CS 440 - Homework 1, Part 2

Relational Algebra

Spring 2023

Submission Instructions: For questions 11 to 20, write your answers on the latex file provided with this homework and generate a pdf file. Submit your pdf file to Gradescope.

Sample syntax:

$\pi_{A,B}(R \bowtie S)$
$\pi_{A,B}(R \bowtie_{R.A=S.A} S)$
$\pi_{A,B}(R \times S)$
$\pi_{A,B}((\sigma_{R.A=123 \wedge S.B<=20000}(R \bowtie S))$
$\pi_{A,B}((\sigma_{R.A=123 \wedge S.B<=20000}(R \bowtie S))$
$\pi_{A,B}(R \rtimes S)$
$\pi_{A,B}(R \ltimes S)$
$\pi_{A,B}(R \rtimes \ltimes S)$
$R \cap S \cup T - U$

1. (5 points):

$R1 \leftarrow Appointments \bowtie_{Appointments.AppointmentID=Vitals.AppointmentID} Vitals$
$R2 \leftarrow R1 \bowtie_{Appointments.AppointmentID=Prescriptions.AppointmentID} Prescriptions$
$R3 \leftarrow R2 \bowtie_{Prescriptions.DrugID=Drugs.ID} Drugs$
$R4 \leftarrow R3 \bowtie_{Patients.PatientID=Appointments.PatientID} Patients$
$R5 \leftarrow R4 \bowtie_{Appointments.DoctorID=Doctors.DoctorID} Doctors$
$R6 \leftarrow \sigma_{Drugs.Name='Cortisone\ Cream'}(R5)$
$R7 \leftarrow \rho_{Vitals.DateTime \rightarrow vital\_time}(R6)$
$R8 \leftarrow \rho_{Drugs.Name \rightarrow drug\_name}(R7)$
$R9 \leftarrow \rho_{Patients.FirstName \rightarrow FirstP}(R8)$
$R10 \leftarrow \rho_{Patients.LastName \rightarrow LastP}(R9)$
$R11 \leftarrow \rho_{Doctors.FirstName \rightarrow FirstD}(R10)$
$R12 \leftarrow \rho_{Doctors.LastName \rightarrow LastD}(R11)$
$R13 \leftarrow \pi_{FirstP||' '||LastP \rightarrow PatientName, FirstD||' '||LastD \rightarrow DoctorName, vital\_time, Temperature, drug\_name, Dosage}(R12)$

2. (5 points):

$$R1 \leftarrow Appointments \times Vitals$$
$$R2 \leftarrow R1 \times Prescriptions$$
$$R3 \leftarrow R2 \times Drugs$$
$$R4 \leftarrow R3 \times Patients$$
$$R5 \leftarrow R4 \times Doctors$$
$$R6 \leftarrow \sigma_{Vitals.AppointmentID=Appointments.AppointmentID}(R5)$$
$$R7 \leftarrow \sigma_{Prescriptions.AppointmentID=Appointments.AppointmentID}(R6)$$
$$R8 \leftarrow \sigma_{Patients.PatientID=Appointments.PatientID}(R7)$$
$$R9 \leftarrow \sigma_{Prescriptions.DrugID=Drugs.ID}(R8)$$
$$R10 \leftarrow \sigma_{Appointments.DoctorID=Doctors.DoctorID}(R9)$$
$$R11 \leftarrow \sigma_{Drugs.Name='Cortisone\ Cream'}(R10)$$
$$R12 \leftarrow \rho_{Vitals.DateTime \rightarrow vital\_time}(R11)$$
$$R13 \leftarrow \rho_{Drugs.Name \rightarrow drug\_name}(R12)$$
$$R14 \leftarrow \rho_{Patients.FirstName \rightarrow FirstP}(R13)$$
$$R15 \leftarrow \rho_{Patients.LastName \rightarrow LastP}(R14)$$
$$R16 \leftarrow \rho_{Doctors.FirstName \rightarrow FirstD}(R15)$$
$$R17 \leftarrow \rho_{Doctors.LastName \rightarrow LastD}(R16)$$
$$R18 \leftarrow \pi_{FirstP||' '||LastP \rightarrow PatientName, FirstD||' '||LastD \rightarrow DoctorName, vital\_time, Temperature, drug\_name, Dosage}(R17)$$

3. (5 points):

$$R1 \leftarrow \pi_{FirstName||' '||LastName \rightarrow PatientName, PatientID}(Patients)$$
$$R2 \leftarrow \pi_{FirstName||' '||LastName \rightarrow DoctorName, DoctorID}(Doctors)$$
$$R3 \leftarrow \pi_{AppointmentID, DateTime \rightarrow vital\_time, Temperature}(Vitals)$$
$$R4 \leftarrow \pi_{ID \rightarrow DrugID, Name \rightarrow drug\_name}(Drugs)$$
$$R5 \leftarrow R1 \bowtie R2$$
$$R6 \leftarrow R5 \bowtie Appointments$$
$$R7 \leftarrow R6 \bowtie R3$$
$$R8 \leftarrow R7 \bowtie Prescriptions$$
$$R9 \leftarrow R8 \bowtie R4$$
$$R10 \leftarrow \sigma_{drug\_name='Cortisone\ Cream'}(R9)$$
$$R11 \leftarrow \pi_{PatientName, DoctorName, vital\_time, Temperature, drug\_time, Dosage}(R10)$$

4. (5 points):

$$R1 \leftarrow \pi_{FirstName||' '||LastName \rightarrow Patient1, PatientID \rightarrow PatientID1, City \rightarrow City1}(Patients)$$
$$R2 \leftarrow \pi_{FirstName||' '||LastName \rightarrow Patient2, PatientID \rightarrow PatientID2, City \rightarrow City2}(Patients)$$
$$R3 \leftarrow R1 \bowtie_{City1 = City2 \wedge PatientID1 < PatientID2} R2$$
$$R4 \leftarrow \pi_{Patient1, Patient2, City1}(R3)$$

5. (5 points):

$$R1 \leftarrow \pi_{PatientID \rightarrow ID, FirstName, LastName}(Patients)$$
$$R2 \leftarrow \pi_{PatientID \rightarrow ID, FirstName, LastName}(Patients \bowtie Appointments)$$
$$R3 \leftarrow R1 - R2$$

6. (5 points):

$R1 \leftarrow Patients \bowtie Appointments$
$R2 \leftarrow R1 \bowtie Prescriptions$
$R3 \leftarrow R2 \bowtie_{Prescriptions.DrugID=Drugs.ID} Drugs$
$R4 \leftarrow \sigma_{Name='Ibuprofen'}(R3)$
$R5 \leftarrow \sigma_{Name='Amoxicillin'}(R3)$
$R6 \leftarrow \pi_{PatientID,LastName}(R4)$
$R7 \leftarrow \pi_{PatientID,LastName}(R5)$
$R8 \leftarrow Appointments \bowtie Vitals$
$R9 \leftarrow \pi_{PatientID,Temperature}(R8)$
$R10 \leftarrow R6 \cap R7$
$R11 \leftarrow R10 \bowtie R9$

7. (5 points):

$\pi_{City,ZipCode}(Patients) - \pi_{City,ZipCode}(Doctors)$

8. (5 points):

$$\pi_{PatientID,DoctorID}(Patients \times Doctors) - \pi_{PatientID,DoctorID}(Appointments)$$

9. (5 points):

b)
minimum = m
maximum = m

c)
minimum = n
maximum = n + m - 1

d)
minimum = m
maximum = m

e)
minimum = max(n, m)
maximum = n * m