ASSIGNMENT-SECOND YEAR STUDENTS

-SHIRSHAKK PURKAYASTHA

I.I.S.E.R. BHOPAL

VALUE-ITERATION ALGORITHM

CODE:

NOTE: I have numbered the grid as :

(0,0) **TERMINAL**	(1,0) NON-TERMINAL	(2,0) NON-TERMINAL	(3,0) NON-TERMINAL	(4,0) NON-TERMINAL
(0,1) NON-TERMINAL	(1,1) NON-TERMINAL	(2,1) NON-TERMINAL	(3,1) NON-TERMINAL	(4,1) NON-TERMINAL
(0,2) NON-TERMINAL	(1,2) NON-TERMINAL	(2,2) NON-TERMINAL	(3,2) NON-TERMINAL	(4,2) **TERMINAL**
(0,3) NON-TERMINAL	(1,3) NON-TERMINAL	(2,3) NON-TERMINAL	(3,3) NON-TERMINAL	(4,3) NON-TERMINAL
(0,4) NON-TERMINAL	(1,4) **TERMINAL**	(2,4) NON-TERMINAL	(3,4) NON-TERMINAL	(4,4) **TERMINAL**

#Compiled on Google Colaboratory

```
import numpy as np
import random
ROWS = 5
COLUMNS = 5
WIN_STATES = []                                  # Creating a list for win_states
for x in range(5):
  for y in range(5):
    WIN_STATES.append((x, y))


WIN_STATES.remove((0,0))
WIN_STATES.remove((1,2))
WIN_STATES.remove((1,3))
WIN_STATES.remove((1,4))
WIN_STATES.remove((1,1))
WIN_STATES.remove((2,1))
WIN_STATES.remove((2,2))
WIN_STATES.remove((2,3))
WIN_STATES.remove((3,1))
WIN_STATES.remove((3,2))
WIN_STATES.remove((3,3))
```

```
WIN_STATES.remove((4,2))
WIN_STATES.remove((4,4))

print("WIN_STATES:",WIN_STATES)

LOSE_STATES = []                                    # Creating list for losing_states
for x in range(5):
  for y in range(5):
    LOSE_STATES.append((x, y))

LOSE_STATES.remove((0,1))
LOSE_STATES.remove((0,2))
LOSE_STATES.remove((0,3))
LOSE_STATES.remove((0,4))
LOSE_STATES.remove((1,0))
LOSE_STATES.remove((1,1))
LOSE_STATES.remove((1,2))
LOSE_STATES.remove((1,3))
LOSE_STATES.remove((2,0))
LOSE_STATES.remove((2,1))
LOSE_STATES.remove((2,2))
LOSE_STATES.remove((2,3))
LOSE_STATES.remove((2,4))
LOSE_STATES.remove((3,0))
LOSE_STATES.remove((3,1))
LOSE_STATES.remove((3,2))
LOSE_STATES.remove((3,3))
LOSE_STATES.remove((3,4))
LOSE_STATES.remove((4,0))
LOSE_STATES.remove((4,1))
LOSE_STATES.remove((4,3))

print("LOSE_STATES:",LOSE_STATES)
START = (1,1)                                       # Defining the start state at (1,1)
DETERMINISTIC = True
```

```
class State:
    def __init__(self, state=START):
        self.board = np.zeros([ROWS,COLUMNS])
        self.board[4,4] = -1
        self.board[4,2] = -1
        self.board[1,4] = -1
        self.board[0,0] = -1
        self.state = state
        self.isEnd = False
        self.determine = DETERMINISTIC
    def giveReward(self):
        if self.state in WIN_STATES:
            return 1
        elif self.state in LOSE_STATES:
            return -1
        else:
            return 0
    def isEndFunc(self):
        if (self.state in WIN_STATES) or (self.state in LOSE_STATES):
            self.isEnd = True
    def nxtPosition(self, action):
         if self.determine:
            if action == "N":
                nxtState = (self.state[0] , self.state[1]- 1)
            elif action == "S":
                nxtState = (self.state[0], self.state[1] + 1)
            elif action == "W":
                nxtState = (self.state[0] - 1, self.state[1])
            else:
                nxtState = (self.state[0] + 1 , self.state[1])
            if (nxtState[0] >= 0) and (nxtState[0] <= 4):
                if (nxtState[1] >= 1) and (nxtState[1] <= 3):
                    if nxtState != (0,0):
                        return nxtState
                    if nxtState != (4,4):
```

```
                return nxtState
            if nxtState != (4,2):
                return nxtState
            if nxtState != (1,4):
                return nxtState
        return self.state
    def showBoard(self):
        self.board[self.state] = 1
        for i in range(0, ROWS):
            print('-----------------')
            out = '| '
            for j in range(0, COLUMNS):
                if self.board[i, j] == 1:
                    token = '*'
                if self.board[i, j] == -1:
                    token = 'z'
                if self.board[i, j] == 0:
                    token = '0'
                out += token + ' | '
            print(out)
        print('-----------------')
class Agent:                                    # Creating an agent for the player
    def __init__(self):
        self.states = []
        self.actions = ["N", "S", "W", "E"]
        self.State = State()
        self.lr = 0.5                           # lr -> Learning Rate
        self.exp_rate = 0.5
        self.state_values = {}                  # Defining rewards
        for i in range(ROWS):
            for j in range(COLUMNS):
                #self.state_values[(i, j)] = 0  # Setting initial value to 0  #Question 2
                #self.state_values[(i,j)] = random.random()  # Setting initial value randomly [0,1)  #Question 1

    def chooseAction(self):                     # Defining the agent to choose the action with the most expected value
```

```
    mx_nxt_reward = 0
    action = ""
    if np.random.uniform(0, 1) <= self.exp_rate:
        action = np.random.choice(self.actions)
    else:                                                    # Greedy Algorithm Stage
        for a in self.actions:
            nxt_reward = self.state_values[self.State.nxtPosition(a)]      # Determining actions for deterministic action
            if nxt_reward >= mx_nxt_reward:
                action = a
                mx_nxt_reward = nxt_reward
    return action
def takeAction(self, action):
    position = self.State.nxtPosition(action)
    return State(state=position)
def reset(self):
    self.states = []
    self.State = State()
def play(self, rounds=5):
    i = 0
    while i < rounds:
        if self.State.isEnd:                                 #Backpropagation Stage
            reward = self.State.giveReward()
            self.state_values[self.State.state] = reward
            print("Game End Reward", reward)
            for s in reversed(self.states):
                reward = self.state_values[s] + self.lr * (reward - self.state_values[s])
                self.state_values[s] = round(reward, 1)
            self.reset()
            i += 1
        else:
            action = self.chooseAction()
            self.states.append(self.State.nxtPosition(action))                    #Appending Traces
            print("current position {} action {}".format(self.State.state, action))
            self.State = self.takeAction(action)
            self.State.isEndFunc()
```

```
            print("Next state", self.State.state)
            print("---------------------")


    def showValues(self):
        for i in range(0, ROWS):
            print('----------------------------------')
            out = '| '
            for j in range(0, COLUMNS):
                out += str(self.state_values[(i, j)]).ljust(6) + ' | '
            print(out)
        print('----------------------------------')
if __name__ == "__main__":
    ag = Agent()
    ag.play(50)
print(ag.showValues())
```

