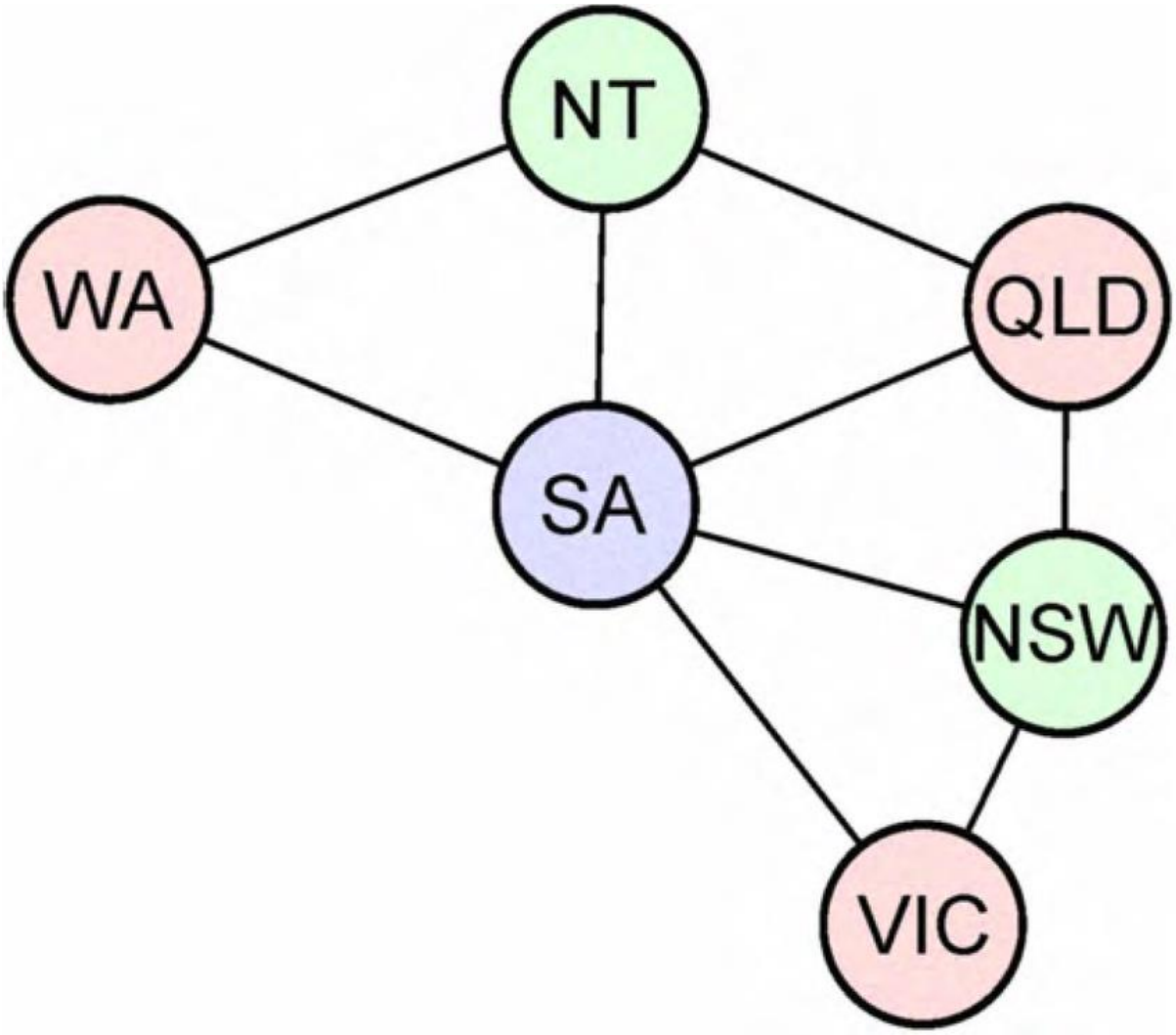
Constraint Satisfaction Problem

Artificial Intelligence Assignment (CS323)



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Problem Statement

To find a suitable assignment of colours to the cities on a map with given number of colours using the following algorithms and comparing the time:

1. Backtrack search

2. Backtrack with forward checking search

3. Backtrack with MAC search

4. Local Search - Min Conflicts

Finding a suitable assignment means that no two cities which are adjacent should be assigned the same colour.

