

# Assignment 2

Pranav Nair 201525149  
Bakhtiyar Syed 201525094

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## 1 Value Iteration

### 1.1 Value Iteration Matrices

Initial State

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 \\ 0.00 & -17.00 & 0.00 & 0.00 \\ 0.00 & 0.00 & 0.00 & 0.00 \end{bmatrix}$$

Iteration 1

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ -0.85 & -0.85 & 12.75 & -0.85 \\ -0.85 & -17.00 & 0.00 & -0.85 \\ -0.85 & -0.85 & -0.85 & -0.85 \end{bmatrix}$$

Iteration 2

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ -1.70 & 7.565 & 12.58 & 9.18 \\ -1.70 & -17.00 & 0.00 & -1.70 \\ -1.70 & -1.70 & -1.70 & -1.70 \end{bmatrix}$$

Iteration 3

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 4.862 & 40.38 & 14.4245 & 9.962 \\ -2.55 & -17.00 & 0.00 & 6.154 \\ -2.55 & -2.55 & -2.55 & -2.55 \end{bmatrix}$$

Iteration 4

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 5.9976 & 9.8167 & 14.5733 & 12.3012 \\ 1.0846 & -17.00 & 0.00 & 8.3504 \\ -3.4 & -3.4 & -3.4 & 3.5632 \end{bmatrix}$$

Iteration 5

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 7.7115 & 10.0903 & 14.9618 & 12.8738 \\ 2.3565 & -17.00 & 0.00 & 10.661 \\ -0.6623 & -4.25 & 1.3206 & 5.8466 \end{bmatrix}$$

Iteration 6

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 8.229 & 10.4285 & 15.0464 & 13.4729 \\ 3.8549 & -17.00 & 0.00 & 11.5812 \\ 0.544 & -1.9186 & 4.0914 & 8.3956 \end{bmatrix}$$

Iteration 7

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 8.7012 & 10.53 & 15.1401 & 13.6925 \\ 4.4187 & -17.00 & 0.00 & 12.2446 \\ 2.0965 & 0.5313 & 6.6847 & 9.6637 \end{bmatrix}$$

Iteration 8

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 8.886 & 10.6151 & 15.1723 & 13.8558 \\ 4.8528 & -17.00 & 0.00 & 12.5529 \\ 2.9477 & 2.8509 & 8.2179 & 10.5805 \end{bmatrix}$$

Iteration 9

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 9.016 & 10.6493 & 15.1971 & 13.9287 \\ 5.044 & -17.00 & 0.00 & 12.7452 \\ 3.6121 & 4.3094 & 9.258 & 11.0722 \end{bmatrix}$$

Iteration 10

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 9.0754 & 10.6726 & 15.2078 & 13.9751 \\ 5.1672 & -17.00 & 0.00 & 12.842 \\ 3.9774 & 5.2873 & 9.8593 & 11.3792 \end{bmatrix}$$

Iteration 11

$$\begin{bmatrix} 0.00 & 0.00 & 17.00 & 0.00 \\ 9.1123 & 10.6835 & 15.2148 & 13.9979 \\ 5.2271 & -17.00 & 0.00 & 12.8985 \\ 4.2943 & 5.8662 & 10.2252 & 11.5474 \end{bmatrix}$$

## 1.2 Optimal Policy

$$\begin{bmatrix} WALL & WALL & GOAL & WALL \\ EAST & EAST & NORTH & WEST \\ NORTH & PIT & WALL & NORTH \\ EAST & EAST & EAST & NORTH \end{bmatrix}$$

## 1.3 Final Expected Utility

4.2943 of the start state as calculated via value iteration.

## 1.4 Optimal Path

From start state : EAST, EAST, EAST, NORTH, NORTH, WEST, NORTH

# 2 Linear Programming

## 2.1 Values of X

0.864 , 0, 0, 0, 0.121, 0, 0, 0, 0.228, 1.080, 0, 0, 0, 0, 0, 1.122  
0, 0.136, 0, 0, 0, 0.135, 1.1279, 0,  $-5.314e^{-15}$ ,  $-1.131e^{-20}$ ,  $2.617e^{-21}$   
 $6.434e^{-16}$ ,  $1.453e^{-15}$ , 1.111,  $-9.271e^{-20}$ ,  $-3.486e^{-15}$ ,  $-7.473e^{-23}$ , 0.987,  
 $-4.715e^{-21}$ ,  $-2.885e^{-18}$ ,  $-2.193e^{-16}$ , 1.111, 0.987,  $-1.548e^{-16}$ ,  $1.192e^{-16}$ ,  
 $3.123e^{-19}$

## **2.2 Final Expected Utility**

The expected utility derived from linear programming is 5.586067.