Lab Report

1. Explain how Backtracking is an improvement on the Depth-First Search Algorithm.

There are two main reasons why backtracking is an improvement on the depth first search algorithm. The first reason is that the depth first search has to go back up to the top of the tree each time it reaches a point where there are no solutions. The other reason that it is less useful is because of constraint propagation. Depth-First will keep searching a branch that is not viable whereas backtracking will prune a branch so that it does not have to keep searching an inviable branch.

2. Explain the idea of propagating constraints and the need for “un-propagating” the constraints in this algorithm.

Propagating the constraint means that a new constraint is added so that an answer can be found without violating a rule. If a move was made and from that point the problem cannot move forward without violating a constraint and the problem has not been solved backtracking must be done. The constraint added at the previous step needs to be removed because it is no longer relevant. A good example of this can be seen in sudoku. Assuming that you put the number one in a box you would have to remove one as a possibility in the row column and box that are associated with that one choice. If you were to figure out that one is not a good option for that box you would have to put one back as an option in all of the boxes were it was removed. This is how a genetic algorithm is able to search a particular branch without having to search an entire branch a second time like in a depth first search.

3. Consider the Sudoku problem, and describe is as a CSP. If you don’t know how to play Sudoku, see https://en.wikipedia.org/wiki/Sudoku.

Variable - the placement of a non-repeating number within a row i.

Column Constraint – a number of the same value can not be placed in the same column j as the number placed in row i.

Box Constraint – Each sub box of the main board is of size square root of the total number of rows by the square root of the total number of columns wide. A number of the same value cannot exist within the same sub box.

Domain- The domain is any value between 1 and the total number of rows i.e. if there are 9 rows the domain would be between 1 and 9.

When a number is placed on the board it becomes a constraint in all other boxes, columns, and rows that are associated with it. The board comes equip with default numbers. The default numbers can be used as a constraint to narrow down the possible values a box can take. When a box is limited to one possible value that box’s value can then become a constraint that is then propagated. This happens over and over again until the puzzle is solved.

4. Explain the benefits and drawbacks of using Backtracking Search to solve Sudoku.

One number has a large rippling effect on the entire board. Any wrong decision made during the sudoku problem leads to a lot of possible backtracking. The more boxes the puzzle has the more this becomes an issue. It would be helpful to look ahead in this context so that a more informed decision can be made. If look forward propagation were used with backtracking it would lend itself better to the sudoku problem.

Submission

Submit lab4.py, and the lab report, lab4.docx to the dropbox on D2L by Monday, February 19 at 11:59pm. The rubric