#### Lecture E1: Review

# **CS 1555: Database Management Systems**

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http://db.cs.pitt.edu/courses/cs1555/current.term/

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### **ACID**

- Atomicity
  - Either all the operations associated with a transaction happen or none of them happens
- - A transaction is a correct program segment. It satisfies the database's integrity constraints at its boundaries
- Isolation

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- Transactions are independent, the result of the execution of concurrent transactions is the same as if transactions were executed serially, one after the other
- Durability (a.k.a. Permanency)
- The effects of completed transactions become permanent surviving any subsequent failure(s)
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## **Useful Terms**

- Cardinality of a relation r(R): # of tuples in r(R) (denoted by |r(R)|)
- Arity or degree of r(R): # of attributes in R (denoted by |R|)

|r(R)| = 3|R| = 4

SID	Degree	Major	Year
123	BS	Math	1992
064	BA	History	1991
445	PhD	CS	1999

- ♦  $Ir(R)I \ge 0$  And IRI > 0
- Cardinality is property of a relation
- Arity is property of relation schema or a relation

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Relational Database Schema

· A database schema is a set of relation schemas

and a set of integrity constraints



- Integrity Constraints
  - Structura/ Integrity Constraints
    - key constraints: uniqueness of keys
    - entity integrity constraint: no primary key value can be NULL
  - referential integrity constraint
  - Semantic Integrity Constraints
    - E.g., ??

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# Relational Algebra

- Operations on entire relations
  - Operands are (constant or variable) relations
  - Result is a relation
- Set theory operations:
  - Union, Intersection, Difference and Cartesian Product (product for short)
- Specific relational operations:
  - Selection, Projection, Join and Division
- Complete set of relational algebra operations:
  - Select, project, product, union and difference
- SQL is <u>based</u> on concepts from relational algebra

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## Relational Algebra

 Suppose relation Student has 20 tuples. What is the minimum and maximum number of tuples in the result of this expression:

 $\rho_{s1(i1,n1,g,h)}Student \bowtie \rho_{s2(i2,n2,g,h)}Student$ 

- a) minimum = 0, maximum = 400
- b) minimum = 20, maximum = 20
- c) minimum = 20, maximum = 400 \*
- d) minimum = 40, maximum = 40



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# Relational Algebra

 Which of the following English sentences describes the result of this expression:

 $\pi_{cName}College - \pi_{cName}(Apply \bowtie (\pi_{sID}(\sigma_{GPA>3.5}Student) \cap \pi_{sID}(\sigma_{major=`CS`}Apply)))$ 

- All colleges with no GPA>3.5 applicants who applied for a CS major at that college
- b) All colleges with no GPA>3.5 applicants who applied for a CS major at any college ✓
- All colleges where all applicants either have GPA>3.5 or applied for a CS major at that college
- d) All colleges where no applicants have GPA>3.5 or no applicants applied for a CS major at that college



Outer Join Examples

STUDENT(<u>SID</u>, Name, Class, Major)
 ENROLLS(<u>CID</u>, <u>SID</u>, <u>Term</u>, Grade)

**□** Q1:

SELECT \*

FROM (STUDENT S LEFT OUTER JOIN ENROLLS E

ON S.SID=E.SID)

order by S.SID;

**□** Q2:

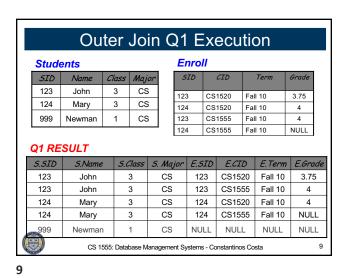
SELECT SID, S.Name, S. Major

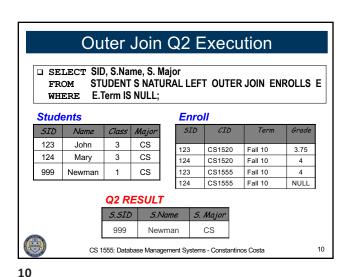
FROM STUDENT'S NATURAL LEFT OUTER JOIN ENROLLS E

WHERE E.Term IS NULL;



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Pattern Matching... · Retrieve all students with local phone numbers (any

area code) which start with 6 and whose third digit

SELECT Name FROM **STUDENT** 

is 3.

