MODULE *dekker*

EXTENDS *TLC*, *Integers*
CONSTANT *Threads*

```
 --algorithm dekker
variables
    flag = [t ∈ Threads ↦ FALSE],
    next_thread ∈ Threads ;

fair process thread ∈ Threads
begin
    P1: flag[self] := TRUE ;
     all threads except self are false
    P2:
        while ∃ t ∈ Threads \ {self} : flag[t] do
            P2_1:
                if next_thread ≠ self then
                    P2_1_1: flag[self] := FALSE ;
                    P2_1_2: await next_thread = self ;
                    P2_1_3: flag[self] := TRUE ;
                end if ;
        end while ;
    CS: skip ;
    P3:
        with t ∈ Threads \ {self} do
            next_thread := t ;
        end with ;
    P4: flag[self] := FALSE ;
    P5: goto P1 ;
end process ;

end algorithm ;
```

BEGIN TRANSLATION ($chksum(pcal) =$ "31494451" $\land\ chksum(tla) =$ "97685e2c")

VARIABLES *flag*, *next_thread*, *pc*

$vars \triangleq \langle flag,\ next\_thread,\ pc \rangle$

$ProcSet \triangleq (Threads)$

$Init \triangleq$ Global variables
$\land\ flag = [t \in Threads \mapsto \text{FALSE}]$
$\land\ next\_thread \in Threads$
$\land\ pc = [self \in ProcSet \mapsto \text{"P1"}]$

$P1(self) \triangleq \land\ pc[self] = \text{"P1"}$
$\land\ flag' = [flag \text{ EXCEPT } ![self] = \text{TRUE}]$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{"P2"}]$

$\land$ UNCHANGED $next\_thread$

$P2(self) \triangleq$ $\land\ pc[self] = \text{“P2”}$
$\land$ IF $\exists\, t \in Threads \setminus \{self\} : flag[t]$
THEN $\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P2\_1”}]$
ELSE $\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“CS”}]$
$\land$ UNCHANGED $\langle flag,\ next\_thread \rangle$

$P2\_1(self) \triangleq$ $\land\ pc[self] = \text{“P2\_1”}$
$\land$ IF $next\_thread \neq self$
THEN $\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P2\_1\_1”}]$
ELSE $\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P2”}]$
$\land$ UNCHANGED $\langle flag,\ next\_thread \rangle$

$P2\_1\_1(self) \triangleq$ $\land\ pc[self] = \text{“P2\_1\_1”}$
$\land\ flag' = [flag \text{ EXCEPT } ![self] = \text{FALSE}]$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P2\_1\_2”}]$
$\land$ UNCHANGED $next\_thread$

$P2\_1\_2(self) \triangleq$ $\land\ pc[self] = \text{“P2\_1\_2”}$
$\land\ next\_thread = self$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P2\_1\_3”}]$
$\land$ UNCHANGED $\langle flag,\ next\_thread \rangle$

$P2\_1\_3(self) \triangleq$ $\land\ pc[self] = \text{“P2\_1\_3”}$
$\land\ flag' = [flag \text{ EXCEPT } ![self] = \text{TRUE}]$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P2”}]$
$\land$ UNCHANGED $next\_thread$

$CS(self) \triangleq$ $\land\ pc[self] = \text{“CS”}$
$\land$ TRUE
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P3”}]$
$\land$ UNCHANGED $\langle flag,\ next\_thread \rangle$

$P3(self) \triangleq$ $\land\ pc[self] = \text{“P3”}$
$\land\ \exists\, t \in Threads \setminus \{self\} :$
$next\_thread' = t$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P4”}]$
$\land\ flag' = flag$

$P4(self) \triangleq$ $\land\ pc[self] = \text{“P4”}$
$\land\ flag' = [flag \text{ EXCEPT } ![self] = \text{FALSE}]$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P5”}]$
$\land$ UNCHANGED $next\_thread$

$P5(self) \triangleq$ $\land\ pc[self] = \text{“P5”}$
$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“P1”}]$
$\land$ UNCHANGED $\langle flag,\ next\_thread \rangle$

$$thread(self) \triangleq P1(self) \lor P2(self) \lor P2\_1(self) \quad \lor P2\_1\_1(self) \lor P2\_1\_2(self) \lor P2\_1\_3(self) \lor CS(self) \lor P3(self) \lor P4(self) \lor P5(self)$$

Allow infinite stuttering to prevent deadlock on termination.

$$Terminating \triangleq \land \forall self \in ProcSet : pc[self] = \text{“Done”} \land \text{UNCHANGED } vars$$

$$Next \triangleq (\exists self \in Threads : thread(self)) \lor Terminating$$

$$Spec \triangleq \land Init \land \Box[Next]_{vars} \land \forall self \in Threads : \mathrm{WF}_{vars}(thread(self))$$

$$Termination \triangleq \Diamond(\forall self \in ProcSet : pc[self] = \text{“Done”})$$

END TRANSLATION

$$AtMostOneCritical \triangleq \forall t1, t2 \in Threads : t1 \neq t2 \Rightarrow \neg(pc[t1] = \text{“CS”} \land pc[t2] = \text{“CS”})$$

$$Liveness \triangleq \forall t \in Threads : \Diamond(pc[t] = \text{“CS”})$$

* Modification History
* Last modified Sun *Sep* 04 11:47:01 *CST* 2022 by *wengjialin*
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