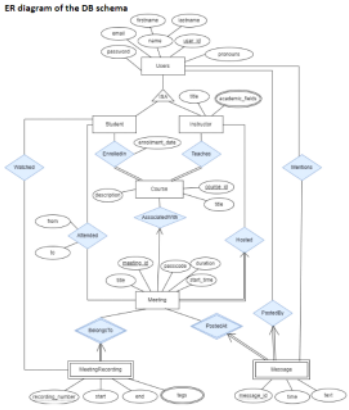
451 Exam 1 Sheet

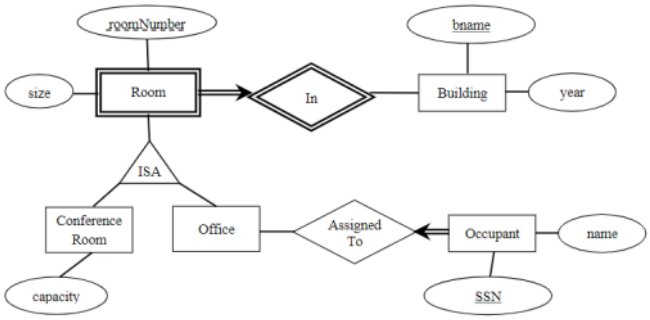
Monday, February 21, 2022 9:22 PM

ER Models:
Entity: Real world object
Entity set: Collection of similar entities
Multi-valued/single valued: phone number/salary
Atomic vs Composite: salary/address
Relationship: Associated between two or more entities
Relationship set: Collection of similar relationships
Key Constraints(Multiplicity): one manager to many departments
Participation Constraints: not all employees are managers
Weak Entities: sets that do not have sufficient attributes to form a key, may also have a partial key -Double Lines
Multiway Relationships: Usually binary relationships and a key

ER diagram of the DB schema



Consider the following ER Diagram




```
CREATE TABLE Building (
      Bname VARCHAR(50),
      year   DATE NOT NULL
      PRIMARY KEY(Bname)
)

CREATE TABLE Room (
      Bname       VARCHAR(50) ,
      roomNumber VARCHAR(50) ,
      size              FLOAT,
      PRIMARY KEY(BName,roomNumber),
      FOREIGN KEY Bname REFERENCES Building(Bname)
)

CREATE TABLE ConferenceRoom (
      Bname       VARCHAR(50) ,
      roomNumber VARCHAR(50) ,
      capacity   INTEGER CHECK (capacity<=50),
      PRIMARY KEY(BName,roomNumber),
      FOREIGN KEY (Bname,roomNumber) REFERENCES
            Room(Bname,roomNumber)
)

CREATE TABLE Office (
      Bname       VARCHAR(50) ,
      roomNumber VARCHAR(50) ,
      PRIMARY KEY(BName,roomNumber),
      FOREIGN KEY (Bname,roomNumber) REFERENCES Room (Bname,roomNumber)
)

CREATE TABLE Occupant (
      SSN         CHAR(9),
      name        VARCHAR(50) NOT NULL ,
      Bname       VARCHAR(50)  NOT NULL,
      roomNumber VARCHAR(50) NOT NULL ,
      PRIMARY KEY (SSN),
      FOREIGN KEY (Bname,roomNumber) REFERENCES Office (Bname,roomNumber)
)
```

(10pts) Question 8

Consider the following schema:
Suppliers(sid, sname, city)
Parts(pid, pname, color)
Catalog(pid, sid, price)

The *Catalog* relation lists the prices charged for *Parts* by *Suppliers*. The primary keys are underlined. In Catalog, "*sid*" is a foreign key referencing "*sid*" in Suppliers, and "*pid*" is a foreign key referencing "*pid*" in "Parts".

Based on the schema above, write the following query in relational algebra:

Find the "sids" of suppliers who charge more for some part than the average cost of that part (averaged over all the suppliers who supply that part).

Use the following link to write your query:
https://dbis-uibk.github.io/relax/calc/gist/517c9bad4ce02011e23dcc96e6390983

Answer:
σ (price>avgPrice) (Catalog ⋈ (γ pid; avg(price)->avgPrice (Catalog)))

(10pts) Question 9

Consider the following schema:
Suppliers(sid, sname, city)
Parts(pid, pname, color)
Catalog(pid, sid, price)

The *Catalog* relation lists the prices charged for *Parts* by *Suppliers*. The primary keys are underlined. In Catalog, "*sid*" is a foreign key referencing "*sid*" in Suppliers, and "*pid*" is a foreign key referencing "*pid*" in "Parts".

Based on the schema above, write the following query in relational algebra:

*Find the "sids, names, and cities" of suppliers who **do not** supply any 'green' parts.*

Use the following link to write your query:
https://dbis-uibk.github.io/relax/calc/gist/517c9bad4ce02011e23dcc96e6390983

Answer:
π sid,sname,city
σ (pid = null) (Suppliers ⟕(Catalog ⋈ (σ(color='green') Parts)))

Consider the following schema:

```
CREATE TABLE T(
      C integer PRIMARY KEY,
      D integer);

CREATE TABLE S(
      B integer PRIMARY KEY,
      C integer REFERENCES T(C) ON DELETE CASCADE);

CREATE TABLE R(
      A integer PRIMARY KEY,
      B integer REFERENCES S(B) ON DELETE SET NULL);
```

Suppose the current content of R,S, T are as follows:

T

C	D
1	1
2	1

S

B	C
1	1
2	1

R

A	B
1	1
2	2

If we delete all tuples in T, what tuples will R contain? Write your answer as a set of tuples.

