

ER Modeling

February 4, 2022

Entity-Relationship Modeling - *Relational data model* (or *relational model*) - *Entity-Relationship Model* (or *ER Model*) - Examples

0.1 Relational Model

- **Relation (table):** 2-dim table, set (not list) of tuples
- **Attributes:** table columns, fields
- **Schema:** Movies(title, year, length, filmType)
- **Tuples:** rows in the table, records
- **Domains:** types

0.1.1 Example Table from a World Database

code	name	continent	region	population	code2
AFG	Afghanistan	Asia	Southern and Central Asia	22720000	AF
ALB	Albania	Europe	Southern Europe	3401200	AL
DZA	Algeria	Africa	Northern Africa	31471000	DZ
ASM	American Samoa	Oceania	Polynesia	68000	AS
AND	Andorra	Europe	Southern Europe	78000	AD
AGO	Angola	Africa	Central Africa	12878000	AO
AIA	Anguilla	North America	Caribbean	8000	AI
ATA	Antarctica	Antarctica	Antarctica	0	AQ
ATG	Antigua and Barbuda	North America	Caribbean	68000	AG
ARG	Argentina	South America	South America	37032000	AR
ARM	Armenia	Asia	Middle East	3520000	AM
ABW	Aruba	North America	Caribbean	103000	AW
AUS	Australia	Oceania	Australia and New Zealand	18886000	AU
AUT	Austria	Europe	Western Europe	8091800	AT
AZE	Azerbaijan	Asia	Middle East	7734000	AZ
BHS	Bahamas	North America	Caribbean	307000	BS
BHR	Bahrain	Asia	Middle East	617000	BH

Table: country (sample data, sorted by country name)

0.1.2 Terminology (1)

- **Entity:** Something of interest to the database user community.
 - customers, parts, geographic locations
- **Column:** An individual piece of data stored in a table.

- **Row:** A set of columns that together completely describe an entity or some action on an entity. Also called a record.
- **Table:** A set of rows, held either in memory (nonpersistent) or on permanent storage (persistent).

0.1.3 Terminology (2)

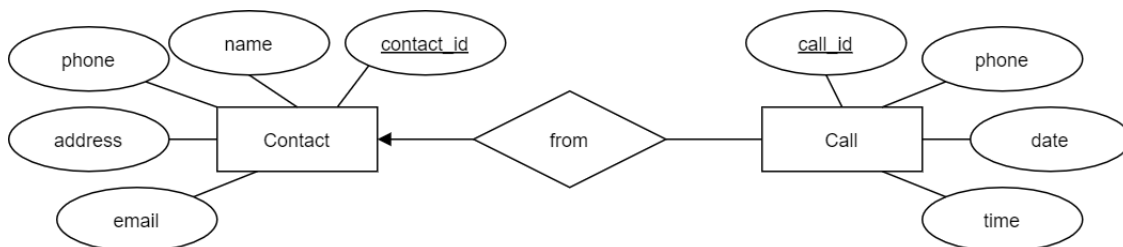
- **Result Set:** Another name for a nonpersistent table, generally the result of an SQL query.
- **Primary Key:** One or more columns that can be used as a unique identifier for each row in a table.
- **Foreign Key:** One or more columns that can be used together to identify a single row in another table.

0.2 Steps to create a new database

1. **Conceptual Model:** model (or design) the database at the *logical* level
 - we are using the traditional **ER model**
 - but we could use other approaches, for example the *UML model*
2. **Relational Data Model:** convert the conceptual model into the relational data model
 - we could use other data models, such as the *object-relational* model or other non-relational models (OO, NoSQL models, ...)
 - the relational model is the most common model, and it cannot be skipped or ignored when learning about data bases
3. **Database Instance Creation:** generate the necessary **CREATE TABLE** and other SQL statements to create a database instance, and fill it with data
 - After the database has been created, you can start using it (**SELECT** statements, data updates, ...)

