CS 4341 D Term 2003
Introduction to Artificial Intelligence

Practice Final Examination

PROBLEM 1 (35 Points)

```
H1:  access = allow
H2:  access = deny
R1:  IF   server = trusted
     THEN access = allow
R2:  IF   login = correct
     THEN access = allow
R3:  If   username = gilbates
     THEN server = trusted
R4:  IF   server = not-trusted
     THEN access = deny
R5:  IF   network = internal
     AND  os = lose98
     THEN server = trusted
R6:  IF   username = ?x
     AND  password = ?y
     AND  check-password(?x ?y) = ok
     THEN login = correct
R7:  IF   os = you-nix
     THEN server = not-trusted
R8:  IF   login = incorrect
     THEN server = not-trusted
R9:  IF   NOT  login = correct
     AND  os = lose98
     THEN login = incorrect
R10: IF   ---
     THEN access = deny
```

Note that the antecedent in rule 10 is always true, so this rule is always triggered. Also, the first antecedent in rule 9 will be true whenever the value of `login` is unknown.

Checking the network log, you notice that agent James has secretly gained access at a time when the following facts were present:

```
os = lose98
username = james
password = ShakenNotStirred
check-password(james ShakenNotStirred) = fail
network = internal
```

Apparently, these facts are sufficient to conclude that `access = allow`.

Be sure to justify your answers to the following questions.

Part A (15 Points)
Assuming that the system is based on forward chaining and that it stops when any hypothesis has been confirmed, which conflict resolution strategy is used?

1. Most specific rule (longest LHS). If two triggered rules have the same length, the highest numbered rule is fired first.
2. Most general rule (shortest LHS). If two triggered rules have the same length, the lowest numbered rule is fired first.
3. Rule order. Check lowest numbered rules first. Whenever a rule fires, check the lowest numbered rules again.
4. Circular queue of rules (R1 is checked, then R2, ..., R10, R1 etc. regardless of which rules fire).

Rule order must be used. The other strategies would conclude that `access = deny`.

Part B (10 Points)
Which rules are fired and in which order for Part A?

R5, R1.

Part C (10 Points)
If the following facts were input, what would be the conclusion using the most specific rule strategy?

```
username = gilbates
os = lose98
network = external
```

Indicate which rules fire and in what order.

R9, R8, R4, R1.

PROBLEM 2 (20 Points)
James is known to explore the Mega-Hard Network by visiting, that is, executing on, one machine at a time. After a random time interval, it selects another machine to visit from the set of all computers that are connected to its present machine. The machine selected is the one with the lowest internet address number that James has not yet visited.

Part A (10 Points)
What search strategy is this?

Depth-first.

Part B (10 Points)
James stores all machines visited in a map data structure. Suggest a strategy for James to go to a specific machine in the fewest moves.

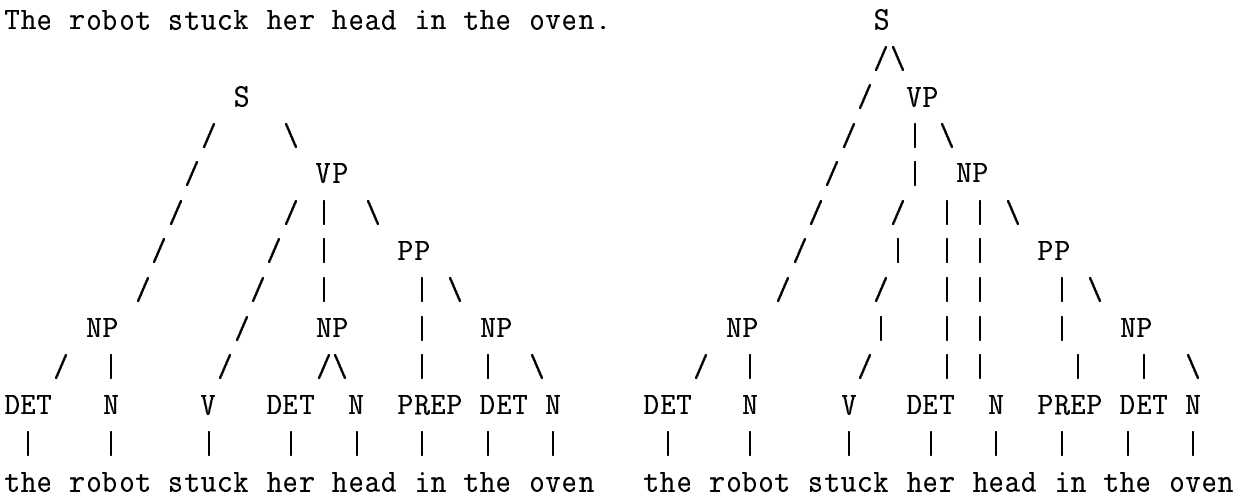
Search the map using branch and bound. It is the simplest approach that will find the optimal path.

PROBLEM 3 (45 Points)
James understands the following simple grammar:

$$\begin{aligned} \texttt{S} &\rightarrow \texttt{NP VP} \\ \texttt{NP} &\rightarrow \texttt{DET N PP}^* \\ \texttt{VP} &\rightarrow \texttt{V NP PP}^* \\ \texttt{PP} &\rightarrow \texttt{PREP NP} \end{aligned}$$

Note that PP* means zero or more prepositional phrases PP.

Part A (15 Points)
Complete parse trees for the two legal parses for the sentence



Part B (5 Points)
Which parse is correct and why?

The left parse is correct. The reason is that "in the oven" modifies "stuck", not "head".

Part C (10 Points)
Show a frame-based representation of the meaning of the sentence pair

```
The robot stuck her head in the oven.  It was warm.
```

Be sure to include all relevant thematic roles.

```
act:         moved          object: oven
agent:       robot       -> temp:   warm
object:      her head   /
destination: oven      /
caused:      sense temp
```

Part D (10 Points)
On the other hand, changing 2 words can change the entire meaning of the sentences. Consider, for example,

```
The robot stuck her head out the door.  It was warm.
```

What is the "it" in the last sentence?
What knowledge can one use to distinguish this example from the previous one?

"It" is the state (temprature) of the outside world. Interestingly, "outside" never appears in the text. One would have to know that one can stick one's head out a door to sense the temperature outside. This is a type of causal knowledge.

Part E (5 Points)
Show the "warm" frame from part D. You do not need to show the "stuck" frame.

```
object:  outside-world
temp:    warm
```