

1. Formulate 3SAT to CSP

The variables are the boolean variables in X . The domain of each variable is $[0, 1]$, with 0 representing false and 1 representing true.

Each clause is represented in a constraint, where at least one variable in its scope must have a value of 1. This is because a clause is a disjunction of literals, so a clause is true when one literal is true.

A 3SAT sentence is the actual CSP problem itself. Every clause (constraint) must be true (satisfied) in order for the sentence (problem) to be true (has a solution).

3SAT question can be converted into a CSP by representing each boolean variable as a CSP variable with domain of $[0, 1]$, representing false and true, respectively.

The constraint relations can be made for an arity of 1, 2, and 3 with every tuple possible where at least one of the elements is 1.

Each clause (disjunction of literals) can be converted into a constraint with the scope as the literal and the relation is one described above with the correct arity.

If 3SAT had a solution, this means there are booleans values assigned to every variable such that the sentence is true.

Since a sentence is a conjunction of clauses, the solution represents that each clause must be true.

This can be translated into each constraint is satisfied by the assigned value to the variables.

Thus, the CSP has a solution that corresponds to the 3SAT solution.

2. The arity of the constraint must be 1, 2, or 3.

3. Reduction

Variables (each have domain of $[0, 1]$):

c1

c2

c3

c4

c5

Constraints:

1:

Scope: c1, c2, c3

Type: Conflicts

Tuples: [(0, 0, 0)]

Arity: 3

2:

Scope: c2, c3, c4

Type: Conflicts

Tuples: [(0, 0, 0)]

Arity: 3

3:

Scope: c_1, c_5

Type: Conflicts

Tuples: $[(1, 0)]$

Arity: 2

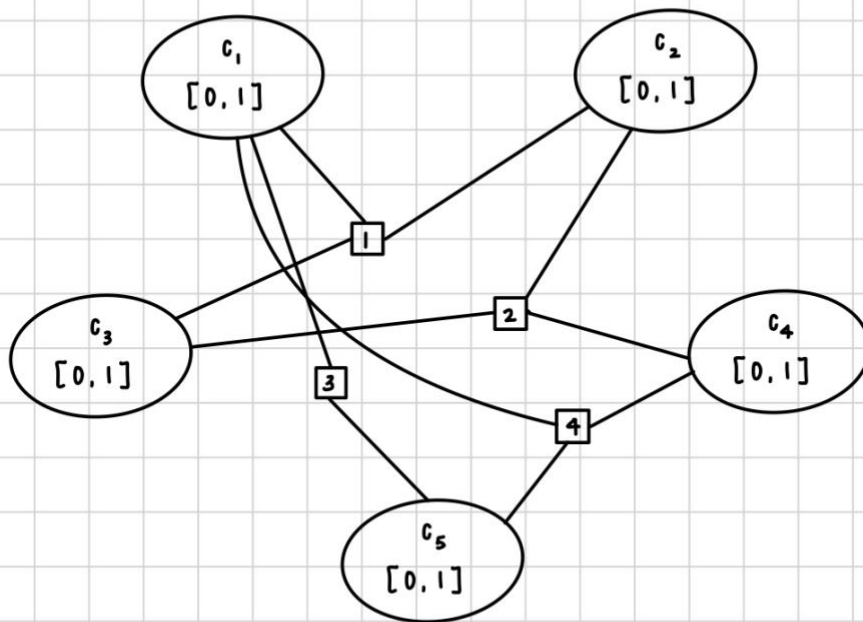
4:

Scope: c_1, c_4, c_5

Type: Conflicts

Tuples: $[(0, 0, 0)]$

Arity: 3



4. It can be represented in a similar way.

The variables and its domain would be the same (the boolean variables with domain of $[0, 1]$).

The constraint relations can include arity of the length of clauses in the SAT sentence.

The relation itself would allow tuples of arity needed where at least one element of the tuple is 1 or not allow tuples where it is all 0.

If there are literals that are negated, it can be slightly modified so that the position of that literal can be flipped.