

The Puzzle

The puzzle consists of a grid with r rows and c columns of cells. Each cell contains exactly one integer in the range from i to j (inclusive), where i and j are positive integers. The player of the puzzle has to start in the upper-left cell (= the start cell) and move with the smallest number of actions to the lower-right cell (= the goal cell). If the player is in a cell that contains integer x , then they can perform one of at most four actions, namely either move x cells to the left (L), x cells to the right (R), x cells up (U), or x cells down (D), provided that they do not leave the grid. An example puzzle of size 5×5 is given below:

3	2	1	4	1
3	2	1	3	3
3	3	2	1	4
3	1	2	3	3
1	4	4	3	G

The shortest solution for the instance is 19 moves: R D L R U D R L R L U D L D R R U D D.

The Value Function for the Puzzle

Below are some of the features that are expected from a ‘good’ puzzle that is both challenging and entertaining.

- The puzzle has a solution.
- The puzzle has a unique shortest solution.
- The puzzle contains as few black holes (dead ends) as possible. Define a reachable cell as a cell that can be reached from the start with a sequence of actions. Define a reaching cell as a cell from

which the goal can be reached with a sequence of actions. A cell is a black hole if and only if it is a reachable, non-reaching cell.

- The puzzle contains as few white holes as possible. A cell is a white hole if and only if it is a reaching, non-reachable cell.
- The puzzle contains as few forced forward moves as possible. A forced forward move occurs when there is only one action that leaves a reachable cell.
- The puzzle contains as few forced backward moves as possible. A forced back-ward move occurs when there is only one action that reaches a reaching cell.

Using these features, I develop the following value function to evaluate a given puzzle:

- Multiply the length of a shortest solution by 5.
- Add $r \times c$ (r = number of rows, c = number of columns) points if there is a unique shortest solution.
- Subtract 2 points for each white or black hole.
- Subtract 2 points for each forced forward or backward move.
- Subtract $r \times c \times 100$ points if the puzzle does not have a solution.