**Assignment 2**

Team number: 16

Dheeraj Reddy Pailla: 20161053

Anshul Gupta: 20161096

**PART B**

As seen below in iteration #0, the initial state of the board consists of 2 goal states represented by -16.0 and 16.0. It also consists of one wall, represented by ‘None’.

The value iteration algorithm is run for this input state, and the output after each iteration is shown below.

Iteration #0

| 0 | 1 | 2 | 3

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0 | -16.0 | 0.0 | 0.0 | 0.0|

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1 | 0.0 | 0.0 | None | 0.0|

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2 | 1.6 | 0.0 | 0.0 | 0.0|

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3 | 0.0 | -1.6 | 0.0 | 16.0|

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Iteration #1

| 0 | 1 | 2 | 3

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0 | -16.0 | -3.2 | -3.2 | -3.2|

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1 | -1.92 | -3.2 | None | -3.2|

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2 | 0.0 | -2.08 | -3.2 | 9.6|

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3 | -2.08 | -6.4 | 9.6 | 16.0|

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Iteration #2

| 0 | 1 | 2 | 3

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0 | -16.0 | -6.4 | -6.4 | -6.4|

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1 | -3.712 | -5.264 | None | 3.84|

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2 | -2.0 | -4.16 | 5.232 | 10.24|

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3 | -4.048 | 2.032 | 10.24 | 16.0|

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Iteration #3

| 0 | 1 | 2 | 3

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0 | -16.0 | -9.486 | -9.6 | -1.408|

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1 | -5.698 | -7.226 | None | 5.76|

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2 | -3.976 | 0.662 | 6.539 | 11.147|

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3 | -2.179 | 3.179 | 11.147 | 16.0|

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Iteration #4

| 0 | 1 | 2 | 3

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0 | -16.0 | -11.54 | -6.246 | 0.307|

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1 | -7.673 | -3.962 | None | 6.87|

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2 | -1.858 | 1.627 | 7.486 | 11.369|

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3 | -1.272 | 4.502 | 11.369 | 16.0|

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Iteration #5

| 0 | 1 | 2 | 3

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0 | -16.0 | -8.595 | -4.204 | 1.702|

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1 | -5.85 | -3.062 | None | 7.269|

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2 | -1.193 | 2.843 | 7.78 | 11.486|

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3 | 0.089 | 4.908 | 11.486 | 16.0|

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Iteration #6

| 0 | 1 | 2 | 3

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0 | -16.0 | -7.67 | -2.679 | 2.365|

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1 | -5.046 | -1.817 | None | 7.442|

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2 | 0.098 | 3.209 | 7.915 | 11.527|

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3 | 0.616 | 5.163 | 11.527 | 16.0|

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Iteration #7

| 0 | 1 | 2 | 3

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0 | -16.0 | -6.292 | -1.844 | 2.722|

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1 | -3.808 | -1.319 | None | 7.51|

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2 | 0.524 | 3.467 | 7.965 | 11.544|

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3 | 1.002 | 5.259 | 11.544 | 16.0|

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Iteration #8

| 0 | 1 | 2 | 3

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0 | -16.0 | -5.436 | -1.391 | 2.896|

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1 | -3.293 | -0.939 | None | 7.537|

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2 | 0.893 | 3.566 | 7.986 | 11.551|

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3 | 1.159 | 5.308 | 11.551 | 16.0|

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Iteration #9

| 0 | 1 | 2 | 3

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0 | -16.0 | -4.95 | -1.162 | 2.98|

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1 | -2.909 | -0.77 | None | 7.548|

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2 | 1.04 | 3.626 | 7.994 | 11.554|

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3 | 1.252 | 5.328 | 11.554 | 16.0|

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Iteration #10

| 0 | 1 | 2 | 3

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0 | -16.0 | -4.701 | -1.048 | 3.02|

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1 | -2.736 | -0.667 | None | 7.553|

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2 | 1.135 | 3.651 | 7.998 | 11.555|

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3 | 1.292 | 5.338 | 11.555 | 16.0|

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Iteration #11

| 0 | 1 | 2 | 3

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0 | -16.0 | -4.575 | -0.993 | 3.039|

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1 | -2.632 | -0.619 | None | 7.554|

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2 | 1.177 | 3.665 | 7.999 | 11.555|

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3 | 1.313 | 5.343 | 11.555 | 16.0|

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Iteration #12

| 0 | 1 | 2 | 3

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0 | -16.0 | -4.514 | -0.967 | 3.048|

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1 | -2.584 | -0.593 | None | 7.555|

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2 | 1.2 | 3.672 | 8.0 | 11.555|

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3 | 1.323 | 5.345 | 11.555 | 16.0|

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Iteration #13

| 0 | 1 | 2 | 3

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0 | -16.0 | -4.484 | -0.955 | 3.052|

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1 | -2.557 | -0.58 | None | 7.555|

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2 | 1.211 | 3.675 | 8.0 | 11.556|

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3 | 1.328 | 5.346 | 11.556 | 16.0|

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After the 13th iteration, the change from iteration #13 to iteration #12 is less than or equal to 1%, hence the algorithm quits after the 13th iteration.

The optimal policy for each state is as follows:

| 0 | 1 | 2 | 3

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0 | Bad | 4 | 4 | 2|

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1 | 2 | 2 | None | 2|

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2 | 4 | 4 | 4 | 2|

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3 | 4 | 4 | 4 | Goal|

In the above policy, ‘Bad’ and ‘Goal’ represent the two end states.

The policy # to direction mapping is as follows:-

1 -> North

2 -> South

3 -> West

4 -> East

The given start state is (3, 0).

Therefore, from the optimal policy displayed above, it is clear that the optimal path is as follows: -

(3, 0) -> (3, 1) -> (3, 2) -> (3, 3)