FINAL EXAM | **Name:** |

CSC 440 - ARTIFICIAL INTELLIGENCE - SPRING 1994

Please print your name at the top of every page.
This is an open book/notes exam.
This exam consists of 9 questions.
Write all answers in the space provided. You may continue at the back of the page if more space is required.
Be as precise and concise as possible.
If you do not understand a question, ask me about it.
The exam will end exactly 120 minutes after it begins.
Good Luck.

Question	**Points**	**Out of**
1		10
2		10
3		15
4		10
5		10
6		10
7		10
8		15
9		10
Total		100
Grade		

Question 1 (10 points) Answer **true** or **false** to each of the following statements:

a) $\square$ Inheritance always guarantees a correct answer if inferential distance is used.

b) $\square$ A logic is monotonic if facts can be retracted.

c) $\square$ Dependency-directed backtracking backtracks on the basis of the order in which choices are made.

d) $\square$ In the syntactic analysis phase of natural processing words are assigned syntactic categories.

e) $\square$ In a wedding script a prop might be the groom.

f) $\square$ Arbitrary first-order logic propositions can be represented in a semantic network.

g) $\square$ Frames correspond to classes.

h) $\square$ In CD the correct primitive action corresponding to the action talk is SPEAK.

i) $\square$ In the semantic analysis phase of natural processing what to do as a result of understanding a sentence is done.

j) $\square$ Bayes' theorem does not require the specification of joint probabilities of all propositions to be useful.

Question 2 (10 points) For the following sentences show their semantic network representation.

a. (5 points) *Bill saw the monkey at the zoo.*

a. (5 points) *Every rich boy loves a poor girl.*

Question 3 (15 points) Provide a frame representation for the following information.

a. (10 points)

- An `EVENT` has a place, day and time.
- A `DISASTER-EVENT` is a type of event that has fatalities, injured, homeless, and damage.
- A `SOCIAL-EVENT` is a type of event that has a host and guests.
- An `EARTHQUAKE` is a type of disaster event that has a faultline and a magnitude.
- A `BIRTHDAY-PARTY` is a type of social event that has a birthday-person and their age.

Question 3 *contd*

b. (5 points) Show the frame for a particular earthquake providing your own values for the slots.

Question 4 (10 points) Using Dempster-Shafer theory, calculate the combined belief function m_3 of m_1 and m_2, where:

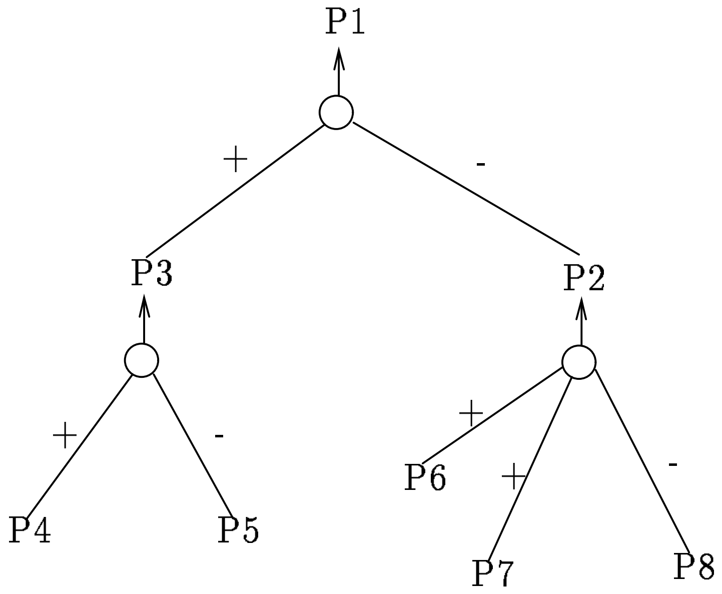
$$m_1 = \begin{array}{ll} \{Cold\} & (0.35) \\ \{Flu,\ Cold\} & (0.10) \\ \{All,\ Pneu\} & (0.40) \\ \Theta & (0.15) \end{array} \qquad\qquad m_2 = \begin{array}{ll} \{Cold,\ Flu\} & (0.5) \\ \Theta & (0.5) \end{array}$$

and $\Theta = \{All,\ Flu,\ Cold,\ Pneu\}$. Fill in the appropriate values for m_3:

$$m_3 = \begin{array}{ll} \{Cold\} & (\boxed{}) \\ \{Flu,\ Cold\} & (\boxed{}) \\ \{All,\ Pneu\} & (\boxed{}) \\ \Theta & (\boxed{}) \end{array}$$

Show your calculations.

Question 5 (10 points) Given the following consistent JTMS dependency network:



Where **P1-P8** correspond to propositions.

a. (5 points) Provide a labelling of nodes **P4, P5, P6, P7, P8** so that node **P1** is labeled `OUT`.

b. (5 points) Provide a labelling of nodes **P4, P5, P6, P7, P8** so that node **P1** is labeled `IN`.

