CS122A: Introduction to Data Management

Lecture 8
Introduction to SQL

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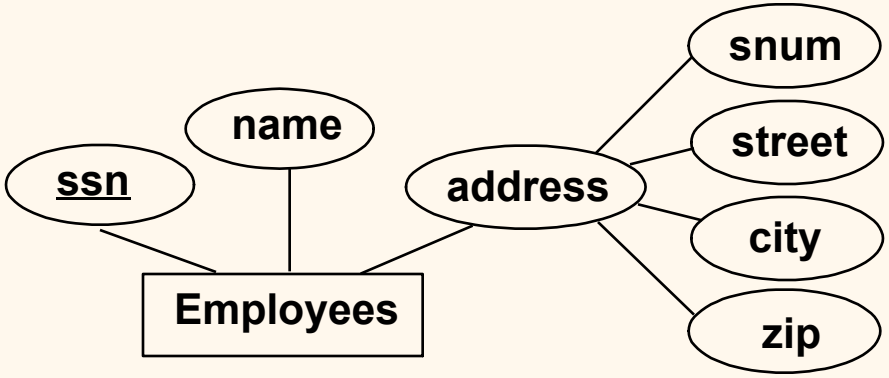
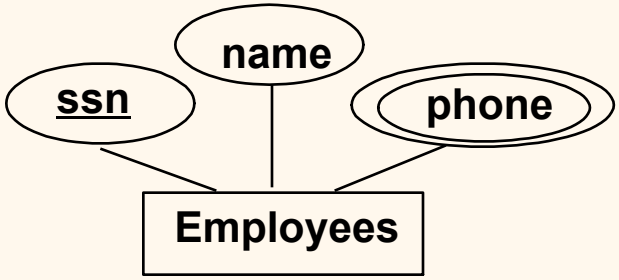
More notes from Quiz 3

Composite attributes




```
CREATE TABLE Employee
   (ssn CHAR(20),  name CHAR(20),
    sname CHAR(20), street CHAR(20),
    city CHAR(20), zip CHAR(10),
    PRIMARY KEY (ssn))
```

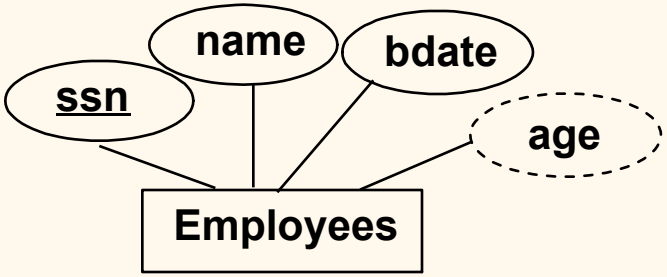
Multi-valued attributes



CREATE TABLE Employee
(ssn CHAR(20), name CHAR(20), …)

CREATE TABLE Phone
(pid INT, ssn CHAR(20), phone CHAR(15),
PRIMARY KEY (pid),
FOREIGN KEY (ssn) REFERENCES Employees)

