

Relational Calculus Practice Questions

Because the coverage of Tuple and Domain Relational Calculus (TRC and DRC, respectively) often occurs in the window of time between the time Homework #1 is assigned and Exam #1 is taken, students don't have a chance to practice with one or both of these languages before being tested on it/them. This handout is meant to provide an opportunity for some of that practice.

Given below is a small DB schema covering student enrollments in university courses, with primary keys underlined and foreign keys listed to the right. Below that are four questions for each type of calculus (two of the questions are shared). Try to answer all of the questions for each language before consulting any of the answers on the second page.

Schema:

Student	$\begin{array}{ c c c } \hline & a & b & c \\ \hline \underline{\text{ID}} & \text{Name} & \text{Major} \\ \hline \end{array}$	Major is a FK to Dept in Course
Course	$\begin{array}{ c c c } \hline & d & e & f \\ \hline \underline{\text{Dept}} & \underline{\text{Num}} & \text{Title} \\ \hline \end{array}$	Dept is a FK to Abbrev in Dept
Dept	$\begin{array}{ c c c } \hline & g & h & i \\ \hline \underline{\text{Abbrev}} & \text{Name} & \text{Office} \\ \hline \end{array}$	
Enroll	$\begin{array}{ c c c c } \hline & j & k & l & m \\ \hline \underline{\text{SID}} & \underline{\text{Dept}} & \underline{\text{Num}} & \text{Date} \\ \hline \end{array}$	SID is a FK to ID in Student; Dept-Num is a FK to Dept-Num in Course

Tuple Relational Calculus

- Express the following English queries in TRC:
 1. What are the department abbreviations and titles of all courses numbered 101?
 2. What are the IDs of the MATH students taking “Discrete Structures?”
- For each of these TRC queries, what is the corresponding query in conversational English?
 3. $\{s.\text{Name}, s.\text{ID} \mid \text{Student}(s) \wedge s.\text{Major} = \text{'CSC'}\}$
 4. $\{e.\text{Date} \mid \text{Enroll}(e) \wedge (\exists c)(\text{Course}(c) \wedge e.\text{Dept} = c.\text{Dept} \wedge e.\text{Num} = c.\text{Num} \wedge c.\text{Title} = \text{'Database Design'})\}$

Domain Relational Calculus

- Express the following English queries in DRC:
 5. What are the department abbreviations and titles of all courses numbered 101?
 6. What are the titles of the courses being taken by majors in the Education department?
- For each of these DRC queries, what is the corresponding query in conversational English?
 7. $\{\langle ba \rangle \mid (\exists c)(\langle abc \rangle \in \text{Student} \wedge c = \text{'CSC'})\}$
 8. $\{\langle i \rangle \mid (\exists g)(\langle ghi \rangle \in \text{Dept} \wedge (\exists de)(\langle def \rangle \in \text{Course} \wedge g = d \wedge d = \text{'MATH'} \wedge e = 243))\}$

(Answers on the next page!)

Solutions

Tuple Relational Calculus

1. What are the department abbreviations and titles of all courses numbered 101?

Answer: $\{c.\text{Dept}, c.\text{Title} \mid \text{Course}(c) \wedge c.\text{Num} = 101\}$

2. What are the IDs of the MATH students taking “Discrete Structures?”

Answer: $\{s.\text{ID} \mid \text{Student}(s) \wedge s.\text{Major} = \text{'MATH'} \wedge$
 $(\exists e)(\text{Enroll}(e) \wedge s.\text{ID} = e.\text{SID} \wedge$
 $(\exists c)(\text{Course}(c) \wedge e.\text{Dept} = c.\text{Dept} \wedge e.\text{Num} = c.\text{Num} \wedge$
 $c.\text{Title} = \text{'Discrete Structures'}))\}$

3. $\{s.\text{Name}, s.\text{ID} \mid \text{Student}(s) \wedge s.\text{Major} = \text{'CSC'}\}$

Answer: What are the names and IDs of the CSC majors?

4. $\{e.\text{Date} \mid \text{Enroll}(e) \wedge$
 $(\exists c)(\text{Course}(c) \wedge e.\text{Dept} = c.\text{Dept} \wedge e.\text{Num} = c.\text{Num} \wedge c.\text{Title} = \text{'Database Design'})\}$

Answer: On which dates did students enroll in “Database Design?”

Domain Relational Calculus

5. What are the department abbreviations and titles of all courses numbered 101?

Answer: $\{\langle df \rangle \mid (\exists e)(\langle def \rangle \in \text{Course} \wedge e = 101)\}$

6. What are the titles of the courses being taken by majors in the Education department?

Answer: $\{\langle f \rangle \mid (\exists de)(\langle def \rangle \in \text{Course} \wedge$
 $(\exists kl)(\langle jklm \rangle \in \text{Enroll} \wedge d = k \wedge e = l \wedge$
 $(\exists gh)(\langle ghi \rangle \in \text{Dept} \wedge k = g \wedge h = \text{'Education'}))\}$

7. $\{\langle ba \rangle \mid (\exists c)(\langle abc \rangle \in \text{Student} \wedge c = \text{'CSC'})\}$

Answer: What are the names and IDs of the CSC majors?

8. $\{\langle i \rangle \mid (\exists g)(\langle ghi \rangle \in \text{Dept} \wedge$
 $(\exists de)(\langle def \rangle \in \text{Course} \wedge g = d \wedge d = \text{'MATH'} \wedge e = 243)\}$

Answer: To which office should we go to ask about MATH 243?