

ASSIGNMENT 3

Q1) In the tests of this question, pacman does not get any observation and it updates its beliefs according to movement tendency of the ghosts or in other words, position distributions of the ghosts. In the 1st test case, ghosts can move every direction with a same probability and for this reason, in total, the probabilities of grids do not change. However, in the 2nd test case, since ghosts have tendency to move south the probabilities of the grids change as time passes and the probability of grids in the south become higher than others.

Q2) In the 2nd test case, pacman can not moving and distance of pacman to all grids stays same in the test case. In our approach, we calculate the probability of the grids based on their distance to pacman. With the observations, pacman can get the distance of the ghost and all the grids whose distance to pacman is same get same probability. For this reason, all the corners get highest probability. However, in the 3rd test case, python can move and can change the distances between it and grids, the probability calculation gets the observation in different locations of the grid, and it updates itself based on them.

Q3) Particles will be reinitialized when the sum of the coefficients of all particles are 0. This means that the pacman get unexpected observations like the existence of the ghost in the grid with very low probability. In this case, for the high probability grids, the observation coefficients will be very low because the ghost is not in them and for the very low probability grids the observation coefficient will be high. In the end, both high probability grids and low probability grids get very low probability and particles will be reinitialized.

Q4) Exact inference is a deterministic approach based on the mathematical approach and gets same result for same test case in all trials. However, in the approximate one, we have particles and the fate of

the particles will be determined based on random samples. Even though in the end, the result of approximate inference converges result of exact inference, there are small uncertainty in the result of approximate inference and result of them is not same in all trials. We can win the game with 300 particle and the 5000 particle may make the results better. However, the time complexity will be increase drastically.

Q5) Time Elapse:

Assume that G is a candidate position and g1 and g2 is old positions of the ghosts.

In each particle, for each ghost, the creation of new particle is done by using the probability:

$$P(G|g1,g2)$$

Weight calculation: Assume that our particle is (p1, p2) and g1 and g2 are real ghost positions. Actually this particle express the probability of $P(g1 = p1, g2 = p2)$.

We are trying to find that $P(g1 = p1, g2=p2 \mid O)$

$$= P(q1 = p1, q2 = p2, O)/P(O) \text{ (it is 1)}$$

$$= P(q1 = p1, O)*(q2 = p2,O) \text{ since they are independent.}$$