CS354: Problem Set-2

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1) a)

RA $\Pi_{Fname, Mname, Lname, Address}\left(\sigma_{Dname = \text{"Research"}}(Employee \bowtie Department)\right)$

TRC $\{t \mid \exists e \in Employee (t[Fname] = e[Fname] \wedge t[Mname] = e[Mname] \wedge t[Lname] = e[Lname] \wedge t[Address] = e[Address] \wedge \exists d \in Department (d[Dname] = \text{"Research"} \wedge d[Dnumber] = e[Dnumber]))\}$

DRC $\{<f, m, l, a> \mid \exists ssn, bd, s, sal, dn (<f, m, l, ssn, bd, a, s, sal, dn> \in Employee \wedge \exists dname, mgrssn, mgrsd (<dname, mgrssn, mgrsd, dn> \in Department \wedge dname = \text{"Research"}))\}$

1) b) Π

RA $\Pi_{Pnumber, Dnumber, Lname, Bdate, Address}$ ($\sigma_{(Plocation = "Delhi") \wedge (MgrSSN = SSN)}$ (Project $\bowtie$ Department $\bowtie$ Employee))

TRC $\{ t \mid \exists p \in Project (t[Pnumber] = p[Pnumber] \wedge$
$t[Dnumber] = p[Dnumber] \wedge p[Plocation] = "Delhi" \wedge$
$\exists d \in Department (p[Dnumber] = d[Dnumber] \wedge$
$\exists e \in Employee (t[Lname] = e[Lname] \wedge t[Bdate] = e[Bdate] \wedge$
$t[Address] = e[Address] \wedge$
$e[Dnumber] = d[Dnumber] \wedge e[SSN] = d[MgrSSN]))) \}$

DRC $\{ < pn, dn, ln, bd, ad > \mid \exists pN (< pN, pn, "Delhi", dn > \in Project \wedge$
$\exists DN, mgrssn, mgrsd (< DN, mgrssn, mgrsd, dn > \in Department \wedge$
$\exists fn, mn, sex, sal (< fn, mn, ln, mgrssn, bd, ad, sex, sal, dn > \in Employee)) \}$

1) c)

RA $\Pi_{Fname, Mname, Lname}(Employee) - \Pi_{Fname, Mname, Lname}(\sigma_{SSN=ESSN}(Employee \times Dependent))$

TRC $\{t \mid e \in Employee (t[Fname] = e[Fname] \wedge t[Mname] = e[Mname] \wedge t[Lname] = e[Lname] \wedge \text{not } \exists d \in Dependent (d[ESSN] = e[SSN]))\}$

DRC $\{<fn, mn, ln> \mid \exists ssn, bd, a, sex, sal, dn (<fn, mn, ln, ssn, bd, a, sex, sal, dn> \in Employee \wedge \text{not } \exists DN, Sex, Bdate, Rel (<ssn, DN, Sex, Bdate, Rel> \in Dependent))\}$

1) d)

RA $\Pi_{Fname, Mname, Lname}\Big(\big(Employee \bowtie \rho_{x(SSN)}(\Pi_{MgrSSN}(Department))\big) \bowtie \rho_{y(SSN)}(\Pi_{ESSN}(Dependent))\Big)$

TRC $\{t \mid \exists e \in Employee(\exists d \in Department(\exists D \in Dependent($
$t[Fname] = e[Fname] \wedge$
$t[Mname] = e[Mname] \wedge$
$t[Lname] = e[Lname] \wedge$
$e[SSN] = D[ESSN] \wedge D[ESSN] = d[MgrSSN]))))\}$

DRC $\{<fn, mn, ln> \mid \exists ssn, x_1, x_2, x_3, x_4, x_5 (<fn, mn, ln, ssn, x_1, x_2, x_3, x_4, x_5> \in Employee$
$\wedge \exists y_1, y_3, y_4 (<y_1, ssn, y_3, y_4> \in Department :$
$\wedge \exists q_2, q_3, q_4, q_5 (<ssn, q_2, q_3, q_4, q_5> \in Dependent)))\}$

2) a) i)

RA $\Pi_{Id}\left(\sigma_{SID=Id \wedge Major=MATH}\left(\left(\sigma_{Title="Discrete\ Structures"}(Enroll \bowtie Course)\right) \times Student\right)\right)$

TRC $\{t \mid \exists s \in Student(t[Id]=s[Id] \wedge s[Major]=MATH$
$\wedge \exists e \in Enroll(e[SID]=s[Id]$
$\wedge \exists c \in Course(c[Title]="Discrete\ Structures"$
$\wedge c[Dept]=e[Dept]$
$\wedge c[Num]=e[Num]))))\}$

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2) a) ii)

RA $\Pi_{Date}\left(\sigma_{Title="Database\ Design"}(Enroll \bowtie Course)\right)$

TRC $\{t \mid \exists e \in Enroll(t[Date]=e[Date]$
$\wedge \exists c \in Course(c[Dept]=e[Dept]$
$\wedge c[Num]=e[Num]$
$\wedge c[Title]="Database\ Design"))\}$

2) b) i)

RA $\Pi_{Title}\left(\sigma_{Major = Dept \wedge Dept = Abbrev \wedge Dept.Name = "Education"}\left(Course \times Dept \times Student\right)\right)$

DRC $\{ <title> \mid \exists\, d, n\, (<d, n, title> \in Course \wedge$
$\exists\, office(<d, "Education", office> \in Dept \wedge$
$\exists\, id, sn(<id, sn, d> \in Student))\}$

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2) b) ii)

RA $\Pi_{office}\left(\sigma_{Dept = Abbrev \wedge Dept = MATH \wedge Num = 243}\left(Course \times Dept\right)\right)$

DRC $\{ <office> \mid \exists\, t\, (<MATH, 243, t> \in Course \wedge$
$\exists\, n(<MATH, n, office> \in Dept))\}$