CPSC 327 Artificial Intelligence Spring 2015: Mid-Term Study Guide

March 3, 2015

1 Name 5 Attributes of Intelligence

Use the reading, class notes, your paper, and my comments to prepare 5 attributes of intelligence that you can write for this part of the test.

2 Grammars

Given the following grammar:

$$
\begin{aligned}
A &\rightarrow B \ \text{'\&'} \ C \\
B &\rightarrow C \ \text{'\%'} \ C \\
C &\rightarrow \ \text{'[a-z]'}
\end{aligned}
$$

which of the following are valid?

1. a % b & c
2. b % c % d
3. x & y % z
4. x % y & z

Given the following grammar:

$U \rightarrow V \text{ ' ' } U \mid V$
$V \rightarrow \text{ '[a-z]+' } \mid \text{ '(' } U \text{ ')' }$

which of the following are valid?

1. I shot an elephant in my pajamas
2. all roads lead to rome
3. amen
4. what is the flying speed of an unburdened sparrow (european or african)

3 Proofs in The Wumpus World

Keep these logic rules in your back pocket:

- Or Commutativity: $A \vee B \equiv B \vee A$.
- And Commutativity: $A \wedge B \equiv B \wedge A$.
- Or Associativity: $A \vee (B \vee C) \equiv (A \vee B) \vee C$.
- And Associativity: $A \wedge (B \wedge C) \equiv (A \wedge B) \wedge C$.
- Double Negation: $\neg\neg A \equiv A$.
- Contraposition: $A \rightarrow B \equiv \neg B \rightarrow \neg A$.
- Implication Elimination: $A \rightarrow B \equiv \neg A \vee B$.
- Biconditional Elimination: $A \leftrightarrow B \equiv (A \rightarrow B) \wedge (B \rightarrow A)$.
- DeMorgan's Law 1: $\neg(A \wedge B) \equiv \neg A \vee \neg B$.
- DeMorgan's Law 2: $\neg(A \vee B) \equiv \neg A \wedge \neg B$.
- Distribute Or: $A \vee (B \wedge C) \equiv (A \vee B) \wedge (A \vee C)$.
- Distribute And: $A \wedge (B \vee C) \equiv (A \wedge B) \vee (A \wedge C)$.

and these inference rules:

- Modus Ponens:
$$\frac{A \rightarrow B, A}{B}$$
.
- And Elimination:
$$\frac{A \wedge B}{A}$$
- Resolution:
$$\frac{(A \vee B \vee C), \neg B}{(A \vee C)}$$

1. Given the rules:

R1: $\neg P_{1,1}$.

R2: $B_{1,1} \leftrightarrow (P_{1,2} \vee P_{2,1})$.

R3: $B_{2,1} \leftrightarrow (P_{1,1} \vee P_{2,2} \vee P_{3,1})$.

we then visit [1,1] and [2,1] and learn the following facts:

R4: $\neg B_{1,1}$.

R5: $B_{2,1}$.

A. Prove that there is no pit at location [1,2].

Step	Rule	Reason
S1	$B_{1,1} \rightarrow (P_{1,2} \vee P_{2,1}) \wedge (P_{1,2} \vee P_{2,1}) \rightarrow B_{1,1}$	Biconditional Elimination of R2.
S2	$(P_{1,2} \vee P_{2,1}) \rightarrow B_{1,1}$	And Elimination.
S3	$\neg B1, 1 \rightarrow \neg(P_{1,2} \vee P_{2,1})$	Contraposition.
S4	$\neg(P_{1,2} \vee P_{2,1})$	Modus Ponens S3 and R4.
S5	$\neg P_{1,2} \wedge \neg P_{2,1}$	DeMorgan.
S6	$\neg P_{1,2}$	And-Elimination

Now move to location [1,2] and learn the fact R6 and add the game rule R7:

R6: $\neg B_{1,2}$.

R7: $B_{1,2} \leftrightarrow (P_{1,1} \vee P_{2,2} \vee P_{1,3})$.

B. Prove that there is a pit in location [3,1]

Step	Rule	Reason
S6	$\neg P_{2,2} \wedge \neg P_{1,3}$	S1 - S5 above and R1 applied to R7.
S7	$\neg P_{2,2}$	And Elimination from S6.
S8	$\neg P_{1,3}$	And Elimination from S6.
S9	$(P_{1,1} \vee P_{2,2} \vee P_{1,3})$	Biconditional Elimination of R3 and Modus Ponens R5.
S10	$P_{1,1} \vee P_{3,1}$	Resolution of S9 and S7.
S11	$P_{3,1}$	Resolution of R1 and S10.

4 prolog Programs

4.1 What, if anything, is wrong with the following prolog clause?

sibling(A,B):- parent(X,A), parent(X,B).

What will result if it is run against family.pl?

?- sibling(stephanie, X).
X = stephanie ;
X = danielle ;
X = stephanie ;
X = danielle.

4.2 Write a set of prolog clauses to define a fibonacci sequence

For an inefficient example,

```
fib(1,1) :- !.
fib(2,1) :- !.
fib(N,F) :- N>2,
            N1 is N-1, fib(N1,F1),
            N2 is N-2, fib(N2,F2),
            F is F1+F2.
```