MODULE *UntimedFischer*

The specification of the untimed version of the Fisher's Mutual Exclusion algorithm. See Section 2.2 of the paper "Real Time is Really Simple" by *Leslie Lamport*, 2005.

Note that without the time constraints, this untimed version does not guarantee mutual exclusion; see the error trace for model "Untimed-5-Thread".

CONSTANTS

Thread the set of threads, ranged over by $t \in Thread$

$NotAThread \triangleq \text{CHOOSE } t : t \notin Thread$

VARIABLES

x, whose $turn \in Thread \cup \{NotAThread\}$ is it now

pc $pc[t] \in \{\text{"ncs"}, \text{"a"}, \text{"b"}, \text{"c"}, \text{"cs"}, \text{"d"}\}$: program counter of thread $t \in Thread$

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

$TypeOK \triangleq$
$\quad \wedge \quad x \in Thread \cup \{NotAThread\}$
$\quad \wedge \quad pc \in [Thread \to \{\text{"ncs"}, \text{"a"}, \text{"b"}, \text{"c"}, \text{"cs"}, \text{"d"}\}]$

$At(t, loc) \triangleq pc[t] = loc$

$GoTo(t, loc) \triangleq pc' = [pc \text{ EXCEPT } ![t] = loc]$

$GoFromTo(t, loc1, loc2) \triangleq$
$\quad \wedge At(t, loc1)$
$\quad \wedge GoTo(t, loc2)$

$Init \triangleq$
$\quad \wedge x = NotAThread$
$\quad \wedge pc = [t \in Thread \mapsto \text{"ncs"}]$

$NCS(t) \triangleq$
$\quad \wedge GoFromTo(t, \text{"ncs"}, \text{"a"})$
$\quad \wedge \text{UNCHANGED } x$

$StmtA(t) \triangleq$
$\quad \wedge x = NotAThread$
$\quad \wedge GoFromTo(t, \text{"a"}, \text{"b"})$
$\quad \wedge \text{UNCHANGED } x$

$StmtB(t) \triangleq$
$\quad \wedge x' = t$
$\quad \wedge GoFromTo(t, \text{"b"}, \text{"c"})$

$StmtC(t) \triangleq$
$\quad \wedge At(t, \text{"c"})$
$\quad \wedge \text{IF } x \neq t \text{ THEN } GoTo(t, \text{"a"}) \text{ ELSE } GoTo(t, \text{"cs"})$

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53        ∧ UNCHANGED x

55  CS(t) ≜
56        ∧ GoFromTo(t, "cs", "d")
57        ∧ UNCHANGED x

59  StmtD(t) ≜
60        ∧ x′ = NotAThread
61        ∧ GoFromTo(t, "d", "ncs")

63  Next ≜
64      ∃ t ∈ Thread :
65          ∨ NCS(t)
66          ∨ StmtA(t) ∨ StmtB(t) ∨ StmtC(t)
67          ∨ CS(t)
68          ∨ StmtD(t)

70  Spec ≜ Init ∧ □[Next]_vars
71 ├──────────────────────────────────────────────────────────────────────┤
72  ME ≜ ¬(∃ t1, t2 ∈ Thread : t1 ≠ t2 ∧ At(t1, "cs") ∧ At(t2, "cs"))
73 └──────────────────────────────────────────────────────────────────────┘
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