INFO8006: Project 3 - Report

Mohamed-Anass Gallass - s174796
Yassine Maziane - s184384

December 20, 2020

1 Bayes filter

a. The sensor model of the rusty sensor contains the approximated distances between Pacman and all the ghosts in the maze. Indeed, each distance is tainted with some error which is the difference between a binomial random variate value and the expectation of the binomial distribution. We can observe that the error will almost always be smaller than the true distance between and the ghosts. .

b. Confused will go anywhere with equal probability but scared and afraid tend to move away from Pacman and we see that scared is more likely to move away from pacman than afraid is. The transition model,where x_t defines the ghost position at time t and X_{t+1} defines it at time t+1, takes the form $P(X_{t+1}|x_t, GhostType)$ and can be defined as follows :

- For any ghost type, $P(X_{t+1}|x_t, GhostType) = 0$ if either one or both of X_{t+1},x_t depicts a wall.
- $P(X_{t+1}|x_t, Confused)$=$\frac{1}{AccessibleNeighbourCells}$
- $P(X_{t+1}|x_t, Scared) = \frac{8}{8A+B}$ if $d(Pacman, Ghost_t) \leq d(Pacman, Ghost_{t+1}$ and $\frac{1}{8A+B}$ otherwise. B represents the number of the ghost's neighbour cells that are closer to pacman and A complements this number with respect to the number of legal moves from the ghost current position.
- $P(X_{t+1}|x_t, Afraid) = \frac{2}{2A+B}$ or $\frac{1}{2A+B}$ with the same conventions given above.

2 Implementation

a. ***Leave empty.***

3 Experiment

a. We decided to define the uncertainty of the belief state of a single ghost as the standard deviation of all the values of the belief state. This measure can be generalized for an arbitrary number of ghosts but we will only consider one for readability purposes. We have :

$$\sigma = \sqrt{\frac{\sum_i^N \sum_j^M (BS(i,j) - \mu)^2}{NM}} \tag{1}$$

Where μ is the average probability, that is $\mu = 1/NM$

b. The measure of quality gives us an information about how far the belief state is from the truth. We decided to define this measure as follows:

$$\text{Quality} = \frac{1}{\text{number of ghost}} \sum_i^N \sum_j^M |\text{trueState}_{(i,j)} - \text{beliefStates}_{(i,j)}|$$

where the truth state is equal to 1 if the position (i, j) corresponds to the ghost cell, and 0 otherwise. N and M are the dimensions of the map.

c. Our results are reported in the end:

   Our graphs are not very stable because it seems that we have not taken enough samples by time steps

d. We first need to define the behaviours of the different ghost types. Scared will look for positions that make him go away from pacman, if pacman does not move, scared will go the a corner. Once in the corner he realizes that all the legal moves he has get him closer to pacman and he will choose one of them with the same probability, he will most likely come back and repeat the process. We realize that scared has the best quality factor while confused is the last. It was predictable since confused promotes all the neighbour cells equally while the two others don't. The layout also plays an essential role,

e. Pacman does not know the exact position of the ghost, it knows the noisy distance, we realized by printing that the noise took values between -2 and 2. Therefore the distance between pacman and the ghost lies in $[evidence - 2; evidence + 2]$, this defines an area of probability where the ghost must be. If the sensor variance is low, the width between the 2 curves is short and the ghost is "well" localized but if the sensor variance is large, the width between the 2 curves is large and ghost is badly localized.

f. For each ghost, we look at the cell that has the highest probability of containing the ghost, we then choose the cell that is the closest to pacman's position(in terms of manhattan distance) and make a step in that direction, we then collect evidence and update our bs, if it seems that we have come closer to the ghost we continue otherwise we repeat the process. This might loop for long if the closest ghost we target happened to change at every iteration or so.

