Introduction to Artificial Intelligence Course 67842

Final Project

Project Group

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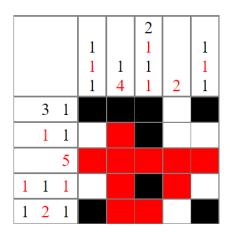Adam Sarsour – adam.m.s – 208005884

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- **What problem are you going to solve?**

  The problem we want to solve is Duo Color Nonogram (NP-Complete Problem), in which we want to create an AI agent that can find the optimal solution for the Duo Color Nonogram game (DCN) with the least possible time.

  Nonogram are picture logic puzzles in which cells in a grid must be colored or left blank (white) according to numbers at the side of the grid.

  This is an upgraded version of the Nonogram (Due Color Nonogram), between each two constraints in the same color we must leave a blank cell and between each two constraints that has not the same color there is no need (we can leave a blank cell or not), we added another color besides the black -and white-, so for example:

- **How are you going to solve it?**

  We think that the best way to solve this problem is by using **Constraint Satisfaction Problems (CSP),** as we will use different heuristics for the backtracking mechanism.

  The heuristics we will try for CSP are: Minimum Remaining Values (MRV), Degree Heuristic, Least Constraining Value (LCV), Forward Chaining (Checking) and Arc Consistency.

  And finally, we will compare the results by using these algorithms: BFS, DFS, A* and local search.

- **Why do you think that your approach is the right one?**
  The board is limited in our game, in particular, the columns and rows are finite, which means we have finite set of cells, that we can describe each cell as a variable, so we have finite number of variables, which corresponds to the definition of the CSP.
  We also have in the margins, numbers which would tell us the color and number of cells we are going to fill, and if we didn't fulfill these rules, then it won't work, which this could be a finite set of constrains as the definition of the CSP says.

  Lastly, for each cell, we will have three colors, which means that, there is a function that maps for each cell (variable) a value (colors), as mentioned in the CSP's definition.

  We think that the LCV heuristic will be more beneficial than others if the constraints will fill most of the column/row, for example if we have 5x5 board, and we have several constraints like 4 and 5 in the columns/rows, because it will go the fill these columns/rows immediately.

  We think that the Forward Chaining will be more beneficial than other heuristics if we have more contradictions between the columns constrains and rows constrains.

- **How are you going to test your results?**
  We will generate different board sizes and compare the running time and the number of backtracks taken to solve problem (for the valid solutions).

  We will compare the results of the heuristics with BFS, DFS, A* and local search, by the number of the expanded nodes of each algorithm.