MODULE *semaphores*

Ref pg 36 handbook of model checking

model the semaphore solution solution with only weak fairness constraints on relevant steps

a) Check mutual exclusion property (for all runs)

b) check starvation freeness (for all runs) (will be violated)

Var x : boolean initially $x = 1$

```
0 : while(True){
1 :         Non − Critical;
2 :         request(x);
3 :         Critical;
4 :         release(x);
5 :     }
```

EXTENDS *Integers*

VARIABLES x, $pc0$, $pc1$

$Init0 \triangleq$
$\land\ pc0 = 0$

$Init1 \triangleq$
$\land\ pc1 = 0$

$Init \triangleq Init0 \land Init1 \land (x = 1)$

$L01 \triangleq$
$\land\ pc0 = 0$
$\land\ pc0' = 1$
$\land$ UNCHANGED $\langle x \rangle$

$L12 \triangleq$
$\land\ pc0 = 1$
$\land\ pc0' = 2$
$\land$ UNCHANGED $\langle x \rangle$

$L23 \triangleq$
$\land\ pc0 = 2$
$\land\ pc0' = 3$
$\land\ x = 1$
$\land\ x' = 0$

$L22 \triangleq$
$\land\ pc0 = 2$
$\land\ pc0' = 2$
$\land\ x = 0$
$\land\ x' = 0$

$L34 \triangleq$
$\land\ pc0 = 3$
$\land\ pc0' = 4$
$\land$ UNCHANGED $\langle x \rangle$

$L45 \triangleq$
$\land\ pc0 = 4$
$\land\ pc0' = 5$
$\land\ x' = 1$

$L50 \triangleq$
$\land\ pc0 = 5$
$\land\ pc0' = 0$
$\land$ UNCHANGED $\langle x \rangle$

$M01 \triangleq$
$\land\ pc1 = 0$
$\land\ pc1' = 1$
$\land$ UNCHANGED $\langle x \rangle$

$M12 \triangleq$
$\land\ pc1 = 1$
$\land\ pc1' = 2$
$\land$ UNCHANGED $\langle x \rangle$

$M23 \triangleq$
$\land\ pc1 = 2$
$\land\ pc1' = 3$
$\land\ x = 1$
$\land\ x' = 0$

$M22 \triangleq$
$\land\ pc1 = 2$
$\land\ pc1' = 2$
$\land\ x = 0$
$\land\ x' = 0$

$M34 \triangleq$
$\land\ pc1 = 3$
$\land\ pc1' = 4$
$\land$ UNCHANGED $\langle x \rangle$

$M45 \triangleq$
$\land\ pc1 = 4$
$\land\ pc1' = 5$
$\land\ x' = 1$

$M50 \triangleq$
$\land\ pc1 = 5$
$\land\ pc1' = 0$
$\land$ UNCHANGED $\langle x \rangle$

$vars \triangleq \langle x,\ pc0,\ pc1 \rangle$

$Next0 \triangleq$
$\lor\ L01$
$\lor\ L12$
$\lor\ L23$
$\lor\ L34$
$\lor\ L45$
$\lor\ L50$

$Next1 \triangleq$
$\lor\ M01$
$\lor\ M12$
$\lor\ M23$
$\lor\ M34$
$\lor\ M45$
$\lor\ M50$

$Next \triangleq$
$\lor\ (Next0 \land$ UNCHANGED $\langle pc1 \rangle)$
$\lor\ (Next1 \land$ UNCHANGED $\langle pc0 \rangle)$

$Fairness \triangleq$
$\land\ \mathrm{WF}_{pc0}(L01)$
$\land\ \mathrm{WF}_{pc0}(L34)$
$\land\ \mathrm{WF}_{pc0}(L45)$
$\land\ \mathrm{WF}_{pc0}(L50)$
$\land\ \mathrm{WF}_{pc1}(M01)$
$\land\ \mathrm{WF}_{pc1}(M34)$
$\land\ \mathrm{WF}_{pc1}(M45)$
$\land\ \mathrm{WF}_{pc1}(M50)$

$Compassion \triangleq$
$\land\ \mathrm{SF}_{pc0}(L22) \Rightarrow \mathrm{SF}_{pc0}(L23)$
$\land\ \mathrm{SF}_{pc1}(M22) \Rightarrow \mathrm{SF}_{pc1}(M23)$

$FairSpec \triangleq$
$\land\ Init$
$\land\ \Box[Next]_{vars}$
$\land\ Fairness$
$\land\ Compassion$

$MUTUAL\_EXCLUSION \triangleq$
$\Box(\neg(pc0 = 3 \land pc1 = 3))$

$NOSTARVE\_0 \triangleq$
$\Box((pc0 = 2) \Rightarrow \Diamond(pc0 = 3))$
This will be violated

$NOSTARVE\_1 \triangleq$
$\Box((pc1 = 2) \Rightarrow \Diamond(pc1 = 3))$

* Modification History
* Last modified *Tue Mar* 05 17:50:28 *IST* 2024 by *neeraj*
* Created *Tue Mar* 05 17:31:22 *IST* 2024 by *neeraj*