OUTPUT FOR QUESTION 1:

****************Change in code: The State Value is initialized randomly from [0,1).**

```
#self.state_values[(i,j)] = random.random()
```

```
WIN_STATES: [(0, 1), (0, 2), (0, 3), (0, 4), (1, 0), (2, 0), (2, 4), (3,
0), (3, 4), (4, 0), (4, 1), (4, 3)]
LOSE_STATES: [(0, 0), (1, 4), (4, 2), (4, 4)]
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
```

```
--------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
--------------------
current position (1, 2) action E
Next state (2, 2)
--------------------
current position (2, 2) action E
Next state (3, 2)
--------------------
current position (3, 2) action W
Next state (2, 2)
--------------------
current position (2, 2) action N
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action E
Next state (3, 1)
```

```
--------------------
current position (3, 1) action W
Next state (2, 1)
--------------------
current position (2, 1) action E
Next state (3, 1)
--------------------
current position (3, 1) action E
Next state (4, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action N
```

```
Next state (1, 1)
---------------------
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action W
Next state (0, 2)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action S
Next state (1, 3)
---------------------
current position (1, 3) action N
Next state (1, 2)
---------------------
current position (1, 2) action W
Next state (0, 2)
---------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action N
```

```
Next state (1, 1)
---------------------
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action W
Next state (0, 2)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
```

```
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action S
Next state (2, 2)
---------------------
current position (2, 2) action E
Next state (3, 2)
---------------------
current position (3, 2) action S
Next state (3, 3)
---------------------
current position (3, 3) action E
Next state (4, 3)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action S
Next state (2, 2)
---------------------
current position (2, 2) action W
Next state (1, 2)
---------------------
current position (1, 2) action W
Next state (0, 2)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
```

```
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action E
Next state (3, 1)
--------------------
current position (3, 1) action E
Next state (4, 1)
--------------------
Game End Reward 1
-----------------------------------
| 0.8521640248192143 | 1.0    | 1.0    | 0.1589981150038381 |
0.7146430175100287 |
-----------------------------------
| 0.1773849356409003 | 0.9    | 0.9    | 0.5    | 0.26681466580931157 |
-----------------------------------
| 0.4348943359512245 | 0.9    | 0.7    | 0.31287059054660193 |
0.06030860833017393 |
-----------------------------------
| 0.14052250656554255 | 0.8    | 0.6    | 0.8    | 0.875070568714668 |
-----------------------------------
| 0.6613946921977949 | 1.0    | 0.33614167775090653 | 1.0    |
0.8634415691119294 |
-----------------------------------
None
```

