

## Problem 3

1.) Empirically, after 3 trials of up to 100 iterations, there is not much improvement per iteration. It doesn't always select a cell that is part of the goal path and therefore doesn't always improve the difficulty of the puzzle. Sometimes, and therefore more likely with more iterations, it does choose a goal-path cell and therefore makes the puzzle more difficult. Generally, it does not improve the puzzle.

Terminal Output:

```
~~~Problem #3 Data Trials~~~  
~~~~~Trial 1~~~~~  
0 better for: 20 iterations.  
0 better for: 20 iterations.  
0 better for: 30 iterations.  
0 better for: 40 iterations.  
0 better for: 50 iterations.  
0 better for: 60 iterations.  
0 better for: 70 iterations.  
0 better for: 80 iterations.  
-1 better for: 90 iterations.  
0 better for: 100 iterations.  
~~~~~Trial 2~~~~~  
-1 better for: 10 iterations.  
0 better for: 20 iterations.  
0 better for: 30 iterations.  
0 better for: 40 iterations.  
0 better for: 50 iterations.  
0 better for: 60 iterations.  
0 better for: 70 iterations.  
0 better for: 80 iterations.  
0 better for: 90 iterations.  
0 better for: 100 iterations.  
~~~~~Trial 3~~~~~  
0 better for: 10 iterations.  
0 better for: 20 iterations.  
0 better for: 30 iterations.  
0 better for: 40 iterations.  
-2 better for: 50 iterations.  
0 better for: 60 iterations.  
0 better for: 70 iterations.  
0 better for: 80 iterations.  
0 better for: 90 iterations.  
0 better for: 100 iterations.
```

2.) Sideways moves are a good thing because it doesn't change the evaluation, but allows it to benefit from any beneficial moves that may be in a sideways move as well.

## Problem 4

1.) After running trials on restarts less than or equal to 10, better mazes are really not yielded. However, after restarts go into the 10s and up to 100, mazes become much better, sometimes getting a solution, where there was none initially. Though 6 and 8 restarts found solutions where there wasn't initially, restarts over 10 consistently provided better mazes.

Terminal output:

```
~~~Problem #4 Data Trial~~~
~~~~~Trial 1~~~~~
0 better for: 1 restarts.
0 better for: 2 restarts.
0 better for: 3 restarts.
0 better for: 4 restarts.
0 better for: 5 restarts.
-1000004 better for: 6 restarts.
0 better for: 7 restarts.
-1000005 better for: 8 restarts.
0 better for: 9 restarts.
0 better for: 10 restarts.
~~~~~Trial 2~~~~~
0 better for: 10 restarts.
0 better for: 20 restarts.
-2 better for: 30 restarts.
-3 better for: 40 restarts.
-1000006 better for: 50 restarts.
-3 better for: 60 restarts.
-4 better for: 70 restarts.
-3 better for: 80 restarts.
0 better for: 90 restarts.
-2 better for: 100 restarts.
```

2.) For all iteration constraints, it is better to do a single descent for all iterations where the likelihood of reaching the local maxima is low or you know that there aren't any. It is also good to not restart when you just need a solution and there is a lot of states where it is not reasonable to re-search the space.

## Problem 5

1.) Trial 1 entailed more iterations, with a constant probability, where trial 2 entailed a constant iteration count and varying probability. It yielded that the more iteration trials performed, the better the mazes that were generated were. Higher probability did not necessarily increase the difficulty of the maze.

```

~~~Problem #5 Data Trial~~~
~~~~~Trial 1~~~~~
0 better for: 10 iterations | prob: 0.2
-1 better for: 20 iterations | prob: 0.2
-3 better for: 30 iterations | prob: 0.2
0 better for: 40 iterations | prob: 0.2
-1000003 better for: 50 iterations | prob: 0.2
0 better for: 60 iterations | prob: 0.2
0 better for: 70 iterations | prob: 0.2
-1 better for: 80 iterations | prob: 0.2
0 better for: 90 iterations | prob: 0.2
0 better for: 100 iterations | prob: 0.2
~~~~~Trial 2~~~~~
0 better for: 50 iterations | prob: 0.05
0 better for: 50 iterations | prob: 0.1
-1000005 better for: 50 iterations | prob: 0.15
0 better for: 50 iterations | prob: 0.2
0 better for: 50 iterations | prob: 0.25
0 better for: 50 iterations | prob: 0.3
1 better for: 50 iterations | prob: 0.35
0 better for: 50 iterations | prob: 0.4
-2 better for: 50 iterations | prob: 0.45
0 better for: 50 iterations | prob: 0.5

```

2.) The probability is not necessarily the same because though you may be taking an uphill step, you may not be escaping a local minima, and therefore the probability of taking an uphill step is higher than the probability of escaping a local minima.