Decision Procedures and Verification

Practical 1

1. (0.5 points) Convert $\neg x \leftrightarrow (y \wedge \neg z)$ to CNF using Tseitin's encoding.
2. (1 point) Consider (simple) original and optimized version of a program below. Transform the problem of an equivalence of these two programs to a SAT problem.

Original program	Optimized program
`if(!a && !b) h();`	`if(a) f();`
`else if(!a) g();`	`else if(b) g();`
`else f();`	`else h();`

3. (1 point) The n-queens puzzle is the problem of placing n queens on an $n \times n$ chessboard such that no two queens attack each other. Model the puzzle as a SAT problem.

Homework

4. (1 point) Let φ be a formula in negation normal form (NNF) and α an assignment of its variables. Let $pos(\alpha, \varphi)$ is a set of positively evaluated literals in φ under α. For every assignment β such that $pos(\alpha, \varphi) \subseteq pos(\beta, \varphi)$ it holds that if $\alpha \models \varphi$ then $\beta \models \varphi$. Give a proof.
5. (1 point) In Tseitin encoding replace equivalence among fresh variables and subformula with left-to-right implication. Is the resulting CNF formula equisatisfiable with the original one? Is it equisatisfiable if the original formula is in NNF? Prove your answers.
6. (1 point) Let $G = (V, E)$ be an undirected graph. Suggest a propositional formula that is satisfiable it and only if G contains a Hamiltonian cycle.