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CS 4300
Assignment 1
August 26 2017

Lab Report

1. *Introduction*
   An agent function that will randomly move around a wumpus world in one of three directions and record selected data of the runs of said agent. What are the average number of steps, the percentage of runs that reached the gold space, the variance of the number of steps, variance on gold reached, the 95% confidence interval for the steps and for the gold? The wumpus world is a 4 by 4 area where they agent is looking in a direction and is given a number of steps that are used to do one of the three actions of rotating left, rotating right or moving forward. What we are looking is as our max number of steps increase how much will our average number of steps increase? Will they increase at a large rate or will the agent on most cases die around the same time that he normally does?
2. *Method*
   The method undertaken had the agent randomly select actions from a pool to execute within the next step. These actions included:
   - *Forward* - Move the agent ahead one space in the direction it is facing in.
   - *Rotate_Left* - Rotates the agent counterclockwise 90 degrees.
   - *Rotate_Right* - Rotates the agent clockwise 90 degrees.

   The algorithm at question is has us uniformly (equally likely) select a random integer from the range 1 to 3. This random integer has actions mapped to each element within it range that our agent will execute upon the next step. It is worth noting that although our agent receives about its world through its precepts as a parameter, the method of choosing actions does not consider the information received by said percepts. Data sets used included the board that is fixed

throughout all trials given in the problem description.

```
function action = CS4300_agent1(percept)
% CS4300_agent1 - random agent example
%   It randomly either changes direction or moves forward
% On input:
%   percept (1x5 Boolean vector): percept values
%    (1): Stench
%    (2): Pit
%    (3): Glitters
%    (4): Bumped
%    (5): Screamed
% On output:
%   action (int): action selected by agent
%    FORWARD = 1;
%    ROTATE_RIGHT = 2;
%    ROTATE_LEFT = 3;
%    GRAB = 4; -- NOT USED
%    SHOOT = 5; -- NOT USED
%    CLIMB = 6; -- NOT USED
% Call:
%   a = CS4300_agent1([0,1,0,0,0]);
% Author:
%   Eric Waugh and Monish Gupta
%   u0947296 and u1008121
%   Fall 2017
%

persistent state
```

Agent Header

```
FORWARD = 1;
ROTATE_RIGHT = 2;
ROTATE_LEFT = 3;

if isempty(state)
    state = 0;
end
state = randi(2);
switch state
    case 0
        action = ROTATE_RIGHT;
    case 1
        action = ROTATE_LEFT;
    case 2
        action = FORWARD;
end
```

