1.1

1) NM

2) 8

3) The Manhattan distance is not admissible, because this heuristic fails to take into account the ability for Schroedinger's cat to occasionally go diagonally at the same cost as cardinally. This causes an overestimation of diagonal moves.

For example, consider the state (0, 0), with the possibility of moving to (1, 1), where (1, 1) is the goal state. The Manhattan Distance incorrectly estimates that this state would take 2 actions to reach the goal, when in reality, it would only be 1.

The end result of using this heuristic is that Schroedinger's cat will always choose cardinal moves first, even when better diagonal options exist.

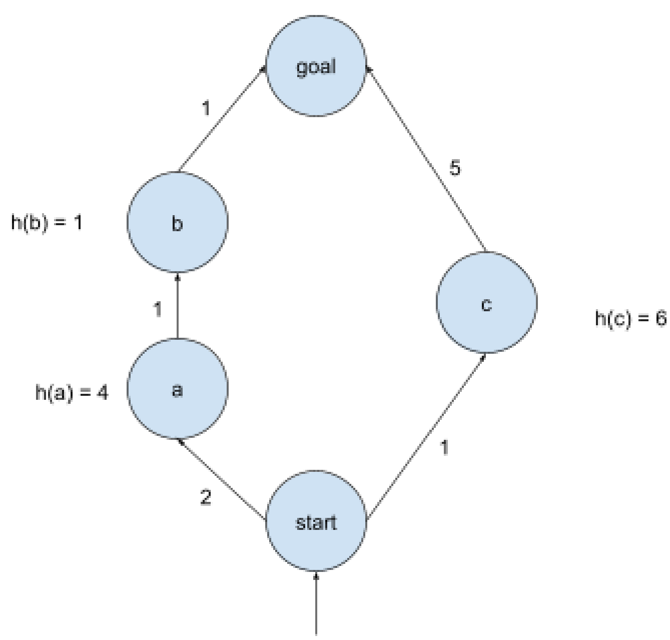
4) Similarly, a Euclidean heuristic will weight a diagonal move from (0, 0) to (1, 1) as sqrt(2), even though this only takes 1 action, thus overestimating the cost of diagonal moves.

5) The diagonal distance heuristic is defined as c(max(∣n.x−goal.x∣,∣n.y−goal.y∣)) works well for this problem, because it allows the program to consider diagonal and cardinal moves equally.

With the diagonal distance heuristic, moving from either (0, 0) or (1, 0) to (1,1) returns 1, which is consistent with the number of actions that Schroedinger's cat would take from either starting point to the goal of (1, 1)

It may occasionally underestimate the benefits of making diagonal moves, but that does not break admissibility.

6) h(n) = exact weight of shortest path from n to goal node + weight of current node to n



It can be seen that 3 = h(a) - h(b) > w(a, b) = 1, but we know the least-cost path will always be chosen by definition of the heuristic.

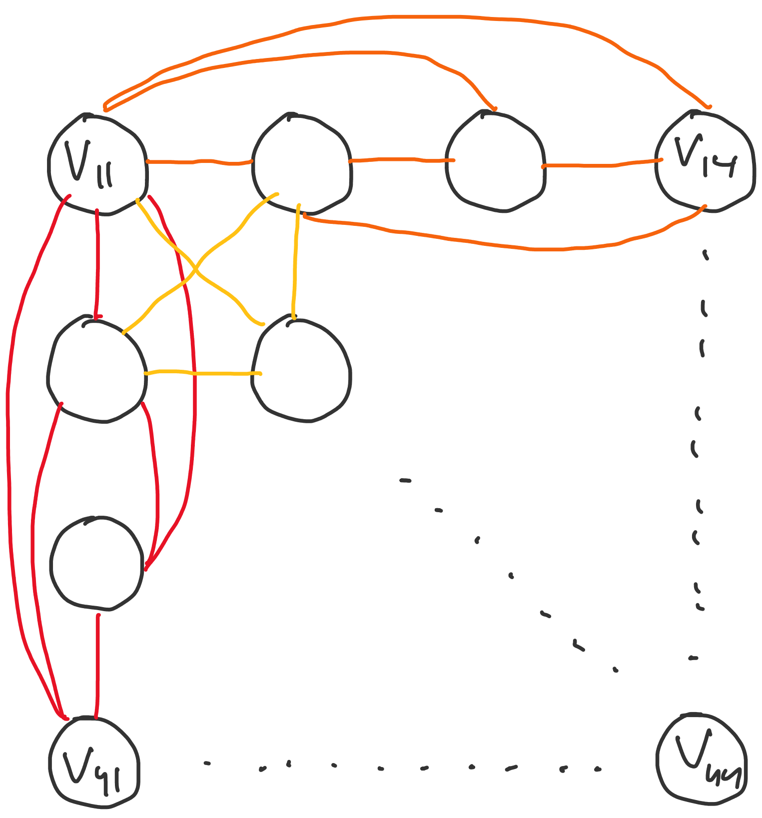
A1 Q1.2

Monday, January 13, 2025 7:33 PM

1.2

1. Variables: $V_{11}, V_{12}, \ldots, V_{44}$ → 16 variables, each square is a variable
   Domain: $\{1, 2, 3, 4\}$
2. Constraints:
   - No 2 squares in the same row can have the same value.
   - No 2 squares in the same column can have the same value.
   - No 2 squares in the same quadrant can have the same value

   1 type of constraint (binary) and 3 constraints of this type

3. 

4.

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

5.

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

By the ordering heuristic, the first variables that will be assigned are $V_{12} = 2$, $V_{13} = 4$, $V_{21} = 3$, $V_{24} = 1$, $V_{31} = 2$, $V_{43} = 1$, and $V_{44} = 2$ since all these variables have only 1 possible value based on the initial state.

6.

1	2		3
4		2	
	1		4
	3		

For variable V_{22}, the solver will remove 2 from the list of possible values, and for variables V_{31}, V_{41}, the solver will remove 4 from the list of possible values. Since it is no longer possible to assign 4 to any variable in the lower-left quadrant w/o violating any constraints and ∴ 4 must be assigned to one of those squares to find a sol^n, the solver will backtrack.