LED Engine

$$initialState := \varnothing \tag{1}$$

$$occupies\,(p,c) \quad \texttt{iff} \quad (p,c) \in currentState \tag{2}$$

$$occupied\,(c) \quad \texttt{iff} \quad occupies\,(`x,c) \lor occupies\,(`o,c) \tag{3}$$

$$rows := hRows \cup vRows \cup diagonals \ \texttt{where} \ hRows = \{\{1,2,3\},\{4,5,6\},\{7,8,9\}\} \land vRows = \{\{1,4,7\}, \tag{4}$$

$$threeInRow\,(p) \quad \texttt{iff} \quad \exists R \in rows.\forall c \in R.occupies\,(p,c) \tag{5}$$

$$boardFull := |currentState| = 9 \tag{6}$$

$$gameOver := boardFull \lor threeInRow\,(`x) \lor threeInRow\,(`o) \tag{7}$$

$$playerToMove := \begin{cases} `x & \texttt{if}\ even\,(|currentState|) \\ `o & \texttt{otherwise} \end{cases} \tag{8}$$

$$even\,(n) \quad \texttt{iff} \quad n \ \texttt{mod}\ 2 = 0 \tag{9}$$

$$legalToMoveIn\,(c) \quad \texttt{iff} \quad \neg occupied\,(c) \land \neg gameOver \tag{10}$$

$$BLACK := color\,(0,0,0) \tag{11}$$

$$WHITE := color\,(255,255,255) \tag{12}$$

$$BLUE := color\,(0,0,255) \tag{13}$$

$$GREEN := color\,(0,255,0) \tag{14}$$

$$RED := color\,(255,0,0) \tag{15}$$

$$gridDisplay := \{L1,L2,L3,L4\} \ \texttt{where} \ L1 = segment\,(point\,(200,700),point\,(200,400),BLACK) \land L2 = segme \tag{16}$$

$$fontSize := 36 \tag{17}$$

$$centerX\,(c) := 150 + 100 \times c - 1 \ \texttt{mod}\ 3 \tag{18}$$

$$centerY\,(c) := 650 - 100 \times \lfloor c - 1 \ / \ 3 \rfloor \tag{19}$$

$$xImage\,(c) := text\,(\text{``x''},point\,(centerX\,(c),centerY\,(c)),fontSize,BLUE) \tag{20}$$

$$oImage\,(c) := text\,(\text{``o''},point\,(centerX\,(c),centerY\,(c)),fontSize,GREEN) \tag{21}$$

$$cellDisplay\,(c) \; := \; \begin{cases} \{xImage\,(c)\} & \texttt{if} \ (`x, c) \in currentState \\ \{oImage\,(c)\} & \texttt{if} \ (`o, c) \in currentState \\ \varnothing & \texttt{otherwise} \end{cases} \tag{22}$$

$$gameBoard \; := \; \{1..9\} \tag{23}$$

$$cellDisplays \; := \; \bigcup_{c \; \in \; gameBoard} cellDisplay\,(c) \tag{24}$$

$$currentPlayerDisplay \; := \; \begin{cases} \{text\,(``x'sturn", point\,(100, 750), fontSize, BLACK)\} & \texttt{if} \ playerToMove = `x \\ \{text\,(``o'sturn", point\,(100, 750), fontSize, BLACK)\} & \texttt{otherwise} \end{cases} \tag{25}$$

$$restartLeft \; := \; 350 \tag{26}$$

$$restartRight \; := \; 550 \tag{27}$$

$$restartBottom \; := \; 725 \tag{28}$$

$$restartTop \; := \; 775 \tag{29}$$

$$restartBottomLeftPoint \; := \; point\,(restartLeft, restartBottom) \tag{30}$$

$$restartBottomRightPoint \; := \; point\,(restartRight, restartBottom) \tag{31}$$

$$restartTopLeftPoint \; := \; point\,(restartLeft, restartTop) \tag{32}$$

$$restartTopRightPoint \; := \; point\,(restartRight, restartTop) \tag{33}$$

$$mid\,(a, b) \; := \; a + b \,/\, 2 \tag{34}$$

$$restartMidX \; := \; mid\,(restartLeft, restartRight) \tag{35}$$

$$restartMidY \; := \; mid\,(restartBottom, restartTop) \tag{36}$$

$$restartButton := \{A1, A2, A3, A4, txt\} \ \texttt{where} \ A1 \, = \, segment\,(restartBottomLeftPoint, restartBottomRightPoint \tag{37}$$

$$gameResultDisplay \; := \; \begin{cases} \{text\,(``xwon", point\,(200, 750), fontSize, BLUE)\} & \texttt{if} \ threeInRow\,(`x) \\ \{text\,(``owon", point\,(200, 750), fontSize, GREEN)\} & \texttt{if} \ threeInRow\,(`o) \\ \{text\,(``catgotit", point\,(200, 750), fontSize, RED)\} & \texttt{otherwise} \end{cases} \tag{38}$$

$$images \; := \; \begin{cases} gameOverDisplay & \texttt{if} \ gameOver \\ inPlayDisplay & \texttt{otherwise} \end{cases} \ \texttt{where} \ alwaysDisplay \, = \, gridDisplay \cup cellDisplays \cup restartl \tag{39}$$

$$xMin\,(c) \;:=\; 100 + 100 \times c - 1 \;\; \text{mod} \;\; 3 \tag{40}$$

$$xMax\,(c) \;:=\; 200 + 100 \times c - 1 \;\; \text{mod} \;\; 3 \tag{41}$$

$$yMin\,(c) \;:=\; 600 - 100 \times \lfloor c - 1\,/\,3 \rfloor \tag{42}$$

$$yMax\,(c) \;:=\; 700 - 100 \times \lfloor c - 1\,/\,3 \rfloor \tag{43}$$

$$cellClicked\,(c) \;\; \text{iff} \;\; mouseClicked \wedge mouseX > xMin\,(c) \wedge mouseX < xMax\,(c) \wedge mouseY > yMin\,(c) \wedge mou \tag{44}$$

$$restartClicked := mouseClicked \wedge mouseX > restartLeft \wedge mouseX < restartRight \wedge mouseY > restartBott \tag{45}$$

$$moveMadeIn\,(c) \;\; \text{iff} \;\; cellClicked\,(c) \wedge legalToMoveIn\,(c) \tag{46}$$

$$movesMade \;:=\; \{(playerToMove, c)\,|\,c \in gameBoard \wedge moveMadeIn\,(c)\} \tag{47}$$

$$newState \;:=\; \begin{cases} initialState & \text{if } restartClicked \\ currentState \cup movesMade & \text{otherwise} \end{cases} \tag{48}$$