Homework

1. State and formally and prove the correctness of universal reduction.
2. Use Q-Resolution to determine the validity of:

$$\exists x_1 \forall x_2 \exists x_3 x_4 \forall x_5 \exists x_6 x_7 . (\neg x_1 \vee \neg x_7) \wedge (x_2 \vee x_6 \vee x_7) \wedge (x_3 \vee \neg x_5 \vee \neg x_6) \wedge$$

$$\wedge (x_4 \vee \neg x_5 \vee \neg x_6) \wedge (\neg x_3 \vee \neg x_4 \vee x_5) \wedge (x_1 \vee x_6)$$

3. Use Nelson-Oppen to determine satisfiability of the following formula over EUF and LIA. For LIA, no decision procedure is necessary, just specify consequences of formulas on paper.

$$1 \leq x \wedge x \leq 2 \wedge \mathsf{f}(1) = \mathsf{a} \wedge \mathsf{f}(x) = \mathsf{b} \wedge \mathsf{a} = \mathsf{b} + 2 \wedge \mathsf{f}(2) = \mathsf{f}(1) + 3$$

4. Propose a game, where the existence of a winning strategy can be specified in QBF, and encode such a formula in QDIMACS format. For example a card game where the opponents have just 2 cards each, a board game where you try to build a line (Gomoku), etc.