CS 761 EXAM

December 17, 1993

1. Convert the following logical sentences to clauses, and then derive $\Box$ by binary resolution and paramodulation.

$\neg\forall x(0 < x \Rightarrow 0 < i(x))$
$\forall x(x \neq 0 \Rightarrow x * i(x) = 1)$
$0 < 1$
$\forall x(0 < x \Rightarrow 0 \neq x)$
$\forall x(x < 0 \quad \vee \quad x = 0 \quad \vee \quad 0 < x)$
$\forall x \forall y(0 < x \wedge y < 0 \Rightarrow x * y \neq 1)$
$\forall x(x * 0 = 0)$
$\forall x(x = x)$

2. In the Boyer-Moore Prover, after bootstrapping, you could define `even` by:

```
(defn flip (p) ; flip 0 and 1
    (if (equal p 0) 1
        (if (equal p 1) 0
           p)))
(defn parity (n) (if (zerop n) 0 (flip (parity (sub1 n)))))
(defn even (n) (equal (parity n) 0))
```

Then, if you try

```
(prove-lemma ee () (implies (even n) (even (plus n 2))))
```

it fails. Why does it fail, and what would you give it as hints and/or auxiliary lemmas to make it work?

3. Let $\mathcal{S}$ be the following prolog program:

$member(X, [X|Tail]).$
$member(X, [Y|Tail]) :- member(X, Tail).$
$p :- member(X, X).$
$q :- not(p).$
$r :- not(member(X, Y)), \quad member(Y, X).$
$s :- not(r).$

For each of the queries, $?-\ p$, $?-\ q$, $?-\ r$, $?-\ s$, answer the following:

a. Does it follow logically from $Comp(\mathcal{S})$?
b. How will a standard prolog respond?
c. Is it true or false in the stratified negation model.

In all cases, explain why. A "standard prolog" is one which does unsound negation and does not do an occur check.