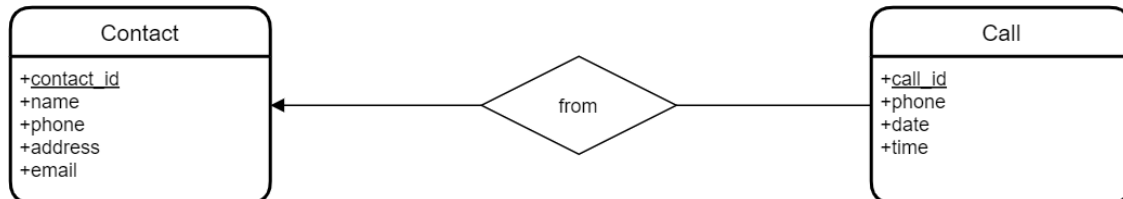
0.2.1 Entity-Relationship (ER) Model

- **Entity sets:** rectangles
- **Relationship sets:** diamonds
- **Attributes:** ovals
- **Arrow heads** for connecting relationship sets to entity sets:
 - *solid black triangle:* at most 1
 - *open round or transparent triangle:* exactly 1
 - no arrow heads: many
- **Primary keys:** underlined attribute names



Contacts DB

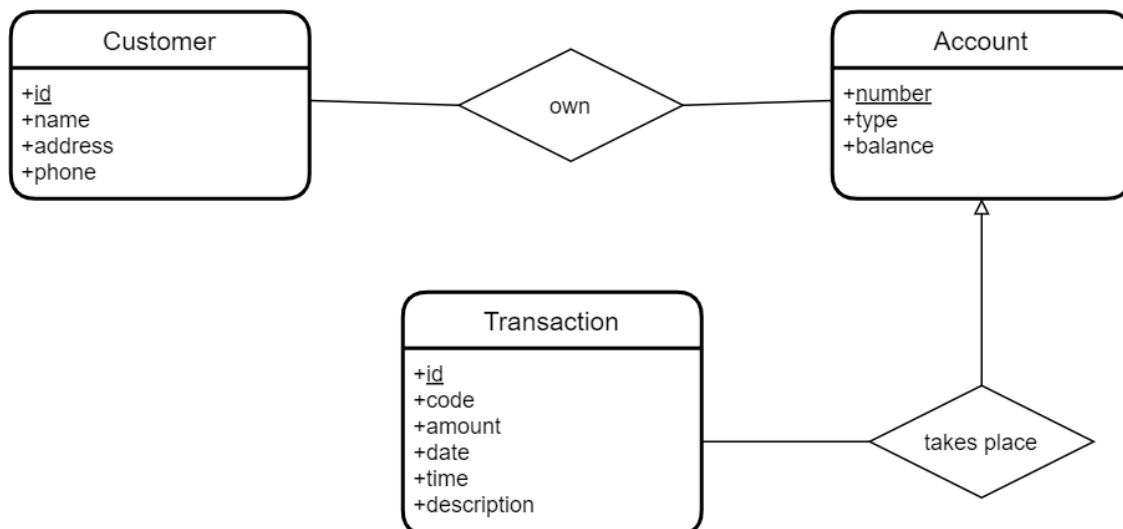
- *entities*: Contact, Call
- *relationship*: from
 - *many-one* relationship from Call to Contact
- *attributes*: all ovals
- *primary keys*: Contact.contact_id, Call.call_id



