SQL: Recursion (and review for midterm)

Introduction to Databases

CompSci 316 Spring 2017

DUKE COMPUTER SCIENCE

Announcements (Mon., Feb. 20)

- Midterm next Wednesday 02/22 in class
  - Up to lecture 9 included
  - We will start at 4:40 pm, come early!
  - Open book, open notes, open written material
  - No electronic devices are allowed
  - No collaboration allowed
- Homework #2 Problem 6 (Gradiance) and Problem X1 (non-Gradiance) : due on Thursday 02/23
- Project milestone 1 due next Monday 02/27

Today

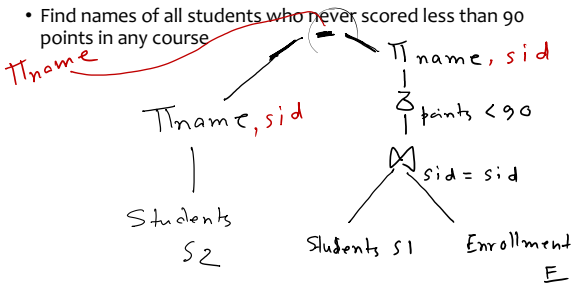
- Finish recursion from Lecture 10
  - Negation and recursion
  - All lecture slides on recursion can be found from Lecture 10
- Practice a few problems for midterm

Practice Problems

- Student(sid, name)
- Enrollment(sid, cid, points)
- Find "names" of all students who never scored less than 90 points in any course
- Write query in RA
- Write query in SQL
  - EXCEPT
  - NOT EXISTS
  - ALL
  - NOT IN

RA (in class)

- Student(sid, name)
- Enrollment(sid, cid, points)
- Find names of all students who never scored less than 90 points in any course



SQL (in class) : EXCEPT

- Student(sid, name)
- Enrollment(sid, cid, points)
- Find names of all students who never scored less than 90 points in any course

```
SELECT name
FROM Student
EXCEPT
SELECT name
FROM  Enrollment E, Student S
WHERE S.sid = E.sid
      AND points < 90
```

direct translation from RA

SQL (in class) : NOT EXISTS

- Student(sid, name)
- Enrollment(sid, cid, points)
- Find names of all students who never scored less than 90 points in any course

```
SELECT name
FROM Student S
WHERE NOT EXISTS
        (SELECT *
        FROM Enrollment E
        WHERE S.sid = E.sid
                AND points < 90)
```

SQL (in class) : NOT IN

- Student(sid, name)
- Enrollment(sid, cid, points)
- Find names of all students who never scored less than 90 points in any course

```
SELECT name
FROM Student S
WHERE sid NOT IN
        (SELECT sid
        FROM Enrollment
        WHERE points < 90)
```

SQL (in class) : ALL

- Student(sid, name)
- Enrollment(sid, cid, points)
- Find names of all students who never scored less than 90 points in any course

```
SELECT name
FROM Student S
WHERE 90 <= ALL
        (SELECT points
        FROM Enrollment E
        WHERE S.sid = E.sid)
```

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BCNF

- Are the following relations in BCNF given the dependencies? If not, decompose into BCNF.
  - R1(A,C,B,D,E), A → B,C → D
- Step 1: Non-trivial A → B violates the condition as A is not a key. Decompose into AB and ACDE.
- Step 2: Non-trivial C → D violates the condition as C is not a key of ACDE.
  Decompose into CD and ACE.
  No more violation.

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Chase

- Let R(ABCD) be a relation with functional dependencies A → B, C → D, AD → C, BC → A
- Is the following a lossless-join decomposition of R into Boyce-Codd Normal Form (BCNF)?
- {AB, AC, CD}?
- Consider a tuple (a,b,c,d) after joining these three relations – need to show belonged to R
- Could only come from some tuples in R of the form (a,b,c1,d1), (a,b2,c,d2), and (a3,b3,c,d), which project as (a,b) in AB, (a,c) in AC, and (c,d) in CD.
- A → B tells us b2=b, and C → D tells us d2=d
- Thus, the tuple (a,b2,c,d2) is really (a,b,c,d). Since we know the former is in R, the latter is in R.
- Hence lossless – also check in BCNF – two-attribute relations are always in BCNF.

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Chase

- Let R(ABCD) be a relation with functional dependenciesA → B, C → D, AD → C, BC → A
- Is the following a lossless-join decomposition of R into Boyce-Codd Normal Form (BCNF)?
- {AB, AD, BC, CD} ?
- Consider a tuple (a,b,c,d) after joining these three relations – need to show belonged to R
- (a,b,c,d) must have come from tuples (a,b,c1,d1), (a,b2,c2,d), (a3,b,c,d3), and (a4,b4,c,d) in R.
- To prove (a,b,c,d) is in R, need to prove that it must be one of these tuples.
- However, the given FD's only allow us to infer b=b2 and d=d3.
- Not lossless.
- We can come up with a counterexample by substituting constants for the variables (or just keep a1, b2,..), e.g., a relation R consisting of tuples (1,2,5,6), (1,2,7,4), (8,2,3,4), and (9,10,3,4). These, projected and joined, yield (1,2,3,4), which is not in R.

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Remember: NULL and 3-valued logic

- A = NULL: wrong
- A IS NULL: correct

- NULL = ½, OR = max, AND = min, TRUE = 1, False = 0

- Given A = UNKNOWN, B = TRUE, C = FALSE
- (A AND B) OR C = (unknown AND True) OR False = Unknown OR False = Unknown

- Where clause selects only "True" evaluations