LED Engine

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

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

$$\mathit{occupied} \quad \texttt{iff} \quad \mathit{occupies}\,(\text{‘}x, c) \vee \mathit{occupies}\,(\text{‘}o, c) \tag{3}$$

$$\begin{array}{l} \mathit{rows} \;:=\; \mathit{hRows} \cup \mathit{vRows} \cup \mathit{diagonals} \\ \;\texttt{where}\;\; \mathit{hRows} \;= \{\{1,2,3\},\{4,5,6\},\{7,8,9\}\} \wedge \mathit{vRows} \;= \{\{1,4,7\},\{2,5,8\},\{3,6,9\}\} \wedge \mathit{diagonals} \;= \{\{1,5,9\},\{3,5,7\}\} \end{array} \tag{4}$$

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

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

$$\mathit{gameOver} \;:=\; \mathit{boardFull} \vee \mathit{threeInRow}\,(\text{‘}x) \vee \mathit{threeInRow}\,(\text{‘}o) \tag{7}$$

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

$$\mathit{even} \quad \texttt{iff} \quad n \;\; \texttt{mod} \;\; 2 \;= 0 \tag{9}$$

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

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

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

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

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

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

$$\begin{array}{l} \mathit{gridDisplay} \;:=\; \{L1, L2, L3, L4\} \\ \;\texttt{where}\;\; L1 \;= \mathit{segment}\,(\mathit{point}\,(200, 700), \mathit{point}\,(200, 400), BLACK) \wedge L2 \;= \mathit{segment}\,(\mathit{point}\,(300, 700), \mathit{point}\,(300, 400), BLACK) \wedge L3 \;= \end{array} \tag{16}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$mid \ := \ a + b \ / \ 2 \tag{34}$$

$$\mathit{restartMidX} \ := \ \mathit{mid}\left(\mathit{restartLeft}, \mathit{restartRight}\right) \tag{35}$$

$$\mathit{restartMidY} \ := \ \mathit{mid}\left(\mathit{restartBottom}, \mathit{restartTop}\right) \tag{36}$$

$$\mathit{restartButton} \ := \{A1, A2, A3, A4, \mathit{txt}\} \tag{37}$$

$\texttt{where} \ A1 \ = \mathit{segment}\left(\mathit{restartBottomLeftPoint}, \mathit{restartBottomRightPoint}, \mathit{BLACK}\right) \wedge A2 \ = \mathit{segment}\left(\mathit{restartTopLeftPoint}, \mathit{restart}\right.$

$$\mathit{gameResultDisplay} \ := \begin{cases} \{\mathit{text}\left(\text{“}\mathit{xwon}\text{”}, \mathit{point}\left(200, 750\right), \mathit{fontSize}, \mathit{BLUE}\right)\} & \texttt{if} \ \mathit{threeInRow}\left(\text{‘}x\right) \\ \{\mathit{text}\left(\text{“}\mathit{owon}\text{”}, \mathit{point}\left(200, 750\right), \mathit{fontSize}, \mathit{GREEN}\right)\} & \texttt{if} \ \mathit{threeInRow}\left(\text{‘}o\right) \\ \{\mathit{text}\left(\text{“}\mathit{catgotit}\text{”}, \mathit{point}\left(200, 750\right), \mathit{fontSize}, \mathit{RED}\right)\} & \texttt{otherwise} \end{cases} \tag{38}$$

$$\mathit{images} \ := \begin{cases} \mathit{gameOverDisplay} & \texttt{if} \ \mathit{gameOver} \\ \mathit{inPlayDisplay} & \texttt{otherwise} \end{cases} \tag{39}$$

$\texttt{where} \ \mathit{alwaysDisplay} \ = \mathit{gridDisplay} \cup \mathit{cellDisplays} \cup \mathit{restartButton} \wedge \mathit{inPlayDisplay} \ = \mathit{alwaysDisplay} \cup \mathit{currentPlayerDisplay} \wedge$

$$\mathit{xMin} \ := \ 100 + 100 \times c - 1 \ \ \texttt{mod} \ \ 3 \tag{40}$$

$$\mathit{xMax} \ := \ 200 + 100 \times c - 1 \ \ \texttt{mod} \ \ 3 \tag{41}$$

$$\mathit{yMin} \ := \ 600 - 100 \times \lfloor c - 1 \ / \ 3 \rfloor \tag{42}$$

$$\mathit{yMax} \ := \ 700 - 100 \times \lfloor c - 1 \ / \ 3 \rfloor \tag{43}$$

$$\mathit{cellClicked} \quad \texttt{iff} \quad \mathit{mouseClicked} \wedge \mathit{mouseX} \ > \mathit{xMin}\left(c\right) \wedge \mathit{mouseX} \ < \mathit{xMax}\left(c\right) \wedge \mathit{mouseY} \ > \mathit{yMin}\left(c\right) \wedge \mathit{mouseY} \ < \mathit{yMax}\left(c\right) \tag{44}$$

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

$$\mathit{moveMadeIn} \quad \texttt{iff} \quad \mathit{cellClicked}\left(c\right) \wedge \mathit{legalToMoveIn}\left(c\right) \tag{46}$$

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

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