Heuristics

The heuristics used, while applying the algorithms were:

1. **Minimum Remaining Values**: While selecting an unassigned variable to assign a colour, we should choose the variable with minimum number of legal values i.e. variable with minimum values in its domain. Also known as Maximum Constraining Variable, this function picks a variable that is most likely to cause a failure soon, thereby pruning the search tree.

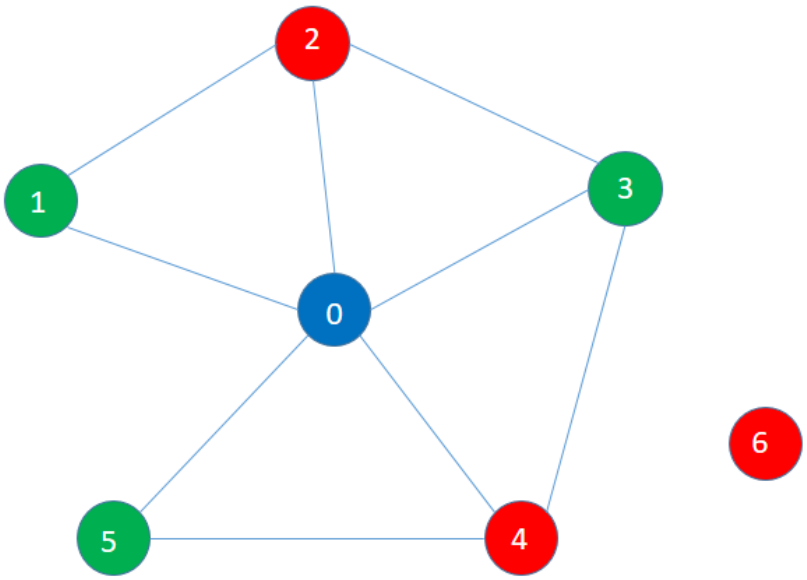
2. **Degree Heuristics**: This heuristic is applied if we have multiple variables having same domain size. It tries to reduce the branching factor on future choices by selecting the variable that is involved in the maximum number of constraints on other unassigned variables.

3. **Least Constraining Value**: Once a variable has been selected, the algorithm must decide on the order in which to examine its values. This heuristic prefers the value that rules out the fewest choices for the neighbouring variables in the constraint graph. It tries to leave the maximum flexibility for subsequent variable assignments.

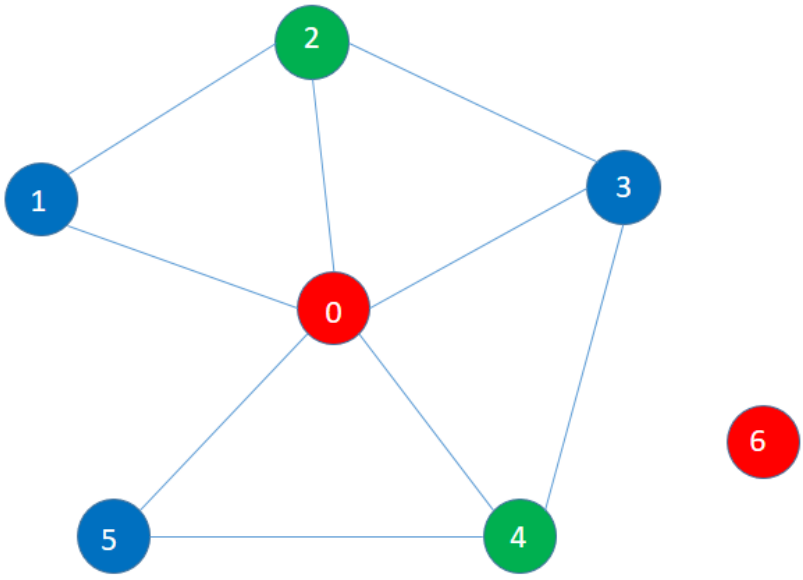
Conclusion

After running multiple iterations of different algorithms on the Constraint Satisfaction Problem, we reach to the conclusion that Local Search – Min Conflicts is generally the fastest one, if it reaches the solution in defined number of steps.

In some cases, where Local Search is unable to find the assignment in limited number of steps, then Backtrack with forward checking is the fastest followed by Backtrack with MAC.



Backtrack Search



Local Search

Algorithm	Average time taken (msec)
Backtrack	0.51
Backtrack with Forward check	0.45
Backtrack with MAC	0.47
Local Search	0.2