Recitation

1 Simple scheduling problem

Courtesy of Rina Dechter

Consider the problem of scheduling five tasks: T_1, T_2, T_3, T_4, and T_5, each of which takes one hour to complete. The tasks may start at 1:00, 2:00, 3:00. Any number of tasks can be executed simultaneously provided the following restrictions are satisfied.

- T_1 must start after T_3.
- T_3 must start before T_4 and after T_5.
- T_2 cannot execute at the same time as T_1.
- T_2 cannot execute at the same time as T_4.
- T_4 cannot start at 2:00.

1. Formulate the problem as a CSP by stating: the variables, their domain, and the applicable constraints.
   Hints: focus on the start time of a task.
2. Draw the constraint graph.
3. Apply arc-consistency to each constraint in the CSP until no values can be ruled out (i.e., the CSP becomes arc-consistent).

2 N-Queen Problem as a CSP

Consider the 4-queens problem where each queen is associated with a row and can be assigned to any column in the row.

1. Define this problem as a CSP. Specify the variables and their domain, and each binary constraint by 'extension.'
2. Define a binary constraint C_{Q_i,Q_j} between two variables Q_i and Q_j by 'intension.'
3. What is the size of this CSP (which is the size of the search tree it may yield)?
4. Draw the constraint graph.

5. Arc-consistency of a binary constraint C_{Q_i,Q_j} between two variables Q_i and Q_j ensures that every value for the variable Q_i has a support (at least one consistent value) in the domain of Q_j and vice-versa. Run manually arc-consistency on the 4-Queens problem. Can you remove any value? At the end of the operation the CSP is said to be arc-consistent.

6. Arc-consistency is also called 2-consistency because it considers all combinations of two variables at the same time. Let's consider all combinations of 3 variables at the same time and let's check whether or not every value in the domain of a given variable has a support in the domain of the two other variables (simultaneously). If it does not, the value can be removed. Can you remove any value? This consistency property is called (1,2)-consistency.