Question 6 (10 points)

a. (8 points) Suppose that an AI knowledge-representation and reasoning system uses a small knowledge base consisting of the following statements in predicate logic, and suppose that that it is capable of making logical deductions, but that it does not know anything special about any of the predicates that might appear in its knowledge base, such as `Color` or `Equal`:

```
Color(Apple1, Red)
Color(Apple2, Green)
Fruit(Apple1)
Fruit(Apple2)
∀ x ((Fruit(x) ∧ Color(x, Red)) → Ripe(x))
```

Assume that the system makes the Closed-World Assumption. For each of the statements below, indicate whether the system would assign a truth value of `True` or `False`:

1. `Color(Apple3, Red)`		2. `Fruit(Apple2)`	
3. `Ripe(Apple1)`		4. `Ripe(Apple2)`	
5. `¬Color(Apple, Red)`		6. `Color(Apple, Blue)`	
7. `NotEqual(Red, Blue)`		8. `Equal(Red, Blue)`	

b. (2 points) Describe two problems with this system.

Question 7 (10 points) Given the following set of facts:

- Most things do not swim.
- Most fish swim.
- Whales swim unless they are sick.
- People can swim.

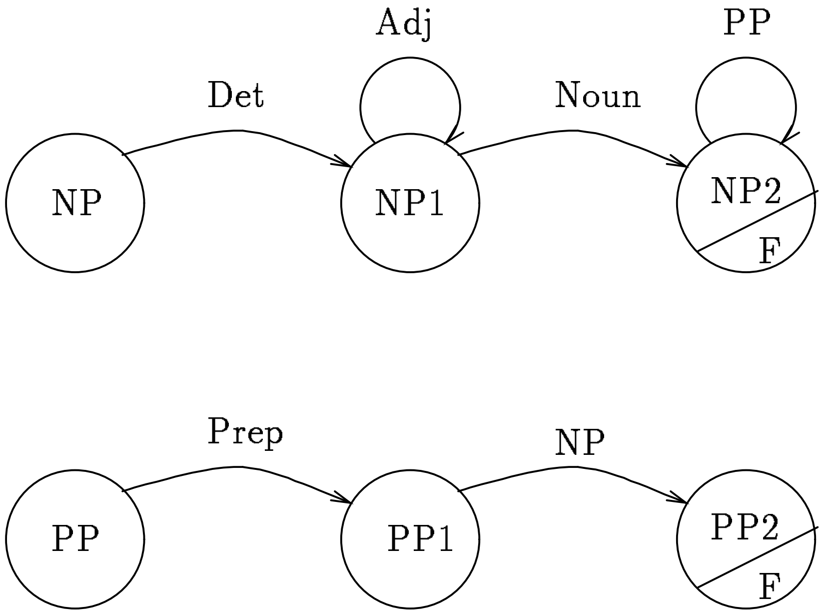
a. (8 points) State these facts as inference rules of default logic (DL).

b. (2 points) If we add the fact: *Namu is a whale* answer the following questions and justify your answer (unsupported answers get no credit) using the inference rules.

i. Does Namu swim?

ii. Does Paul swim?

Question 8 (15 points) Consider the following context-free phrase structure grammar and ATN:



NP –> DET NP1

NP1 –> ADJ NOUN PPS

PPS –> PP

PPS –> PP PPS

PP –> PREP NP

a. State two ways is which the languages described by these two grammars differ. For each, give a sample noun phrase that is recognized by one grammar but not the other and that demonstrates the diference.

Question 8 *(contd)*

b. Write a new context-free phrase structure grammar equivalent to the ATN shown here.

c. Write a new ATN equivalent to the context-free phrase structure grammar shown here.

Question 9 (10 points) A script is a list of CDs (conceptual dependency expressions) that depicts a typical sequence of events for a given situation. For example, a typical shopping script could have the following events:
1. Someone goes to a store.
2. S/he picks up an object.
3. The store transfers possession of the object to him/her.
4. S/he transfers possession of some money to the store.
5. S/he leaves the store.
Using primitive actions of the CD formalism, we can express the above script as (symbols preceded by a ? are variables):

```
((ptrans (actor ?shopper)
         (object ?shopper)
         (to ?store))
 (ptrans (actor ?shopper)
         (object ?bought)
         (to ?shopper))
 (atrans (actor ?store) (object ?bought)
         (from ?store) (to ?shopper))
 (atrans (actor ?shopper) (object MONEY)
         (from ?shopper) (to ?store))
 (ptrans (actor ?shopper) (object ?shopper)
         (from ?store) (to ?elsewhere)))
```

Given a story like:
a) Nimrod went to Doofus Drinks.
b) He bought a Jolt Cola.
c) He went home.

Give representations of each of these sentences in CD form **(3 points)**.

Question 9 *(contd.)*
Show which of these forms match the forms in the shopping script **(2 points)**.

Write an instantiated script to depict a complete understanding of the above story **(5 points)**