

1)

CS-354  
Assignment-2

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a) RA :

(Department  $\bowtie$  Employee)

$\pi$  (  $\sigma_{dname="Research"}$   
fname, mname,  
lname, address

TRC:

$\{ t.fname, t.mname, t.lname, t.address \} \quad (t \in Employee)$

$\wedge$

$(\exists q \in Department (q.dname = t.dname))$

$\wedge (q.dname = "Research")$

DRC:  $\{ \langle f, m, l, a \rangle \mid (\langle f, m, l, a, ss, bd, se, sa, dnu \rangle \in Employee)$

$\wedge$

$(\langle dno, mgrss, mgrst, dnu \rangle \in Department)$

$\wedge$

$(dno = "Research") \}$

1)

$$b) RA \div: \pi \left( \sigma_{Plocation = "Delhi"} (Project \bowtie Department \bowtie Employee) \right) \\ Pnumber, Dnumber, \\ Lname, Bdate, address$$

TRC  $\div$ :

$$\{ p.pnumber, p.dnumber, e.lname, \\ e.bdate, e.address \mid (\exists p \in Project (p.location = "Delhi") \\ \wedge (\exists d \in Dept. (d.dnumber = p.dnumber)) \\ \wedge (\exists e \in Employee (e.ssn = d.mgrssn)))$$

$$DRC \div: \{ \langle Pno., Dno, ln, bd, add \rangle \mid \langle Fn, Mn, Ln, Ssn, bd, add, \\ sex, sal, Dno \rangle \in Employee \\ \wedge \langle Dna, MgrSSN, MgrSD, Dno_1 \rangle \in Department$$

$$\wedge \langle Pna, Pno, Plo, Dno_2 \rangle \in Project \\ \wedge MgrSSN = Ssn \wedge Dno_2 = Dno, \wedge Plo = "Delhi" \}$$

1)

2)

RA:

$$\pi_{\text{fname, mname, lname}}(\text{Employee}) - \pi_{\text{fname, mname, lname}}(\text{Employee} \bowtie \text{Dependent})$$

$\text{employee.ssn} = \text{dependents.ssn}$

TRC:

$$\{ E.\text{name} \mid (\exists E \in \text{Employee}) \wedge \neg (\exists d \in \text{Dependent} (d.\text{ssn} = e.\text{ssn})) \}$$

DRC:

$$\{ \langle efn, emn, eln \rangle \mid \langle efn, emn, eln, essn, eBd, eAdd, esex, esal, ednum \rangle \in \text{Employee} \wedge \neg (\exists d \langle dssn, ddn, dsex, dBd, drel \rangle \in \text{dependent} \wedge dssn = essn) \}$$

1)

d) RA:

$$\pi_{\text{fname, mname, lname}} \left( \rho_x (\text{Department} \bowtie \text{Employee}) \bowtie \left( \pi_{\text{ESSN}} (\text{Dependent}) - \pi_{\text{ESSN}} (\sigma_{\text{Dependent} \cdot \text{dependentname} \neq y \cdot \text{Dependentname}}) \right) \right)$$

$\rho_y (\text{dependent})$   
 $\text{dependent} \cdot \text{dependentname}$   
 $\neq y \cdot \text{Dependentname}$

$$\text{TRC} \doteq \{ t \cdot \text{fname}, t \cdot \text{mname}, t \cdot \text{lname} \mid \exists t \in \text{Employee} \\ \wedge \exists d \in \text{Department} \wedge t[\text{SSN}] = d[\text{mgrSSN}] \\ \wedge \exists f_1 \in \text{dependent} (t[\text{SSN}] = f_1[\text{ESSN}] \\ \wedge (\neg \exists f_2 \in \text{dependent} (f_1[\text{dependentname}] \neq f_2[\text{dependentname}]))) \}$$

$$\text{DRC} \doteq \{ \langle \text{fn}, \text{mn}, \text{ln} \rangle \mid \langle \text{fn}, \text{mn}, \text{ln}, \text{ss}, \text{bd}, \text{add}, \text{sex}, \text{sal}, \text{dnu} \rangle \in \text{Employee} \\ \wedge \langle \text{dna}, \text{mgrss}, \text{mgrst}, \text{dnu} \rangle \in \text{Department} \\ \wedge \langle \text{ess}, \text{dna1}, \text{se}, \text{bd}, \text{se} \rangle \in \text{dependent} \\ \wedge \neg (\langle \text{ess}, \text{dna2}, \text{se}, \text{bd}, \text{se} \rangle \in \text{dependent}) \\ \wedge (\text{dna}_1 \neq \text{dna}_2) \wedge (\text{mgrss} = \text{ss} \wedge \text{ss} = \text{ess}) \}$$

2)

a)

i)

$$RA \div \pi_{id} \left( \sigma_{\substack{\text{Title} \wedge \text{Major} \\ = \text{"Discrete structures"}}} \left( \rho_x (\text{Enroll} \bowtie \text{Course}) \bowtie_{\substack{SID \\ = ID}} \text{Student} \right) \right)$$

TRC:

$$\{ s.Id \mid (s \in \text{student}) \wedge$$

$$(\exists c \in \text{course} (c[dept, num] = e[dept, num] \wedge c.title = \text{"Discrete structures"}))$$

$$\wedge (\exists e \in \text{Enroll} (s[Id] = e[SID])) \}$$

2)

a)

$$(ii) RA \doteq \pi_{dates} \left( \sigma_{Title = \text{"Database design"}} (Course \bowtie Enroll) \right)$$

TRC:

$$\{ e \cdot dates \mid (e \in Enroll) \wedge$$

$$(\exists c \in Course (c[dept, num] = e[dept, num] \wedge$$

$$c \cdot title = \text{"Database design"} )$$

2)

b)

$$(i) RA \doteq \pi_{Title} \left( \sigma_{\substack{\text{Dept-Name} \\ = \text{"Education"}}} (Dept \bowtie_{\substack{\text{Abbrev} \\ = x \cdot dept}} \rho_x (Enroll \bowtie Course)) \right)$$

$$DRC \doteq \{ ctit \mid \langle cdept, cnum, ctit \rangle \in courses$$

$$\wedge \langle dabb, dnam, dosff \rangle \in dept$$

$$\wedge \langle esid, edept, enum, edate \rangle \in enroll$$

$$(\text{dnam} = \text{"Education"}) \wedge (dabb = cdept) \wedge (cdept = edept) \wedge (cnum = enum)$$

2)  
b)  
ii) RA:

$$\pi_{\text{office}} \left( \sigma_{\substack{x.\text{dept} \\ = \text{"MATH"} \\ \wedge \\ x.\text{num} \\ = 243}} \left( \rho_x \left( \text{Dept} \bowtie_{\substack{\text{Abbrev} \\ = \text{dept}}} \text{Course} \right) \right) \right)$$

DRC:

$$\{ \langle of \rangle \mid \begin{array}{l} \langle ab, na, of \rangle \in \text{Dept} \\ \wedge \\ \langle dt, num, tit \rangle \in \text{Course} \\ \wedge \\ (ab = dt) \wedge dt = \text{"MATH"} \wedge num = 243 \end{array} \}$$