Artificial Intelligence LAB 2 Constraint Satisfaction Problem

Warmup Exercise : Latin Square

1. Introduction

The aim of the task was to become acquainted with the basic algorithms used to solve problems complying with restrictions (called Constraint Satisfaction Problem, CSP), by working on implementation and examining their properties of the problem.

2. Definition of CSP in Latin Square

- Each square in the N X N square is defined as variables , for eg for 3X3 there are 9 variables defined.
- Domain is the number 1-N .
- Constraints : Only one occurrence of a number in each row, column and unit.

3. Approach to the Problem

3.1. Backtracking search

- Depth First Search method , each step determines the value of one variable.
- the order of the variable assigned is determined.
- If the determination of the next variable is not feasible without breaking referential returns then we withdraw some assignments of the variables.

3.2. Forward Searching

The new proposed variable is compared with the values of variables not yet considered. It eliminates variables that do not meet the limitations of all domains with which the given variable connects. If any of the areas remain empty, then this value should be rejected. If all values of a given variable are rejected, the algorithm returns.

4. Analysis

4.1 Latin Square

The dependency of the time (ms) algorithm to the size of the problem, for the square.

N	1-3	4	5
BT	3,19	85	19019
FC	0	16	2645

It was noted that Forward search is a faster way to find all the solutions. Backward check was quite slow as it took a lot of operations.

The dependence of the number of nodes visited by the algorithm, the size of the problem,

N	1	2	3	4	5
BT	2	15	247	20421	10764431
FC	2	9	94	5585	2178805

It was noted that **the algorithm for backward check** visits much more nodes than forward check algorithm.

Output is as follows :

Found this solution

[1][2]

[2][1]

For size: 2

BACKTRACK CHECKING

Time is: 0.0ms

Operations: 15

FORWARD CHECKING

Time is: 0.0ms

Operations: 9

Found this solution

[1][2][3]

[2][3][1]

[3][1][2]

For size: 3

BACKTRACK CHECKING

Time is: 12.0ms

Operations: 247

FORWARD CHECKING

Time is: 10.0ms

Operations: 94

6. Conclusion

Forward Search was better than Backward search in the case of a Latin Square as it visited less no of nodes and took less time . It was a faster way to generate a latin square.