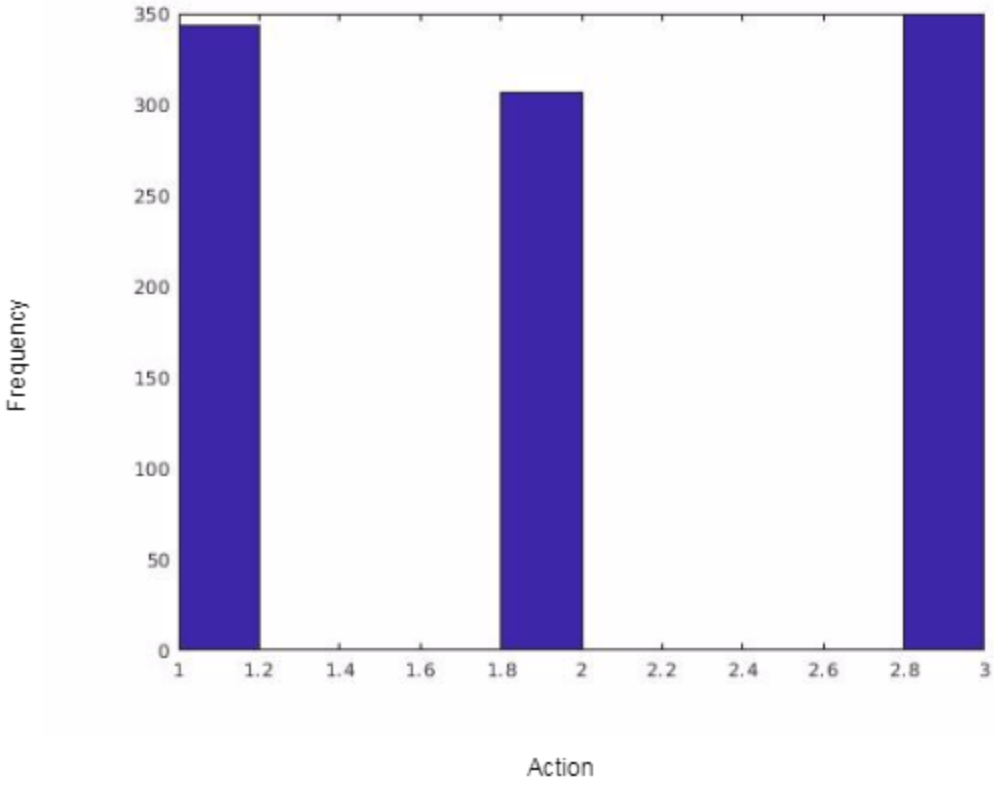
Agent Code

This was the function to run the 2000 trials for a set number of steps to gather data:

```
mean_steps = 0;
percent_gold = 0;
variance_steps = 0;
variance_gold = 0;
convidence_interval_low_steps = 0;
convidence_interval_high_steps = 0;
convidence_interval_low_gold = 0;
convidence_interval_high_gold = 0;
NUM_ROWS = 4;
sample_steps = zeros(2000,1);
sample_gold = zeros(2000,1);
trial = 0;

while trial<2000
    trial = trial + 1;
    t=CS4300_WW2(num_steps,'CS4300_agent1');
    mean_steps = mean_steps + length(t);
    sample_steps(trial,1) = length(t);
    for i = 1:length(t)
        loc_r = NUM_ROWS - t(i).agent.y + 1;
        loc_c = t(i).agent.x;
        if loc_r==2&&loc_c==2
            sample_gold(trial,1) = 1;
            percent_gold = percent_gold + 1;
            i = length(t);
        end
    end
end

mean_steps = mean_steps / 2000;
percent_gold = percent_gold / 2000;
variance_steps = var(sample_steps(:,1));
variance_gold = var(sample_gold(:,1));

convidence_interval_high_steps = mean_steps + 1.645 * sqrt(variance_steps/2000);
convidence_interval_low_steps = mean_steps - 1.645 * sqrt(variance_steps/2000);

convidence_interval_high_gold = percent_gold + 1.645 * sqrt(variance_gold/2000);
convidence_interval_low_gold = percent_gold - 1.645 * sqrt(variance_gold/2000);
```

Code to run trials and gather information for variance, confidence intervals and means.

3. *Verification of Program*



Histogram to ensure random selection is uniform.

To verify our program we got the results of running our agent function 1000 times and put it in a histogram to show that our agent was actually picking a random number in the correct range.

4. *Data and Analysis*

   There were 5 main categories of information to track. The number of maximum steps the agent could move (the agent could be killed before this number of steps). The average amount of steps taken before it was killed or reached the max number of steps. The percentage of agents that touched the gold at any step in their lifetimes. The variance of the steps taken in the 2000 trials performed. The 95% confidence interval in which we expect 2000 trials to have a mean number of steps within.

Number of Max Steps	50	100	150	200
Mean Steps Taken	24.3130	26.7035	27.0355	27.1545
% of Agents Reached Gold	49.65%	59.20%	52.90%	56.20%
Variance of Steps Taken	223.9380	408.0336	478.2644	480.9061
95% Confidence Intervals of Steps	23.7626 - 24.8634	25.9605 - 27.4465	26.2311 - 27.8399	26.3479 - 27.9611
Variance of % of Reached Gold	0.1279	0.1398	0.1385	0.1444
95% Confidence Interval % of Reached Gold	48.33% - 50.97%	57.82% - 60.58%	51.53% - 54.27%	54.80% - 57.60%

The only adjusted variable in this experiment was the number of maximum steps an agent could take. The mean steps increased slightly as the number of maximum steps increased. The percentage of agents that reached the gold appears to have increased slightly. The confidence intervals yielded to be slightly wider as the max number of steps increased (because the variance of each experiment was also getting larger), and their middle offsets became bigger as well (because the mean steps taken had increased with higher max steps counts.

5. *Interpretation*
   So when looking at our data you will notice that our mean number of steps doesn't increase that much as the max number of steps does. This is because the only trials to increase the means steps taken would be those that exceeded the max in the previous experiment, which very few agents managed.To their credit, the agents that did go above the previous limit did have a much bigger impact to the mean than those that were closer to the mean value. Ultimately, we can say that the mean steps did increase as the max steps increased. The variance does increase a lot more between larger step counts because the average does not change as much like stated above but when an agent did go above the typical average by a larger amount it would increase the variance at a high rate. The variance increases at a much high rate in all cases due to the variance being the squared value of difference between the mean.
6. *Critique*
   Further data collection and analysis could be performed upon those agents that reached their maximum number of steps in their respect experiments. Analysis can be performed on the impact of these outlier agents with respect to agents that did not exceed the maximum step count. A better understanding was obtained of statistical intervals and data collection. The interaction between percepts, actions , and agents also became more clear as the experiment was carried out.

7. *Log*

Monish -

Understanding supplied code - 2 hours.
Writing agent code - 1 hour.
Writing data collection code - 1 hour.
Lab Report - 2 hours.

Eric -

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Writing agent code - 1 hour.
Writing data collection code - 1 hour.
Lab Report - 2 hours.