Answer:

{ (1, NULL), (2, NULL)}

- Union, intersection, and difference.

Consider the following relations R(A,B) and S(B,C,D).
R's primary key is A and S's primary key is B,C.

Instances of R and S are given below.

R

A	B
1	2
7	4
5	6

S

B	C	D
2	4	6
4	6	8
4	7	9

Compute the **full outer join** of R and S, where the join condition is:
R.A<=S.C AND R.B=S.B.

Write your answer as a set of tuples.

Answer:

R.A	R.B	S.B	S.C	S.D
1	2	2	4	6
7	4	4	7	9
5	6	NULL	NULL	NULL
NULL	NULL	4	6	8

OR

{(1,2,2,4,6) , (7,4,4,7,9) , (5,6,NULL,NULL,NULL) , (NULL,NULL,4,6,8)}

(8pts) Question 2: TRUE / FALSE

Consider the following relation R(A,B,C,D). An instance of R is given below.

A	B	C	D
1	3	2	2
2	3	2	4
3	1	3	6
3	1	1	12

Consider the query:

σ (C>1) (γ A,B,max(C)->M (R))

Claim: The above query will run successfully on R.

If TRUE, give output.
If FALSE, explain why.

Answer:

The result of the inner expression (γ A,B,max(C)->M (R)) will only include A, B and M attributes. "C" attribute will not be included in its schema. Therefore the selection (σ (C>1)) will cause an error since C will be an undefined attribute.

(6pts) Question 3 : TRUE / FALSE

Consider two relations R(A,B) and S(C,D), where all attributes are integers, and they cannot be NULL. The primary keys are underlined. For each of the below relational algebra expressions, indicate hether left expression is equal to the right expression (i.e., return the same set of tuples).

(a) R ⟕(B=C) S = S ⟕(C=B) R

{ (1, NULL), (2, NULL)}

- Union, intersection, and difference.
  - Usual set operations, but ***both operands must have the same relation schema***.
- Selection (σ): picking certain rows.
- Projection(Π): picking certain columns.
- Products (X) and joins($\bowtie_C$): compositions of relations.
- Renaming of relations and attributes.

(6pts) Question 3 : TRUE / FALSE

Consider two relations R(A,B) and S(C,D), where all attributes are integers, and they cannot be NULL. The primary keys are underlined. For each of the below relational algebra expressions, indicate hether left expression is equal to the right expression (i.e., return the same set of tuples).

(a) $R \bowtie_{(B=C)} S = S \bowtie_{(C=B)} R$

(b) $R - \Pi_{A,B}(R \bowtie_{(B=C)} S) = \Pi_{A,B}(R \bowtie_{(B=C)} S)$

(a) TRUE / FALSE
(b) TRUE / FALSE

Types of JOIN:

Various forms of join operatio

Inner Joins:

- Theta join
- EQUI join
- Natural join

Outer join:

- Left Outer Join
- Right Outer Join
- Full Outer Join

Right Outer Join: (A⟕ B)

In the right outer join, operation allows keeping all tuple in the right relation. However, if there is no matching tuple is found in the left relation, then the attributes of the left relation in the join result are filled with null values.

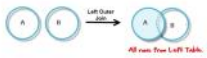
A ⟕ B

A ⟕ B

Num	Cube	Square
2	8	4
3	18	9
5	75	–

Left Outer Join(A ⟕ B)

In the left outer join, operation allows keeping all tuple in the left relation. However, if there is no matching tuple is found in right relation, then the attributes of right relation in the join result are filled with null values.



Consider the following 2 Tables

A

Num	Square
2	4
3	9
4	16

B

Num	Cube
2	8
3	18
5	75

A ⟕ B

A ⟕ B

Num	Square	Cube
2	4	8
3	9	18
4	16	–

Full Outer Join: (A ⟗ B)

In a full outer join, all tuples from both relations are included in the result, irrespective of the matching condition.

A ⟗ B

A ⟗ B

Num	Cube	Square
2	4	8
3	9	18
4	16	–
5	–	75

Theta-Join

$R \bowtie_{R.A>S.C} S$

R(A,B)

A	B
3	4
5	7

S(C,D)

C	D
2	7
6	8

R × S

A	B	C	D
3	4	2	7
~~3~~	~~4~~	~~6~~	~~8~~
5	7	2	7
~~5~~	~~7~~	~~6~~	~~8~~

Result

A	B	C	D
3	4	2	7
5	7	2	7

Theta-Join

$R \bowtie_{R.A>S.C \text{ and } R.B \neq S.D} S$

R(A,B)

A	B
3	4
5	7

S(C,D)

C	D
2	7
6	8

R × S

A	B	C	D
3	4	2	7
~~3~~	~~4~~	~~6~~	~~8~~
~~5~~	~~7~~	~~2~~	~~7~~
~~5~~	~~7~~	~~6~~	~~8~~

Result

A	B	C	D
3	4	2	7

Equi-Join

- Special kind of theta-join: ***C*** only uses the equality operator.

R(A,B)

A	B
3	4
5	7

S(C,D)

C	D
2	7
6	8

$R \bowtie_{R.B=S.D} S$

R.A	R.B	R.C	R.D
5	7	2	7