

* Title: Constraint Satisfaction Problem.

* Problem statement: Implement 8-queens problem or n-queens or graph colouring problem using Backtracking and Branch-and-Bound.

* Objective: To learn and implement Constraint Satisfaction problem.

* Outcome: Student will be able to implement Constraint satisfaction problem.

* Software & Hardware apparatus:

Operating System:- 64 bit Windows or Linux.

programming language: python or Java.

Mouse, keyboard, Computer.

* Theory:-

Constraint Satisfaction problem consists of a set of variables, a domain for each variable & a set of constraints.

The aim is to choose a value for each variable so that the resulting possible world satisfies the constraints, we want a model of the constraints.

A finite CSP has a finite set of variables and a finite domain for each variable. Many of the methods considered in this chapter only work for finite CSP's although some are designed for

infinite, even, Continuous domains.

Given CSP there are a number of tasks that can be performed:

1. Determine whether or not there is a model.
2. Find a model.
3. Find all of the models or enumerate the models.
4. Count the number of models.
5. Find the best model, given a measure of how good models are.
6. Determine whether some statement holds in all models.

* Backtracking:

Backtracking is an algorithmic technique for solving problems recursively by trying to build a solution incrementally, one piece at a time, removing those solutions that fail to satisfy the constraints of the problem at any point of time.

Some types of problems in backtracking:-

1. Decision problem:-

We search for a feasible solution.

2. Optimization problem:-

We search for the best solution.

3. Enumeration problem:-

We find all feasible solution.

* Branch & Bound:

Used to find optimal solution to many optimization problems, especially in discrete and combinations optimization. Systematic enumeration of all candidate solution, discarding large subsets of fewer candidates by using upper and lower estimated bounds of quantity being optimized.

* Terminology:-

Live node: Is a node that has been generated but whose children have not yet been generated. E-node: is a live node whose children are currently being explored.

Dead-node: is a generated node that is not expanded or explored further.

Branch and Bound is the method of state space search in which all children of E-node are generated first.

* Test Cases:-

N-queens using Backtracking.

0	0	1	0
1	0	0	0
0	0	0	1
0	1	0	0

N-queens using Branch & Bound.

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1 0 0 0 0 0 0 0
0 0 0 0 0 0 1 0
0 0 0 0 1 0 0 0
0 0 0 0 0 0 0 1
0 1 0 0 0 0 0 0
0 0 0 1 0 0 0 0
0 0 0 0 0 0 1 0
0 0 1 0 0 0 0 0
  
```

Conclusion:-

N-queens problem using Backtracking and Branch and Bound is solved and Constraint Satisfaction problem implemented.