Phone **LIKE** '\_\_\_6\_3%'; WHERE

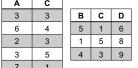
· Escape defines the escape character that causes SQL to interpret a wildcard char (%) as itself in a string:

> **SELECT** VideoName FROM **RENTALS**

WHERE Discount LIKE '10&%' ESCAPE '&';

**Natural JOIN** 

- Suppose relation R(A,C) has the following tuples and relation S(B,C,D) has the following tuples:
- Compute the natural join of R and S. Which of the following tuples is in the result? Assume each tuple has schema (A,B,C,D).



a) (6, 4, 3, 9) b) (2, 4, 3, 9) <

c) (2, 3, 1, 6)

d) (5, 1, 6, 4)

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# Theta JOIN

- Suppose relation R(A,C) has the following tuples and relation S(B,C,D) has the following tuples:
- · Compute the theta-join of R and S with the condition R.B = S.B AND R.A < S.C Which of the following tuples is in the result? Assume each tuple has schema (A, R.B, S.B, C, D).

Α	В		В	С	D
1	а		С	5	6
7	t		а	7	8
2	g		t	8	9
4	С				
9	t				

a) (2, g, c, 5, 6)

b) (4, c, c, 7, 8)

c) (1, a, c, 5, 6)

d) (4, c, c, 5, 6) <

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**Projection** 

- Suppose relation R(A,B,C) has the following tuples
- Compute the projection  $\pi$  C,B (R). Which of the following tuples is in the result?

В	С
2	3
2	3
5	6
5	3
2	6
	2 2 5 5

a) (6,2) 🗸

b) (5,6)

c) (5,3)

d) (2,6)

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### Difference

- Suppose relation R(A,B,C) has the following tuples and relation S(A,B,C) has the following tuples:
- Compute (R S) union (S R), often called the "symmetric difference" of R and S. Which of the following tuples is in the result?

	Α	В	С	Α	В	С
	1	2	3	2	5	3
	4	2	3	2	5	4
	4	5	6	4	5	6
ſ	2	5	3	1	2	3
	1	2	6			

a) (1,2,3)

b) (2,5,4) <

c) (4,5,6)

d) (1,5,6)

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Intersection

- Suppose relation R(A,B,C) has the following tuples and relation S(A,B,C) has the following tuples:
- Compute the intersection of the relations R and S. Which of the following tuples is in the result?

Α	В	С	Α	В	С
1	2	3	2	5	3
4	2	3	2	5	4
4	5	6	4	5	6
2	5	3	1	2	3
1	2	6			

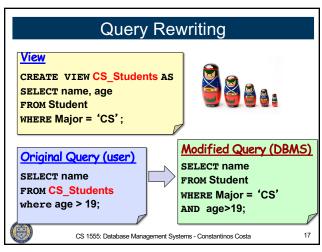
a) (2,2,6)

b) (2,5,4) c) (1,2,3)

d) (2,4,3)

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**Views** 

- Consider tables R(A,B) and S(B,C) and a view V = select A,C from R,S where R.B=S.B. Suppose  $R=\{(1,5),(2,5)\}\$ and  $S=\{(5,10)\}\$ so  $V=\{(1,10),(2,10)\}\$ . The user wants to delete tuple (2,10) from V. Which of the following modifications to R and/or S does NOT correctly reflect this modification?
- a) delete (2,5) from R
- b) update (2,5) to (2,6) in R
- c) update (2,5) to (1,6) in R
- d) delete (5,10) from S 🕶



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- **Views**
- Consider tables R(A,B) and S(B,C) and a query Q = select A,C from R,S where R.B=S.B and A < 10 and C > 20. Which of the following materialzed views can NOT be used to help evaluate Q?
- a) V1 = select A,C from R,S where R.B=S.B
- b) V2 = select A,C from R,S where A < 10 and C > 20 <
- c) V3 = select A,R.B,S.B,C from R,S where A < 10 and C >
- d) V4 = select \* from R where A < 10



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