CSE 571

Problem Set 4

Q1. For each of the following pairs of sentences, determine whether or not the sentences are logically equivalent.

1.1. $(p \Rightarrow q \vee r)$ and $(p \wedge q \Rightarrow r)$

1.2. $(p \Rightarrow q \vee r)$ and $(p \wedge \neg q \Rightarrow r)$

1.3. $(p \Rightarrow q \vee r)$ and $(\neg p \wedge q \Rightarrow r)$

1.4. $(p \Rightarrow q \vee r)$ and $(\neg r \wedge p \Rightarrow q)$

1.5. $(p \Rightarrow (q \Rightarrow r))$ and $(p \wedge q \Rightarrow r)$

1.6. $((p \Rightarrow q) \vee (q \Rightarrow r))$ and $(p \vee \neg p)$

Q2. Use the Truth Table Method to answer the following questions about logical entailment.

2.1. $\{p \Rightarrow q \vee r\} \models (p \Rightarrow r)$

2.2. $\{p \Rightarrow r\} \models (p \Rightarrow q \vee r)$

2.3. $\{p \Rightarrow q \vee r, q \Rightarrow r\} \models (p \Rightarrow r)$

Q3. Convert the following sentences to conjunctive normal form.

3.1. $(A \rightarrow B) \rightarrow C$

3.2. $A \rightarrow (B \rightarrow C)$

3.3. $(\neg P \rightarrow (P \rightarrow Q))$

Q4. Given the knowledge base KB, use resolution to tell if we can entail query A:

- $B \wedge C \rightarrow A$
- B
- $D \wedge E \rightarrow C$
- $E \vee F$
- $D \wedge \neg F$

Q5. Given the knowledge base KB below, can we use resolution to prove E is true? Show if we can.

- A
- B
- D
- $\neg A \vee \neg B \vee C$
- $\neg C \vee \neg D \vee E$

Q6. Consider the following Progression planning problem

- State variables: S = {a, b, c, d}
- Initial State: I = {a, b}
- Goal State: G = {b, d}
- Actions (format: <parameters, precondition, effect>):
    - O1: < ∅, {a, b}, {¬b, c}>
    - O2: < ∅, {a, b}, {¬a, ¬b, d}>
    - O3: < ∅, {c}, {b, d}>

6.1. Show if we can reach the goal state or not.

6.2. What are the state(s) that will be added to the search space when state {a,b} is expanded by progression search?

Q7. Consider the same planning problem in Q6

- State variables: S = {a, b, c, d}
- Initial State: I = {a, b}
- Goal State: G = {b, d}
- Actions (format: <parameters, precondition, effect>):
- O1: < ∅, {a, b}, {¬b, c}>
- O2: < ∅, {a, b}, {¬a, ¬b, d}>
- O3: < ∅, {c}, {b, d}>

7.1. What is the result of regressing G over O1?

7.2. What is the result of regressing G over O2?

7.3. What is the result of regressing G over O3?