Translating an ER diagram to a relational schema

Given an ER diagram, we can look for a relational schema that closely approximates the ER design.

The translation is approximate because it is not always feasible to capture all the constraints in the ER design within the relational schema. (In SQL, certain types of constraint, for example, are inefficient to enforce, and so usually not implemented.)

There is more than one approach to translating an ER diagram to a relational schema. Different translations amount to making different implementation choices for the ER diagram.

It is possible to make these translations complete (work for any diagram) and automatic (in a push-button graphical tool); but in this course we shall just consider a few examples illustrating some of the main ideas.

Mapping entity sets

Algorithm

• Create a table for the entity set.
• Make each attribute of the entity set a field of the table, with an appropriate type.
• Declare the field or fields comprising the primary key

create table Students (  
mn char(8),
name char(20),
age integer,
email char(15),
primary key (mn) )
Mapping relationship sets (no key constraints)

Algorithm
- Create a table for the relationship set.
- Add all primary keys of the participating entity sets as fields of the table.
- Add a field for each attribute of the relationship.
- Declare a primary key using all key fields from the entity sets.
- Declare foreign key constraints for all these fields from the entity sets.

```
create table Takes (
    mn char(8),
    code char(20),
    mark integer,
    primary key (mn, code),
    foreign key (mn) references Students,
    foreign key (code) references Courses
)
```

Part I: Structured Data I.2: The relational model

Mapping relationship sets (with key constraints)

Algorithm
- Create a table for the relationship set.
- Add all primary keys of the participating entity sets as fields of the table.
- Add a field for each attribute of the relationship.
- Declare a primary key using the key fields from the source entity set only.
- Declare foreign key constraints for all the fields from the source and target entity sets.
Mapping relationship sets (with key constraints)

create table Directed_By (  
mn char(8),  
staff_id char(8),  
primary key (mn),  
foreign key (mn) references Students,  
foreign key (staff_id) references DoS )

Note that this has captured the key constraint, but not the participation constraint. That requires an alternative approach, and a further kind of declaration.

Part I: Structured Data I.2: The relational model

Mapping relationship sets (with key constraints, 2nd method)

Algorithm

- Create a table for the source and target entity sets as usual.
- Add every primary key field of the target as a field in the source.
- Declare these fields as foreign keys.

Because the Directed_By relation is many-to-one, we don’t in fact need a whole table for the relation itself. However, this does slightly “pollute” the source entity table.

create table Students (  
mn char(8),  
name char(20),  
age integer,  
email char(15),  
dos_id char(8),  
primary key (mn),  
foreign key (dos_id) references DoS )

Note that this has still not included the participation constraint on Students in Directed_By, but we are now nearer to doing so...
Null values

In SQL, a field can have the special value *null*

A null value means that a field is either unknown/missing/unavailable, or undefined/makes no sense here.

Some implementations do not allow the null value to appear in *primary key* fields.

They may allow nulls to appear in *foreign key* fields.

Null values can be disallowed from specific fields with a *not null* declaration.

In certain circumstances, by disallowing null, we can enforce a *participation constraint*.

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Mapping relationship sets with key+participation constraints

Algorithm

- Create a table for the source and target entity sets as usual.
- Add every primary key field of the target as a field in the source.
- Declare these fields as *not null*.
- Declare these fields as foreign keys.

```sql
create table Students ( 
    mn           char(8),
    name         char(20),
    age          integer,
    email        char(15),
    dos_id       char(8) not null,
    primary key  (mn),
    foreign key  (dos_id) references DoS )
```
Mapping weak entity sets and identifying relationships

Algorithm

- Create a table for the weak entity set.
- Make each attribute of the weak entity set a field of the table.
- Add fields for the primary key attributes of the identifying owner.
- Declare a foreign key constraint on these identifying owner fields.
- Instruct the system to automatically delete any tuples in the table for which there are no owners.

Algorithm

- Create a table for the weak entity set.
- Make each attribute of the weak entity set a field of the table.
- Add fields for the primary key attributes of the identifying owner.
- Declare a foreign key constraint on these identifying owner fields.
- Instruct the system to automatically delete any tuples in the table for which there are no owners.

Algorithm

- Create a table for the weak entity set.
- Make each attribute of the weak entity set a field of the table.
- Add fields for the primary key attributes of the identifying owner.
- Declare a foreign key constraint on these identifying owner fields.
- Instruct the system to automatically delete any tuples in the table for which there are no owners.

### Part I: Structured Data

#### I.2: The relational model

`create table Rooms (  
    number char(8),
    capacity integer,
    building_name char(20),
    primary key (number,building_name),
    foreign key (building_name) references Buildings  
    on delete cascade )`
create table PT.Students ( 
  mn char(8),
  pt_frac integer,
  primary key (mn),
  foreign key (mn) references Students )