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COMP3311 Week 1 Tuesday Lecture

- In today's lecture ...
- Reminders
- ER Model (recap)
- N:M Relationships
- 1:N Relationships
- 1:1 Relationships
- Class Hierarchies
- Exercise: Student/Lecturer Class Hierarchy
- Developing ER Models
- Exercise: Medical Information
- Exercise: Book Publishing Scenario
- Data Models
- Relational Model
- Exercise: ER-to-relational Mapping

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❖ In today's lecture ...

- Entity-Relationship (ER) Model (cont)
- Relational Model
- SQL Data Definition Language (DDL)
- Mapping ER → SQL

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❖ Reminders

Using PostgreSQL on vxdb2 ...

- ssh to vxdb2
- set up environment (PGDATA)
- start PostgreSQL server p1
- ... play with PostgreSQL ...
- stop PostgreSQL server p0

Lectures ... see Lecture Material link

- Slides ... available before lecture
- Video ... available > 3 hours after lecture (Echo360, YouTube)
- Data ... what I do in the exercises, available after lecture

❖ ER Model (recap)

ER models give a visual representation of database structure

Primary components

- Entities = objects of interest in the scenario
- Relationships = associations between entities
- Attributes = properties of entities

ER models don't capture all information from the scenario

- e.g. types and constraints on attribute values

ER models are useful as a step towards an SQL [schema](#)

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❖ ER Model (recap) (cont)

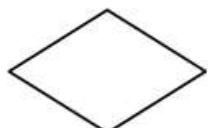
ER design elements:



Entity



Weak entity



Relationship



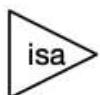
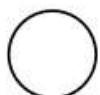
Identifying
Relationship



Attribute



Multi-valued
Attribute



Inheritance



Derived
Attribute

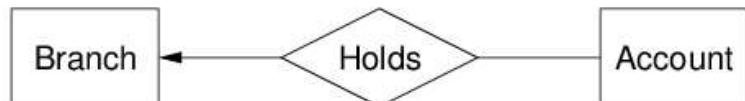
❖ ER Model (recap) (cont)

Relationships:

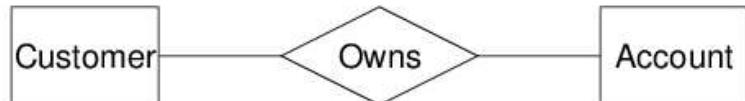
one-to-one



one-to-many



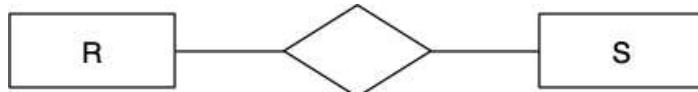
many-to-many



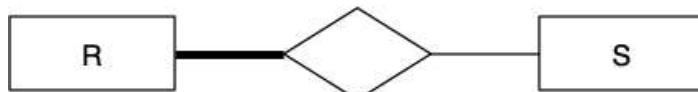
Thick line = total participation; thin line = partial participation

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❖ N:M Relationships



*Each R is associated with 0 or more S
Each S is associated with 0 or more R*



*Each R is associated with 1 or more S
Each S is associated with 0 or more R*



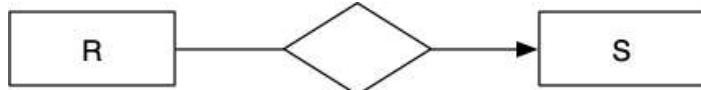
*Each R is associated with 0 or more S
Each S is associated with 1 or more R*



*Each R is associated with 1 or more S
Each S is associated with 1 or more R*

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❖ 1:N Relationships



*Each R is associated with 0 or 1 S
Each S is associated with 0 or more R*



*Each R is associated with 1 S
Each S is associated with 0 or more R*



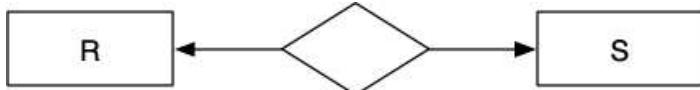
*Each R is associated with 0 or 1 S
Each S is associated with 1 or more R*



