MODULE *xnos*

EXTENDS *Integers*

VARIABLES *board*, *row*1, *row*2, *row*3, *curr*

$$
\begin{array}{l}
Init \triangleq \ \land row1 = \langle 0,\ 0,\ 0\rangle \\
\land row2 = \langle 0,\ 0,\ 0\rangle \\
\land row3 = \langle 0,\ 0,\ 0\rangle \\
\land curr\ = 1 \\
\land board = \langle row1,\ row2,\ row3\rangle
\end{array}
$$

$$
\begin{array}{l}
Move(row,\ col,\ player) \triangleq \\
\land board[row][col] = 0 \\
\land curr = player \\
\land \text{IF } row = 1 \text{ THEN} \\
\qquad \land row1' = [i \in 1\,..\,3 \mapsto \text{IF } i = col \text{ THEN } player \text{ ELSE } row1[i]] \\
\qquad \land \text{UNCHANGED } \langle row2,\ row3\rangle \\
\quad \text{ELSE IF } row = 2 \text{ THEN} \\
\qquad \land row2' = [i \in 1\,..\,3 \mapsto \text{IF } i = col \text{ THEN } player \text{ ELSE } row2[i]] \\
\qquad \land \text{UNCHANGED } \langle row1,\ row3\rangle \\
\quad \text{ELSE} \\
\qquad \land row3' = [i \in 1\,..\,3 \mapsto \text{IF } i = col \text{ THEN } player \text{ ELSE } row3[i]] \\
\qquad \land \text{UNCHANGED } \langle row1,\ row2\rangle \\
\land \text{IF } player = 1 \text{ THEN } curr' = 2 \text{ ELSE } curr' = 1 \\
\land board' = \langle row1,\ row2,\ row3\rangle
\end{array}
$$

$p1$: 1, $p2$: 2

$$
\begin{array}{l}
Next \triangleq \ \exists\, row \in \ 1\,..\,3 : \exists\, col \in 1\,..\,3 : \\
\quad Move(row,\ col,\ 1) \lor Move(row,\ col,\ 2)
\end{array}
$$

$P1$ or $P2$ victory invariants

$$
\begin{array}{l}
P1NotWinning \triangleq \\
\lor \neg(\exists\, i \in 1\,..\,3 : \\
\quad \lor (board[1][i] = 1 \land board[2][i] = 1 \land board[3][i] = 1) \\
\quad \lor (board[i][1] = 1 \land board[i][2] = 1 \land board[i][3] = 1) \\
\quad) \\
\lor \neg(board[1][1] = 1 \land board[2][2] = 1 \land board[3][3] = 1) \\
\lor \neg(board[1][3] = 1 \land board[2][2] = 1 \land board[3][3] = 1)
\end{array}
$$

$$
\begin{array}{l}
P2NotWinning \triangleq \\
\lor \neg(\exists\, i \in 1\,..\,3 : \\
\quad \lor (board[1][i] = 2 \land board[2][i] = 2 \land board[3][i] = 2) \\
\quad \lor (board[i][1] = 2 \land board[i][2] = 2 \land board[i][3] = 2) \\
\quad) \\
\lor \neg(board[1][1] = 2 \land board[2][2] = 2 \land board[3][3] = 2) \\
\lor \neg(board[1][3] = 2 \land board[2][2] = 2 \land board[3][3] = 2)
\end{array}
$$

\ * Modification History
\ * Last modified *Fri Dec* 08 19:13:54 *EST* 2017 by *aditya*
\ * Created *Thu Dec* 07 21:45:57 *EST* 2017 by *aditya*