MODULE *Chameneos*

A specification of a 'concurrency game' requiring concurrent and symmetrical cooperation - https://*cedric.cnam.fr*/fichiers/*RC*474.*pdf*

EXTENDS *Integers*

*N* - number of total meeting after which *chameneoses* fade
*M* - number of *chameneoses*

CONSTANT $N$, $M$
ASSUME $N \in (Nat \setminus \{0\}) \land M \in (Nat \setminus \{0\})$

VARIABLE *chameneoses*, *meetingPlace*, *numMeetings*

$vars \triangleq \langle chameneoses,\ meetingPlace,\ numMeetings \rangle$

$Color \triangleq \{\text{"blue"},\ \text{"red"},\ \text{"yellow"}\}$
$Faded \triangleq$ CHOOSE $c : c \notin Color$

$ChameneosID \triangleq 1 \,..\, M$
$MeetingPlaceEmpty \triangleq$ CHOOSE $e : e \notin ChameneosID$

RECURSIVE $Sum(\_, \_)$
$Sum(f,\ S) \triangleq$ IF $S = \{\}$ THEN $0$
ELSE LET $x \triangleq$ CHOOSE $x \in S$ : TRUE
IN $f[x] + Sum(f,\ S \setminus \{x\})$

$TypeOK \triangleq \land chameneoses \in [ChameneosID \to (Color \cup \{Faded\}) \times (0 \,..\, N)]$
$\land meetingPlace \in ChameneosID \cup \{MeetingPlaceEmpty\}$

$Complement(c1,\ c2) \triangleq$ IF $c1 = c2$
THEN $c1$
ELSE CHOOSE $cid \in Color \setminus \{c1,\ c2\}$ : TRUE

$Meet(cid) \triangleq$ IF $meetingPlace = MeetingPlaceEmpty$
THEN IF $numMeetings < N$
chameneos enters meeting empty meeting place
THEN $\land meetingPlace' = cid$
$\land$ UNCHANGED $\langle chameneoses,\ numMeetings \rangle$
chameneos takes on faded color
ELSE $\land chameneoses' = [chameneoses$ EXCEPT $![cid] = \langle Faded,\ @[2] \rangle]$
$\land$ UNCHANGED $\langle meetingPlace,\ numMeetings \rangle$
meeting place is not empty - two *chameneoses* mutate
ELSE $\land meetingPlace \neq cid$
$\land meetingPlace' = MeetingPlaceEmpty$
$\land chameneoses' =$
LET $newColor \triangleq Complement(chameneoses[cid][1],$
$chameneoses[meetingPlace][1])$
IN $[chameneoses$ EXCEPT $![cid] = \langle newColor,\ @[2] + 1 \rangle,$

$$!\,[meetingPlace] = \langle newColor,\ @[2] + 1\rangle]$$
$$\land\ numMeetings' = numMeetings + 1$$

$$\begin{aligned} Init \ \triangleq\ & \land\ chameneoses \in [ChameneosID \to Color \times \{0\}] \\ & \land\ meetingPlace = MeetingPlaceEmpty \\ & \land\ numMeetings = 0 \end{aligned}$$

repeatedly try to enter meeting place for *chameneoses* that are not faded yet

$$Next \ \triangleq\ \land \exists\, c \in \{x \in ChameneosID : chameneoses[x][1] \neq Faded\} : Meet(c)$$

$$Spec \ \triangleq\ Init \land \Box[Next]_{vars}$$

$$\begin{aligned} SumMet \ \triangleq\ numMeetings = N \Rightarrow\ & \text{LET}\ f[c \in ChameneosID] \ \triangleq\ chameneoses[c][2] \\ & \text{IN}\quad Sum(f,\ ChameneosID) = 2 * N \end{aligned}$$