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Suggestions for Msc. Projects 2005 - 2006

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Knowledge Representation and Reasoning

- Answer Set Programming
  - a non-monotonic reasoning language
  - specification and program are the same
  - Prolog
  - Answer set solvers

Example I

There are five houses in five different colors. In each house lives a person of different nationality. These owners drink a certain beverage, smoke a certain brand of cigarettes and keep a certain pet. No owner has the same pet, drinks the same drink or smokes the same brand. Question: Who owns the fish? Hints:

- The Brit lives in the red house.
- The Swede keeps a dog.
- The Dane drinks tea.
- The green house is on the left of the white house.
- The green house's owner drinks coffee.
- The person who smokes Pall Mall rears birds.
- The owner of the yellow house smokes Dunhill.
- The man living in the house right in the center drinks milk.
- The Norwegian lives in the first house.
- The man who smokes Blend lives next to the one who has cats.
- The man who has horses lives next to the Dunhill smoker.
- The owner who smokes Bluemaster drinks beer
- The German smokes Princess.
- The Norwegian lives next to the blue house.
- The man who smokes Blend has a neighbour who drinks water.

Logic Program

$$
\begin{array}{ll}
h(1,red) \oplus h(1,wh) \oplus h(1,gr) \oplus h(1,ye) \oplus h(1,bl) & \leftarrow \\
h(2,red) \oplus h(2,wh) \oplus h(2,gr) \oplus h(2,ye) \oplus h(2,bl) & \leftarrow \\
h(3,red) \oplus h(3,wh) \oplus h(3,gr) \oplus h(3,ye) \oplus h(3,bl) & \leftarrow \\
h(4,red) \oplus h(4,wh) \oplus h(4,gr) \oplus h(4,ye) \oplus h(4,bl) & \leftarrow \\
h(5,red) \oplus h(5,wh) \oplus h(5,gr) \oplus h(5,ye) \oplus h(5,bl) & \leftarrow \\
n(1,br) \oplus n(1,sw) \oplus n(1,no) \oplus n(1,da) \oplus n(1,ge) & \leftarrow \\
n(2,br) \oplus n(2,sw) \oplus n(2,no) \oplus n(2,da) \oplus n(2,ge) & \leftarrow \\
n(3,br) \oplus n(3,sw) \oplus n(3,no) \oplus n(3,da) \oplus n(3,ge) & \leftarrow \\
n(4,br) \oplus n(4,sw) \oplus n(4,no) \oplus n(4,da) \oplus n(4,ge) & \leftarrow \\
n(5,br) \oplus n(5,sw) \oplus n(5,no) \oplus n(5,da) \oplus n(5,ge) & \leftarrow
\end{array}
$$

Code cont.

$$
\begin{aligned}
a(1, dog) \oplus a(1, bi) \oplus a(1, ca) \oplus a(1, ho) \oplus a(1, fi) &\leftarrow \\
a(2, dog) \oplus a(2, bi) \oplus a(2, ca) \oplus a(2, ho) \oplus a(2, fi) &\leftarrow \\
a(3, dog) \oplus a(3, bi) \oplus a(3, ca) \oplus a(3, ho) \oplus a(3, fi) &\leftarrow \\
a(4, dog) \oplus a(4, bi) \oplus a(4, ca) \oplus a(4, ho) \oplus a(4, fi) &\leftarrow \\
a(5, dog) \oplus a(5, bi) \oplus a(5, ca) \oplus a(5, ho) \oplus a(5, fi) &\leftarrow \\
b(1, tea) \oplus b(1, co) \oplus b(1, mi) \oplus b(1, be) \oplus b(1, wa) &\leftarrow \\
b(2, tea) \oplus b(2, co) \oplus b(2, mi) \oplus b(2, be) \oplus b(2, wa) &\leftarrow \\
b(3, tea) \oplus b(3, co) \oplus b(3, mi) \oplus b(3, be) \oplus b(3, wa) &\leftarrow \\
b(4, tea) \oplus b(4, co) \oplus b(4, mi) \oplus b(4, be) \oplus b(4, wa) &\leftarrow \\
b(5, tea) \oplus b(5, co) \oplus b(5, mi) \oplus b(5, be) \oplus b(1, wa) &\leftarrow
\end{aligned}
$$

