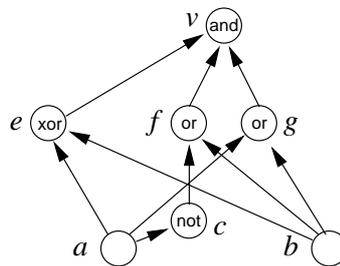


1. Encode the SET COVER problem as a constraint satisfaction problem (CSP).
2. Encode the TSP optimization problem as a constrained optimization problem.
3. Give a propositional formula that express the Boolean function that the circuit below computes.



4. Give a propositional formula in CNF that expresses the Boolean function
 - a) $odd(x_1, x_2, x_3)$ which evaluates to true iff an odd number of x_1, x_2, x_3 have the value true;
 - b) $atleast_2(x_1, \dots, x_n)$ which evaluates to true iff the number of x_1, \dots, x_n having the value true is at least 2;
 - c) $atmost_{n-1}(x_1, \dots, x_n)$ which evaluates to true iff the number of x_1, \dots, x_n having the value true is at most $n - 1$;
5. Give a Boolean circuit that performs lexicographic comparison of two n bit strings, i.e., construct a circuit that has input gates $x_1, \dots, x_n, y_1, \dots, y_n$ and its output gate has the value true in a truth assignment T iff the bit string $b_1b_2 \dots b_n$ given as input for the gates x_1, \dots, x_n in T is lexicographically properly greater than $c_1c_2 \dots c_n$ given as input for the gates y_1, \dots, y_n .

Here when a bit string $b_1b_2 \dots b_n$ is given as input for the gates x_1, \dots, x_n in a truth assignment T it means that for $i = 1, \dots, n$, if $b_i = 1$ then $T(x_i) = true$ else $T(x_i) = false$ and similarly for the input gates y_1, \dots, y_n .

Hint: For example, the bit string 01000 is lexicographically properly greater than 00111.