p4_tracking_q2_exact_inference_time_elapse

Question 2 (4 points): Exact Inference with Time Elapse

In the previous question you implemented belief updates for Pacman based on his observations. Fortunately, Pacman's observations are not his only source of knowledge about where a ghost may be. Pacman also has knowledge about the ways that a ghost may move; namely that the ghost can not move through a wall or more than one space in one timestep.

To understand why this is useful to Pacman, consider the following scenario in which there is Pacman and one Ghost. Pacman receives many observations which indicate the ghost is very near, but then one which indicates the ghost is very far. The reading indicating the ghost is very far is likely to be the result of a buggy sensor. Pacman's prior knowledge of how the ghost may move will decrease the impact of this reading since Pacman knows the ghost could not move so far in only one move.

In this question, you will implement the `elapseTime` method in `ExactInference`. Your agent has access to the action distribution for any `GhostAgent`. In order to test your `elapseTime` implementation separately from your `observe` implementation in the previous question, this question will not make use of your `observe` implementation.

Since Pacman is not utilizing any observations about the ghost, this means that Pacman will start with a uniform distribution over all spaces, and then update his beliefs according to how he knows the Ghost is able to move. Since Pacman is not observing the ghost, this means the ghost's actions will not impact Pacman's beliefs. Over time, Pacman's beliefs will come to reflect places on the board where he believes ghosts are most likely to be given the geometry of the board and what Pacman already knows about their valid movements.

For the tests in this question we will sometimes use a ghost with random movements and other times we will use the GoSouthGhost. This ghost tends to move south so over time, and without any observations, Pacman's belief distribution should begin to focus around the bottom of the board. To see which ghost is used for each test case you can look in the .test files.

To run the autograder for this question and visualize the output:

```
python autograder.py -q q2
```

As an example of the GoSouthGhostAgent, you can run

```
python autograder.py -t test_cases/q2/2-ExactElapse
```

and observe that the distribution becomes concentrated at the bottom of the board.

As you watch the autograder output, remember that lighter squares indicate that pacman believes a ghost is more likely to occupy that location, and darker squares indicate a ghost is less likely to occupy that location. For which of the test cases do you notice differences emerging in the shading of the squares? Can you explain why some squares get lighter and some squares get darker?

Hints:

- Instructions for obtaining a distribution over where a ghost will go next, given its current position and the `gameState`, appears in the comments of `ExactInference.elapseTime` in `inference.py`.
- We assume that ghosts still move independently of one another, so while you can develop all of your code for one ghost at a time, adding multiple ghosts should still work correctly.