Due at 5:30 PM on 25/2/2010. The paper part (Problems 1 and 2) should be turned in to Prof. Henz in his office. The penalty for late assignments is five points per minute, rounding up. The Coq part (Problem 3) should be handed in via IVLE; the system will reject submissions after 5:30 PM.

Problem 1: Natural Deduction, 25 points

Please use natural deduction to prove the following sequents:

1) $\vdash (p \wedge q) \rightarrow (p \vee q)$ (5 points)
2) $\vdash (p \rightarrow q) \rightarrow (r \rightarrow q) \rightarrow (p \vee r) \rightarrow q$ (5 points)
3) $\vdash (p \rightarrow q) \rightarrow (\neg q \rightarrow \neg p)$ (5 points)
4) $\vdash (\neg q \rightarrow \neg p) \rightarrow (p \rightarrow q)$ (10 points)

Problem 2: Semantics, 25 points

Please classify the following formulas as valid, satisfiable, or not satisfiable, and prove using the semantic method.

1) $(p \wedge q) \rightarrow (p \vee q)$ (5 points)
2) $(p \wedge \neg q) \vee q$ (5 points)
3) $(\neg q \rightarrow \neg p) \rightarrow (p \rightarrow q)$ (5 points)
4) $\neg q \rightarrow q$ (5 points)
5) $(\neg q \rightarrow q) \wedge (q \rightarrow \neg q)$ (5 points)

Problem 3: Propositional Logic in Coq, 63 points

Please download the files `coq_as1.v` and `coq_intro_lib.vo` from the class website. Put the files in the same directory. The file `coq_as1.v` can be loaded directly into CoqIDE. The instructions in the comment at the beginning of the file explain what needs to be done.

Hint: you might find it easier to do the Coq part of the homework first, or even switch back and forth between pen-and-paper and Coq. That way you can apply insights from one area to another. **Please remember to do the**

Coq part of the problem set entirely on your own. The *minimum* penalty for collaboration on the Coq part is all people involved get -113 points for the assignment. You may use "ordinary" collaboration on the paper part (that is, feel free to discuss but do not actively copy).