**MIE567 Assignment 1**

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Deterministic Gridworld

Part A

2. The state space is represented as s(x)(y), which refers to the x-th row and y-th column beginning with the top left. Thus, the set of feasible state spaces are:   
   {s11, s13, s14, s15, s21, s23, s24, s25, s31, s32, s33, s34, s35, s41, s45, s51, s52, s53, s54, s55}

In this problem, we begin at s51, and our goal is to reach s13.

The action space is {U, D, L, R}, which represents the action of going up, down, left, and right respectively.

1. The transition probability matrix is dependent on the action taken:

This is the set of actions that result in not moving, because they would have moved into a blocked square:



This is the set of actions that result in moving to a different (i.e. non-blocked) square:

|  |  |  |  |
| --- | --- | --- | --- |
| Origin state (s) | Action (a) | Destination state (s') | P(s'|s,a) |
| s11 | D | s21 | 1 |
| s14 | D | s24 | 1 |
| L | s13 | 1 |
| R | s15 | 1 |
| s15 | D | s25 | 1 |
| L | s14 | 1 |
| s21 | U | s11 | 1 |
| D | s31 | 1 |
| s23 | U | s13 | 1 |
| D | s33 | 1 |
| R | s24 | 1 |
| s24 | U | s14 | 1 |
| D | s34 | 1 |
| L | s23 | 1 |
| R | s25 | 1 |
| s25 | U | s15 | 1 |
| D | s35 | 1 |
| L | s24 | 1 |
| s31 | U | s21 | 1 |
| D | s41 | 1 |
| R | s32 | 1 |
| s32 | L | s31 | 1 |
| R | s33 | 1 |
| s33 | U | s23 | 1 |
| L | s32 | 1 |
| R | s34 | 1 |
| s34 | U | s24 | 1 |
| L | s33 | 1 |
| R | s35 | 1 |
| s35 | U | s25 | 1 |
| D | s45 | 1 |
| L | s34 | 1 |
| s41 | U | s31 | 1 |
| D | s51 | 1 |
| s45 | U | s35 | 1 |
| D | s55 | 1 |
| s51 | U | s41 | 1 |
| R | s52 | 1 |
| s52 | L | s51 | 1 |
| R | s53 | 1 |
| s53 | L | s52 | 1 |
| R | s54 | 1 |
| s54 | L | s53 | 1 |
| R | s55 | 1 |
| s55 | U | s45 | 1 |
| L | s54 | 1 |

1. We define the Reward function as the following:

for all other

We define a high reward (+25) for reaching the goal state of s13 because we want to be incentivized to go there.

We assign a cost of -1 to any regular feasible move so as to disincentivize taking too many moves.

1. See Gridworld.py

Part B – Value Iteration

<show result graphs here>

Part C – Policy Iteration

<show result graphs here>

Windy Gridworld

Part A

1. The state space is represented as s(x)(y), which refers to the x-th row and y-th column beginning with the top left. Thus, the set of feasible state spaces are:   
   {s11, s13, s14, s15, s21, s23, s24, s25, s31, s32, s33, s34, s35, s41, s45, s51, s52, s53, s54, s55}

In this problem, we begin at s51, and our goal is to reach s13.

The action space is {U, D, L, R}, which represents the action of going up, down, left, and right respectively.

*(nothing has changed here)*

1. The transition actions are still the same, except instead of a deterministic movement, the likelihood of achieving the intended movement is now . As such, the transition probability matrices are still as follows.

We assume that attempting to move to a blocked square will still fail with probability 1, so the transition probability matrix for such moves remains the same.



For the other movement attempts, the transition probability matrix changes to the following:

|  |  |  |  |
| --- | --- | --- | --- |
| Origin state (s) | Action (a) | Destination state (s') | P(s'|s,a) |
| s11 | D | s21 | p |
| D | s11 | 1-p |
| s14 | D | s24 | p |
| D | s14 | 1-p |
| L | s13 | p |
| L | s14 | 1-p |
| R | s15 | p |
| R | s14 | 1-p |
| s15 | D | s25 | p |
| D | s15 | 1-p |
| L | s14 | p |
| L | s15 | 1-p |
| s21 | U | s11 | p |
| U | s21 | 1-p |
| D | s31 | p |
| D | s21 | 1-p |
| s23 | U | s13 | p |
| U | s23 | 1-p |
| D | s33 | p |
| D | s23 | 1-p |
| R | s24 | p |
| R | s23 | 1-p |
| s24 | U | s14 | p |
| U | s24 | 1-p |
| D | s34 | p |
| D | s24 | 1-p |
| L | s23 | p |
| L | s24 | 1-p |
| R | s25 | p |
| R | s24 | 1-p |
| s25 | U | s15 | p |
| U | s25 | 1-p |
| D | s35 | p |
| D | s25 | 1-p |
| L | s24 | p |
| L | s25 | 1-p |
| s31 | U | s21 | p |
| U | s31 | 1-p |
| D | s41 | p |
| D | s31 | 1-p |
| R | s32 | p |
| R | s31 | 1-p |
| s32 | L | s31 | p |
| L | s32 | 1-p |
| R | s33 | p |
| R | s32 | 1-p |
| s33 | U | s23 | p |
| U | s33 | 1-p |
| L | s32 | p |
| L | s33 | 1-p |
| R | s34 | p |
| R | s33 | 1-p |
| s34 | U | s24 | p |
| U | s34 | 1-p |
| L | s33 | p |
| L | s34 | 1-p |
| R | s35 | p |
| R | s34 | 1-p |
| s35 | U | s25 | p |
| U | s35 | 1-p |
| D | s45 | p |
| D | s35 | 1-p |
| L | s34 | p |
| L | s35 | 1-p |
| s41 | U | s31 | p |
| U | s41 | 1-p |
| D | s51 | p |
| D | s41 | 1-p |
| s45 | U | s35 | p |
| U | s45 | 1-p |
| D | s55 | p |
| D | s45 | 1-p |
| s51 | U | s41 | p |
| U | s51 | 1-p |
| R | s52 | p |
| R | s51 | 1-p |
| s52 | L | s51 | p |
| L | s52 | 1-p |
| R | s53 | p |
| R | s52 | 1-p |
| s53 | L | s52 | p |
| L | s53 | 1-p |
| R | s54 | p |
| R | s53 | 1-p |
| s54 | L | s53 | p |
| L | s54 | 1-p |
| R | s55 | p |
| R | s54 | 1-p |
| s55 | U | s45 | p |
| U | s55 | 1-p |
| L | s54 | p |
| L | s55 | 1-p |

1. We define the Reward function as the following:

*(nothing changes here)*

1. <need a new V(s51) function with probabilities