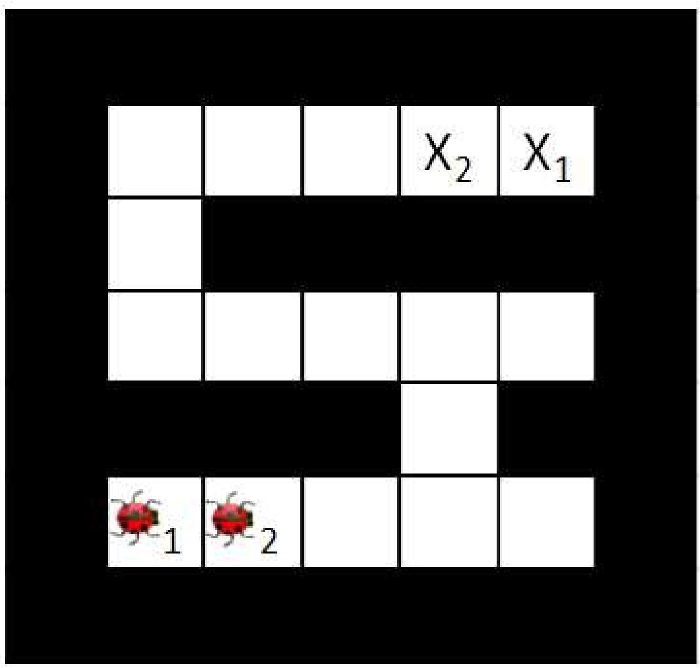
hw1_search_q6_hive_minds_swarm_movement

Question 6: Hive Minds: Swarm Movement

0.0/9.0 points (graded)

You control K insects, each of which has a specific target ending location X_k. No two insects may occupy the same square. In each time step all insects move **simultaneously** to a currently free square (or stay in place); adjacent insects cannot swap in a single time step.



Which of the following is a minimal correct state space representation?

- (selected, correct) K tuples $((x_1, y_1), (x_2, y_2), \ldots, (x_K, y_K))$ encoding the x and y coordinates of each insect.
- K tuples $((x_1, y_1), (x_2, y_2), \ldots, (x_K, y_K))$ encoding the x and y coordinates of each insect, plus K boolean variables indicating whether each insect is next to another insect.

- K tuples $((x_1, y_1), (x_2, y_2), \ldots, (x_K, y_K))$ encoding the x and y coordinates of each insect, plus MN booleans indicating which squares are currently occupied by an insect.
- MN booleans $(b_1, b_2, \ldots, b_{MN})$ encoding whether or not an insect is in each square.

Given the position of every insect, we can formulate the goal test and successor function.
Goal test: $\forall i \in \{1, 2, \ldots, K\} : (x_i, y_i) = Goal_i$
Successor: Similar to Pacman successors. EAST changes (x_i, y_i) to $(x_i - 1, y_i)$, for example.

What is the size of the state space?

- MN
- 2^{MN}
- KMN
- $(MN)^K$ ✔
- $(MN)^K 2^K$
- $(MN)^K 2^{MN}$
- $2^K MN$
- 2^{MNK}

There are MN choices for each position tuple, and K total tuples, so a total of $(MN)^K$ total states.

Which of the following heuristics are admissible (if any)?

- [ ] Sum of Manhattan distances from each insect's location to its target location.
- [ ] Sum of costs of optimal paths for each insect to its goal if it were acting alone in the environment, unobstructed by the other insects.
- [x] Max of Manhattan distances from each insect's location to its target location. ✔
- [x] Max of costs of optimal paths for each insect to its goal if it were acting alone in the environment, unobstructed by the other insects. ✔
- [ ] Number of insects that have not yet reached their target location.

Option 1: Consider the state where every insect is right next to its target location. Because you can move every insect in one turn, the true cost from this state to the goal is 1. However, the heuristic would return K, which is an overestimate, so not admissable.
Option 2: Consider the same state as above. The heuristic would again return K, so not admissable.
Option 3: The cost will never be less than the distance from the furthest insect from the goal. The cost could be greater because the insect's path could be obstructed by another insect, so admissable.
Option 4: Admissable, for the same reason as option 3.
Option 5: Consider the same state as in option 1. The heuristic would again return K, so not admissable.

Submit

Answers are displayed within the problem