
In algorithm A, we have \( f(n) = g(n) + h(n) \), where \( h(n) \) is the estimated distance from node \( n \) to the goal. The picture above shows the real distances between the nodes. Give values to \( h(A) \) and \( h(B) \), so the function \( f(n) \) is

a) optimistic and monotone
b) optimistic but not monotone
c) not optimistic but monotone
d) not optimistic and not monotone

If some case isn't possible explain why.

e) What does it mean for the search process if \( f(n) \) is monotone and/or optimistic?

2. LISP (5).

Write a lisp function, FOO, which transforms logical expressions with AND, OR and NOT to expressions with only IMPLIES and NOT.

We have

\[
\begin{align*}
(\text{AND } A \; B) & \quad \text{becomes} & (\text{NOT} \; (\text{IMPLIES} \; A \; (\text{NOT} \; B))) \\
(\text{OR } A \; B) & \quad \text{becomes} & (\text{IMPLIES} \; (\text{NOT} \; A) \; B)
\end{align*}
\]

So if we do

\[(\text{FOO} \; ' \; (\text{AND} \; (\text{OR} \; A \; B) \; C))\]

we should get

\[(\text{NOT} \; (\text{IMPLIES} \; (\text{IMPLIES} \; (\text{NOT} \; A) \; B) \; (\text{NOT} \; C)))\]

(continue)
3. Planning (5)
a) Explain briefly what we need to model/define/describe in order to solve a planning problem.
b) Explain what the frame problem is in the context of planning.
c) How does STRIPS handle the frame problem?

4. Expert systems (5)
a) What three roles are identified in relation to expert systems?
b) What functions should an expert system have?
c) Describe briefly the advantages and disadvantages of Certainty Factors compared to pure statistics (using Bayes’ rule) in expert systems. If you can, discuss them for each of the roles of question a).

5. Learning (6)
Explain the concept and give a concrete example, of
a) supervised learning,
b) unsupervised learning and
c) reinforcement learning.

6. Natural Language (5).
Suppose we have the following context free grammar:

```
S -> NP VP   N -> John
NP -> N PP   N -> Bill
NP -> N   N -> a telescope
VP -> V NP PP  V -> saw
VP -> V NP   P -> with
VP -> V PP
VP -> V
PP -> P NP
```

The sentence "John saw Bill with a telescope." could then be parsed in more than one way. Draw the parse trees and explain how they could be interpreted.
7. Bayesian network and logic (8).

Suppose we have the following skeleton of a Bayesian network:

![Bayesian Network Diagram]

a) Put the following concepts of a car's electrical system into the nodes above:

- Battery
- Gas
- Ignition
- Moves
- Music
- Radio
- Starts

b) Discuss how information influences the probabilities if we learn in turn:

- The car doesn't move
- We hear music

c) Transform the Bayesian network into *equivalences* (*not* implications) in propositional logic (so we now leave the probabilistic aspect aside, and assume that all connections are certain in both directions)

d) Transform the equivalences into clauses.

e) Based on these clauses and the facts “The car doesn't move” and “We hear music”, use resolution to prove that the car has no gas.

Good Luck!

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