Derived attributes



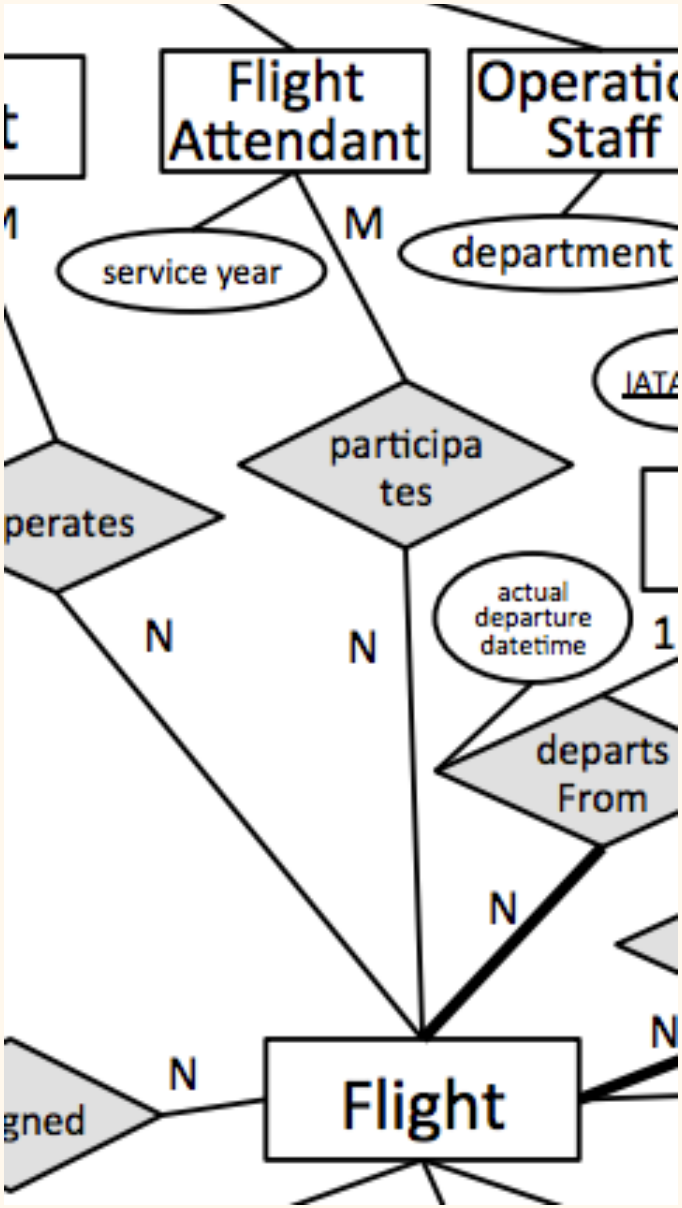
CREATE TABLE Employee

(ssn CHAR(20), name CHAR(20), bdate DATETIME, age INT, PRIMARY KEY (ssn))

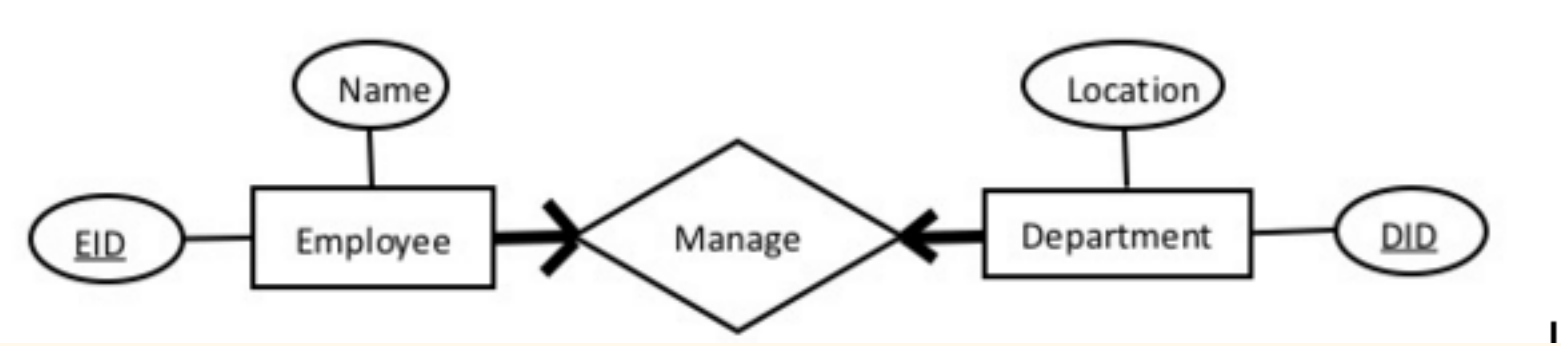
HW1 solution

Q: Why we don't have a total participation constraint from "Flight" to "Attendant"?

