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Computational Logic, WS 2025/2026,
Exercise sheet 2,
due date: **2 November 2025, 23:59 via Moodle**

Problem 6 (20 Points)
Let p, q and r be propositional variables. Given the formula $\neg(\neg p \vee (q \wedge r)) \Rightarrow (p \vee (\neg q \Leftrightarrow \neg r))$. Construct its logically equivalent NNF, CNF and DNF by logical transformations (no truth tables are allowed).

Problem 7 (20 Points)
Let A, B and C be propositional variables. Translate the formula

$$(A \Rightarrow B \vee C) \wedge \neg(A \wedge \neg B \Rightarrow C)$$

into a definitional CNF, providing the intermediate steps.
Is the new formula logically equivalent to the initial one? Explain in detail why (not), also what the exact relationship between the original and the resulting formula is and why this so is.

Problem 8 (20 Points)
Let A, B and C be propositional variables. Given the formula $((A \Rightarrow B) \Rightarrow C) \Rightarrow (\neg A \Rightarrow C)$. Using OCaml construct automatically a sequent calculus proof (command "gprove", you have to load the source code from file "prop2.ml" distributed in the "Software Examples").
Then transform it into a SCT proof. Submit both the output of the OCaml software and a screenshot of the completed SCT proof.

Problem 9 (20 Points)

a) Given the following facts: *If it rains, Alex brings his umbrella. If Alex has an umbrella, he does not get wet. If it does not rain, Alex does not get wet.*
Formalize the above facts and using the resolution method prove that *Alex does not get wet.*

b) Given the following facts: *Either Bob attended the meeting or Bob was not invited. If the boss wanted Bob at the meeting, then he was invited. Bob did not attend the meeting. If the boss did not want Bob there, and the boss did not invite him there, then he is going to be fired.*
Formalize the above facts and using the resolution method prove that *Bob is going to be fired.*

Problem 10 (20 Points)
Let p, q and r be propositional variables. Given the premise $(p \Rightarrow q \wedge r)$, use the resolution method to prove the conclusion $(\neg q \vee \neg r \Rightarrow \neg p)$. In particular:

a) Explicitly state the formula to be refuted by the resolution proof;

b) Construct the CNF of this formula (show the intermediate steps);

c) Construct the graph that visualizes the refutation of the formula by resolution.