partIIId

Version 2.11: 2004/05/14 14:23:45.286 GMT-5

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Abstract

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1 Modeling with Relations

ASIDE: Note that the nhbr relation can actually represent an arbitrarily weird board, such as locations that look adjacent on the map but actually aren't, boards which wrap around a cylinder[1] or toroid[2], or a location with a tunnel connecting it to a location far across the board (like the secret passages in the game Clue, or the harrowing sub trip through the planet Naboo in *Star Wars: The Phantom Menace*[3].) One-way passages can be encoded as well (meaning the nhbr relation need not be symmetric). Actually, *any* graph can be represted!

Exercise 1:

How shall we encode concepts such as "location A has 3 dangerous neighbors", using relations?

Solution:

(solution set will be posted later)

Proofs otherwise unchanged. Note that we might express our rules as "for any locations x and y, we have the following axiom: shows3(x), nhbr(xy) $\rightarrow \neg$ safe(y)" Really, note that there's something else going on here: x and y are symbols which can represent *any* location: they are variables, whose value can be any element of the domain.

For the domain of types-of-vegetables, the relation yummy is a useful one to know, when cooking. In case you weren't sure, yummy (brussel sprouts) = false, and yummy (carrots) = true.

Suppose we had a second relation, yucky. Is it conceivable that we could model a vegetable that's neither yucky nor yummy, using these relations? Sure! (Iceberg lettuce, perhaps.) In fact, we could even have a vegetable which is both yummy and yucky – radishes!

[1]http://hades.ph.tn.tudelft.nl/Internal/PHServices/Documentation/MathWorld/math/math/c/c904.htm
[2]http://hades.ph.tn.tudelft.nl/Internal/PHServices/Documentation/MathWorld/math/math/t/t188.htm
[3]http://www.starwars.com/episode-i/

ASIDE: A quick digression on a philosophical nuance: the domain for the above problem is *not* vegetables; it's types-of-vegetables. That is, we talk about whether or not carrots are yummy; this is different than talking the yumminess of the carrot I dropped under the couch yesterday, or the carrot underneath the chocolate sauce. In computer science, this often manifests itself as the difference between values, and types of values – that is, we distinguish between 3 and the set of all integers; we distinguish between particular carrots and the abstract idea of carrots. (Some languages even include types as values.) Philosophers enjoy debating how particular instances define the abstract generalization, but for our purposes we'll take each both vegetables and types-of-vegetables as given.

1.1 Domains which are unions of other sets

Exercise 2:

You might have objected to the idea of the unary relation yummy, since different people have different tastes. How could you model individuals' tastes? (Hint: Use a *binary* relation.))

Solution:

(solution set will be posted later)

Modeling actors and the has-starred-with relation didn't include information about specific movies. For instance, it was impossible to write any formula which could capture the notion of three actors all being in the same movie.

Exercise 3:

Why not? Why doesn't $\text{coStarred}\,(a,b)\ \wedge\ \text{coStarred}\,(b,c)\ \wedge\ \text{coStarred}\,(c,a)$ Prove your answer by giving a counterexample.

Solution:

(solution set will be posted later)

Exercise 4:

How might we make a model which *does* capture this? What is the domain? What relations do you want?

Solution:

(solution set will be posted later)

Of course, the notion of interpretations are still with us, though usually everybody wants to be thinking of one standard interpretation. Consider a relation with elements such as $\text{isChildOf}\,(\text{Bart}, \text{Homer}, \text{Marge})$. Would the triple (Bart, Marge, Homer) be in the relation as well as (Bart, Homer, Marge)?

As long as all the writers and users of formulas involving isChildOf all agree on what the intended interpretation is, either convention can be used.