

Artificial Intelligence—Spring 2011

Qualification Exam (Open Book and Notes)

Question 1

(40 points) Represent the following sentences as formulae of a first order logic knowledge base KB :

- Every book has many pages and chapters.
- Each page in a book belongs to one chapter.
- “My story” is a book.

You should use the predicate $book(B)$ (B is a book), $page(X, B)$ (X is a page of B), $chapter(C, B)$ (C is a chapter of B), and $belong(X, C)$ (X belongs to C). You can introduce additional predicates, constants, etc. with their intuitive meaning if needed but you need to justify your choice.

Answer the following:

- Translate the English sentence “‘My story’ has some pages and chapters’ into a formula, say φ , in the language of your KB .
- Use refutation to show that $KB \models \varphi$.
- Expand your knowledge base with the following information “Each page in a book belongs to one and only one chapter” and 1 and 10 are two different pages of the book “My story.” Let the new KB be KB' .

Translate the formula

$$\psi = \neg\exists C.[chapter(C, "Mystory") \wedge belongs(1, C) \wedge belongs(10, C)]$$

into English. Show that your KB' does not entail the formula ψ .

Question 2

(30 points) Suppose that we have the logic program

$$P = \begin{cases} p(0) & \leftarrow \\ q(1, Y) & \leftarrow p(Y) \\ r(X) & \leftarrow p(X), \text{ not } t(X) \\ t(X) & \leftarrow q(X, Y), \text{ not } r(X) \end{cases}$$

Answer the following:

- What are the rules of $ground(P)$?
- Compute answer sets (or stable models) of P .
- Does $P \models p(0)$?
- Does $P \models t(1)$?

Justify your answer.

Question 3

(30 points) In an all-you-can-eat restaurant, customers can choose one starter, one main course, one dessert, and one drink from the daily menu and pay the same price. Today's menu are:

- *Starter*: potato salad (denoted by ps), soup (so), and salad (sa);
- *Main course*: beef (b), chicken (c), pork (p), fish (f), and lamb (l);
- *Dessert*: ice cream (ic), yogurt (yo), and cake (ca);
- *Drink*: coke (k), white wine (ww), red wine (rw), and tea (t).

Tom comes to the restaurant and wants to place an order. He does have a few preferences

- He does not want to drink red wine or coke if he orders fish.
- Whenever he orders beef, he would like to have ice cream as dessert.
- If he takes soup as starter, he will have chicken for the main course.
- If he chooses lamb for the main course, he definitely will have the red wine for drink.

Help Tom making choices satisfying his preferences by developing a logic program whose answer sets correspond to the choices that Tom can make. Provide some intuitive arguments that justify the correctness of your program.