Code cont.

$$
\begin{array}{l}
c(1,pm) \oplus c(1,bl) \oplus c(1,bm) \oplus c(1,du) \oplus c(1,pr) \leftarrow \\
c(2,pm) \oplus c(2,bl) \oplus c(2,bm) \oplus c(2,du) \oplus c(2,pr) \leftarrow \\
c(3,pm) \oplus c(3,bl) \oplus c(3,bm) \oplus c(3,du) \oplus c(3,pr) \leftarrow \\
c(4,pm) \oplus c(4,bl) \oplus c(4,bm) \oplus c(4,du) \oplus c(4,pr) \leftarrow \\
c(5,pm) \oplus c(5,bl) \oplus c(5,bm) \oplus c(5,du) \oplus c(5,pr) \leftarrow
\end{array}
$$

$$
\begin{array}{ll}
\leftarrow & h(S,H), h(T,H), T \neq S \\
\leftarrow & b(S,B), b(T,B), T \neq S \\
\leftarrow & c(S,C), c(T,C), T \neq S \\
\leftarrow & n(S,N), n(T,N), T \neq S \\
\leftarrow & a(S,A), a(T,A), T \neq S
\end{array}
$$

Code cont.

$$
\begin{array}{rcl}
n(O, br) & \leftarrow & h(O, red) \\
n(O, sw) & \leftarrow & a(O, dog) \\
n(O, da) & \leftarrow & b(O, tea) \\
 & \leftarrow & h(W, wh), h(G, gr), W \leq G \\
h(O, gr) & \leftarrow & b(O, co) \\
a(O, bi) & \leftarrow & c(O, pm) \\
h(O, ye) & \leftarrow & c(O, du) \\
b(3, mi) & \leftarrow & \\
n(1, no) & \leftarrow &
\end{array}
$$

Code cont.

$$
\begin{aligned}
a(O_1, ca) \oplus a(O_2, ca) &\leftarrow c(O, bl), O_1 = O + 1, O_2 = O - 1 \\
a(O_1, ho) \oplus a(O_2, ho) &\leftarrow c(O, du), O_1 = O + 1, O_2 = O - 1 \\
b(O, be) &\leftarrow c(O, bm) \\
n(O, ge) &\leftarrow c(O, pr) \\
n(O_1, no) \oplus n(O_2, no) &\leftarrow h(O, bl), O_1 = O + 1, O_2 = O - 1 \\
c(O_1, bl) \oplus c(O_2, bl) &\leftarrow b(O, wa), O_1 = O + 1, O_2 = O - 1
\end{aligned}
$$

Solution

The solution for this riddle equals:

number	color	nationality	pet	beverage	cigarettes
1	yellow	Norwegian	cats	water	Dunhill
2	blue	Dane	horses	tea	Blend
3	red	Brit	birds	milk	Pall Mall
4	green	**German**	**fish**	coffee	Princess
5	white	Swede	dog	beer	Bluemaster

Applications

ASP is being used in the real world!

- ★ Decision support systems (NASA)
- ★ Data-integration (Info-Mix)
- ★ Circuit design and verification (A-Circuit)
- ★ Planning (Qsmodels)
- ★ Agents (Dali)

Project Suggestions

- Estimating Answer Set Density
- "SETI@Home" Style Answer Set Solver
- Finite State Autonoma Generation
- Incremental Propositional OCLP
- Compute Time Estimator for ASP
- Precomputing branching strategies for Logic Programs
- An open implementation of DLT
- DLV - Smodels Converter
- Argumentation Frameworks
- Playing Answer Set Programs as Games

More Information?

- Visit `www.cs.bath.ac.uk` and follow the links to Msc. project page
- Email me
- Come to my office 1W2.28
- Note: I will not be in Bath between Friday 17th - Sunday 26th - I should have email access for some part.