Contacts DB Alternative Notation

0.2.2 Simple Bank Database

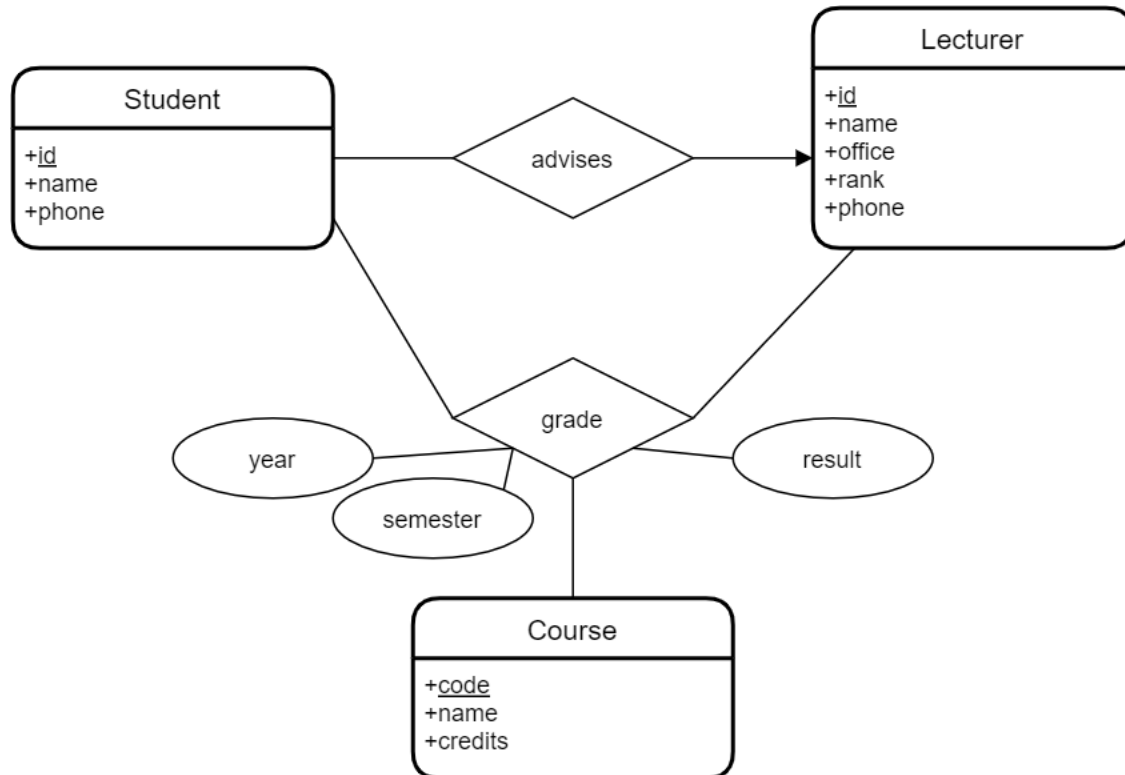
- The database application called BANK, which keeps track of a Bank's customers and their accounts.
 - Customers are identified by their name, address, phone and customer ID.
 - Accounts have numbers, types (e.g., savings, checking) and balances.
 - Also record the customer(s) who own an account.
 - A transaction takes place on exactly one account.
 - Each transaction has an ID, a code, an amount, a date, a time and a description.