*Each R is associated with 1 S
Each S is associated with 1 or more R*

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❖ 1:1 Relationships



*Each R is associated with 0 or 1 S
Each S is associated with 0 or 1 R*



*Each R is associated with 1 S
Each S is associated with 0 or 1 R*



*Each R is associated with 0 or 1 S
Each S is associated with 1 R*



*Each R is associated with 1 S
Each S is associated with 1 R*

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❖ Class Hierarchies

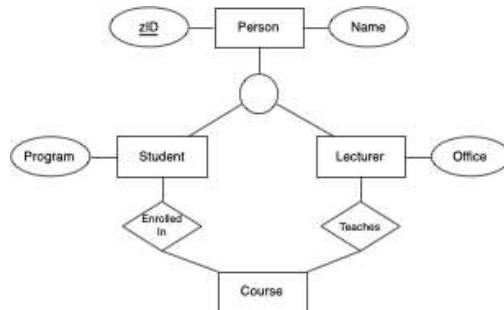
ER also implements super-class / sub-class hierarchies

- both super- and sub-classes consist of entities
- super-class has common properties of all entities in hierarchy
- sub-classes *can* add extra properties to specialise
- entities in super-class *may* have corresponding entities in sub-class
- sub-classes can be
 - disjoint ... entities are members of only one sub-class
 - overlapping ... entities can be members of several sub-classes

❖ Exercise: Student/Lecturer Class Hierarchy

Modify the minimal ER class hierarchy to represent

- some people in the database are students or lecturers
- all people in the database are students or lecturers
- all people in the database are students XOR lecturers
- some people in the database are students XOR lecturers



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❖ Developing ER Models

A complete ER model should ...

- include all entities and their attributes
- identify key attributes
- capture accurate semantics for all relationships
- include class hierarchies where appropriate

There are frequently different kinds of people (\Rightarrow subclasses)

❖ Exercise: Medical Information

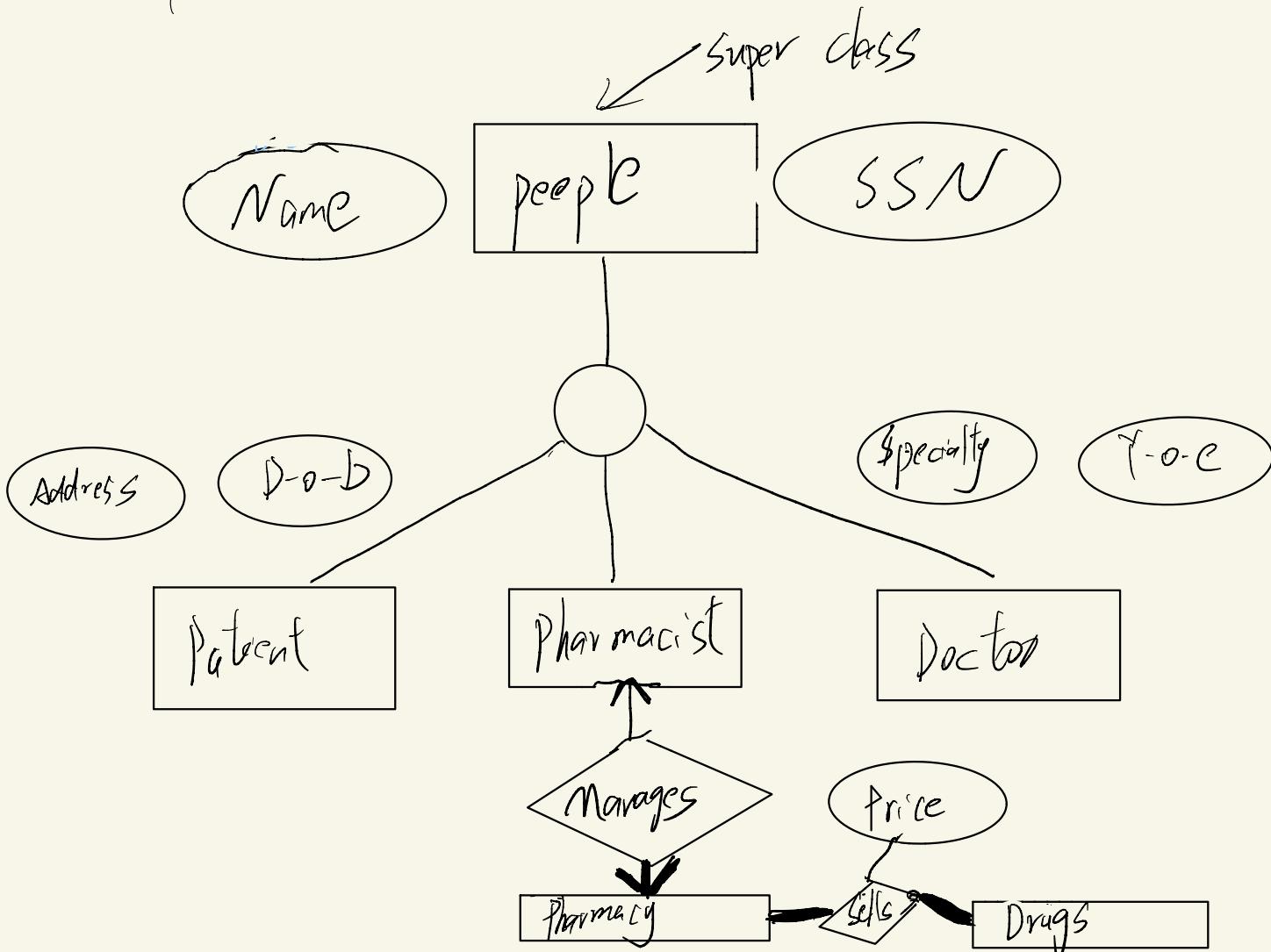
Develop an ER model for the following scenario:

