Russi Sinha	A20411286
Name	CWID

Homework Assignment 1

Due Date: Tuesday, Sept 19, 2017

CS425 - Database Organization

Please leave this empty!

Instructions

1.1	1.2	1.3	1.4	1.5	1.6

1.7	1.8	1.9	1.10	1.11	1.12	Sum

- Try to answer all the questions using what you have learned in class

- **When writing a query, write the query in a way that it would work over all possible database instances and not just for the given example instance!**

Consider the following database schema and example instance:

Student

sid	name	dept
001	Alice	CS
002	Bob	EE
003	Carol	CS
004	David	PHYS

Course

cid	title	dept	credits
CS425	Databases	CS	3
CS595	Database Security	CS	3
EE591	Microcomputers	EE	4
EE401	VLSI Design	EE	3
PHYS571	Radiation Physics	PHYS	3

Enroll

cid	Sid	grade	gradepoint
CS425	001	A	4.0
CS595	001	B	3.0
CS595	002	A	4.0
EE401	001	A	4.0
EE401	002	B	3.0
EE401	004	A	4.0
PHYS571	002	C	2.0
PHYS571	004	A	4.0

Prereq

cid	pid
CS595	CS425
EE591	EE401
...	...

Hints:

- Underlined attribute form the primary key of a relation.
- The attribute *cid* and *sid* of relation *Enroll* is a foreign key to relations *Course* and *Student*, respectively. All the attributes *cid* and *pid* (except for the one in *Course*) is a foreign key to relation *Course*.
- Attribute *gradepoint* is converted from the letter *grade* (4.0 scale).

Part 1.1 Relational Algebra (Total: 100 Points)

Question 1.1.1 (6 Points)

Find the names of all the students enrolled in 'EE401'.

$$\pi_{name}\ (\sigma_{cid='EE401'}\ (Student \bowtie Enroll))$$

Question 1.1.2 (6 Points)

Return the result as "title, name, and grade" where the grade is 'A' (title and name represent the course title and student name, respectively).

$$\pi_{title,\ name,\ grade}\ (\sigma_{grade='A'}\ (Enroll \bowtie Course \bowtie_{Enroll.sid=Student.sid} Student))$$

Question 1.1.3 (8 Points)

Find the students (sid and name) who has taken the prerequisite(s) for 'CS595' and got an 'A'.

$$E \leftarrow \pi_{pid}\ (\sigma_{cid='CS595'}\ (Prereq))$$
$$\rho_{E1(pid \rightarrow cid)}\ (E)$$
$$\pi_{sid,\ name}\ (\sigma_{grade='A'}\ (Student \bowtie Enroll \bowtie E1))$$

Question 1.1.4 (10 Points)

Find all the EE students (sid and name) who has taken all the courses offered by the 'CS' department.

$$E1 \leftarrow \pi_{cid}\ (\sigma_{dept='CS'}\ (Course))$$
$$E2 \leftarrow (\pi_{name,\ cid}\ (Student \bowtie Enroll)) \div E1$$
$$\pi_{sid,\ name}\ (\sigma_{dept='EE'}\ (E2 \bowtie Student))$$

Question 1.1.5 (10 Points)

Find the IDs of all the students, whose grade in 'EE401' is lower than the grade in 'CS595'.

$$E \leftarrow \pi_{sid,\ gradepoint}\ (\sigma_{cid='EE401'}\ (Enroll))$$
$$\rho_{E1(gradepoint \rightarrow grade\_EE401)}\ (E)$$
$$E0 \leftarrow \pi_{sid,\ gradepoint}\ (\sigma_{cid='CS595'}\ (Enroll))$$
$$\rho_{E2(gradepoint \rightarrow grade\_CS595)}\ (E0)$$
$$\pi_{sid}\ (\sigma_{grade\_EE401<grade\_CS595}\ (E1 \bowtie E2))$$

Question 1.1.6 (8 Points)

List all the students (sid and name) who never got a grade lower than 'B' (grade point below 3.0).

$$\pi_{sid,\ name}\ (Student) - \pi_{sid,\ name}\ (\sigma_{gradepoint<3}\ (Enroll \bowtie Student))$$

Question 1.1.7 (8 Points)

List the titles of all the courses 'Alice' has not taken.

$$E1 \leftarrow \pi_{cid}\ (\sigma_{name='Alice'}\ (Enroll \bowtie Student))$$
$$\pi_{title}\ ((\pi_{cid}\ (Course) - E1) \bowtie Course)$$

Question 1.1.8 (6 Points)

List all the students and their GPA (result: sid and GPA).

$$sid\ \gamma\ avg(gradepoint)\ as\ GPA\ (Enroll)$$

Question 1.1.9 **(8 Points)**

List all the courses and each course's number of prequisites.

$$\text{cid, title } \gamma_{\text{count(cid) as count}} (\text{Course} \bowtie \text{Prereq})$$

Question 1.1.10 **(8 Points)**

List the number of courses for which the average grade of all the enrolled students is lower than 'B' (grade point below 3.0).

$$E1 \leftarrow \sigma_{\text{gpa<3}} (_{\text{cid}} \gamma_{\text{avg(gradepoint) as gpa}} (\text{Enroll}))$$
$$\gamma_{\text{count(cid) as count}} (E1)$$

Question 1.1.11 **(10 Points)**

For every course, return the names of the highest-scoring students (result: course title and student name).

$$E1 \leftarrow {}_{\text{Enroll.cid}} \gamma_{\text{max(gradepoint) as gradepoint}} (\text{Enroll})$$
$$\pi_{\text{title, name}} (E1 \bowtie \text{Enroll} \bowtie \text{Course} \bowtie_{\text{Enroll.sid=Student.sid}} \text{Student})$$

Question 1.1.12 **(12 Points)**

List all the students (sid and name) enrolled in the courses where the prerequisites are taken.

$$E1 \leftarrow \pi_{\text{cid} \leftarrow \text{pid}} (\text{Prereq})$$
$$E2 \leftarrow \pi_{\text{cid}} (\pi_{\text{pid} \leftarrow \text{cid}} (\text{Enroll} \bowtie E1) \bowtie \text{Prereq})$$
$$\pi_{\text{sid, name}} (E2 \bowtie \text{Enroll} \bowtie \text{Student})$$