MODULE *petersons*

Peterson's Algorithm for mutual exclusion, as specified in *Wikipedia*'s *pseudocode*[1]

[1] https://*en.wikipedia.org*/wiki/*Peterson*%27*s_algorithm*#*The_algorithm*

EXTENDS TLC, $Integers$

VARIABLES
$flag$,
$turn$,
pc

$vars \triangleq \langle flag, turn, pc \rangle$

$Threads \triangleq \{0, 1\}$

$Init \triangleq$
$\land flag \in [Threads \to \{\text{FALSE}\}]$
$\land turn \in Threads$
$\land pc \in [Threads \to \{\text{"init"}\}]$

$SetFlag(self) \triangleq$
$\land \ pc[self] = \text{"init"}$
$\land \ flag' = [flag \text{ EXCEPT } ![self] = \text{TRUE}]$
$\land \ pc' = [pc \text{ EXCEPT } ![self] = \text{"flag\_set"}]$
$\land \ \text{UNCHANGED } turn$

$SetTurn(self) \triangleq$
$\land \ pc[self] = \text{"flag\_set"}$
$\land \ turn' = 1 - self$
$\land \ pc' = [pc \text{ EXCEPT } ![self] = \text{"busy\_wait"}]$
$\land \ \text{UNCHANGED } flag$

$BusyWait(self) \triangleq$
$\land pc[self] = \text{"busy\_wait"}$
$\land \lor \neg flag[1 - self]$
$\lor turn = self$
$\land pc' = [pc \text{ EXCEPT } ![self] = \text{"enter\_critical"}]$
$\land \text{UNCHANGED } \langle flag, turn \rangle$

$Critical(self) \triangleq$
$\land pc[self] = \text{"enter\_critical"}$
$\land \text{TRUE}$ perform critical stuff
$\land pc' = [pc \text{ EXCEPT } ![self] = \text{"exit\_critical"}]$
$\land \text{UNCHANGED } \langle flag, turn \rangle$

$ExitCritical(self) \triangleq$
$\land pc[self] = \text{"exit\_critical"}$
$\land flag' = [flag \text{ EXCEPT } ![self] = \text{FALSE}]$

$\land\ pc' = [pc \text{ EXCEPT } ![self] = \text{“init”}]$
$\land$ UNCHANGED $turn$

$ThreadSteps(t) \triangleq$
$\lor\ SetFlag(t)$
$\lor\ SetTurn(t)$
$\lor\ BusyWait(t)$
$\lor\ Critical(t)$
$\lor\ ExitCritical(t)$

$Next \triangleq \exists\, t \in Threads : ThreadSteps(t)$

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

$Safety \triangleq$
$\lor\ \forall\, t \in Threads : pc[t] \neq$ “enter_critical”
$\lor\ \exists\, t \in Threads :$
$\land\ pc[t] =$ “enter_critical”
$\land\ \forall\, u \in Threads \setminus \{t\} : pc[u] \neq$ “enter_critical”

$Liveness \triangleq \forall\, t \in Threads : \Diamond(pc[t] =$ “enter_critical”$)$