Name ______________________

Introduction to Expert Systems

EE 4785

Final Examination

8 May 1996, 12:30–14:30 CDT

Alias ______________________

Complete for confidential E-mail grade notification:

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Provide indexes in place of alias:

Final exam index (0-100) __________

Course grade index (0-100) __________

Choose indexes randomly; remember choices.

For best security choose unequal indexes.

Problem 1	__________	(25 pts)
Problem 2	__________	(25 pts)
Problem 3	__________	(25 pts)
Problem 4	__________	(25 pts)
Exam Total	__________	(100 pts)

Good Luck!

Problem 1: A list is of order n if it exactly consists of one or more repetitions of a length-n sublist. For example, `[a,b,c]` is of order 3 (1 repetition), `[a,b,a,b]` is of order 2, and `[a,a,a,a,a]` is of order 1. Write a Prolog program to determine the order of a list so that goal `order(List,Order)` issued with `List` bound to a list will succeed and unify `Order` with the order of the list. (25 pts) For example,

```
 ?- order([a,b,c],X).

X = 3

yes
 ?- order([a,b,a,b],X).

X = 2

yes
 ?- order([a,a,a,a],X).

X = 1

yes
 ?- order([a,a,a,a,c],X).

X = 5

yes
 ?- order([a,a,c,a,a,c],X).

X = 3
```

Problem 2: Information about books in a bookstore is represented using OAVs. There are two classes, `Book`, which holds general information about books; and `Stock`, which describes information about books as inventory (stock) items. The `Book` object includes the following attributes: `binding` (hardcover or paperback), `author`, `series` (such as Star Trek, Dilbert), and `title`. (Several books can belong to the same series.) The `Stock` object includes the following attributes: `cost`, `title`, `numInStock`. Suppose there is a `book` object for every book in print and that all titles are unique. Write rules for `shellOAVbc` to do the following: (25 pts)

- Find a book for under \$5.00 and assign the book instance to `cheapBook`.
- Find a hardcover for under \$5.00 and assign the book instance to `cheapHardCover`.
- Determine if the store stocks all Dilbert books, if so assign `True` to stocksAllDilbert.

Hints: The rules do not need to create new instances. Exact syntax is much less important than showing rules that almost (or do!) work or at least show understanding of objects, instances, and quantifiers.

Problem 3: John is twenty minutes late. Here are some possible reasons and supporting evidence:

Reason 1: Car broken. Evidence 1, yesterday John mentioned that his car was acting strangely; evidence 2, someone saw a tow truck go in the direction of his house; evidence 3, owns an unreliable car.

Reason 2: Not supposed to be here. Evidence 1, this is his scheduled vacation time; evidence 2, John is out buying lunch (it's his turn). Both pieces of evidence can be determined with 100% certainty (certainly true or certainly false).

Reason 3: Some people live on the other side of the river which can only be crossed by the ferry which does not run in bad weather. Evidence 1, bad weather; evidence 2, tried to come in after bad weather started; evidence 3, lives on other side of river.

Construct rules to find the certainty of the three reasons using certainty factors. Be sure to appropriately combine the evidence. (25 pts)

Problem 4: Answer each question below.

The two sentences below are used in the next two problems.

John threw the ball to Jack.

John mailed the ball to Jack.

(a) Represent the information in the first sentence using both thematic-role and primitive-action frames. (Assume that "mail" and "throw" are primitive actions. (6 pts)

(b) What information might an ES have if the sentences above are represented using primitive action frames that may not be available using thematic role frames? Give an example of what the ES can do with the primitive action frames that could not be done with thematic role frames. (Consider the different meanings of the two sentences.) (6 pts)

(c) Why would it be difficult to use linguistic modifiers on a fuzzy set G, the set of good movies, whereas linguistic modifiers can easily be used with something like F the set of fast speeds? (6 pts)

(d) Show how operators are defined so that the text below is syntactically correct Prolog. (`Car` is the name of the frame, it has two immediate superclasses, `RoadVehicle` and `PersonalProperty`, and two slots, `airbag` with value `true` and `numCupHolders` with value 5.) The operator definition should allow a class frame to have one or more immediate superclasses and should restrict an instance frame to one immediate superclass. (7 pts)

```
car ako roadVehicle ako personalProperty
 slots [
  [airbag, true],
  [numCupHolders, 5]].

car1 isa car
 slots [
  [brand, gm],
  [color, arrestMeRed]].
```