

Artificial Intelligence

Assignment 5

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1 Prolog

(4 Points)

Here are four different ways to extend our family example with `childOf/2` to arbitrary descendants:

1. `descendantOf(X,Y) :- childOf(X,Y).`
`descendantOf(X,Y) :- childOf(X,Z), descendantOf(Z,Y).`
2. `descendantOf(X,Y) :- descendantOf(Z,Y), childOf(X,Z).` `descendantOf(X,Y) :- childOf(X,Y).`
3. `descendantOf(X,Y) :- childOf(X,Y).`
`descendantOf(X,Y) :- descendantOf(Z,Y), childOf(X,Z).`
4. `descendantOf(X,Y) :- childOf(X,Z), descendantOf(Z,Y).` `descendantOf(X,Y) :- childOf(X,Y).`

All those definitions are logically equivalent. Which ones work well in Prolog and which ones do not? Why?

The Prolog command `trace.` might help you.

Solution

1. Correct.
2. There are cyclic relationships found, which means that the program gets stuck in a recursion loop as shown below.

```
abhinavralhan@Abhinavs-MBP: ~/Downloads/ai/assignments/assignment5
$ swipl simpleFamily2.pl
Welcome to SWI-Prolog (threaded, 64 bits, version 9.0.4)
SWI-Prolog comes with ABSOLUTELY NO WARRANTY. This is free software.
Please run ?- license. for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?- trace.
true.

[trace] ?- descendantOf(maria, claudia).
Call: (10) descendantOf(maria, claudia) ? creep
Call: (11) descendantOf(_12616, claudia) ? creep
Call: (12) descendantOf(_13428, claudia) ? creep
Call: (13) descendantOf(_14240, claudia) ? creep
Call: (14) descendantOf(_15052, claudia) ? creep
Call: (15) descendantOf(_15864, claudia) ? creep
Call: (16) descendantOf(_16676, claudia) ? creep
Call: (17) descendantOf(_17488, claudia) ? creep
Call: (18) descendantOf(_18300, claudia) ? creep
Call: (19) descendantOf(_19112, claudia) ? creep
Call: (20) descendantOf(_19924, claudia) ? creep
Call: (21) descendantOf(_20736, claudia) ? creep
Call: (22) descendantOf(_21548, claudia) ? creep
Call: (23) descendantOf(_22360, claudia) ? creep
Call: (24) descendantOf(_23172, claudia) ? creep
Call: (25) descendantOf(_23984, claudia) ? creep
```

3. There are cyclic relationships found, which means that the program gets stuck in a recursion loop as shown below.

```
abhinavralhan@Abhinavs-MBP: ~/Downloads/ai/assignments/assignment5
$ swipl simpleFamily4.pl
Welcome to SWI-Prolog (threaded, 64 bits, version 9.0.4)
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Please run ?- license. for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?- trace.
true.

[trace] ?- descendantOf(maria, claudia).
  Call: (10) descendantOf(maria, claudia) ? creep
  Call: (11) childOf(maria, _12610) ? creep
  Exit: (11) childOf(maria, claudia) ? creep
  Call: (11) descendantOf(claudia, claudia) ? creep
  Call: (12) childOf(claudia, _15042) ? creep
  Exit: (12) childOf(claudia, berta) ? creep
  Call: (12) descendantOf(berta, claudia) ? creep
  Call: (13) childOf(berta, _17474) ? creep
  Fail: (13) childOf(berta, _17474) ? creep
  Redo: (12) descendantOf(berta, claudia) ? creep
  Call: (13) childOf(berta, claudia) ? creep
  Fail: (13) childOf(berta, claudia) ? creep
  Fail: (12) descendantOf(berta, claudia) ? creep
  Redo: (11) descendantOf(claudia, claudia) ? creep
  Call: (12) childOf(claudia, claudia) ? creep
  Fail: (12) childOf(claudia, claudia) ? creep
  Fail: (10) descendantOf(maria, claudia) ? creep
```

4. Correct.

2 Default rules

(6 Points)

Represent the following sentences as default rules:

1. Spouses of Germans rarely hate soccer.
2. People usually have the same hometown as their spouse.
3. Most of the time, a person's hometown is where his or her employer is located.

Use predicate symbols spouse/2, employer/2, german/1 and hate/2, as well as function symbols hometown/1, location/1 and soccer/0.

