THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC

6b. HW/Exam Review

CSCI 2541 Database Systems & Team Projects

Wood & Chaufournier

Today…

Exam Logistics

SQL HW Review

Normalization HW Review

Shopping Cart

Lab on Sessions

Exam Logistics

Wednesday starting at 12:45PM

Exam will be on on paper and ??on computer??

- Short answer, multiple choice, T/F, SQL queries, etc
- Expect questions similar to Homeworks

Class ends at 3:25PM

- You can use both periods if you need

If you have a disability that affects your ability to complete the exam, contact me by Monday!

You…

may:

- Use 1 page (double sided) of hand written notes
- Use my SQL and normalization reference sheets
  - I will provide a copy

may not:

- Use a computer/phone/device to access any material not explicitly allowed by the exam
- Discuss questions or get help from anyone else
- Do anything else which violates the course or GW's academic integrity policies

Violating these policies will have severe consequences, including **failing** the course

Suggestions

Make your own notes

- Explain the core concepts to yourself by rewriting in your own words
- Writing out your own version of the key rules (2NF vs 3NF, lossless decomposition rules, etc) will help you fully understand them!
- Try to solve the homework problems without looking at solutions

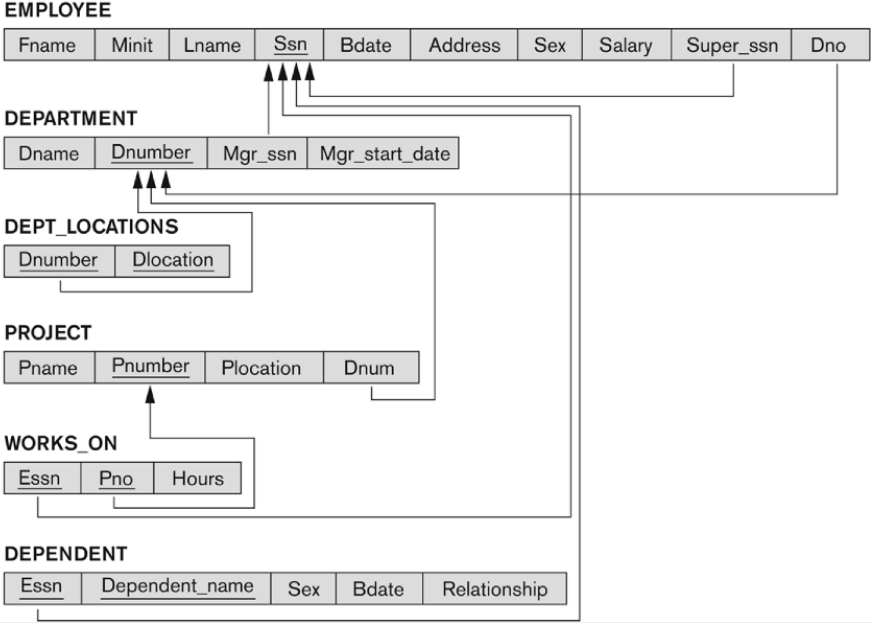
Be an efficient test taker

- Hopefully nobody will get 100% on the exam
- Focus first on the sections you are most confident with
- Don't waste too much time on any one question

