1. Tangled Web of Relationships

Formalize family relationships in Prolog to understand and answer queries about the following news item from a July 1922 Zurich newspaper:

I married a widow who had a grown-up daughter. My father, who visited us quite often, fell in love with my step-daughter and married her. Hence, my father became my son-in-law, and my step-daughter became my mother. Some months later, my wife gave birth to a son, who became the brother-in-law of my father as well as my uncle. The wife of my father, that is my step-daughter, also had a son. Thereby, I got a brother, and at the same time, a grandson. My wife is my grandmother, since she is my mother’s mother. Hence, I am my wife’s husband, and at the same time, her step-grandson; in other words, I am my own grandfather.


2. Puzzled Farmer Needs Your Help

Write a logic program to solve the following puzzle involving state-space search:

A farmer must ferry a wolf, a goat, and a cabbage across a river using a boat that is too small to take more than one of the three across at once. If he leaves the wolf and the goat together, the wolf will eat the goat, and if he leaves the goat with the cabbage, the goat will eat the cabbage. How can he get all three across the river safely?

*Hint:* Define a state-machine based on the predicate `state/4` that captures which river bank a particular entity is at. (E.g., `state(left,left,right,left)` denotes the state in which the farmer, the wolf, and the cabbage are on the left bank, and the goat is alone on the right bank.)

3. English to Prolog via Geography

Build a sample database of geographical information by listing facts for the following five predicates: `ocean(X)` means X is an ocean; `country(X)` means X is a country; `continent(X)` means X is a continent; `borders(X,Y)` means X borders Y, where X and Y are either countries or oceans; and `loc(X,Y)` means X is located in Y, where X is a country and Y is a continent. (Include enough data to provide non-null answers to the following questions.)

1. What European countries border an ocean?
2. What oceans border some Asian country, but do not border an African country?

3. Find all pairs of countries located in different continents that border a common ocean.

4. Find all pairs of countries A and B, where A and B have a common border, A borders one ocean, B borders another ocean, and A and B do not border the same ocean.

4. Non-looping Meta-Interpreter

Write a propositional Prolog (proplog) meta-interpreter that simulates the ordinary Prolog interpreter and improves upon it by detecting loops and failing finitely for such cases.

Can this be generalized to (i) Prolog with variables (datalog) and (ii) Prolog with functional symbols (full Prolog) straightforwardly?

How to turnin the solution?

Turnin your well-documented solution file asg-LP.pl to Pilot DropBox. Note that sample test cases, and documentation should be included as comments.

You may work alone or in two member teams.