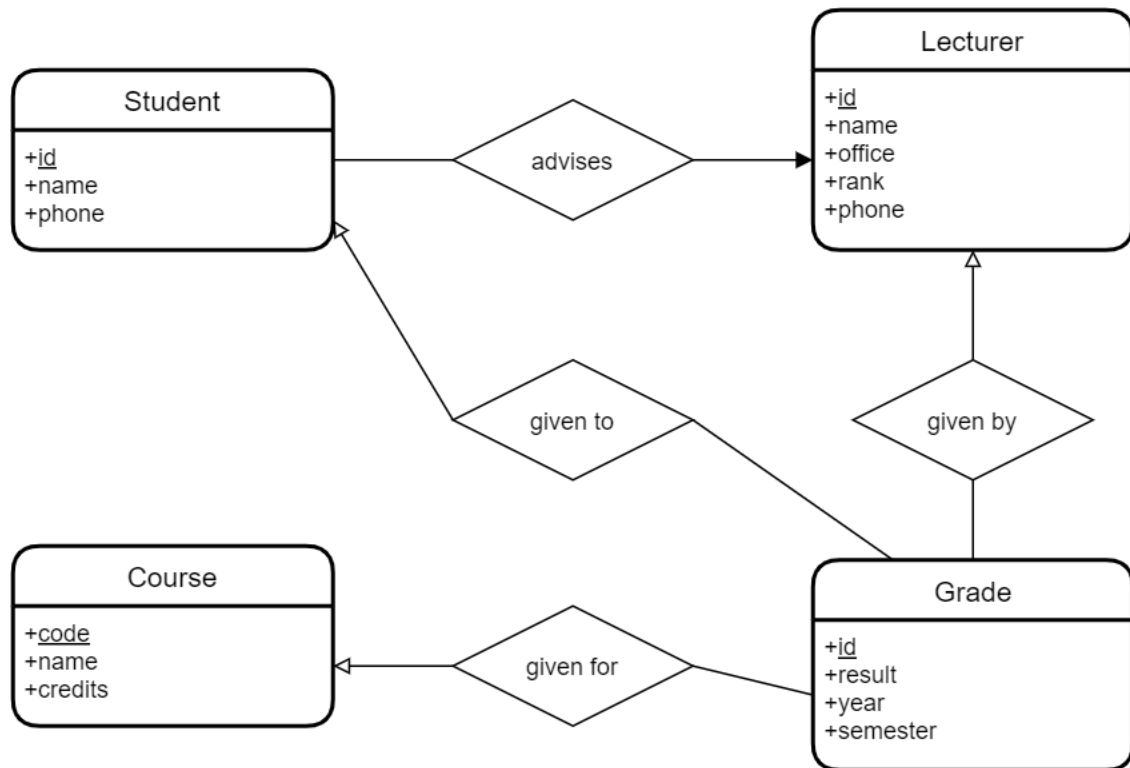


0.2.3 College Database

- In this database, you have to record students, lecturers, courses, grades and student advisers.
 - Every student has a student number, a name and an address.
 - Every lecturer has an employee number, a name, an office room number, a rank and a phone number.

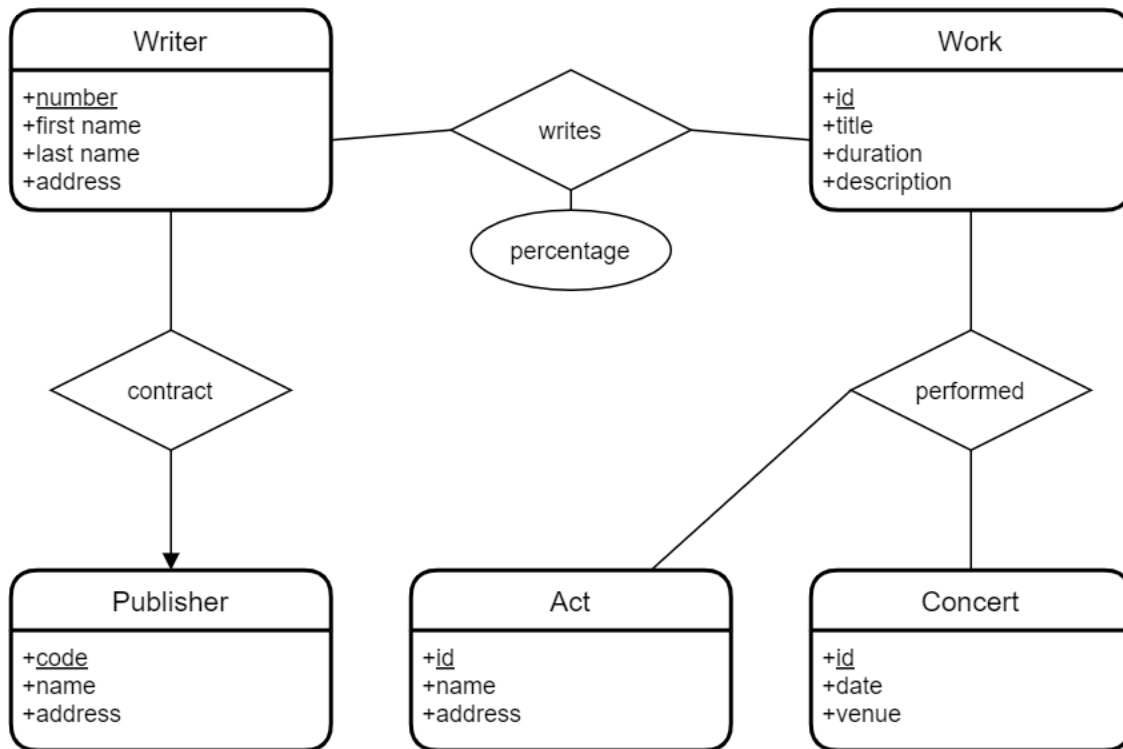
- For each course, its code, name and number of credits are recorded.
- A grade is given to a student by an lecturer for a course taught during a semester (A, B, or C) of a particular year.
- Student advisers are lecturers.





