COMP9311 Week 03 Lecture

ER-to-relational Mapping

So far, have considered mappings for ...

- ER attribute → relational attribute
- ER entity → relational table
- ER key → primary key for table
- n:m relationship → relational table
  (with foreign key for each participating entity plus relationship attributes)
- 1:n relationship → foreign key plus relationship attributes
- 1:1 relationship → foreign key plus relationship attributes

---

n-way Relationships

Relationship mappings above assume binary relationship.

If multiple entities are involved:

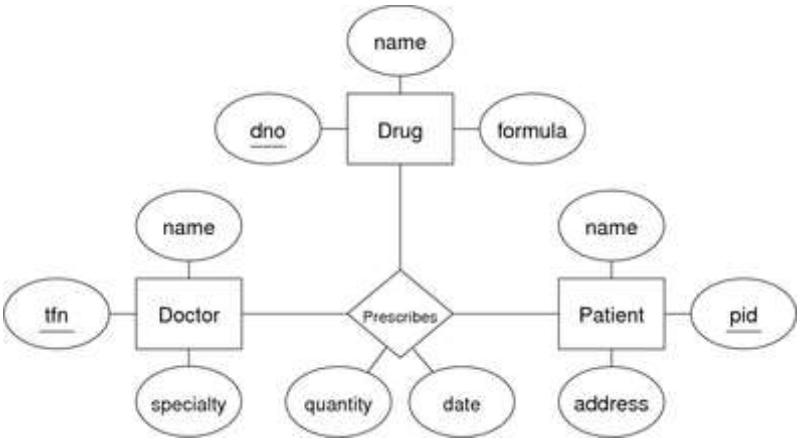
- n:m generalises naturally to n:m:p:q
  - include foreign key for each participating entity
  - include any other attributes of the relationship
- other multiplicities (e.g. 1:n:m) ...
  - need to be mapped the same as n:m:p:q
  - so not quite an accurate mapping of the ER

Some people advocate converting n-way relationships into:

- a new entity, and a set of n binary relationships

Exercise: 3-way relationship

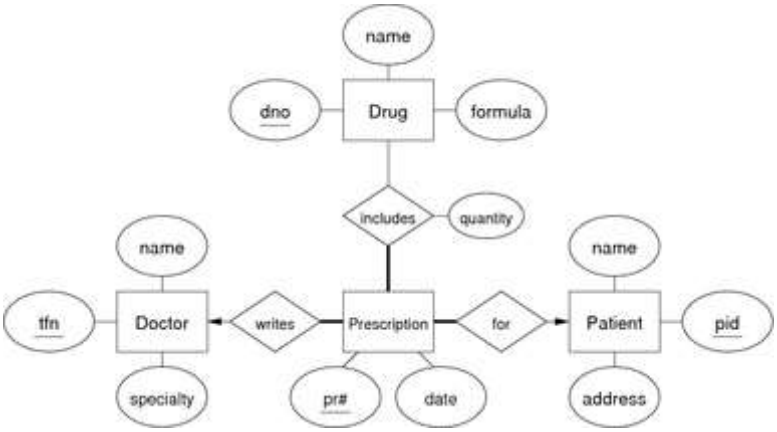
Translate the following ER design to a relational schema:



[Solution]

Exercise: Alternative prescription model

Translate the following ER design to a relational schema:



[Solution]

Mapping Composite Attributes

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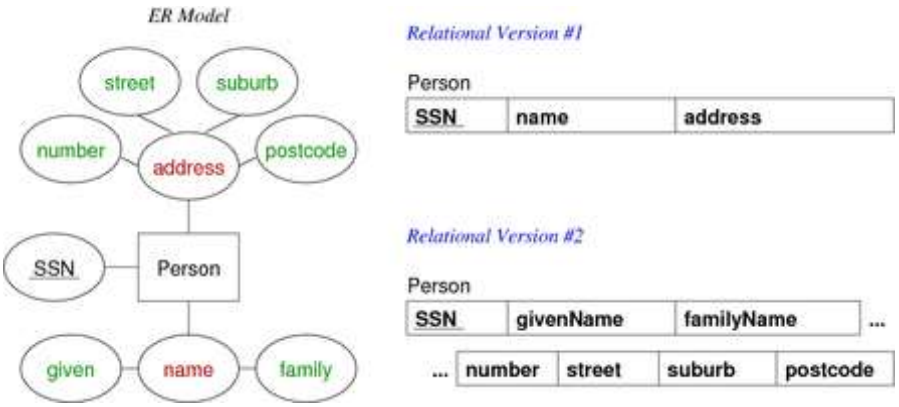
Composite attributes are mapped by concatenation or flattening.

