Name ______________________________

# Expert Systems
# EE 4785
# Final Examination

10 May 1994, 10:00-12:00

| | | |
|---|---|---|
| Problem 1 | ________ | (25 pts) |
| Problem 2 | ________ | (25 pts) |
| Problem 3 | ________ | (25 pts) |
| Problem 4 | ________ | (25 pts) |
| Exam Total | ________ | (100 pts) |

Alias ______________________________

*Good Luck!*

Problem 1: Modify the deduce clauses below so that they make use of certainty factors. Instead of binding `TV` to a truth value, as they do now, the clauses should bind `TV` to the appropriate certainty factor. Assume that the other deduce clauses have been modified to return certainty factors.

*(a)* The disjunction clause. (10 pts)

```
deduce(Goal1 or Goal2,TV):-!,
 deduce(Goal1,V1),
 once (
  V1=true,TV=true
  ;
  V1=false,deduce(Goal2,V2),
  TV=V2
 ).
```

*(b)* The rule-using clause. (15 pts)

```
deduce(Prop,Res):-
 _:if _ then Prop,!,
 once (
  Rule:if Ante then Prop,
  deduce(Ante,true),
  TV=true
  ;
  TV=false
  ),
 conclude(Prop,TV,byRule(Rule)),
 !,Res=TV.
```

Problem 2: A common problem encountered by programmers is mismatched delimiters (such as parenthesis), for example `human(socrates]` or `DdePostAdvise(getII(i1),tNh,getINhan(i2);`. Write a Prolog procedure taking a single argument, a string possibly containing mismatched delimiters. The procedure should succeed if delimiters (, [, {, }, ], and ), are matched correctly in the string. (25 pts)

Let the procedure be called `bal`. Then the following goals should succeed: `bal("()")`, `bal("ab(cd){} ( ef) [()]")`, `bal("a")`. The following goals should fail: `bal("ab(cd")`, `bal("(]")`. Note that a Prolog string is simply a list of character codes, *e.g.*, `"(A{B[C]D}E)"=[40,65,123,66,91,67,93,68,125,69,41]`

Problem 3: (25 pts) Develop a frame system which represents knowledge about places which lodge visitors. The frame system should have the following frames: **Lodging:** This frame should be a superclass of most other frames. **Institution:** This frame is for places which offer lodging so that people can engage in some activity at the site. For example, at a college those that stay in the dorms are there to learn. **Comfortable:** This frame is for places people choose to go to for the quality of the lodging. (For example, conference centers, but not university dormitories.)

Also include the following additional frames in the appropriate places: **prison, motel, dormitory, hospital, resort hotel, conference hotel.** Include the following slots *in the appropriate frames* (some possible slot values are shown in parenthesis): length-of-visit, takes-credit-cards, food-type {cafeteria, restaurant}, activities-on-site {planned, available, none}, clothing-needed {provided-by-facility, business, athletic}.

*(a)* Show a frame/slot for which the class-before-superclass rule applies. Similarly, show at least one frame/ slot for which the left-before-right rule applies. You may add additional slot types and frames, if necessary.

*(b)* Show how a `when-requested` demon procedure could be used to compute an estimate of costs. Explain how a `when-written` demon procedure could perform the same computation.

*(c)* Show how composition could be used to give information about dining facilities (illustrate your example for just one frame). Illustrate what problems could occur if inheritance were used instead.

Problem 4: Answer each question below.

*(a)* (9 pts) Authorizer's assistant, American Express' charge authorization expert system, works alongside human experts. Explain the relative strengths and weaknesses of each (human expert and expert system). Suppose that people will always find new reasons to not pay their charge card bills. Could an expert system eliminate the need for human authorization experts under those circumstances? Explain.

*(b)* (8 pts) Ed rolls a fair die; John and Bill watch. A distant observer cannot see the outcome, but can see Ed, John, and Bill. If Bill faints ($E_1$) there is a 0.2 probability that an even number had been rolled ($H_1$). If John walks away ($E_2$), there is a 0.6 probability that an even number had been rolled.

Compute $\mathrm{MB}[H_1|E_1]$ and $\mathrm{MB}[H_1|E_2]$.

*(c)* (8 pts) Consider the scenario above, omitting the probabilities. The rules below describe three possible ways of finding the likelihood of an even roll. Describe a situation for which *each* set of rules would be appropriate.

```
rA1:  if E1 and E2 then H1.

rB1:  if E1 or E2 then H1.

rC1:  if E1 then H1.
rC2:  if E2 then H1.
```