1)]]$
$\land pc' = [pc \text{ EXCEPT } ![self] = \text{“J1”}]$

$j(self) \triangleq J1(self)$

$Next \triangleq (\exists\, self \in \{0\} : i(self))$
$\lor (\exists\, self \in \{N\} : n(self))$
$\lor (\exists\, self \in Procs : j(self))$

$$
\begin{aligned}
\mathit{Spec} \triangleq\ & \land \mathit{Init} \land \Box[\mathit{Next}]_{\mathit{vars}} \\
& \land \forall\, \mathit{self} \in \{0\} : \mathrm{WF}_{\mathit{vars}}(i(\mathit{self})) \\
& \land \forall\, \mathit{self} \in \{N\} : \mathrm{WF}_{\mathit{vars}}(n(\mathit{self})) \\
& \land \forall\, \mathit{self} \in \mathit{Procs} : \mathrm{WF}_{\mathit{vars}}(j(\mathit{self}))
\end{aligned}
$$

END TRANSLATION

$T\_0 \triangleq \text{IF } (((c[0]+1)\%3) = c[1]) \text{ THEN } 1 \text{ ELSE } 0$

$T\_N \triangleq \text{IF } ((c[(N-1)] = c[0]) \land (c[N] \neq ((c[N-1]+1)\%3))) \text{ THEN } 1 \text{ ELSE } 0$

$T \triangleq \mathit{Cardinality}(\{k \in \mathit{Procs} : ((((c[k]+1)\%3) = c[k-1]) \lor (((c[k]+1)\%3) = c[k+1]))\}) + T\_0 + T\_N$

$\mathit{Invariant} \triangleq T = 1$

$\mathit{Stabilization} \triangleq \Box\Diamond \mathit{Invariant}$

$\mathit{LowerBound} \triangleq T \geq 1$

$\mathit{DoesNotMoveAway} \triangleq \Box[T' \leq T]_{\mathit{vars}}$

$\mathit{MovesTowards} \triangleq \forall\, M \in 1 \,..\, N+1 : \Box\Diamond(T \leq M)$

* Modification History

* Last modified Sun *Dec* 13 01:56:17 *EST* 2015 by *chartoin*

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