

Logic Programming

Qualifying Examination

This exam is closed book and closed notes.

Question 1 [30 Pts]

Consider the following logic program P :

```
a(X) :- b(X), c(X).
a(X) :- a(X), b(X).
b(1).
b(2).
c(X) :- d(X), b(X).
c(X) :- b(X).
e(X) :- c(X), a(X).
f(X) :- d(X), e(X).
g(X) :- h(X).
```

Answer the following questions:

1. Reproduce the notion of T_P operator and discuss under what conditions it admits a least fixpoint;
2. Provide two distinct Herbrand models for this program;
3. Describe the result obtained from repeatedly applying the T_P operator for the above program;
4. Describe the least Herbrand model for the above program;
5. Add to the program the following rules:

```
d(X) :- b(X), not h(X).
h(X) :- b(X), not d(X).
```

Compute the stable models/answer sets of the new program.

Please make explicit any assumptions you use in solving these questions.

Question 2 [40 Points]

Answer the following questions:

1. Describe the notion of *Computation Rule* as used in logic programming;
2. Describe the computation rule used by the Prolog language; provide two distinct programs P_1 and P_2 such that
 - (a) The goal $?-p$ computed in P_1 using Prolog computation rule terminates successfully

- (b) The goal $? - p$ computed in P_2 using Prolog computation rule leads to an infinite computation

You can use the predicate fail.

3. Develop a Prolog meta-interpreter that always selects first the subgoal with the smallest number of matching clauses.

Exercise 3 [30 Points]

Use Constraint Logic Programming to solve the following problem.

Bill is returning from a trip and he is recollecting the delicious food that he had in different cities he visited. He mentioned having a great pizza, fantastic seafood, outstanding pasta, and decent salad. During his trip he visited Barcelona, Rome, Budapest, and London. Unfortunately he has problems recollecting in which city he had each of the dishes. There are some facts he can recollect:

- *He definitely had seafood while in Rome;*
- *The city he visited after the one where he had pasta was not London;*
- *Barcelona was the second stop in the trip;*
- *He had salad in the second city after leaving Budapest.*

Provide the modeling of the problem using CLP. Clearly identify variables, domains, and labeling phase. Demonstrate by hand the resolution process using whatever propagation strategy you desire.