

IDS Lecture 9: Relational Calculus

- extension of predicate logic

Relational Calculus

A **relational calculus query** is an expression of the form $\{\bar{x} \mid \phi\}$ where,

- head (\bar{x}) is a tuple of variables
- body (ϕ) is a FOL formula
- all the free variables in the body must be mentioned in the head.
- queries without heads are called boolean queries.

Example 1: Name the customers younger than 33 or older than 50 (where Customer = Id, Name, Age).

$$\{y \mid \exists x, z \text{ Customer}(x, y, z) \wedge (z < 33 \vee z > 50)\}$$

Example 2: Name and age of customers having an account in London (where Account = Number, Branch, CustID).

$$\{y, z \mid \exists x \text{ Customer}(x, y, z) \wedge \exists w \text{ Account}(w, \text{'London'}, x)\}$$

Example 3: ID of customers who have an account in *every* branch.

$$\{x \mid \exists y, z \text{ Customer}(x, y, z) \wedge (\forall u, w, v \text{ Account}(u, w, v) \rightarrow \exists u' \text{ Account}(u', w, x))\}$$

Interpretations

Every constant is interpreted as itself

Answer to Queries

With every constant fixed, relational calculus queries are really a ‘database’ as they only operate over the relations.

The answer to a query $Q = \{\bar{x}\varphi\}$ on a database D is

$$Q(D) = \{v(\bar{x}) \mid v : \mathbf{free}(\varphi) \rightarrow \delta \text{ such that } D, v \models \varphi\}$$

Safety

Safety A query is safe if it gives a finite answer on all databases and this answer does not depend on the universe Δ .

- Safety Test: can this query give me an infinite answer (on an infinite database)?