The RST (Richard-Spencer-Tenniel) Project

Problem Description

(1) Suppose you are given an $m \times n$ matrix $B = (b_{ij})$ such that
- $b_{ij} \in \{0, 1, 2, 3, \ldots, R\}$
- $(i_0, j_0), (i_f, j_f) \in \{1, 2, \ldots, m\} \times \{1, 2, \ldots, n\}$
- $b_{i_0 j_0}, b_{i_f j_f} \in \{0, 1\}$

(2) The matrix B represents a battleground where a robot will start at $b_{i_0 j_0}$ and seek the goal $b_{i_f j_f}$. Further, an entry of
- 0 designates fog is not present in that position.
- 1 designates fog is present in that position.
- 2 designates a chasm in that position.
- $3, 4, 5, \ldots, R$ designates a later described obstruction.

(3) The scenario is bound by the following constraints.
- Your robot can only move in the $\binom{1}{0}$ and $\binom{0}{1}$ directions. Hence, any path from $(0, 0)$ to $(1, 1)$ has length ≥ 2.
- Upon entering an unvisited position, all adjacent cells containing fog will lose their fog designation.
- You can only reach your goal position if a (valid) fog-free path exists from the current position to the goal position.
- You cannot enter a cell containing a chasm or type-$3, 4, 5, \ldots, R$ obstruction.

(4) The robot will have the following information provided upon initialization
- The dimensions m and n
- The starting position $b_{i_0 j_0}$
- The goal position $b_{i_f j_f}$

(5) The aforementioned obstructions can be interpreted as three (not necessarily distinct) mountain ranges such that
- The values of $3, 4, 5, \ldots, R$ determine the boundaries of the minimal encapsulating set[1] containing those particular instances of $3, 4, 5, \ldots R$. That is, form the minimal encapsulating set containing 3s, the minimal encapsulating set containing 4s, and so on. The minimal encapsulating sets will occupy some non-negative quantity of cells.[2]
- The encapsulating sets may have non-empty intersection; form the union of the encapsulating sets in this case.
- In simple terms, we describe the minimal encapsulating set by imagining stretching a rubber band so that it encapsulates all of those squares filled with a 3, 4, etc. If the rubber band "holds" at least half of a given square's area, then it is considered part of the set. The exception to this is if a particular square contains a chasm. In this case, it remains a chasm.[3]

Desired Outcome(s)

A path (if it exists) from $b_{i_0 j_0}$ to $b_{i_f j_f}$.

Aesthetics

- You should display a graphical representation of the "map" and the traversal of the map by the robot as it decides upon its path.

Intended Representation

1	1	0	1	1	1	1	1	0
0	1	4	1	2	4	1	1	1
1	1	1	2	1	1	4	1	1
1	2	2	4	1	1	1	1	2
1	1	1	1	3	1	1	1	2
0	1	1	1	1	1	3	1	1
0	1	3	1	1	2	1	1	1
1	0	2	0	1	2	1	1	1

$\longrightarrow$

1	1	0	1	1	1	1	1	0
0	1	4	1	2	4	1	1	1
1	1	1	2	1	1	4	1	1
1	2	2	4	1	1	1	1	2
1	1	1	1	3	1	1	1	2
0	1	1	1	1	1	3	1	1
0	1	3	1	1	2	1	1	1
1	0	2	0	1	2	1	1	1

$\longrightarrow$

1	1	0	1	1	1	1	1	0
0	1	4	4	4	4	4	1	1
1	1	4	4	4	4	4	1	1
1	2	2	4	4	4	1	1	2
1	1	1	3	3	3	1	1	2
0	1	3	3	3	3	3	1	1
0	1	3	3	3	2	1	1	1
1	0	2	0	1	2	1	1	1

[1]This is related to the convex hull, but the encapsulating set is not necessarily convex per the forthcoming conventions.
[2]Note there could be zero instances of $3, 4, \ldots, R$.
[3]This clearly has no impact on the solution.