

2004 Comprehensive Examination

Artificial Intelligence

1. Search.

There are several ways this can be done. The following are examples.

- (a) 9, 8, 7, 6, 5, 4, 3, 2, 1
- (b) 1, 2, 3, 4, 5, 6, 7, 8, 9

2. Logic

- (a) Incomplete
- (b) Incomplete
- (c) Complete
- (d) Incomplete
- (e) Complete

3. Automated Reasoning.

- 1. $\{-p(a,y), q(a,y)\}$
- 2. $\{p(a,y), -q(a,y)\}$
- 3. $\{p(x,f(x)), q(x,g(x))\}$
- 4. $\{-p(x,y), -q(x,y)\}$

- 5. $\{-q(a,y)\}$
- 6. $\{-p(a,y)\}$
- 7. $\{q(a,g(a))\}$
- 8. $\{\}$

4. Probability.

$$\begin{aligned} p(B1|Red) &= p(Red | B1) * p(B1) / p(Red) \\ &= 2/11 * 1/3 / (2/11 + 4/9 + 3/10) * 1/3 \\ &= 0.1963 \end{aligned}$$

5. Natural Language.

(a) There is no semantic interpretation in this case.

(b) $\text{hates}(\text{tom}, \text{mary})$ & $\text{hates}(\text{harry}, \text{mary})$

(c) One way is to add a number parameter, as shown below.

$$\begin{aligned} S(r(x, z) \wedge r(y, z)) &\rightarrow Q(r(\text{both}(x, y), z)) \\ Q(w(u, v)) &\rightarrow NP(u, n) \text{ Verb}(w, n) NP(v) \\ NP(x, s) &\rightarrow Noun(x) \\ NP(\text{both}(x, y), p) &\rightarrow NP(x, z) \textbf{ and } NP(y, z) \\ Noun(\text{tom}) &\rightarrow \textbf{Art} \\ Noun(\text{dick}) &\rightarrow \textbf{Bob} \\ Noun(\text{harry}) &\rightarrow \textbf{Cal} \\ Noun(\text{mary}) &\rightarrow \textbf{Deb} \\ Verb(\text{hates}, p) &\rightarrow \textbf{hate} \\ Verb(\text{hates}, s) &\rightarrow \textbf{hates} \end{aligned}$$

It is also possible to accomplish this by splitting the rules for Q , NP , and $Verb$; but this can be more cumbersome.