COS470 Final Study Guide

For each of the following 5 questions, first represent the statement as first-order predicate logic, then convert it to conjunctive normal form.  If a statement cannot be represented in  FOL, then say so and explain why not.

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| **Question 1** |  | 0.5 / 2 points |

1. **It always snows in Maine in March.**

Ǝ  
Ɐx (month(x, march) ∧

1. **John and Mary are both professors.**

∃x ∃y (person(x) ∧ named(x, Mary) ∧ (person(y) ∧ named(y, John)) ∧ professor(x) ∧ professor(y)

Professor(John)   
Professor(Mary)

1. **There will be a day in March when it snows and is warm.**

∃x ∃y (month(x) ∧ named(x, March) ∧ (day(y) ∧ in(y, x)) ∧ weather(warm) ∧ weather(snowing)

Weather(snowing)  
Weather(warm)  
DayInMonth(march)

1. **All dogs are canines and all dogs are not canines.**

Ɐx (dog(x) ∧ canine(x)) ∧ (dog(x) ∧ ¬canine(x))

1. **As a rule, if someone loves dogs, then there's someone  who loves them (i.e., the person).**

∀x ∃y lovesdogs(x) -> loves(y, x)

¬(loves(y, x) V lovesdogs(x)

For each of the next two questions, use the axiom set given below.  Note that you **must show your answer in the form of a proof tree**, as shown in class.

Text, letter

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| **Question 6** |  | 2 / 5 points |

1. **Prove: Marcus was dead in AD 250.**

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| **Question 7** |  | 2 / 5 points |

1. **Marcus was Pompeian and Marcus is dead now.**
2. **Someone tells you that they have a new algorithm for theorem proving using resolution that can prove any FOL expression with respect to a set of axioms or let the user know the expression cannot be proven.  What can  you say about this person's claim, and why?**
3. **What is true of the role of mutations and crossover in genetic algorithms?**

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|  | They are used to eliminate solutions with poor fitness. |
|  | They are used to keep the algorithm from generating poor choices by accident, and so focus search. |
|  | They are the only things that provide a means to explore the problem's search space, and they allow "uphill moves" in the search space. |
|  | They are used to ensure that genetic algorithms behave like their biological counterparts. |

1. **Given the simple neural network below, and assuming that all weights are labeled similarly to the one shown and that all neurons (except the input neurons) have an activation function 𝜎:**
2. **What is the value of the output neuron D in  terms of A's, B's, and C's activation? (You can just use "A" to represent A's activation, etc.)**
3. **What is the value of the output neuron G in terms of A's, B's, and C's activations?**

Diagram

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| **Question 11** |  | 5 / 5 points |

1. **Suppose you are given these description logic statements in the Tbox (recall, the terminological box, or definitions):**

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and these statements in the Abox (recall, the axioms about objects):

Text

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1. **Do you think you have enough information to prove that Roy is a father?  Why or why not?**
2. **Do you have enough information to prove that Elise is a mother?  Why  or  why not?**

1.) No, because we can't prove that Roy is a man.

2.) Yes, because we can prove Elise is a Woman and has a child  
therefore, Elise is a parent

1. In knowledge representation, a frame:

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|  | is a knowledge structure that encapsulates related data and that has methods that can be called to use the data. |
| Correct Answer | is a knowledge structure contains attributes and values of some thing as well as relationships to other things represented as frames. |
|  | is one slice of time represented as FOL statements, meant to be strung together to represent time passing for an object. |
| Correct Answer | is related to other frames via its isa or instance-of slot to form an inheritance hierarchy (which might really be a tangled hierarchy). |

1. **Which is/are true about planning?**

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|  | A causal link records what an operator causes, that is, it links the operator to its effects. |
|  | Plans can be created in general in polynomial time and space. |
| Correct Answer | If operators are considered as predicate calculus functions representing situations, then resolution theorem proving using situation calculus can create plans, but it cannot using FOL without considering situations. |
|  | A nonlinear planner can be created by just running multiple linear planners in parallel. |

1. **Compare and contrast first-order predicate logic, frames, semantic nets, and description logic.  (Don't just give me the definitions or a bunch of facts about them; how are they similar? how do they differ?)**
2. **Suppose the POP partial-order planner has an operator Go(?a,?d) with preconditions:**

* agent(?a)
* at(?a,?s)
* location(?s)
* location(?d)

and effects:

* ￢at(?a,?s)
* at(?a,?d)

1. **If the planner adds Go(Roy, UMaine) to the plan to achieve one of the Finish actions preconditions, at(Roy,UMaine), what would the causal link and the instantiated action look like?**
2. **If the planner adds the action Go(Roy,Hannaford) to the plan, would this threaten the causal link? If not, why not?  And, if so, how would the planner know this?**
3. **Compare and contrast forward-chaining and backward-chaining  rule-based expert systems.  Your answer  should address issues of what they are used for, the need for uncertain reasoning (and why/why not), and how they operate.**

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