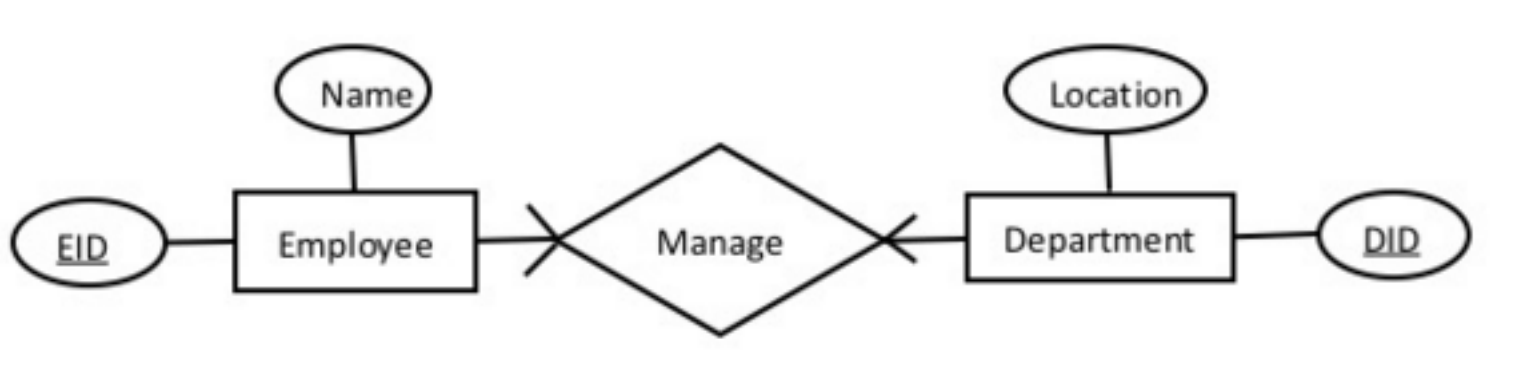
A: "5. Each flight is initialized with departure/arrival airports, projected departure datetime, and projected arrival datetime. Pilots, flight attendants, and an airplane can be assigned later to finalize a flight.



Examples in Quiz 3



- The solution used two tables;
- Alternatively we could use one table.



- Is it a good idea to use one table for this ER?

Next topic: SQL!

SQL-Based DBMSs

- Commercial RDBMS choices include
  - DB2 (IBM)
  - Oracle
  - SQL Server (Microsoft)
  - Teradata
- Open source RDBMS options include
  - MySQL
  - PostgreSQL
- And for so-called "Big Data", we also have
  - Apache Hive (on Hadoop) + newer wannabees

Example Instances

- We'll use these instances of our usual Sailors and Reserves relations in our examples.
- (If the key for the Reserves relation contained only the attributes *sid* and *bid*, how would the semantics differ?)

R1

sid	bid	day
22	101	10/10/96
58	103	11/12/96

S1

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

S2

sid	sname	rating	age
28	yuppy	9	35.0
31	lubber	8	55.5
44	guppy	5	35.0
58	rusty	10	35.0

Example Data in MySQL

Sailors

sid	sname	rating	age
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	4	25.5
95	Bob	3	63.5
101	Joan	3	NULL
107	Johan…	NULL	35.0

Reserves

sid	bid	date
22	101	1998-10-10
22	102	1998-10-10
22	103	1998-10-08
22	104	1998-10-07
31	102	1998-11-10
31	103	1998-11-06
31	104	1998-11-12
64	101	1998-09-05
64	102	1998-09-08
74	103	1998-09-08
NULL	103	1998-09-09
1	NULL	2001-01-11
1	NULL	2002-02-02

Boats

bid	bname	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Basic SQL Query

```
SELECT      [DISTINCT]  target-list
FROM        relation-list
WHERE       qualification
```

- *relation-list* A list of relation names (possibly with a *range-variable* after each name).
- *target-list* A list of attributes of relations in *relation-list*
- *qualification* Comparisons (Attr *op* const or Attr1 *op* Attr2, where *op* is one of <, <=, =, >, >=, <>) combined using AND, OR and NOT.
- DISTINCT is an optional keyword indicating that the answer should not contain duplicates. Default is that duplicates are *not* eliminated! (Bags, not sets.)

Conceptual Evaluation Strategy

- Semantics of an SQL query defined in terms of the following conceptual evaluation strategy:
  - Compute the cross-product of *relation-list*.
  - Discard resulting tuples if they fail *qualifications*.
  - Project out attributes that are not in *target-list*.
  - If DISTINCT is specified, eliminate duplicate rows.
- This strategy is probably the least efficient way to compute a query! An optimizer will find more efficient strategies to compute *the same answers*.

