Game Structures for the Simulation and Experimental Cases

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1 Simulation Case

We model the interaction between R and K as a game $\mathcal{A} = (V = V_0 \dot{\cup} V_1, E, v_1)$ with R as Player 0 and K as Player 1. We show a part of the graph in Figure 1 to further illustrate the game. In order to provide more clarity, we explain some of the elements in detail below.

- v_2 represents the region WS 2;
- $q_0 = (v_2, \epsilon)$ represents that K choose not to close any door at WS 2;
- $q_1 = (v_2, d_S)$ represents that K choose to close the southern door at WS 2;
- v_4 represents the region WS 4;
- $q_4 = (v_4, \epsilon)$ represents that K choose not to close any door at WS 4;
- v_9 represents the region F-WH 2;
- for any $e = (v, v') \in E$ with $v \in V_0, v' \in V_1$, we have $\omega(v, v') = 1$;
- for any $e = (v, v') \in E$ with $v \in V_1, v' \in V_0$, we have $\omega(v, v') = 0$,

where ω is the weight function for R.

2 Experimental Case

We model the interaction between M and B as a game graph $\mathcal{A} = (V = V_0 \dot{\cup} V_1, E, v_0)$ with M as Player 0 and B as Player 1. Every vertex $v \in V$ is a four-tuple $v = (g, g', \odot, k)$ with $g \in \{g_1, \cdots, g_{16}\}$, $g' \in \{g_2, g_6, g_7, g_{11}, g_{15}\}$, $\odot \in \{e, w, s, n\}$ and $k \in \{0, 1\}$, where g is the position of M, g' is the position of B, $\odot$ is the orientation of M and k is a binary state denoting who will move next. If $k = 0$, then M moves; otherwise, B moves. We show a part of the graph in Figure 2 to further illustrate the game. In order to provide more clarity, we explain some of the elements in detail below.

- $v_0 = (g_1, g_{11}, n, 0)$ represents that M is in grid g_1 facing north, B is in grid g_{11} and it is the turn of M to move;
- $v_0' = (g_2, g_{11}, e, 1)$ represents that M is in grid g_2 facing east, B is in grid g_{11} and it is the turn of B to move;
- $v_1' = (g_5, g_{11}, s, 1)$ represents that M is in grid g_5 facing south, B is in grid g_{11} and it is the turn of B to move;
- $v_2' = (g_3, g_7, e, 1)$ represents that M is in grid g_3 facing east, B is in grid g_7 and it is the turn of B to move;
- $v_3' = (g_2, g_7, e, 1)$ represents that M is in grid g_2 facing east, B is in grid g_7 and it is the turn of B to move;
- $v_5' = (g_9, g_{15}, s, 1)$ represents that M is in grid g_9 facing south, B is in grid g_{15} and it is the turn of B to move;
- $v_1 = (g_2, g_7, e, 0)$ represents that M is in grid g_2 facing east, B is in grid g_7 and it is the turn of M to move;
- $v_4 = (g_5, g_{15}, s, 0)$ represents that M is in grid g_5 facing south, B is in grid g_{15} and it is the turn of M to move;
- $e = (v_0, v_0')$ represents that M moves right to grid g_2 from g_1;

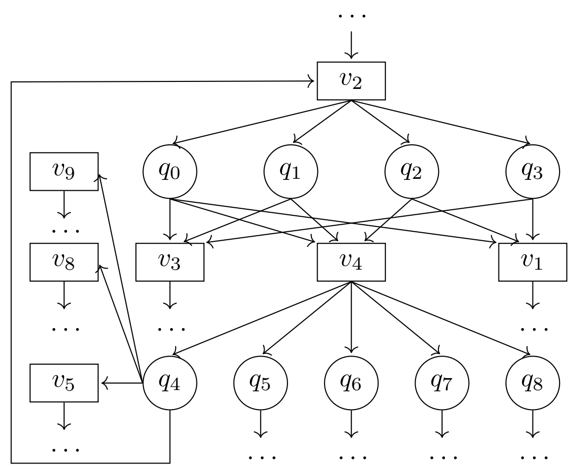

Figure 1: Some parts of the game structure describing the interaction between R and K, where we use circles and squares to denote the vertices of R and K, respectively.

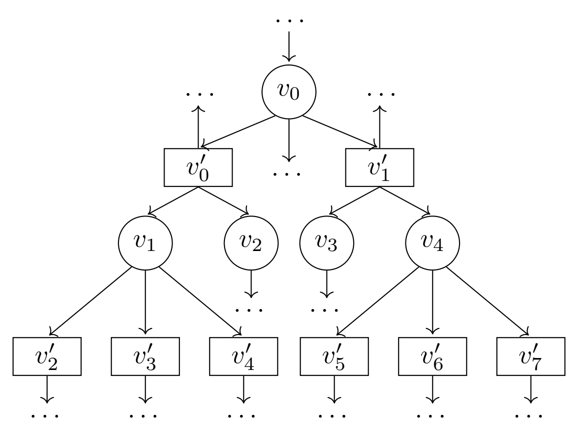

Figure 2: Some parts of the game structure with respect to the interaction between M and B, where we use circles and squares to denote the vertices of M and B, respectively.

- $e_1 = (v_0, v'_1)$ represents that M moves backward to grid g_5 from g_1;
- $e_2 = (v'_0, v_1)$ represents that B proceeds to g_7 from g_{11};
- $e_3 = (v'_1, v_4)$ represents that B proceeds to g_{15} from g_{11};
- $e_4 = (v'_1, v_4)$ represents that B proceeds to g_{15} from g_{11};
- $e_4 = (v_1, v'_3)$ represents that M chooses to stay at g_2 by taking action $\mathbf{S}$;
- $\omega(v_0, v'_0) = 1, \omega(v_0, v'_1) = 4, \omega(v_1, v'_3) = 10$;
- for any $e = (v, v') \in E$ with $v \in V_1, v' \in V_0$, we have $\omega(v, v') = 0$,

where ω is the weight function for M.