UIUC, CS498, Section EA - Autumn 04 - Homework #1

Eyal Amir

September 9, 2004

1 The Missionaries and Cannibals Problem (50%)

The *K Missionaries and Cannibals Problem* is the following problem:

> K missionaries and K cannibals get to a river. There is a boat that can carry only two people at the same time, and the groups want to go across the river. However, if the cannibals ever outnumber the missionaries, the latter will get eaten. How shall they cross so that nobody gets hurt (emotional feelings don't count here)?

1. Write the settings of the problem in propositional logic.
2. Convert your problem to CNF and enter it to a propositional SAT solver (**not a resolution theorem prover**) of your choice (you can download one from www.salib.org or www.satlive.org). Is it possible to transfer 3 missionaries and 3 cannibals? 4 missionaries and 4 cannibals? 6 and 5?
3. Implement resolution (recommendation: do this in LISP). For those cases where you showed before that there is no way to cross the river, prove your assertion using your resolution implementation.

2 DPLL (20%)

This problem concerns DPLL, a satisfiability search method that is described in chapter 7 of [Russell and Norvig, 2003].

1. Prove that DPLL is sound and complete for SAT checking (from first principles).
2. Extend DPLL so that it counts the number of models satisfying a given set of clauses.

3 Resolution (30%)

1. Prove that resolution is sound (this is pretty much what we did in class).
2. Show that resolution is not complete.
3. Prove that resolution is complete for consequence finding.
4. Prove that checking if a clause is a prime implicate of a CNF formula is NP-Complete

References

[Russell and Norvig, 2003] Stuart Russell and Peter Norvig. *Artificial Intelligence, a Modern Approach*. Prentice Hall, 2nd edition, 2003.