Next: SQL Queries

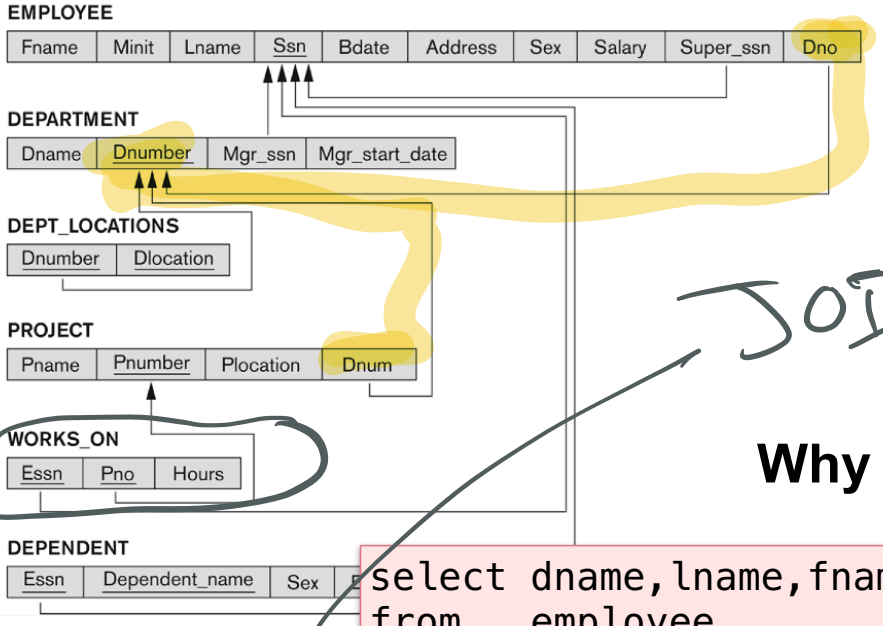
Schema for Company DB

- Employee
  - Connects to Department by Dno
- Department
  - Connects to Employee with Mgr_ssn
- Dept_locations
  - Connects to department
- Project
  - Connects to Department
- Works_On
  - Connects from Employee to Project
- Dependent
  - Connects to Employee



SQL HW

7. Retrieve the list of employees, the projects they are working on, and their salary.



JOIN works.ON
ON ssn = essn

Why is this wrong?

```
select dname,lname,fname,pname,salary
from   employee
JOIN department on department.dnumber=employee.dno
JOIN project on project.Dnum = Employee.dno;
```

SQL HW

7. Retrieve the list of employees, the projects they are working on, and their salary.

Just because a project is in a department, doesn't mean that employee works on it! Need to join using the works_on table.

```
select dname,lname,fname,pname,salary
from   department
JOIN employee on department.dnumber=employee.dno
JOIN works_on on works_on.essn = employee.ssn
JOIN project on project.pnumber = works_on.pno
```

Complex Queries

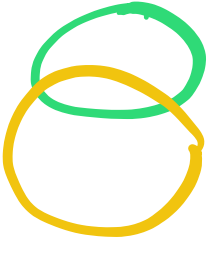
Sometimes you need a subquery within a query

```
SELECT name FROM
instructors
WHERE rating = (
  SELECT rating
  FROM instructors
  WHERE name = 'Wood'
);
```

```
SELECT name
FROM city
WHERE country_id IN (
  SELECT country_id
  FROM country
  WHERE population > 20000000
);
```

Or you need to combine results from queries

- UNION, INTERSECT, EXCEPT



```
SELECT DISTINCT name FROM instructors
EXCEPT
SELECT DISTINCT name from students;
```

Practice!

There is an extra copy of SQL HW3 if you want to try it again (Replit week 6)

Engage!

- Write a DB query problem and post on Slack in #engage

Any other questions on SQL?

Next: Normalization

Normal Forms - more definitions

2NF: A schema is in 2NF if

- No nonprime attribute is partially dependent on the candidate key (i.e., depends on only part of a candidate key)

3NF: A schema is in 3NF if

- It is in 2NF and,
- no nonprime attribute is transitively dependent on the primary key (LHS must be a full key, unless RHS is a key)

BCNF: A schema is in BCNF if

- It is in 3NF and,
- LHS must be a super key

Normalization - Finding Keys

Q5b) Consider the relation *R3 = (A, B, C, D)*, with the following functional dependencies:

- **AB -> C** and **C -> D**

What is the Candidate Key for this relation? What normal form does *R3* satisfy? You may assume that all tuples are unique and attributes are atomic.

A, B 2NF

Normalization - Finding Keys

Q5b) Consider the relation *R3 = (A, B, C, D)*, with the following functional dependencies:

- **AB -> C** and **C -> D**

What is the Candidate Key for this relation? What normal form does *R3* satisfy? You may assume that all tuples are unique and attributes are atomic.

Candidate Key is AB since:
AB -> C and
AB -> C -> D
so, with AB we can determine all attributes

Normal form is 2NF since C->D violates 3NF

Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

Will this be a loss-free decomposition, i.e., will we still be able to reconstruct all data by joining the two tables together? What normal form will *R51* and *R52* be in?

