CS404 - ASSIGNMENT 2

Berkay Barış Turan - 28132

April 2023

Answers

I have created a dictionary of $(n-1) \times (n-1)$ for each is assigned to a grid. CSP model components are defined as follows:

- **Variables:** In total $(n-1) \times (n-1)$ variables in the model.
- **Domains:** A grid can have either '/' or '
  '. In the model I donated these domains as '/' as 1 and '
  ' as 0, so the domain is binary numbers.
- **Assignment:** Assigning binary numbers (i.e., 0 or 1) to a grid which does not violate any constraint.
- **Constraints:**
  - The number inside each circle is exactly the number of diagonal lines that intersect at that circle. I formulated this constraint by separating it into 3 cases:
    - Corner Cases: Checking only one grid/variables.
    - Edge Cases: Checking only two grid/variables.
    - Middle Cases: Checking all of the adjacent (i.e., four) grid/variables.
  - The diagonal lines do not form a loop.

  Puzzle Instances Levels:

  - We have to bare in mind some key points before deciding difficulty levels. There are some constraints that makes a puzzle more solvable (i.e., in fallowing cases it is obvious how to put a slant in which orientation. Additionally, I concluded these observations via analysing the puzzles provided in the website https://www.puzzle-slant.com/):
    - Having a 4,
    - Having an edge/corner 0,
    - Having an edge 2,

Slunt Puzzle CSP Model Observations						
Instance	**Level**	**# of Variables**	**# of Constraints**	**# of Choices**	**CPU Time**	**# of Bra**
Basic1	Basic	25	15	4	0.01826	10
Basic2	Basic	25	16	4	0.01343	10
Basic3	Basic	25	12	8	0.03192	20
Basic4	Basic	25	14	1	0.01884	0
Basic5	Basic	25	14	2	0.01816	5
Normal1	Normal	25	15	4	0.05091	12
Normal2	Normal	25	13	2	0.03084	7
Normal3	Normal	25	14	2	0.0297	5
Normal4	Normal	25	12	2	0.01217	3
Normal5	Normal	25	17	2	0.01952	5
Difficult1	Difficult	25	11	8	0.08705	22
Difficult2	Difficult	25	14	2	0.02926	11
Difficult3	Difficult	25	13	3	0.09123	27
Difficult4	Difficult	25	12	2	0.03210	5
Difficult5	Difficult	25	13	14	0.17452	86

        * Having an edge/corner 1.

    - Easy: Having corner cases in the puzzle. (Corner cases are easy to assign value because need only one variable check.)
    - Middle: Having edge cases in the puzzle, but not corner cases. (Edge cases are easy, but not as much as corner cases because need only two variable checks.)
    - Difficult: Only having middle cases in the puzzle.

CSP is more appropriate for solving this puzzle in comparison to A*. Because we have to consider a lot of constraints while trying to find to legal solution satisfying all of the constraints, if there exists. While trying to find a state satisfying constraints, A* algortihm have to keep track of all of the states leading to the current state which is inefficient in terms of time and space complexity of it. On the other hands, CSP algorithm just keeps track of 1 state, and performing other operations by assigning possible values existing in the domain.