Solution

1. Spouses of Germans rarely hate soccer.

$$\text{Spouse}(X,Y) \wedge \text{German}(Y) : \neg \text{Hate}(X, \text{soccer}) / \neg \text{Hate}(X, \text{soccer})$$

2. People usually have the same hometown as their spouse.

$$\text{Spouse}(X,Y) \wedge \text{hometown}(Y) = Z : \text{hometown}(X) = Z / \text{hometown}(X) = Z$$

3. Most of the time, a person's hometown is where his or her employer is located.

$$\text{Employer}(X,Y) \wedge \text{location}(Y) = Z : \text{hometown}(X) = Z / \text{hometown}(X) = Z$$

3 Default theory

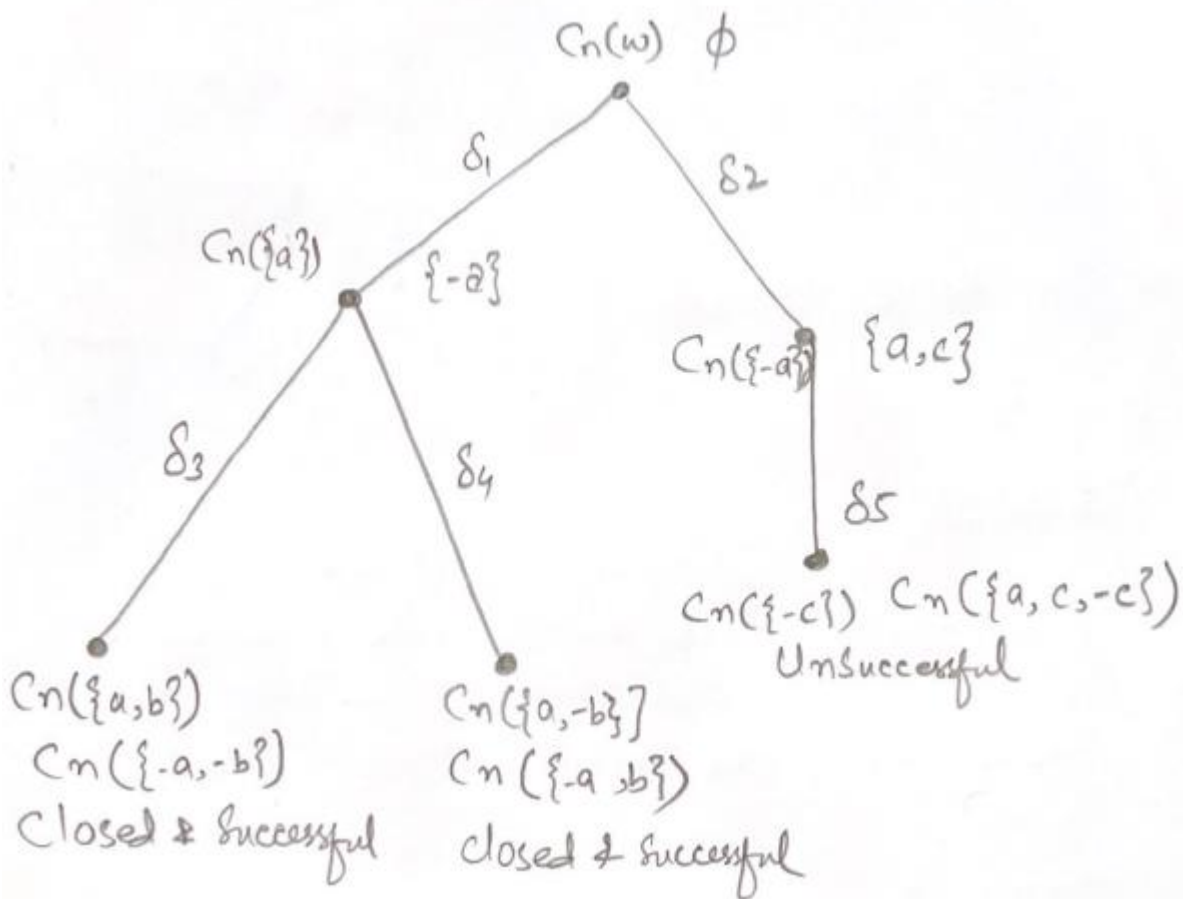
(10 Points)

Let $T = (W, \Delta)$ be a default theory with $W = \emptyset$ and $\Delta = \{\delta_1, \delta_2, \delta_3, \delta_4, \delta_5\}$ with

$$\delta_1 = \frac{T : a}{a}, \quad \delta_2 = \frac{T : \neg a, \neg c}{\neg a}, \quad \delta_3 = \frac{a : b}{b}, \quad \delta_4 = \frac{a : \neg b}{\neg b}, \quad \delta_5 = \frac{\neg a : c}{c}$$

Calculate all extensions of T using a process tree. Make sure that you both draw the tree and state the resulting extensions.

Solution



The extensions are $\{a, b\}$ and $\{a, -b\}$