OUTPUT FOR QUESTION 2:

****************Change in code: The State Value is initialized to Zero.**

```
#self.state_values[(i, j)] = 0
```

```
WIN_STATES: [(0, 1), (0, 2), (0, 3), (0, 4), (1, 0), (2, 0), (2, 4), (3,
0), (3, 4), (4, 0), (4, 1), (4, 3)]
LOSE_STATES: [(0, 0), (1, 4), (4, 2), (4, 4)]
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action E
Next state (3, 1)
---------------------
current position (3, 1) action W
Next state (2, 1)
---------------------
current position (2, 1) action E
Next state (3, 1)
---------------------
current position (3, 1) action E
Next state (4, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action E
Next state (3, 1)
---------------------
current position (3, 1) action S
Next state (3, 2)
---------------------
current position (3, 2) action N
Next state (3, 1)
---------------------
current position (3, 1) action E
Next state (4, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action S
Next state (2, 2)
---------------------
current position (2, 2) action N
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action E
Next state (3, 1)
---------------------
current position (3, 1) action E
Next state (4, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
```

```
--------------------
current position (1, 2) action E
Next state (2, 2)
--------------------
current position (2, 2) action N
Next state (2, 1)
--------------------
current position (2, 1) action E
Next state (3, 1)
--------------------
current position (3, 1) action S
Next state (3, 2)
--------------------
current position (3, 2) action E
Next state (4, 2)
--------------------
Game End Reward -1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action N
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action S
Next state (2, 2)
--------------------
current position (2, 2) action E
Next state (3, 2)
--------------------
current position (3, 2) action W
Next state (2, 2)
--------------------
current position (2, 2) action N
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
```

```
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action E
Next state (2, 2)
---------------------
current position (2, 2) action N
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action S
Next state (2, 2)
---------------------
current position (2, 2) action E
Next state (3, 2)
---------------------
current position (3, 2) action E
Next state (4, 2)
---------------------
Game End Reward -1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action N
Next state (1, 1)
---------------------
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
```

```
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action N
Next state (2, 1)
---------------------
current position (2, 1) action S
Next state (2, 2)
---------------------
current position (2, 2) action W
Next state (1, 2)
---------------------
current position (1, 2) action N
Next state (1, 1)
---------------------
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action S
Next state (1, 3)
---------------------
current position (1, 3) action W
Next state (0, 3)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
```

```
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
--------------------
current position (2, 1) action W
Next state (1, 1)
--------------------
current position (1, 1) action W
Next state (0, 1)
--------------------
```

```
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action W
Next state (0, 2)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action S
```

```
Next state (1, 2)
---------------------
current position (1, 2) action N
Next state (1, 1)
---------------------
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action S
Next state (1, 2)
---------------------
current position (1, 2) action W
Next state (0, 2)
---------------------
Game End Reward 1
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action E
Next state (2, 1)
---------------------
current position (2, 1) action W
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
```

```
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
current position (1, 1) action N
Next state (1, 1)
---------------------
current position (1, 1) action W
Next state (0, 1)
---------------------
Game End Reward 1
---------------------------------
| 0      | 1.0    | 1.0    | 1.0    | 0      |
---------------------------------
| 0      | 0.9    | 0.9    | 0.5    | 0      |
---------------------------------
| 0      | 0.9    | 0.2    | 0      | 0      |
---------------------------------
| 0      | 0.2    | -0.5   | 0      | 0      |
---------------------------------
| 0      | 1.0    | -1.0   | 0      | 0      |
---------------------------------
None
```