R5 = (**A**, **B**, C, **D**, E)

F =

A -> C

BD -> C

ABD -> E

F+

(R51 ∩ R52) -> R51 - R52

(R51 ∩ R52) -> R52 - R51

1) AB -> DE ✗

2) AB -> C ✓

Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

Will this be a loss-free decomposition?

R5 = (**A**, **B**, C, **D**, E)

A -> C
BD -> C
ABD -> E

Lossless Decomposition test:

(from normalization lecture 2)

- **R1**, **R2** is a lossless join decomposition of **R** with respect to **F** **iff** at least one of the following dependencies is in **F+**
- **(R1 ∩ R2) → R1 – R2**
- **(R1 ∩ R2) → R2 – R1**

Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

Will this be a loss-free decomposition?

R5 = (**A**, **B**, C, **D**, E)

A -> C
BD -> C
ABD -> E

Lossless Decomposition test:

(from normalization lecture 2)

- **R1**, **R2** is a lossless join decomposition of **R** with respect to **F** **iff** at least one of the following dependencies is in **F+**
- **(R1 ∩ R2) → R1 – R2**
- **(R1 ∩ R2) → R2 – R1**

R51 ∩ R52 = AB
R51 - R52 = DE
R52 - R51 = C

AB -> C is part of F+

Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

R5 = (**A**, **B**, C, **D**, E)

A -> C

BD -> C

ABD -> E

What normal form will *R51* and *R52* be in?

R51 = BCNF

R52 = 1NF

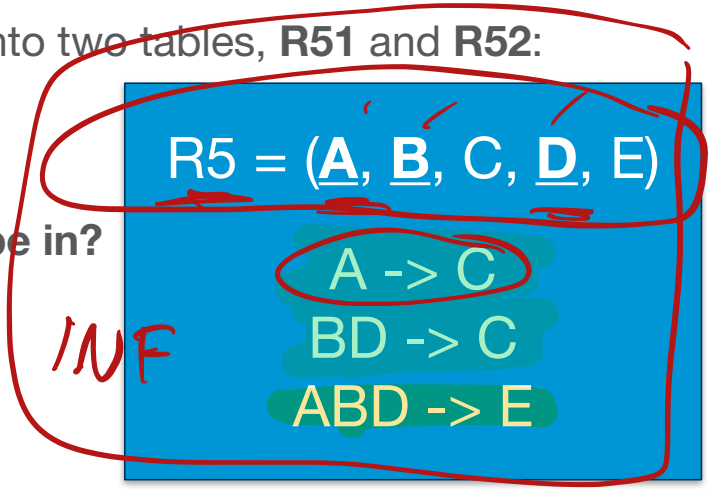
Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

BCNF

1NF



What normal form will *R51* and *R52* be in?

R51 is 3NF/BCNF since only ABD->E holds and ABD is the full candidate key

R52 is 1NF since A->C holds and A is a partial candidate key, so it cannot be 2NF

Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

How can we decompose and ensure 3NF for all relations?

R5 = (**A**, **B**, C, **D**, E)

A -> C

BD -> C

ABD -> E

$R_1 \cap R_2 \rightarrow R_1 - R_2$

$R_1 \cap R_2 \rightarrow R_2 - R_1$

BD → AE ✗

BD → C ✓

Lossy-free

Decomposition

Q6 Suppose we decompose Relation **R5** into two tables, **R51** and **R52**:

- **R51 = (A, B, D, E)**
- **R52 = (A, B, C)**

How can we decompose and ensure 3NF for all relations?

ABCD

R5 = (**A**, **B**, C, **D**, E)

A -> C
BD -> C
ABD -> E

R51 is already 3NF

To fix R52 we could use
R53 = (A, C)

This must be 3NF

R51 ∩ R53 = A
R51 - R53 = BDE
R53 - R51 = C

A -> C is part of F+

Any other questions on Normalization?

Next: Shopping Cart

Shopping Cart Tips

Carefully read spec

- Make a list of tasks and workflows to test

Implement the tables from our ER diagram

Plan mockups of pages you will need

- Start with simplest requirements!
- Don't worry about making it pretty until later

If your code won't run… fix it!

- Don't try to write a lot of code without testing