

ER to Relational / SQL Exercises

Announcements

Feedback sheet: Experiment continues!

Q1: Refer to other attributes using foreign keys?

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foreign keys?

ER diagrams: never happens

SQL: Must refer to primary key or unique
(candidate key)

FOREIGN KEY (a, b) REFERENCES other (x, y)

Relational Constraints

Domain constraints

Primary key constraints

Foreign key constraints

Unique constraints

NOT NULL constraints

CHECK constraints

Single Column Shortcut Notation

```
CREATE TABLE A(  
    id int,  
    ref int,  
    PRIMARY KEY (id),  
    FOREIGN KEY (ref) REFERENCES other  
);
```

Single Column Shortcut Notation

```
CREATE TABLE A(  
    id int PRIMARY KEY,  
    ref int REFERENCES other,  
PRIMARY KEY (id),  
FOREIGN KEY (ref) REFERENCES other  
);
```

ER → Relational translation

Translate ignoring constraints:

- Entity: new table with primary key, no foreign key
- Relationship: new table;
 - Primary key = set of primary key of related entities
 - Foreign keys: each primary key of related entities
- Aggregation: Relationship like others
- ISA: Create tables for each type

Add constraints

At most one: On relationship, add: UNIQUE(entity key)
OR combine tables (permit NULL)

Exactly one: Combine tables; NOT NULL constraints

At least one: Not representable

Eliminate redundancy:

PRIMARY KEY (a, b) + UNIQUE (b) = PRIMARY KEY (b)
(same primary key? Can combine tables)

Perfect translation

For all possible database instances:

Constraints violated in ER are violated in relational

Constraints violated in relational are violated in ER

If ER doesn't violate, neither should relational

If relational doesn't violate, neither should ER

Some diagrams cannot be perfectly translated
(e.g. at least one constraints)

How to check a translation?

For each ER constraint:

1. a. Find example that violates ER constraint
1. b. Verify it violates relational version
2. a. Find example that passes ER constraint
2. b. Verify it passes relational version

“Proof by example”: No guarantee; effective

How to check a translation?

For each ER constraint:

1. a. Find example that violates ER constraint
1. b. Verify it violates relational version
2. a. Find example that passes ER constraint
2. b. Verify it passes relational version

~~“Proof by example”~~: No guarantee; effective

Non-exhaustive examples (with bastardized notation!)

And how to check them

[Instructors] – <Teaches> – [Courses]

Instructors(
iid int,
name text,
primary key (iid)
)

iid	name
1	Evan
2	Luis
3	Martha

Teaches(
iid int,
cid int,
primary key (iid, cid),
foreign key (iid) references Instructors,
foreign key (cid) references Courses,
)

iid	cid
1	4111
2	4111
3	3827
3	4111
3	3134

Courses(
cid int,
title text,
primary key (cid)
)

cid	title
4111	databases
3827	Systems
3134	Data structures

Single column keys

Abbreviated syntax:

columnName columnType PRIMARY KEY

columnName columnType UNIQUE

columnName columnType REFERENCES table

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Teaches(
iid int references Instructors,
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)

iid	name
1	Evan
2	Luis
3	Martha

iid	cid
1	4111
2	4111
3	3827
3	4111
3	3134

cid	title
4111	databases
3827	Systems
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[Instructors] – <Teaches> ← [Courses]

Instructors(
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Teaches(
iid int references Instructors,
cid int references Courses,
primary key (iid, cid)
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Q1: What data is no longer valid?

Q2: How do we correct the schema?

iid	cid
1	4111
2	4111
3	3827
3	4111
3	3134

cid	title
4111	databases
3827	Systems
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[Instructors] – <Teaches> ← [Courses]

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Courses(
cid int primary key,
title text
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2	Luis
3	Martha

Teaches(
iid int references Instructors,
cid int references Courses,
primary key (iid, cid),
unique (cid)
)

Q: Is there any redundancy here?

iid	cid
1	4111
2	4111
3	3827
3	4111
3	3134

cid	title
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Primary key + unique: Superkey

primary key (iid, cid),
unique (cid)

→

primary key (cid)

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```
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```

```
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  title text  
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iid	name
1	Evan
2	Luis
3	Martha

iid	cid
1	4111
3	3827
null	3134

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Null permitted by SQL by default

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Instructors(
iid int primary key,
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```

```
Courses_Teaches(  
  cid int primary key,  
  title text,  
  iid int references Instructors  
)
```

iid	name
1	Evan
2	Luis
3	Martha

cid	title	iid
4111	databases	1
3827	Systems	3
3134	Data structures	3
4118	operating systems	null

null required to represent the ER diagram

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At least one: Not easily representable

Permit many relationships: relationship is a separate table
Enforce a relationship: merge table, NOT NULL constraint

Effectively: a contradiction

(possible with multi-table assertions; not in this course)

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  primary key (iid, cid)  
  unique (iid),  
  unique (cid)  
)
```

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