Relational Calculus

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Relational calculus

Syntactic sugar for first-order predicate calculus.

Basic notions

- constants
- variables
- database relation symbols
- binary comparison symbols
- boolean connectives
- quantifiers.

Variables

- atomic values (domain relational calculus), or tuples (tuple relational calculus)
- either bound by a quantifier or free.

Basic notions

Terms

- constants
- variables.

Well-formed formulas (wffs)

- atomic formulas $R(t_1, \ldots, t_n)$ with a database relation symbol R and terms $t_1, \ldots, t_n$
- atomic formulas $t_1 \theta t_2$ with a comparison symbol θ and terms t_1 and t_2
- $\neg E$ where E is a wff
- $E_1 \wedge E_2$ where E_1 and E_2 are wffs
- $E_1 \vee E_2$ where E_1 and E_2 are wffs
- $\exists x.E$ where x is a variable and E a wff
- $\forall x.E$ where x is a variable and E a wff.

Valuation

- mapping from a set of variables to a set of constants (ground substitution)
- constants mapped to themselves

Semantics

Given

- a wff E
- a relational database instance D
- a valuation h.

E is true in D under h

1. $R(t_1, \ldots, t_n)$ is true in D under h iff the tuple $(h(t_1), \ldots, h(t_n))$ is in the instance of R in D
2. $t_1 \theta t_2$ is true in D under h iff $h(t_1) \theta h(t_2)$
3. $\neg E$ is true in D under h iff E is not true in D under h
4. $E_1 \wedge E_2$ is true in D under h iff both E_1 and E_2 are true in D under h
5. $\exists x.E$ is true in D under h iff E is true in D under some valuation h' that coincides with h for all variables other than x.

Answer to query Q (with free variables $x_1, \ldots, x_n$) in D

A tuple $(h(x_1), \ldots, h(x_n))$ such that Q is true in D under h.