Example of Conceptual Evaluation

SELECT S.sname
FROM Sailors S, Reserves R ← *using S1*
WHERE S.sid=R.sid AND R.bid=103

(sid)	sname	rating	age	(sid)	bid	day
22	dustin	7	45.0	22	101	10/10/96
22	dustin	7	45.0	58	103	11/12/96
31	lubber	8	55.5	22	101	10/10/96
31	lubber	8	55.5	58	103	11/12/96
58	rusty	10	35.0	22	101	10/10/96
58	rusty	10	35.0	58	103	11/12/96

A Note on Range Variables

Sailors(sid, sname, rating, age)
Reserves(sid, bid, day)
Boats(bid, bname, color)

- Really needed only if the same relation appears twice in the FROM clause. The previous query can also be written as:

```
SELECT  sname
FROM    Sailors S, Reserves R
WHERE   S.sid=R.sid AND bid=103
```

OR

```
SELECT  sname
FROM    Sailors, Reserves
WHERE   Sailors.sid=Reserves.sid
        AND bid=103
```

It is good style, however, to use range variables ***always****!*

Find sailors who've reserved at least one boat

Sailors(sid, sname, rating, age)
Reserves(sid, bid, day)
Boats(bid, bname, color)

```
SELECT  S.sid
FROM  Sailors S, Reserves R
WHERE  S.sid=R.sid
```

- Would adding DISTINCT to this query make a difference? (With our data? With possible data?)
- What is the effect of replacing *S.sid* by *S.sname* in the SELECT clause? Would adding DISTINCT to this variant of the query make a difference?

Expressions and Strings

Sailors(sid, sname, rating, age)

```
SELECT  S.sname, S.age, S.age+1 AS age1, 7*S.age AS age2
FROM  Sailors S
WHERE  S.sname LIKE 'B_%B'
```

- Illustrates use of arithmetic expressions and string pattern matching: *Find triples (of ages of sailors and two fields defined by expressions) for sailors whose names begin and end with B and contain at least three characters.*
- AS provides a way to (re)name fields in result.
- LIKE is used for string matching. `_' stands for any one character and `%' stands for 0 or more arbitrary characters.

Find sid's of sailors who've reserved a red or a green boat

Sailors(sid, sname, rating, age)
Reserves(sid, bid, day)
Boats(bid, bname, color)

- If we replace OR by AND in this first version, what do we get?
- UNION: Can be used to compute the union of any two *union-compatible* sets of tuples (which are themselves the result of SQL queries).
- Also available: EXCEPT (What do we get if we replace UNION by EXCEPT?)

```
SELECT  S.sid
FROM  Sailors S, Boats B, Reserves R
WHERE  S.sid=R.sid AND R.bid=B.bid
  AND (B.color= 'red' OR B.color= 'green' )
```

```
SELECT  S.sid
FROM  Sailors S, Boats B, Reserves R
WHERE  S.sid=R.sid AND R.bid=B.bid
            AND B.color= 'red'
UNION
SELECT  S.sid
FROM  Sailors S, Boats B, Reserves R
WHERE  S.sid=R.sid AND R.bid=B.bid
            AND B.color= 'green'
```

Find sid's of sailors who've reserved a red and a green boat

Sailors(sid, sname, rating, age)
Reserves(sid, bid, day)
Boats(bid, bname, color)

- INTERSECT: Can be used to compute the intersection of any two *union-compatible* sets of tuples.
- Included in the SQL/92 standard, but some systems don't support it.
- Contrast symmetry of the UNION and INTERSECT queries with how much the other versions differ.

```
SELECT  S.sid
FROM  Sailors S, Boats B1, Reserves R1,
        Boats B2, Reserves R2
WHERE  S.sid=R1.sid AND R1.bid=B1.bid
 AND  S.sid=R2.sid AND R2.bid=B2.bid
 AND (B1.color= 'red'  AND B2.color= 'green'
```

Key field!

```
SELECT  S.sid
FROM  Sailors S, Boats B, Reserves R
WHERE  S.sid=R.sid AND R.bid=B.bid
            AND B.color= 'red'
INTERSECT
SELECT  S.sid
FROM  Sailors S, Boats B, Reserves R
WHERE  S.sid=R.sid AND R.bid=B.bid
            AND B.color= 'green'
```