**Problem 7.1** PL Concepts

**Answer:**

1. **Every satisfiable formula is valid [False]**

Let, model , then

satisfiable in , iff for some assignment

valid in , iff for all assignments

Therefore, if a formula is satisfiable for some assignment, that doesn’t mean it will be valid for all assignments.

1. **Every valid formula is satisfiable [True]**

Considering the previous model , if a formula already valid for all the assignments, then it will certainly satisfiable.

1. **If is satisfiable, then is unsatisfiable [True]**

Let’s say, (satisfiable) then (unsatisfiable), but if (unsatisfiable) then (satisfiable).

1. **If , then [True]**

means all assignments that make true also make true, if that is the case then,

if is true for then will also be true for same value of , thus the statement is true.

1. **Every admissible inference rule is derivable [True]**

As the admissible rules are those inference rules which can be consistently employed in derivations in a given system, admissible inference rule is derivable.

1. **If is sound for and , then is satisfiable if and are [True]**

As can be derived from and , that means it is sound, therefore is satisfiable if and are satisfiable.

**Problem 7.2** Equivalence of CSP and SAT

**Answer:**

1. According to the problem description,

SAT instance , where is a set of propositional variables and is propositional formula

CSP instance

**SAT to CSP:**

* Variables in CSP are the propositional variables of SAT, thus
* Domains in CSP are the universe of SAT, thus
* Constraints in CSP are the propositional formula of SAT, thus
* Assignments in CSP are the model of SAT , where is universe and interpretation function
* And two bijections are as follows,
  + Solution of will be for some assignment
  + for some assignment

1. According to the problem description,

CSP instance and SAT instance

**CSP to SAT:**

* Propositional variables in SAT are the variables in CSP, thus
* Propositional formula in SAT is the constrains in CSP, thus
* And two bijections are as follows,
  + Solution of will be the consistent total assignment of CSP, thus

where is a consistent total variable assignment

* + where is an inconsistent variable assignment

**Problem 7.3** Calculi Comparison

**Answer:**