CS323 - Problem Set #2

TA: Eyal Amir

February 11, 1996

1 Abnormality Theory

Problem 1.1 *Write the following in Situation calculus (Note that I sometimes wrote words such as 'usually', and 'in general', but there are some times that I omitted them). Decide where should abnormalities be used.*

1. *Tweety is a bird. Birds normally fly. Penguins normally do not fly. Penguins are birds. In general things do not fly. Birds are 'things'.*

2. *A tool is normally usable. A boat is a tool. Boats usually have oars. Oars are tools. A broken oar is not usable. Boats are usable only in the presence of usable oars. A motorboat is usable even in the absence of oars. A motorboat requires gasoline for its actions.*

2 PVS vs The Missionaries and Cannibals Problem

Definition 2.1 *The* Missionaries and Cannibals Problem *is the following problem:*

> *3 missionaries and 3 cannibals get to a river. There is a boat on their bank of the river, and they want to cross over to the other bank. They do have a problem though. The boat can carry two people at one time, and if ever the Cannibals outnumber the Missionaries in either bank, these last will be eaten. How shall they cross?*

Problem 2.2 1. *Formulate the MCP in the PVS using Situation Calculus and a* counting *formalism instead of naming of the missionaries and cannibals. Prove that the problem is solvable using the PVS.*

2. *Discuss what are the benefits and drawbacks of this approach (compared to the (yet undefined)* Names/Sets *approach). Hint: Find what happens when you hear that one of the missionaries is Jesus Christ.*

3 Circumscription

Problem 3.1 *Circumscribe the following formulas (these should become simple 1st order formulas describing the circumscribed predicate).*

1. $CIRC[isblock(A) \wedge isblock(B); isblock]$ *(no variables, and everything that is not mentioned, is a constant)*
2. $CIRC[isblock(A) \vee isblock(B); isblock]$
3. $CIRC[isblock(A) \vee isblock(B); isblock; A, B]$
4. $CIRC[\forall x \neg P(x); P]$
5. $CIRC[\forall x\ Q(x) \supset P(x); P]$
6. $$CIRC[(Block(x) \wedge \neg Ab(x) \supset Ontable(x)) \\ \wedge \neg Ontable(B_1) \wedge Block(B_1) \wedge Block(B_2) \wedge B_1 \neq B_2 \\ ; Ab; Ontable]$$
7. *Let x be a tuple of variables, $F(x)$ a formula with all parameters explicitly shown. Prove that if $F(x)$ does not contain P, then*

$$CIRC[\forall x(F(x) \supset P(x)); P] \ \equiv \ \forall x(F(x) \equiv P(x))$$

(i.e., in some cases Circumscription *is reducible to* predicate completion*.*