

# CPSC 322- 2010 Final Practice Questions

*Answers to the following questions should not be more than a few sentences long; point form is fine.*

## 1 Logic

1. **(Logic)** What is missing from propositional definite clause logic that is present in full propositional logic?
2. **(Logic)** What is the difference between an interpretation and a model in propositional definite clause logic?
3. **(Logic)** Without using the words “model” or “interpretation”, explain what it means to say that  $KB \models g$ .
4. **(Logic)** At its essence, is a proof a syntactic or a semantic operation? why?
5. **(Logic)** Define what it means for a proof procedure to be complete.
6. **(Logic)** Define what it means for a proof procedure to be sound.
7. ~~**(Logic)** Give a proof procedure that was not presented in the class slides.~~
8. **(Logic)** Explain how in the top-down proof procedure, the rule of inference (called SLD resolution) is performed.
9. **(Logic)** When does the top-down proof procedure terminate?
10. **(Logic)** Why might you prefer to use the top-down proof procedure instead of the bottom-up proof procedure?
11. **(Logic)** Does it make sense to talk about the truth value of a variable in Datalog? Why or why not?

## 2 Uncertainty

1. **(Uncertainty)** What is the difference between a random variable and a probability distribution? Provide an example.
2. **(Uncertainty)** In probability theory, what is a possible world? Provide an example.
3. **(Uncertainty)** Explain, both in words and using math, the difference between  $P(H|E)$  and  $P(H, E)$ .

4. **(Uncertainty)**

| X | Y | Z | Prob. |
|---|---|---|-------|
| T | T | T | 0     |
| T | T | F | 0     |
| T | F | T | 1     |
| T | F | F | 0     |
| F | T | T | 0     |
| F | T | F | 0     |
| F | F | T | 0     |
| F | F | F | 0     |

Consider the above joint probability distribution over the three random variables  $X, Y, Z$ . compute the marginal probability distributions for  $P(X)$ ,  $P(Y)$  and  $P(Z)$ .

5. **(Uncertainty)** Name an operation that could be performed on a factor  $f$  that could *decrease*  $f$ 's dimensionality, and explain how much smaller the new factor would be.
6. **(Uncertainty)** Name an operation that could be performed on a factor  $f$  that could *increase*  $f$ 's dimensionality, and explain how much bigger the new factor could be.
7. **(Uncertainty) [8 points]** Consider a node  $N$  in a Bnet.  $N$ 's domain has size  $d$ .  $N$  has  $k$  parents, each with also domain size  $d$ . What is the size of the CPT for  $P(N|parentsOfN)$ ? Is it true that the sum of all the entries in this CPT is equal to  $d$ ? why or why not?
8. ~~**(Uncertainty) [6 points]** How many different Markov Chains on  $k$  possible states there are, in which the agent is equally likely to start in any state and then it is stuck in the same state forever? Show the tables  $P(S_0)$  and  $P(S_{t+1}|S_t)$  for one of such Chains when  $k = 3$ .~~
9. ~~**(Uncertainty)** Describe in words the meaning of each probability distribution needed to define a stationary hidden Markov model.~~

### 3 Decision Theory

1. **(Decision Theory)** Explain why utility functions are a strictly more expressive preference model than the goals used in deterministic planning.
2. **(Decision Theory)** What is the difference between random variables and decision variables?
3. **(Decision Theory)** In words, what is an agent's expected utility for making a single decision?
4. **(Decision Theory)** How is a sequential decision problem different from a single decision problem? Why does it make sense that in the "single decision" framework, we can still talk about problems (such as the example given in the slides) where there is more than one decision variable?
5. **(Decision Theory)** In words, define a policy for a sequential decision problem.
6. **(Decision Theory)** In words, what makes a policy "optimal" in a sequential decision problem?
7. **(Decision Theory)** How is a decision variable  $D$  eliminated, when Variable Elimination is applied to a sequential decision problem?
- ~~8. **(Decision Theory)** How is a decision process different from a sequential decision problem?~~
- ~~9. **(Decision Theory)** In what way(s) does a (stationary) Markov Decision Process augment a stationary Markov chain?~~
- ~~10. **(Decision Theory)** How many possible policies there are for Markov Decision Process with  $n$  possible states and  $k$  possible actions?~~