Example:



Mapping Multi-valued Attributes (MVAs)

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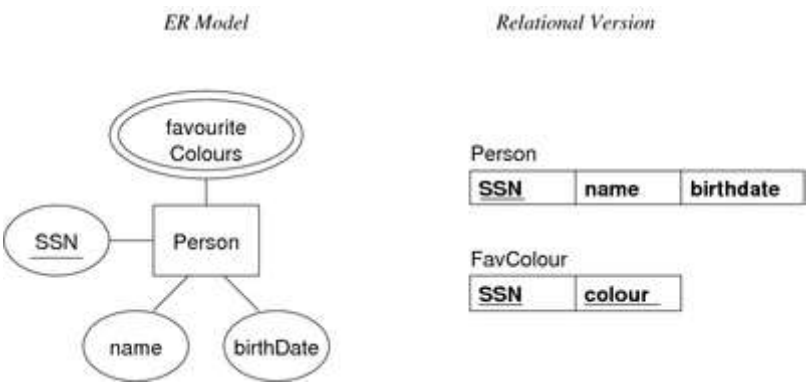
MVAs are mapped by a new table linking values to their entity.

Example:



... Mapping Multi-valued Attributes (MVAs)

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Example: the two entities

```
Person(12345, John, 12-feb-1990, [red, green, blue])
Person(54321, Jane, 25-dec-1990, [green, purple])
```

would be represented as

```
Person(12345, John, 12-feb-1990)
Person(54321, Jane, 25-dec-1990)
FavColour(12345, red)
FavColour(12345, green)
FavColour(12345, blue)
FavColour(54321, green)
FavColour(54321, purple)
```

Exercise: Attribute Mappings

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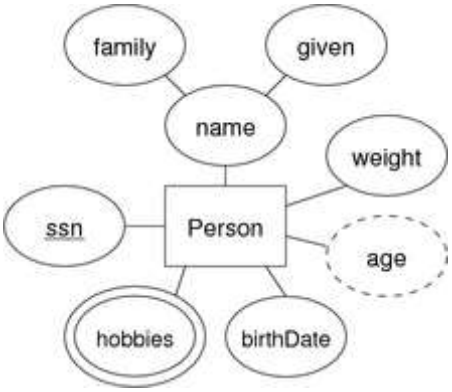
Convert this ER design to relational form:



... Mapping Subclasses

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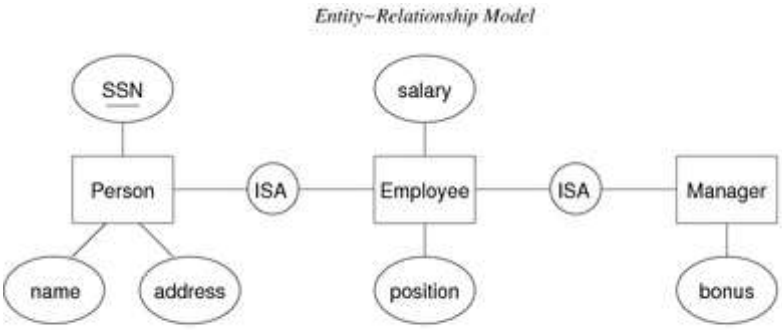
Example of object-oriented mapping:



