WRITTEN ASSIGNMENT 1

Q1. [10 points] Negative costs in Search. Do Problem 3.8 from AIMA 3rd Edition.

Q2. [10 points] Symmetries in CSPs. Several kinds of symmetries are exploited in constraint satisfaction problems to reduce the size of the search space. This happens in two steps. First we recognize that two or more states represent the same structure in the problem, and hence will behave similarly (i.e., will either both have a solution or both won't have a solution). As an example, consider a 7-queens representation of the problem where Xi represents the location of queen in the i^{th} column. The board configuration B=(X1,...,X7) is symmetric to configuration Bv=(X7,...,X1) because Bv is a mirror image of B1 along the vertical axis.

One way to break this symmetry we need to add constraint(s) so that only one of the symmetric configurations will be explored by the algorithm. For example, in the previous example we can add an additional “global” constraint X1<=X7. Verify that this constraint allows it to break configurations symmetric along the vertical axis. In this question consider a similar symmetry along the horizontal axis of the board. Give an algebraic representation of the configuration (Bh) that is symmetric along horizontal axis if B is (X1,...,X7). Add constraint(s) so that only one of B and Bh are explored by the CSP algorithm. Are any other symmetries present in 7-queens?

(Extra Credit): Symmetries can also be dynamic. After a value assignment new symmetries may become valid. Suppose the first queen we place is X1=1. Are there new symmetries present in the problem? How about if the first queen is X4=1?

Q3. [20 points] Transform the Australian map coloring problem (with 3 colors) as an instance of a SAT problem. Define your variables and list all (types of) clauses. The SAT problem should be such that if the map coloring is solvable then the solution of SAT can be converted into a feasible coloring. And if the map coloring is not solvable, then your SAT formula is also not satisfiable.