RELATIONAL CALCULUS

- Relational Algebra is a PROCEDURAL LANGUAGE

  => we must explicitly provide a *sequence of operations* to generate a desired output result

- Relational Calculus is a DECLARATIVE LANGUAGE

  => we specify *what* to retrieve, *not how* to retrieve it

Declarative ~ Non-Procedural

- TUPLE Relational Calculus
  Domain Relational Calculus

} Two variants of relational calculus

⇒ Both based on 1st order predicate calculus

RELATIONAL CALCULUS

If a retrieval can be specified in the relational calculus, it can be specified in the relational algebra, and vise versa

$\rightarrow$expressive power of the languages is identical

A query language L is Relationally complete if L can express any query that can be expressed in the relational calculus

OPERATIONS in Tuple Relational Calculus

$\wedge$ - AND

$\vee$ - OR

$\neg$ - NOT

$\exists x$ – there exists x

$\forall x$ – for all x

General power of 1st order predicate calculus – allow more flexible expression formats

TUPLE RELATIONAL CALCULUS

A query in the T.R.C

→ { t| P(t) }

Predicate

Set of all tuples such that P(t) is true for t

Example:

{t | t ∈ Employee (∧) t.salary and t[SALARY] > 5000

Employee.salary > 5000

Boolean test that tuple t is a member of the employee realtion

Arrtibute of t

Operator or single tuple only

Standard conditional operation

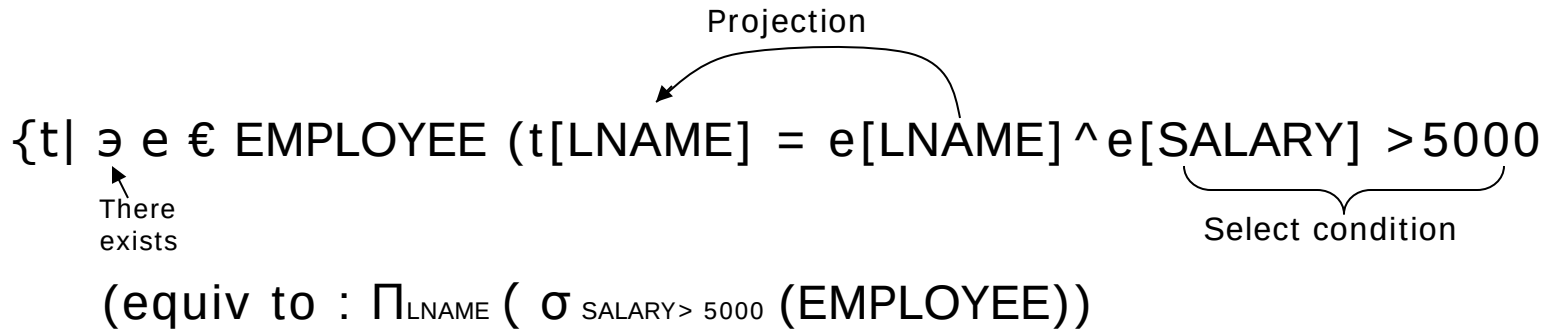
=>similar in function to SELECT(σ)

$T \leftarrow \sigma_{salary > 5000}(EMPLOYEE)$

condition relation

TUPLE RELATIONAL CALCULUS

Handling Projections (Π)



(equiv to : Π_{LNAME} ($\sigma_{SALARY> 5000}$ (EMPLOYEE))

The new relation t is only defined for the attributes it is explicitly assigned (eg LNAME)

JOINS IN THE TUPLE RELATIONAL CALCULUS

projection

{t | ə d € DEPARTMENT (t[DNAME] = d[DNAME]

projection

^ ə e € EMPLOYEE (t[LNAME] = e[LNAME]

^ d[MGRSSN] = e[SSN]))

Join condition

~ Π DNAME,LNAME (DEPARTMENT ⋈ MGRSSN=SSN (DNO=DNUMBER) EMPLOYEE

Another join option

GENERAL FORMAT OF THE TUPLE RELATIONAL CALCULUS

Result relation t (only has attributes explicitly defined)

$$\{ t \mid \exists d \in \text{DEPARTMENT} (t[\text{DNAME}] = d[\text{DNAME}]$$

Project and rename

$$\wedge t[\text{DNO}] = d[\text{DNUMBER}]$$

$$\vdots$$

$$\wedge d[\text{DNUMBER}] < 3$$

Selection (σ) on DEPARTMENT

$$\vdots$$

$$\wedge \exists e \in \text{EMPLOYEE}(t[\text{LNAME}] = e[\text{LNAME}]$$

Project and rename

$$\wedge t[\text{FNAME}] = e[\text{FNAME}]$$

$$\wedge \quad \vdots$$

$$\wedge e[\text{SEX}] = \text{M}$$

$$\wedge e[\text{SALARY}] < 50000$$

Selection (σ) conditions on EMPLOYEE

$$\vdots$$

$$\wedge d[\text{MGRSSN}] = e[\text{SSN}])) \}$$

Join condition

GENERAL FORMAT OF THE TUPLE RELATIONAL CALCULUS

{ t | ə d € DEPARTMENT (

ə e € EMPLOYEE (

d[DNUMBER] <3

^ e[SEX] = M

^ e[SALARY] <50000

^ d[MGRSSN] = e[SSN]

^ t[DNO] = d[DNUMBER]

^ t[DNAME] = d[DNAME]

^ t[LNAME] = e[LNAME]

^t[FNAME] = e[FNAME]

)) }

Existentialize Relations

Selection (σ) on DEPARTMENT And EMPLOYEE

Join Condition(s)

Projection

DOMAIN RELATIONAL CALCULUS

Can represent/constraint domain/attribute values more directly

TRC: {t | t € EMPLOYEE ^ t[SALARY] >50000}

DRC :{<f,l,s> | < f,l,s,b,a> € EMPLOYEE ^ S>50000}

The "domain" values satisfying the following conditions

Attributes listed explicitly

An attribute of <…>

DRC : { <l> | <f,l,s,b,a> € EMPLOYEE ^ S>50000}

Projecting domain value for last name