Relational Model

Person

SSN	name	address

Employee

SSN	name	address	salary	position

Manager

SSN	name	address	salary	position	bonus

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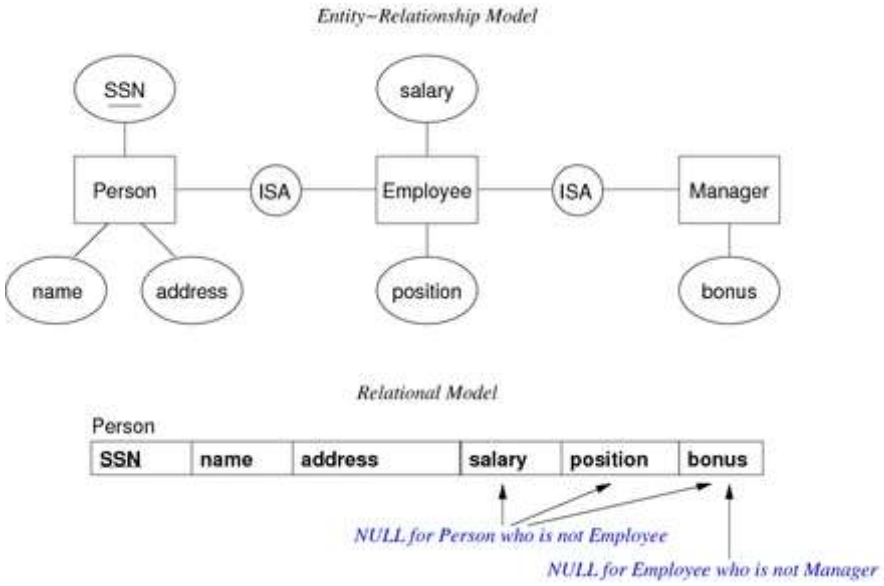
... Mapping Subclasses

Example of single-table-with-nulls mapping:



Exercise: Disjoint subclasses

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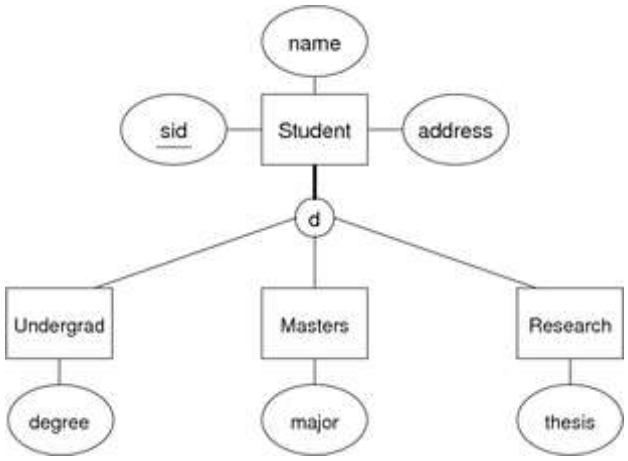
Translate the following ER design to a relational schema:



Use (a) ER-mapping, (b) OO-mapping, (c) 1-table-mapping

Are there aspects of the ER design that can't be mapped?

[Solution]

Exercise: Overlapping subclasses

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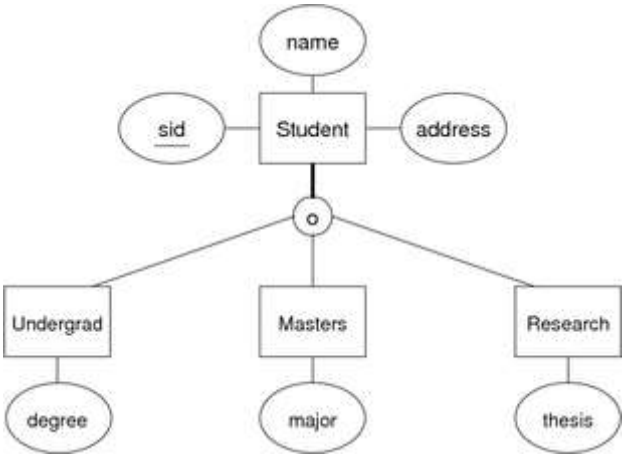
Translate the following ER design to a relational schema:



Use (a) ER-mapping, (b) OO-mapping, (c) 1-table-mapping

Are there aspects of the ER design that can't be mapped?

[Solution]

Relational DBMSs

What is an RDBMS?

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A relational database management system (RDBMS) is

- software designed to support large-scale data-intensive applications
- allowing high-level description of data (tables, constraints)
- with high-level access to the data (relational model, SQL)
- providing efficient storage and retrieval (disk/memory management)
- supporting multiple simultaneous users (privilege, protection)
- doing multiple simultaneous operations (transactions, concurrency)
- maintaining reliable access to the stored data (backup, recovery)

Note: databases provide persistent storage of information

Describing Data

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RDBMSs implement ≅ the relational model.

