**Problem 5.1** Three Rooks on a Small Board

**Answer:**

The model of the three rooks on a chessboard as a constraint satisfaction problem is given below,

1. **Set of Variables :**

Let,

variables represent the coordinates (row & column) of 1st rook in chessboard, similarly,

variables represent the coordinates of 2nd rook in chessboard, and

variables represent the coordinates of 3rd rook in chessboard

Therefore, set of variables for this problem,

1. **Domain:** Since, the chessboard’s dimension is ,

for rows:

for columns:

1. **Constraints:** In a chessboard rooks can move horizontally and vertically as far as they like, then they will not threaten each other, if and only if, their row and column values can not be the same.

Therefore, constraints will be as follows,

1. Finally, the assignment of , , and will correspond to the coordinates of the squares of rooks in the chessboard.

**Problem 5.2** CSP as a Search Problem

**Answer:**

According to the problem description, a binary CSP with,

* Set of variables,
* Domains,
* Constrains, , where is the dual of

Therefore,

* Constraint network,
* Variable assignment , if for all

The search problem corresponding to is defined below:

* **States:** For CSP state are variable assignments. Therefore, states set,
* **Initial State:** Initial state is empty assignment . So,
* **Goal State:** Goal state means the solution of CSP which is a consistent total assignment. So,
* **Actions:** Action will be the extension of current assignment , let’s say extension of is , So,
* **Transition model:** For CSP, Transition model will be the next successful assignment via backtracking.

**Problem 5.3** Basic Definitions

**Answer:**

According to the problem description,

**Assignment of variables:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | c | d |  |  |  |  |  | Partial (P) or Total (T) | Consistent or Inconsistent | Solution |
| F | - | - | - | F | T | T | T | T | P | IC | No |
| \*\*\* | | | | | | | | | P | IC | No |
| F | 0 | 0 | 0 | F | F | T | F | T | T | IC | No |
| \*\*\* | | | | | | | | | T | IC | No |
| T | - | - | - | T | T | T | T | T | P | C | No |
| T | 0 | - | - | T | T | T | T | T | P | C | No |
| T | 1 | - | - | T | T | T | T | T | P | C | No |
| T | 2 | - | - | T | T | T | T | T | P | C | No |
| T | 3 | - | - | F | T | T | T | T | P | IC | No |
| \*\*\* | | | | | | | | | P | C/IC | No |
| T | 0 | 0 | 0 | T | T | T | F | T | T | IC | No |
| T | 0 | 0 | 1 | T | T | T | F | F | T | IC | No |
| \*\*\* | | | | | | | | | T | IC | No |
| T | 1 | 0 | 0 | T | T | T | T | T | T | C | Yes |
| T | 1 | 0 | 1 | T | T | T | F | F | T | IC | No |
| \*\*\* | | | | | | | | | T | IC | No |
| T | 2 | 0 | 0 | T | T | T | T | T | T | C | Yes |
| T | 2 | 0 | 1 | T | T | T | T | F | T | IC | No |
| \*\*\* | | | | | | | | | T | IC | No |
| T | 2 | 1 | 0 | T | T | T | T | F | T | IC | No |
| T | 2 | 1 | 1 | T | T | T | T | F | T | IC | No |
| \*\*\* | | | | | | | | | T | IC | No |

According to the above table,

1. All solutions:
2. An inconsistent total assignment:
3. All consistent partial assignment such that :