

22AIE 201 Fundamentals of AI

Theory Assignment 2

Propositional Logic

1. Suppose that the statement $p \rightarrow \neg q$ is false. Find all combinations of truth values of r and s for which $(\neg q \rightarrow r) \wedge (\neg p \vee s)$ is true.
2. Without using truth table prove $(p \wedge q) \rightarrow (p \vee q) \equiv T$
3. When is a propositional formula P valid? When is P satisfiable?
4. Use the truth table to answer the following questions about logical entailment.
 - a. $\{p \Rightarrow q \vee r\} \models (p \Rightarrow r)$
 - b. $\{p \Rightarrow r\} \models (p \Rightarrow q \vee r)$
 - c. $\{q \Rightarrow r\} \models (p \Rightarrow q \vee r)$
 - d. $\{p \Rightarrow q \vee r, p \Rightarrow r\} \models (q \Rightarrow r)$
 - e. $\{p \Rightarrow q \vee r, q \Rightarrow r\} \models (p \Rightarrow r)$
5. Determine whether each of the following is a tautology, a contradiction or neither:
 - a. $p \rightarrow (p \vee q)$
 - b. $(p \rightarrow q) \wedge (\neg p \vee q)$
 - c. $(p \vee q) \leftrightarrow (q \vee p)$
 - d. $(p \wedge q) \rightarrow p$

Predicate Logic

6. Translate the following English sentences to first-order logic using the following predicates: Owns(x, y), Dog(x), Cat(x), Cute(x), and Scary(x). For example, Owns(x, y) means that object x owns object y :
 - (a) Joe has a cute dog.
 - (b) All of Joe's dogs are cute
 - (c) Unless Joe owns a dog, he is scary.
 - (d) Either Joe has at least one cat and at least one dog or he is scary (but not both at the same time).
 - (e) Not all dogs are both scary and cute.
7. Consider the following axioms:

1. All hounds howl at night.
2. Anyone who has any cats will not have any mice.
3. Light sleepers do not have anything which howls at night.
4. John has either a cat or a hound.

Prove by Resolution tree “If John is a light sleeper, then John does not have any mice”