0.2.4 Music Copyrights Database

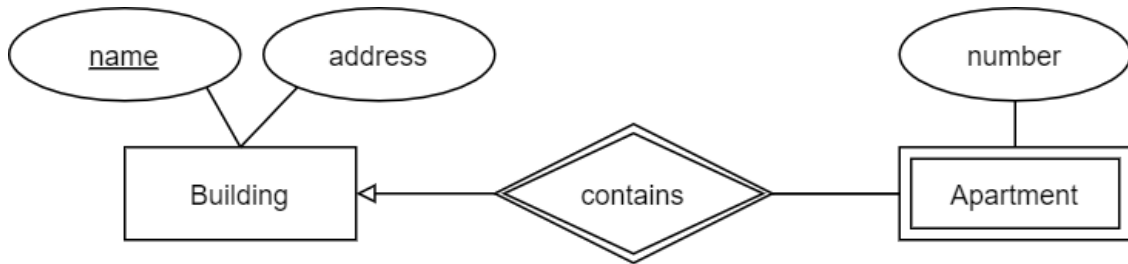
- You are asked to design a music copyright collection agency database, including information as follows:
 - A writer has a writer number, first name, last name and address.
 - Writers may be signed with a publisher. Publishers sign up many writers.
 - Publishers have a publisher code, name and address.
 - Writers write works. Works may have more than one writer. Each writer writes a percentage of a work.
 - A work has a title, duration and description.
 - Works get performed at concerts (or music shows) by an act.
 - A concert has a date and a venue.



0.2.5 Apartments for Rent

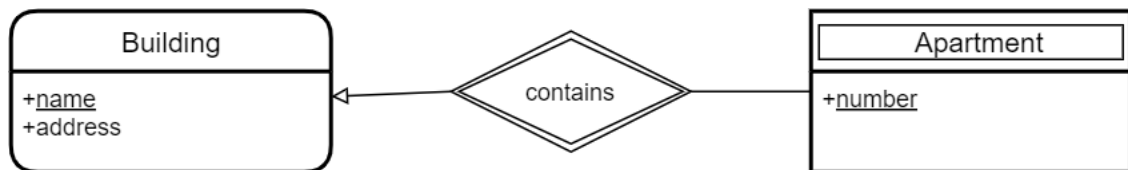
- You have to design a database to manage the information of a company managing a set of apartments for rent.
 - This company manages many buildings, each consisting of at least one apartment.
 - Suppose that an apartment can be uniquely identified by its number within its building.
 - For each apartment, there is at least one tenant, if it is rented.
 - The monthly rent and the end-of-lease date (if known) must be included.
 - For each apartment available soon, the date of availability and the asking monthly rent must be included.
 - For each tenant, the first name, last name, the home phone number, the name of his/her employer and his/her work phone number must be included.
- This end-of-lease date is not always the day after the end of the previous lease because an apartment could be unavailable for some time because of renovations, for example.
- Following a similar reasoning, the asking monthly rent is not necessarily the same as the current rent.

