Report Assignment 2
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1- Give the representation of a solution (answer) of the problem.

$$X = \begin{Bmatrix} X_{1,1} \ldots X_{1,j} \ldots X_{1,m} \\ X_{i,1} \ldots X_{i,j} \ldots X_{i,m} \\ X_{m,1} \ldots X_{m,j} \ldots X_{m,m} \end{Bmatrix}$$

- (i) represents each row.
- (j) represents each column.
- (m) is equal to 9 which is the size of the sudoku grid.
- Domain of each Xi,j is {1, 2, 3, 4, 5, 6, 7, 8, 9}

2- Give the equation for the restriction(s) of the problem

- This equation ensure that no two cells in the same row have the same value
  - Xi,j != Xi,k for all k=1 to 9 and j != k
- This equation ensure that no two cells in the same column have the same value
  - Xi,j != Xk,j for all k=1 to 9 and i != k
- This equation ensure that no two cells in the same small grid(3x3) have the same value
  - Xi,j != Xp,k for all p,k such that (i,j) and (p,k) belong to the same 3x3 mini-grid and (i,j) != (p,k)

3- What is considered as a state? In addition, explain why.

- The state is the grid of the sudoku game.The grid representation allows us to apply the row, column, and 3x3 grid constraint to the Sudoku problem

4- Which is the initial state? In addition, explain why.

- The initial state is a grid which is partially filled with numbers and the algorithm job is to complete the grid. The grid representation allows us to apply the row, column, and 3x3 grid constraint to the Sudoku problem

5- Which is/are the possible action(s)? In addition, explain why.

- The possible actions in the algorithm is to select an empty cell of the Sudoku grid and assign a number to it based on the constraints of the game. And if the number assigned to the empty cell is later discovered as an invalid solution the algorithm backtracks and tries another number. The algorithm continues to assign numbers to the empty cells until a valid solution is found or all possible combinations have been used.

6- What is the maximum branching factor of the tree (b)? In addition, explain why.

- The maximum branching factor of the tree is 9. The branching factor depends on the number of possible actions. If a cell is empty and its corresponding row, column, and mini-grid are empty then the branching factor for that cell would be 9, as any of those values could potentially be placed in that cell.

7- What is the maximum depth of the search tree (m)? In addition, explain why.

- The maximum depth of the tree is 81. This is because the Sudoku board contains 81 cells, and in the worst-case scenario, all of them can be empty. However, in practice, it is highly unlikely that all the cells of the board will be empty. The depth factor depends on the number of empty cells.