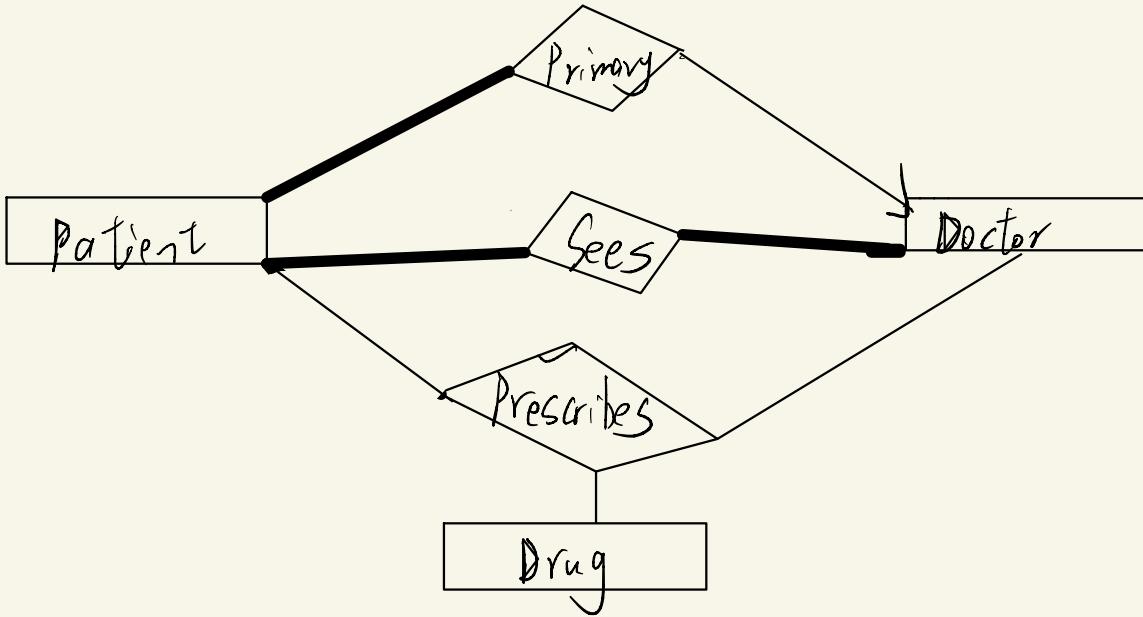
- Patients are identified by an SSN, and their names, addresses and ages must be recorded.
- Doctors are identified by an SSN. For each doctor, the name, specialty and years of experience must be recorded.
- A pharmacist is identified by an SSN, he/she can only work for one pharmacy. For each pharmacist, their name must be recorded.
- Each pharmacy has a name, address and phone number. A pharmacy must have a manager, who is a pharmacist.
- For each drug, the trade name and formula must be recorded.
- Every patient has a primary physician. Every doctor has at least one patient.
- Each pharmacy sells several drugs, and has a price for each. A drug could be sold at several pharmacies, and the price could vary between pharmacies.
- Doctors prescribe drugs for patients. A doctor could prescribe one or more drugs for several patients, and a patient could obtain prescriptions from several doctors. Each prescription has a date and quantity associated with it.

