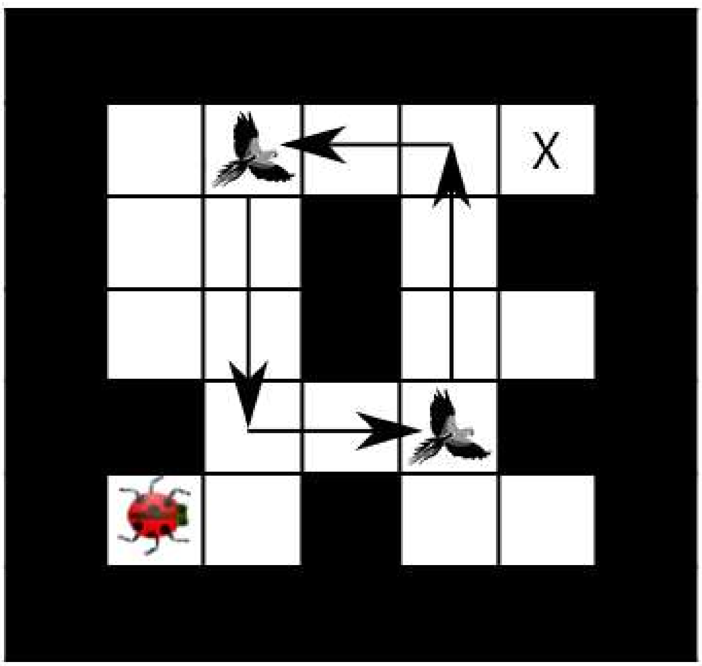
hw1_search_q7_hive_minds_migrating_birds

Question 7: Hive Minds: Migrating Birds

0.0/9.0 points (graded)

You again control a single insect, but there are B birds flying along *known* paths. Specifically, at time t each bird b will be at position $(x_b(t), y_b(t))$. The tuple of bird positions repeats with period T. Birds might move **up to 3 squares** per time step. An example is shown below, but keep in mind that you should answer for a general instance of the problem, not simply the map and path shown below.



Your insect *can* share squares with birds and it can even hitch a ride on them! On any time step that your insect shares a square with a bird, the insect may either move as normal or move directly to the bird's next location (either action has cost 1, even if the bird travels farther than one square).

Which of the following is a minimal state representation?

- A tuple (x, y) giving the position of the insect.

- ○ A tuple (x, y) giving the position of the insect, plus a tuple of bird positions (x_b, y_b) giving the location of each bird.
- ◉ A tuple (x, y) giving the position of the insect, plus an integer $r = t \bmod T$ where t is the time step. ✔
- ○ A tuple (x, y) giving the position of the insect, plus B boolean variables indicating whether each of the birds is carrying an insect passenger.
- ○ A tuple (x, y) giving the position of the insect, plus a tuple of bird positions (x_b, y_b) giving the location of each bird, plus B boolean variables indicating whether each of the birds is carrying an insect passenger.

You need the (x, y) position for the goal test, and, in addition to the position of the insect, the bird positions need to be known to compute successors. To know the bird positions it is sufficient to know the time modulo T.
Goal test: $(x, y) = Goal$
Successor: All of the actions from the last problem, and an additional BIRD action which is only available when $(x, y) = (x_b(t), y_b(t))$ and moves (x, y) to $(x_b(t+1), y_b(t+1))$.

Which of the following is the size of the state space?

- ○ MN
- ◉ MNT ✔
- ○ MNB
- ○ $MNTB$
- ○ $(MN)^{B+1}$
- ○ $2^{MN}MN$
- ○ $(MN)^{B+1}2^B$

The position tuple (x, y) can take MN values, and the time t can take T values, so the total number of states is MNT.

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

- [ ] Cost of optimal path to target in the simpler problem that has no birds.
- [ ] Manhattan distance from the insect's current position to the target.
- [ ] Manhattan distance from the insect's current position to the nearest bird.
- [x] Manhattan distance from the insect's current position to the target divided by three. ✔

Option 1: Consider the state where an insect is three squares from the goal, but is on the same spot as a bird that will fly to the goal. If the insect takes the BIRD action, it will move to the goal in 1 step. However, the heuristic would return 3, so not admissable.
Option 2: Consider the same state as above. The heuristic would return 3, so not admissable.
Option 3: Consider the state where an insect is two squares from a bird, but one grid from the goal. The heuristic would return 2, while the true cost is 1, so not admissable.
Option 4: An insect can travel at most 3 grids per move (via a bird), so dividing the Manhattan distance by 3 gives us an admissable heuristic.

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Answers are displayed within the problem