0.2.6 Weak Entity: Apartment



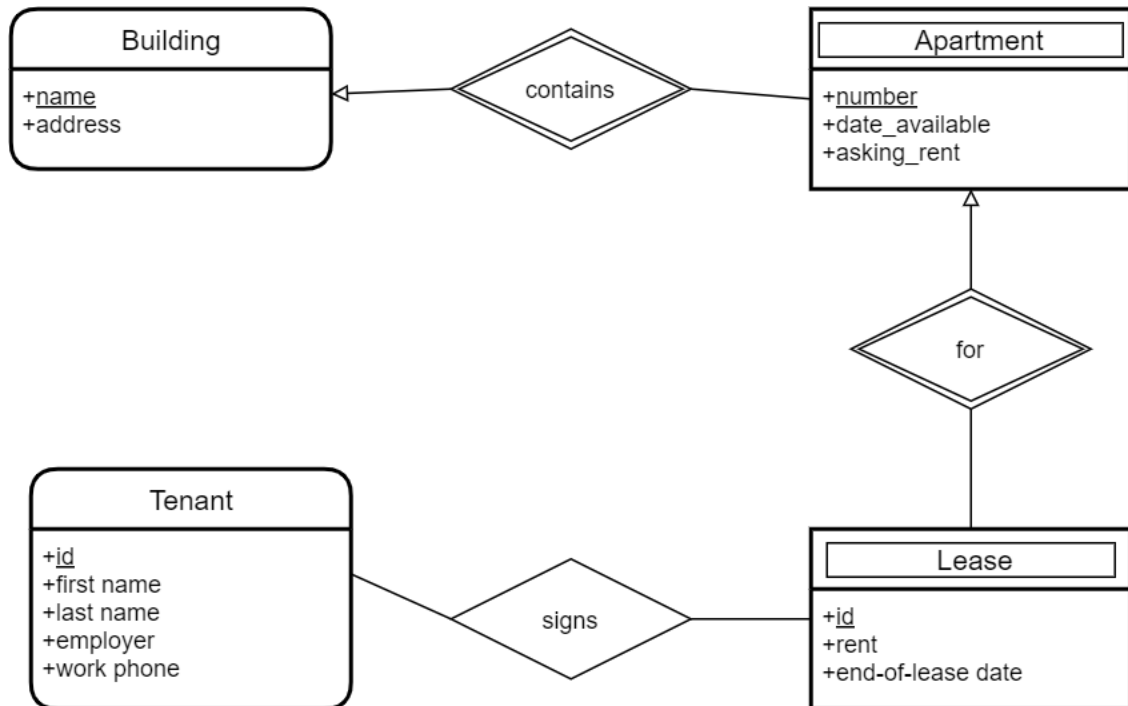
Traditional Notation

0.2.7 Weak Entity: Apartment



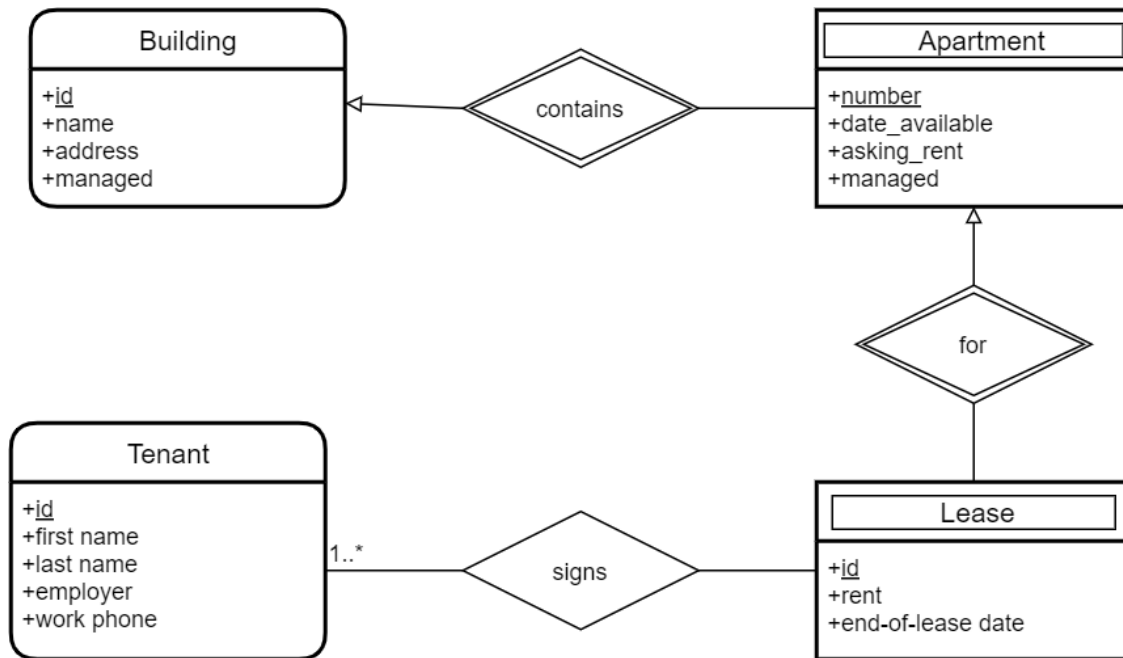
Alternative Notation

0.2.8 Apartments for Rent



Full diagram

0.2.9 Apartments for Rent



Improved diagram