❖ Exercise: Book Publishing Scenario

Develop an ER model for the following scenario:

- for each person, we need to record their tax file number (TFN), their real name, and their address
- authors write books, and may publish books using a "pen-name" (a name, different to their real name, which they use as author of books); they may use multiple pen-names
- editors ensure that books are written in a manner that is suitable for publication
- every editor works for just one publisher
- editors and authors have quite different skills; someone who is an editor cannot be an author, and vice versa
- a book may have several authors, just one author, or no authors (published anonymously)
- every book has one editor assigned to it, who liaises with the author(s) in getting the book ready for publication
- each book has a title, and an edition number (e.g. 1st, 2nd, 3rd)
- each published book is assigned a unique 13-digit number (its ISBN); different editions of the same book will have different ISBNs
- publishers are companies that publish (market/distribute) books
- each publisher is required to have a unique Australian business number (ABN)
- a publisher also has a name and address that need to be recorded
- a particular edition of a book is published by exactly one publisher





❖ Data Models

Entity-relationship (ER) model

- world is modelled via entities, relationships, attributes

Relational model

- world is modelled via tuples, relations, constraints

SQL schemas

- a good approximation of the relational model

Also ODL, UML, and a variety of others ... but not in this course.

❖ Relational Model

Tuples are collections of values (cf. Python tuples, C structs)

- e.g. (1234567, John Smith, BE, SENG, 75.2)

Relations are sets of tuples

- e.g. { (1,2,3), (3,2,1), (1,3,5), (2,4,6) }

Constraints are logical statements on valid data

- e.g. zID is unique and $0 \leq \text{WAM} \leq 100$

Tuples correspond to entities

Relations correspond to entity sets *and* relationships

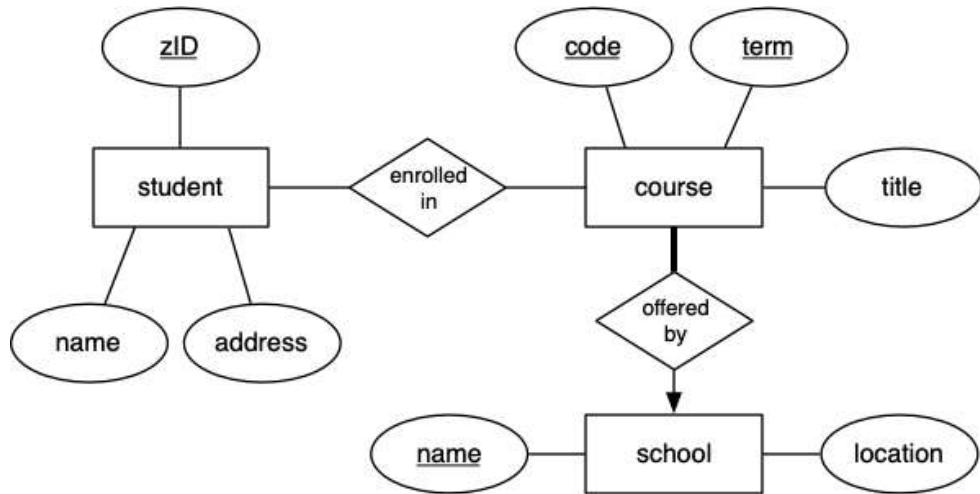
❖ Relational Model (cont)

Different kinds of constraints

- **unique** = value of attribute is unique in relation
- **key** = chosen unique attribute to distinguish tuples
- **domain** = type of attribute, restrictions within type
- **referential integrity** = foreign key
 - tuple in relation R has attribute F
 - whose value corresponds to key attribute K in relation S

❖ Exercise: ER-to-relational Mapping

Convert this ER model to a relational model



Produced: 17 Feb 2023