CS331 (Spring 2015): Introduction to Artificial Intelligence  
Written Assignment #2

Date handed out: April 27, 2015  
Date due: May 4, 2015 at the start of class  
Total: 35 points

The written portion of this assignment is to be done individually. Please hand in a hardcopy. Assignments done on a word processor are preferred but not mandatory. For hand written assignments, if we cannot read your writing, we cannot mark your assignment.

1. (From 7.4 in the book) For each of the following statements, prove if it is true or false.  
   a) \((A \land B) \models (A \iff B)\) [3 points]  
   b) \((A \lor B) \land \neg (A \Rightarrow B)\) is satisfiable [3 points]

2. The deduction theorem states that for any sentences \(\alpha\) and \(\beta\), \(\alpha \models \beta\) if and only if the sentence \((\alpha \Rightarrow \beta)\) is valid. For this question, prove the “forward” direction of the deduction theorem ie. prove that if the sentence \((\alpha \Rightarrow \beta)\) is valid, then \(\alpha \models \beta\). (Note: you don’t have to prove the other direction for this question). [4 points]

3. (From 7.10 in the book) Decide whether each of the following sentences is valid, unsatisfiable or neither. Verify your decisions using truth tables or the equivalence rules of Figure 7.11.  
   a) \(\text{Smoke} \Rightarrow \text{Smoke}\) [2 points]  
   b) \((\text{Smoke} \Rightarrow \text{Fire}) \Rightarrow (\neg \text{Smoke} \Rightarrow \neg \text{Fire})\) [4 points]  
   c) \((\text{Smoke} \Rightarrow \text{Fire}) \Rightarrow ((\text{Smoke} \land \text{Heat}) \Rightarrow \text{Fire})\) [4 points]

4. Five cops A, B, C, D and E are at the heart of an internal affairs investigation regarding corruption. We know the following are true:  
   1. Either C or B or both are corrupt  
   2. Either D or E but not both are corrupt  
   3. If A is corrupt, then D is corrupt  
   4. E is corrupt if and only if C is corrupt  
   5. If B is corrupt, then both A and C are corrupt.

   a) Express the facts above in CNF and write out the KB. [5 points]

   b) Using the KB from part (4a), can you figure out who is corrupt and who isn’t? Show all the resolution steps for partial credit. [10 points]