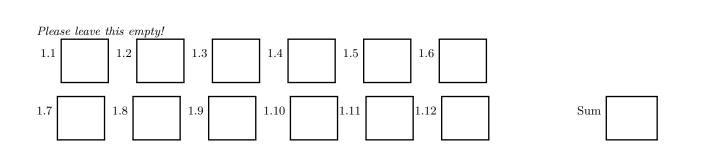
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Homework Assignment 1

Due Date: Tuesday, Sept 19, 2017

CS425 - Database Organization Results



Instructions

- 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

$\underline{\mathbf{sid}}$	name	\mathbf{dept}
001	Alice	CS
002	Bob	EE
003	Carol	CS
004	David	PHYS

Course

$\underline{\operatorname{cid}}$	${ m title}$	dept	$\operatorname{credits}$
CS425	Databases	CS	3
CS595	Database Security	CS	3
EE591	Microcomputers	EE	4
EE401	VLSI Design	EE	3
PHYS571	Radiation Physics	PHYS	3

Enroll

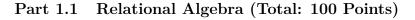
$\underline{\operatorname{cid}}$	$\underline{\operatorname{sid}}$	grade	${f gradepoint}$
CS425	001	A	4.0
CS595	001	В	3.0
CS595	002	A	4.0
EE401	001	A	4.0
EE401	002	В	3.0
EE401	004	A	4.0
PHYS571	002	С	2.0
PHYS571	004	A	4.0

Prereq

$\underline{\mathbf{cid}}$	$\underline{\mathbf{pid}}$
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).



Question 1.1.1 (6 Points)

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

Solution

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

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).

Solution

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

Question 1.1.3 (8 Points)

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

Solution

 $\pi_{sid,name}(\sigma_{Enroll.cid=`CS595' \land grade=`A'}(Enroll \bowtie_{Enroll.cid=Prereq.pid}Prereq \bowtie Student))$

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

Solution

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

$$E2 \leftarrow \pi_{cid}(\sigma_{dept=`CS'}(Course))$$

$$E \leftarrow E1 \div E2$$

Question 1.1.5 (10 Points)

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

Solution

$$\begin{split} E1 \leftarrow & \sigma_{cid=`EE401'}(Enroll) \\ E2 \leftarrow & \sigma_{cid=`CS595'}(Enroll) \\ E \leftarrow & \pi_{E1.sid}(\sigma_{(E1.sid=E2.sid) \land (E1.gradepoint < E2.gradepoint)}(E1 \times E2)) \end{split}$$

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).

Solution

$$S' \leftarrow \pi_{sid}(Student) - \pi_{sid}(\sigma_{gradepoint < 3.0}(Enroll))$$
$$S \leftarrow \pi_{sid,name}(S' \bowtie Student)$$

Question 1.1.7 (8 Points)

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

Solution

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

Question 1.1.8 (6 Points)

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

Solution

$$gp \leftarrow \pi_{Enroll.cid,sid,(gradepoint*credits) \ as \ gp}(Enroll \bowtie Course)$$

$$totalgp \leftarrow_{sid} \mathcal{G}_{sum(gp) \ as \ tgp}(gp)$$

$$totalcre \leftarrow_{sid} \mathcal{G}_{sum(credits) \ as \ tcr}(Enroll \bowtie Course)$$

$$result \leftarrow \pi_{totalgp.sid,(tgp/tcr) \ as \ GPA}(totalgp \bowtie totalcre)$$

Question 1.1.9 (8 Points)

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

Solution

```
courseprereq \leftarrow Enroll \bowtie_{Enroll.cid=Prereq.cid} Prereq
noprereq \leftarrow \pi_{cid}(Course) - \pi_{cid}(Prereq)
numpre \leftarrow_{Enroll.cid} \mathcal{G}_{count(*)}(courseprereq) \cup \pi_{cid,0}(noprereq)
```

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).

Solution

$$avgG \leftarrow_{cid} \mathcal{G}_{avg(gradepoint)}(Enroll)$$
$$num \leftarrow \mathcal{G}_{count(*)}(\sigma_{avg(gradepoint) < 3.0}(avgG))$$

Question 1.1.11 (10 Points)

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

Solution

```
nonhigh \leftarrow \pi_{Enroll.cid,Enroll.sid}(\sigma_{(Enroll.gradepoint < x.gradepoint) \land Enroll.course = x.course}(Enroll \times \rho_x(Enroll)))
cidsid \leftarrow \pi_{Enroll.cid,Enroll.sid}(\pi_{cid,sid}(Enroll) - nonhigh)
result \leftarrow \pi_{title,name}(Course \bowtie cidsid \bowtie Student)
```

Question 1.1.12 (12 Points)

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

Solution

```
cidpre \leftarrow \pi_{Enroll.cid,Enroll.sid,Prereq.pid}(Enroll \bowtie_{Enroll.cid=Prereq.cid} Prereq)pretaken \leftarrow \pi_{cidpre.sid}(\sigma_{(cidpre.pid=x.cid) \land (cidpre.sid=x.sid)}(cidpre \times \rho_x(Enroll)))result \leftarrow \pi_{sid,name}(pretaken \bowtie Student)
```