ICS 171
Fall 2006
Prof. R. Dechter
Homework Assignment 5
Due Tuesday November 7th

1. Consider the statement "The car is either at John's house or at Fred's house. If the car is not at John's then it must be at Fred's house."

    (a) Describe a set of propositional letters which can be used to represent this statement.

    (b) Describe the statement using a propositional formula on the propositions you described for (a).

    (c) Can you determine where is the car?

2. Problem 7.4 in Russel and Norvig. Your proofs should use truth tables and the meanings of the words such as "valid" and "unsatisfiable"

3. (Problem 7.5 from Russell and Norvig). Consider a vocabulary with only four propositions, A, B, C and D. How many models are there for the following sentences:

    (a) $(A \wedge B) \vee (B \wedge C)$

    (b) $A \vee B$

    (c) $A <--> C <--> B$

4. Convert the following propositional calculus setntence into clauses:

$$\neg[((P \vee \neg Q) \rightarrow R) \rightarrow (P \wedge R)]$$

5. Use truth tables to show that the following sentences are valid, and thus that the equivalences hold. Some of these equivalence rules have standard names, which are given in the right column.

$P \wedge (Q \wedge R)$	$\Leftrightarrow$	$(P \wedge Q) \wedge R$	Associativity of conjunction
$P \wedge (Q \vee R)$	$\Leftrightarrow$	$(P \wedge Q) \vee (P \wedge R)$	Associativity of conjunction
$\neg(P \wedge Q)$	$\Leftrightarrow$	$\neg P \wedge \neg Q$	de Morgans Law
$P \Leftrightarrow Q$	$\Leftrightarrow$	$(P \wedge Q) \vee (\neg P \wedge \neg Q)$	Associativity of conjunction

6. (Problem 7.8 from Russel and Norvig) Look at the following sentences and decide for each if it is valid, unsatisfiable, or neither. Verify your decisions using truth tables, or by using the equivalences.

    (a) $Smoke \Rightarrow Smoke$

(b) $Smoke \Rightarrow Fire$

(c) $(Smoke \Rightarrow Fire) \Rightarrow (\neg Smoke \Rightarrow \neg Fire)$

(d) $Smoke \lor Fire \lor \neg Fire$

(e) $((Smoke \land Heat) \Rightarrow Fire) \Leftrightarrow ((Smoke \Rightarrow Fire) \lor (Heat \Rightarrow Fire))$

(f) $(Smoke \Rightarrow Fire) \Rightarrow ((Smoke \land Heat) \Rightarrow Fire)$

(g) $Big \lor Dumb \lor (Big \Rightarrow Dumb)$

(h) $(Big \land Dumb) \lor \neg Dumb$