T-79.4201 **Autumn 2007**
Search Problems and Algorithms
Tutorial 5, 18 October
Problems

1. Give all solutions to the following constraint satisfaction problem (CSP)

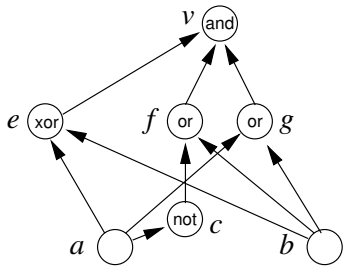
$$\langle \{C_1(z,y), C_1(y,x), C_1(x,z)\};$$
$$x \in \{1,2,3\}, y \in \{1,2,3\}, z \in \{1,2,3\}\rangle$$

   where $C_1 = \{(1,3),(1,2),(1,1),(2,3),(2,2),(3,3)\}$

2. Encode the SET COVER problem as a constraint satisfaction problem (CSP).

3. Encode the TSP optimization problem as a constrained optimization problem.

4. a) Give a propositional formula that expresses the Boolean function that the circuit below computes.



   b) Give a propositional formula in CNF that expresses the Boolean function

   i) $odd(x_1, x_2, x_3)$ which evaluates to true iff an odd number of x_1, x_2, x_3 have the value true;

   ii) $atleast_2(x_1, \ldots, x_n)$ which evaluates to true iff the number of $x_1, \ldots, x_n$ having the value true is at least 2;

   iii) $atmost_{n-1}(x_1, \ldots, x_n)$ which evaluates to true iff the number of $x_1, \ldots, x_n$ having the value true is at most $n-1$;

5. Consider the Boolean circuit given as a system of equations:

$$x_1 = \mathsf{or}(y_1, y_2, y_3)$$
$$y_1 = \mathsf{and}(z_{11}, z_{12})$$
$$y_2 = \mathsf{and}(z_{21}, z_{22})$$
$$y_3 = \mathsf{and}(z_{31}, z_{32})$$

   Write (i) the corresponding equivalent propositional formula, (ii) give the formula in equivalent conjunctive normal form and (iii) write the corresponding CNF of the circuit directly using the Tseitin translation.