CS557E – Artificial Intelligence

Washington University of Virginia

Mid-Term Exam

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Exercise 1 : 60 Points

Which of the following are correct?
   a. False $\models$ True.
   b. True $\models$ False.
   c. $(A \land B) \models (A \Leftrightarrow B)$.
   d. $A \Leftrightarrow B \models A \lor B$.
   e. $A \Leftrightarrow B \models \neg A \lor B$.
   f. $(A \lor B) \Rightarrow C \models (A \Rightarrow C) \lor (B \Rightarrow C)$.
   g. $(C \lor (\neg A \land \neg B)) \equiv ((A \Rightarrow C) \land (B \Rightarrow C))$.
   h. $(A \lor B) \land (\neg C \lor \neg D \lor E) \models (A \lor B)$.
   i. $(A \lor B) \land (\neg C \lor \neg D \lor E) \models (A \lor B) \land (\neg D \lor E)$.
   j. $(A \lor B) \land \neg(A \Rightarrow B)$ is satisfiable.
   k. $(A \Leftrightarrow B) \land (\neg A \lor B)$ is satisfiable.
   l. $(A \Leftrightarrow B) \Leftrightarrow C$ has the same number of models as $(A \Leftrightarrow B)$ for any fixed set of proposition symbols that includes A, B, C.

Exercise 2 : 15 Points
You have a number of trucks with which to deliver a set of packages. Each package starts at some location on a grid map, and has a destination somewhere else. Each truck is directly controlled by moving forward and turning. Construct a hierarchy of high-level actions for this problem. What knowledge about the solution does your hierarchy encode?

Exercise 3 : 25 Points
In your local nuclear power station, there is an alarm that senses when a temperature gauge exceeds a given threshold. The gauge measures the temperature of the core. Consider the Boolean variables A (alarm sounds), FA (alarm is faulty), and FG (gauge is faulty) and the multivalued nodes G (gauge reading) and T (actual core temperature).
   a. Draw a Bayesian network for this domain, given that the gauge is more likely to fail when the core temperature gets too high.
   b. Is your network a polytree? Why or why not?
   c. Suppose there are just two possible actual and measured temperatures, normal and high; the probability that the gauge gives the correct temperature is x when it is working, but y when it is faulty. Give the conditional probability table associated with G.
   d. Suppose the alarm works correctly unless it is faulty, in which case it never sounds. Give the conditional probability table associated with A.

e. Suppose the alarm and gauge are working and the alarm sounds. Calculate an expression for the probability that the temperature of the core is too high, in terms of the various conditional probabilities in the network.