

Answer Set Programming HW1

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Abstract—The purpose of this homework is to understand how to describe a language, identify relations and construct rules in answer set programming.

Index Terms—answer set programming, SPARC, intelligent system

I. PROBLEM I

A. Problem description.

Background. A computer science depart such as the one in Tech. Questions. What is the course code for Intelligent System? What is the course title of CS3368? Where does CS5368 meet? Is Peter in class CS3368? Who is the instructor of CS3368? Who is an instructor of Peter? Do CS3368 and CS5368 have the same title?

B. Convention

Follow our modeling methodology to identify the objects and relations in the problem, and to list knowledge and corresponding rules. Your writing should follow the following example format for family problem.

objects: cs3366, cs5368, intelligent system, room217, zhang, peter.

relations:

course(X,Y) denotes that the title of course code X is Y

location(X,Y) denotes that the location of course code X is Y

enroll(X,Y) denotes that person X is enroll (in) class Y.

instructor(X,Y) denotes that person X is the instructor of class Y.

iSameTilte(X,Y) denotes that the title of course code X is the same as the title of course code Y.

instructedby(X,Y) denotes that person X is instructed by person Y.

knowledge/rule:

% the title of course code cs5368 is intelligent system
course(cs5368, intelligent system).

% the title of course code cs3366 is intelligent system
course(cs3366, intelligent system).

% the location of course code cs5368 is in room217
location(cs5368, room217).

% the location of course code cs3366 is in room217
location(cs3366, room217).

% zhang is the instructor of course code cs5368
instructor(zhang,cs5368).

% zhang is the instructor of course code cs3366
instructor(zhang,cs3366).

% peter is enrolled in course code cs3366

enroll(peter, cs3366).

% for all X, Y, course code X has the same title with course code Y IF there exists a course title Z such that the title of course code X is Z and the title of course code Y is Z. $X \neq Y$.
iSameTilte(X,Y):- course(X,Z), course(Y,Z).

% for all X, Y, a person X is instructed by an instructor Y IF there exists a course code Z such that person X is enrolled in course code Z and Y is the instructor of course code Z.
instructedby(X,Y):- enroll(X,Z), instructor(Y, Z).

SPARC source code can be found via:
<https://goo.gl/Hjg94G>

II. PROBLEM II

Write an English description of what uncle is using parent and brother. Represent your knowledge into rule(s).

English description: for all X and Y, X is the uncle of Y if exists a Z such that X is brother of Z and Z is parent of Y.

Rules: uncle(X,Y) :- brother (X, Z), parent (Z, Y).

SPARC source code can be found via:
<https://goo.gl/rnkHXP>

III. PROBLEM III

Write an English description of what an ancestor is using parent. Represent your knowledge into rules.

English description: for all X and Y, X is the ancestor of Y if X is parent of Y or X is (recursively) parent of an antecedent.

Rules:

% ancestor(X,Y) denotes that X is ancestor of Y

ancestor(X,Y) :- parent (X, Y).

ancestor(X,Y) :- parent(X, Z), ancestor(Z, Y).

IV. PROBLEM IV

Problem description: Background Knowledge. Factorial in mathematics.

Questions: is 1 the factorial of 0? What is the factorial of 2? Which numbers factorial is 2? is 3 the factorial of 2? (answer should be no).

Write relations needed and their meaning and rules to answer those questions. Do not submit a full program. If you want to test the program on SPARC, please dont use number bigger than 4 (e.g., factorial of 4 is fine).

Relations: factorial(N,F) denotes that F is the factorial of N. Based case factorial(0,1) denotes that factorial of 0 is 1. - factorial(N,F) denotes that if we do not know F is the factorial of N then F is NOT the factorial of N **sorts**

#number = 0..24.

predicates

factorial(#number,#number).

rules

% factorial(0,1) denotes that 1 is the factorial of 0 (base case)
factorial(0,1).

factorial(N+1, F*(N+1)):- factorial(N,F), N < 24.

% -factorial(N,F) denotes that if we do not know F is the factorial of N then F is NOT the factorial of N

-factorial(N,F):- not factorial(N,F).

Questions

- is 1 the factorial of 0 ? factorial(0,1): yes
- What is the factorial of 2? factorial(2,F): F =2
- Which numbers factorial is 2? factorial(N,2): N = 2
- is 3 the factorial of 2? factorial(2,3): no

SPARC source code can be found via: <https://goo.gl/uA2dr4>

V. PROBLEM V

It is important to be able to read a rule correctly by using proper quantifiers and the meaning of relations. Write the reading of each of the following rules. Meaning of each relation can be found in slides or book.

- parent(X, Y) :- father(X, Y). *X is parent of Y if X is father of Y.*
- grandparent(X, Y) :- parent(X, Z), parent(Z, Y). *X is the grandparent of Y if exists Z such that X is parent of Z and Z is parent of Y.*
- val(W, 1) :- type(G, and), output_wire(G, W), input_wire(G, Wi), val(Wi, 1). *The signal of a wire W is 1 IF there exists an gate G, wire Wi such that the type of gate G is 'and', the output wire of G is W, the input wire of G is Wi, and the signal of wire Wi is 1.*

VI. PROBLEM VI

Write a workable SPARC program to model the circuit in the slides of L3.

- Refer to L2-program.txt on blackboard for a complete SPARC program example.
- To edit a SPARC program and ask queries to the program, go to <http://wave.ttu.edu>.
- Manual of SPARC language can be found here: <https://bit.ly/2wTpbLc>
- Your program must contain rules to represent the circuit in the slides and rules representing general knowledge on three types of gates: and, or, not.
- Your program should be able to answer typical questions about the circuit such as those listed in the slides.
- You must include proper comments, i.e., an English description of knowledge, for your rules.

- Coding methodology: it is a good idea to test each rule or a small set of related rules. It is a BAD idea to write all the rules and then test them together.

SPARC source code can be found via:
<https://goo.gl/mTLTQp>