Provide facilities to define:

- domains, attributes, tuples, tables
- constraints (domain, key, referential)

Variations from the relational model:

- no strict requirement for tables to have keys
- bag semantics, rather than set semantics
- no standard support for general (multi-table) constraints

RDBMS Operations

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RDBMSs typically provide at least the following:

- create/remove a database or a schema
- create/remove/alter tables within a schema
- insert/delete/update tuples within a table
- queries on data, define named queries (views)
- transactional behaviour (ACID)

Most also provide mechanisms for

- creating/managing users of the database
- defining/storing procedural code to manipulate data
- implementing complex constraints (triggers)
- defining new data types and operators (less common)

PostgreSQL Architecture

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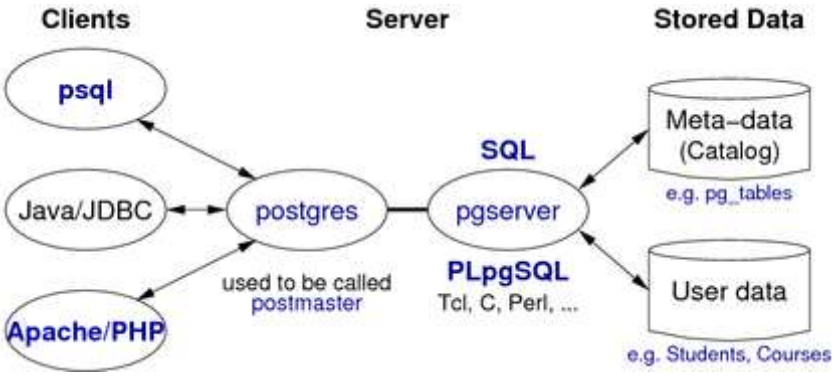
PostgreSQL's client-server architecture:



Using PostgreSQL

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Using your PostgreSQL server in CSE (once installed):

- login to grieg, set up environment, start server
- use psql, etc. to manipulate databases
- stop server, log off grieg

```
wagner$ ssh YOU@grieg
grieg$ priv srvr
grieg$ source /srvr/YOU/env
grieg$ pg start
grieg$ psql mydb
... do stuff with your database ...
grieg$ pg stop
grieg$ exit
```

... Using PostgreSQL

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PostgreSQL files (helps to understand state of server)

- PostgreSQL home directory ... /srvr/YOU/pgsql903/
- under the home directory ...
  - postgresql.conf ... main configuration file
  - base/ ... subdirectoriess containing database files
  - postmaster.pid ... process ID of server process

    - .s.PGSQL.5432 ... socket for clients to connect to server
    - .s.PGSQL.5432.lock ... lock file for socket
- PostgreSQL environment settings ... /srvr/YOU/env

Building/Maintaining Databases

Managing Databases

Shell commands:

- createdb dbname
- dropdb dbname

(If no dbname supplied, assumes a database called YOU)

SQL statements:

- CREATE DATABASE dbname
- DROP DATABASE dbname

(Neither of the above is SQL-standard)

... Managing Databases

Shell commands (dump/restore):

- pg_dump dbname > dumpfile
- psql dbname -f dumpfile

(Database dbname is typically created just before restore)

SQL statements (used in dumpfile):

- CREATE TABLE table (Attributes+Constraints)
- ALTER TABLE table TableSchemaChanges
- COPY table (AttributeNames) FROM STDIN

Managing Tables

SQL statements:

- ALTER TABLE table TableSchemaChanges
- DROP TABLE table(s) [CASCADE]
- TRUNCATE TABLE table(s) [CASCADE]

(All conform to SQL standard, but all also have extensions)

DROP..CASCADE drops objects which depend on the table

TRUNCATE..CASCADE truncates tables which refer to the table

Managing Tuples

SQL statements:

- INSERT INTO table (attrs) VALUES tuple(s)
- DELETE FROM table WHERE condition
- UPDATE table SET AttrValueChanges WHERE condition

AttrValueChanges is a comma-separated list of:

- attrname = expression

Each list element assigns a new value to a given attribute.

Exercise: Generating IDs

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Consider the following schema:

```
create table T (
    id serial primary key,
    x  integer,
    y  varchar(10)
);
```

- what does serial actually produce (look in the catalog)?
- write INSERT statements to add some tuples
- how could an application program get the generated id?
  (select max(id) from T may not give the correct result; why not?)

Managing Other DB Objects

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Databases contain objects other than tables and tuples:

- views, functions, sequences, types, indexes, roles, ...

Most have SQL statements for:

- CREATE ObjectType name ...
- DROP ObjectType name ...

Views and functions also have available:

- CREATE OR REPLACE ObjectType name ...

See PostgreSQL documentation Section IV, Chapter I for SQL statement details.

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