INDIANA UNIVERSITY
B561 Advanced Database Concepts
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Homework 2

(Q1) Find the sids and names of all students who never got a grade lower than A- (A- is OK).

RA: $\pi_{sid,name}(Students \bowtie Take) - \pi_{sid,name}(Students \bowtie_{\substack{grade!=``A+"\wedge \\ grade!=``A"\wedge \\ grade!=``A-"}} Take)$

RC: $\{s \in Students | \exists t \in Students(s.sid = t.sid \wedge s.name = t.name \wedge \forall a \in Take(a.sid = t.sid \wedge (a.grad = ``A+" \vee a.grade = ``A" \vee a.grade = ``A-")))\}$

SQL: SELECT S.sid,S.name FROM Students as S,Take as T
                         WHERE S.sid = T.sid
EXCEPT
SELECT S.sid,S.name FROM Students as S,Take as T
                         WHERE S.sid = T.sid and T.grad!='A+' and
                         T.grad!='A' and T.grad!='A-'

Q2 Find the students who have never taken any course that is not required by his/her department

RA: $\pi_{sid}(Student) - \pi_{sid}(\pi_{sid,cid}(Take) - \pi_{sid,cid}(Students \bowtie RequiredCourses))$

RC: $\{t \in Students | \exists s \in Students(s.sid = t.sid \wedge \forall a \in Taken(a.sid = s.sid \wedge \exists r \in RequiredCourse(r.dept = s.dept \wedge a.cid = r.cid)))\}$

SQL: SELECT St.sid FROM Students as St
EXCEPT
SELECT St.sid FROM (SELECT T.sid,T.cid FROM Take as T
                              EXCEPT
                              SELECT S.sid,R.cid FROM Students as S,RequiredCourse as R
                              WHERE S.dept = R.dept) as St

Q3 For each department, find the name of the students with the highest GPA (if more than one student has the same GPA, return them all)

SQL: SELECT name,dept,GPA FROM Students as S1
WHERE GPA = (SELECT max(GPA) FROM Students as S2 WHERE S1.dept=S2.dept)

For each department, as stored in the Student's table, we calculate the max GPA and test if the student's GPA matches the max GPA. If it does, the query returns the student.

Q4 A student can get the degree from his/her department if he/she has taken a total of 90 credit hours' courses, has a overall GPA over 2.0, and has taken all required courses. Please find the sids and names of the students who can get the degree from their department.

SQL: SELECT S1.sid,S1.name FROM Students as S1 WHERE GPA >2 and
NOT EXISTS(
                    SELECT S.sid,RC.cidFROM Students as S,RequiredCourse as RC
                    WHERE S.dept = RC.dept and S.sid=S1.sid

INTERSECT
        SELECT T.sid,T.cid FROM Take as T,RequiredCourse as RC
        WHERE S1.sid = T.sid and T.cid=RC.cid) and
EXISTS(
        SELECT SUM(C.credit) FROM Students as S,Take as T, Courses as C
        WHERE S1.sid = S.sid and S.sid=T.sid and T.cid = C.cid
        GROUP BY S.sid
        HAVING SUM(C.credit)>=90)

A student will be returned if GPA is greater than two; and does not exists any recored in the intersection between the required courses of the student's department and the required courses the student has taken; and we can calculate the student's sum of courses' credits to be greater or equal than 90.

Q5 (bonus) Find the courses (cid and name) that are required by more than 10 departments for its degree program.

   SQL: SELECT C.cid,C.name FROM Courses as C,RequiredCourse as RC
        WHERE C.cid=RC.cid
        GROUP BY RC.cid HAVING COUNT(RC.dept)>10

   The query groups the required courses by the course id and counts the dept column for each group. If the count is more than 10, the course's id and name is returned.