g. ***Leave empty.***

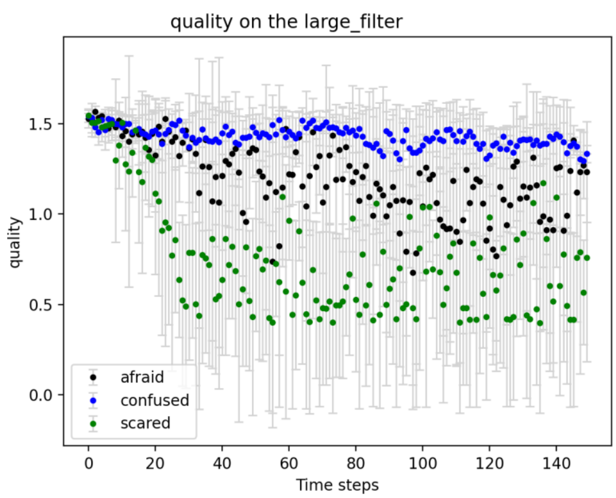

Figure 1: Quality on large filter

h.

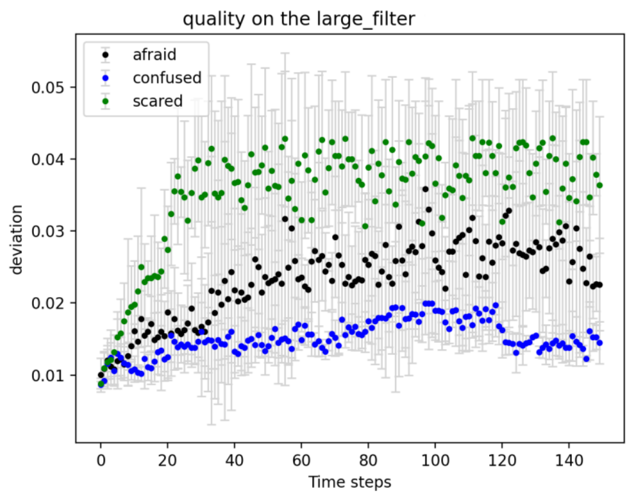

Figure 2: Deviation on large filter

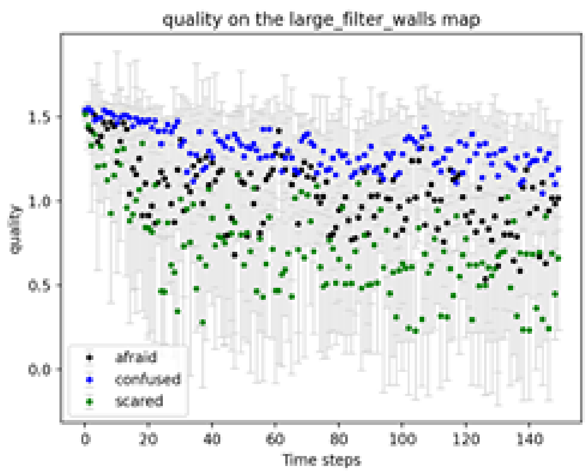

Figure 3: Quality on large filter walls

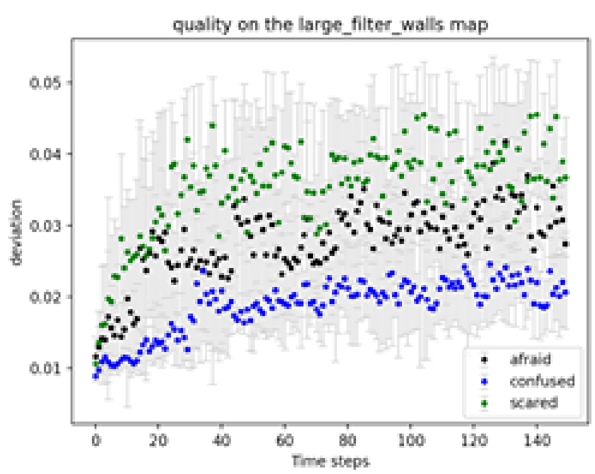

Figure 4: Deviation on large filter walls