

Artificial Intelligence Course Assigned: Monday, December 25, 2023 Due: Monday, January 1, 2024

Assignment 4 Reinforcement Learning

1 Overview

1. For this assignment you will be making a maze solver. Your program will generate a maze of size NxN. Also you should generate barriers at random grid locations. Then you will try to learn the path out of the grid using policy and value iteration.

2 Application

2.1 Algorithm

You will need to implement the NxN maze solver problem using the Policy Iteration and Value Iteration.

Value Iteration (VI)

- Initialize V₀(s)=0 for all states s
- 2. Set k=1
- Loop until [finite horizon, convergence]
 - · For each state s

$$V_{k+1}(s) = \max_{a} R(s, a) + \gamma \sum_{s' \in S} P(s'|s, a)V_k(s')$$

· View as Bellman backup on value function

$$\begin{array}{rcl} V_{k+1} & = & BV_k \\ \pi_{k+1}(s) & = & \arg\max_a R(s,a) + \gamma \sum_{s' \in S} P(s'|s,a) V_k(s') \end{array}$$



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Policy Iteration (PI)

- 1. i=0; Initialize $\pi_0(s)$ randomly for all states s
- 2. While i == 0 or $|\pi_i \pi_{i-1}| > 0$
 - Policy evaluation: Compute value of π_i
 - i=i+1
 - · Policy improvement:

$$\begin{split} Q^{\pi_i}(s,a) &= r(s,a) + \gamma \sum_{s' \in S} p(s'|s,a) V^{\pi_i}(s') \\ \pi_{i+1}(s) &= \arg \max Q^{\pi_i}(s,a) \end{split}$$

Use a L1 norm: measures if the policy changed for any state

3 Notes

Output should be in a traaceable format as every step should be printed (best visualization will grant a bonus)

3.1 Deliverables

- 1. well commented code
- 2. Report should include
 - (a) path to goal
 - (b) cost of path
 - (c) running time
- 3. Report should contain data structures used (if any) and algorithms, Assumptions and details you find necessary to be clarified, sample runs and how algorithms operate

3.2 Further Notes

- You may use Java, Python or C++ for your implementation.
- Copied assignments will be severely penalized.
- You can work in groups of 2 or 3.
- You will be evaluated individually in discussion



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Good Luck