

ICS 271
 Fall 2008
 Prof. R. Dechter
 Homework Assignment 5
 Due Tuesday November 10th

1. (15) 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. (15) (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) $A < -- > C < -- > B$
3. (10) How would you use the truth table to prove that *modus ponens* is sound.
4. (10) (Problem 13.5 from Nilsson) Show how the N -Queens problem can be represented as a PSAT problem. (Hint: Introduce one atom $q_{k,l}$ for each square (k, l) of the $N \times N$ board. If $q_{k,l}$ has value *True*, there is a queen on square (k, l) ; if it has value *False*, that square is empty. Now state the constraints of the problem in terms of these atoms.)
5. (10) (Problem 14.5 from Nilsson) Convert the following propositional calculus wff into clauses:

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

6. (20) 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
$\neg(P \wedge Q)$	$\Leftrightarrow$	$\neg P \vee \neg Q$	de Morgans Law
$P \Leftrightarrow Q$	$\Leftrightarrow$	$(P \wedge Q) \vee (\neg P \wedge \neg Q)$	Associativity of conjunction

7. (25) (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) $Smoke \vee Fire \vee \neg Fire$
 - (e) $((Smoke \wedge Heat) \Rightarrow Fire) \Leftrightarrow ((Smoke \Rightarrow Fire) \vee (Heat \Rightarrow Fire))$
 - (f) $(Smoke \Rightarrow Fire) \Rightarrow ((Smoke \wedge Heat) \Rightarrow Fire)$
 - (g) $Big \vee Dumb \vee (Big \Rightarrow Dumb)$
 - (h) $(Big \wedge Dumb) \vee \neg Dumb$
8. (15) (Problem 7.17 in Russell and Norvig) Trace the behavior of DPLL on the knowledge-base in Figure 7.15 when trying to prove Q , and compare this behavior with that of forward chaining algorithm.