

Lab 1: Entity Relationship (ER) Modeling



Recap



X to any Y



X to at most one Y



X to one or more Y



X to exactly one Y

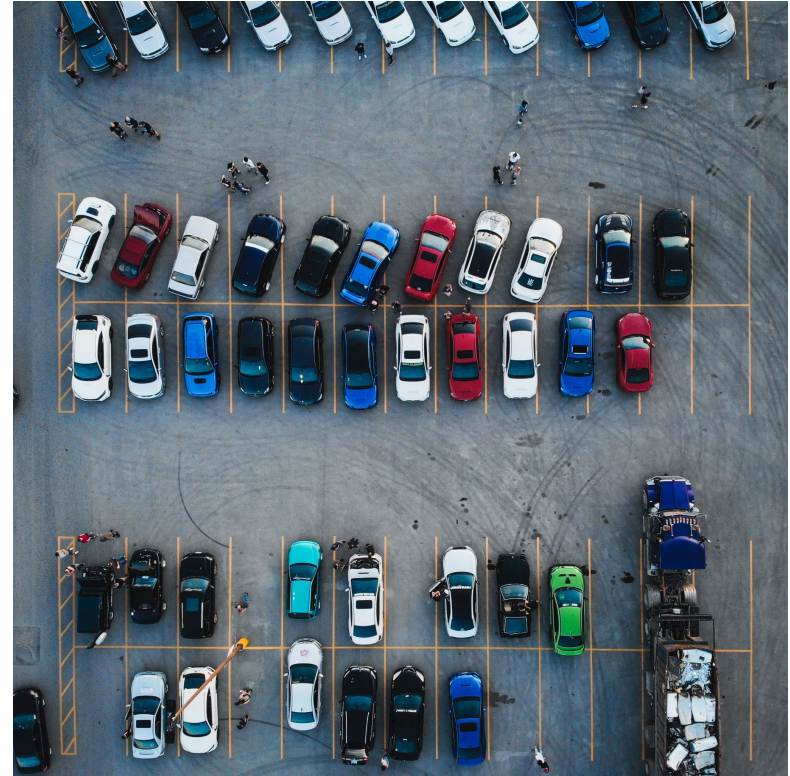
Example 1

A car is assigned to a parking lot

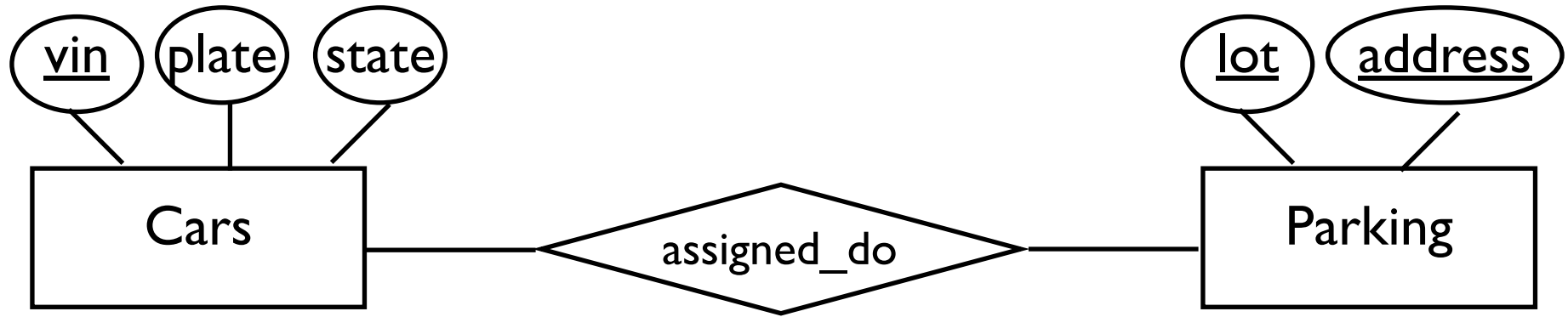
Cars (VIN, plate, state)

Parking (lot, address)

Assigned_To ()



Example 1 (solution)



Example 2

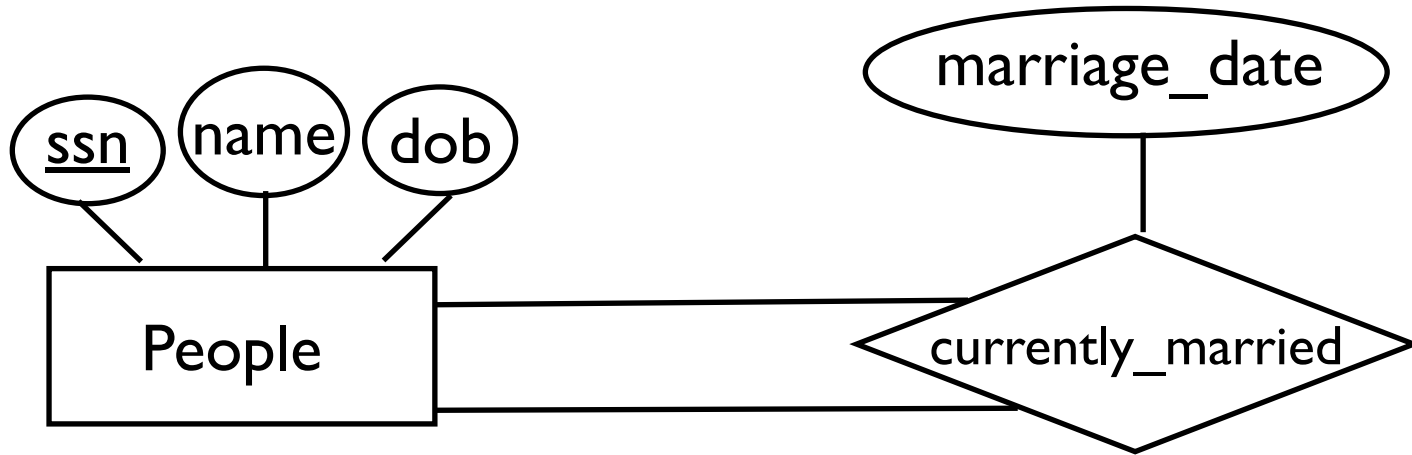
A person is married to another person

People (SSN, name, dob)

Currently_Married (marriage_date)



Example 2 (solution)



Example 3

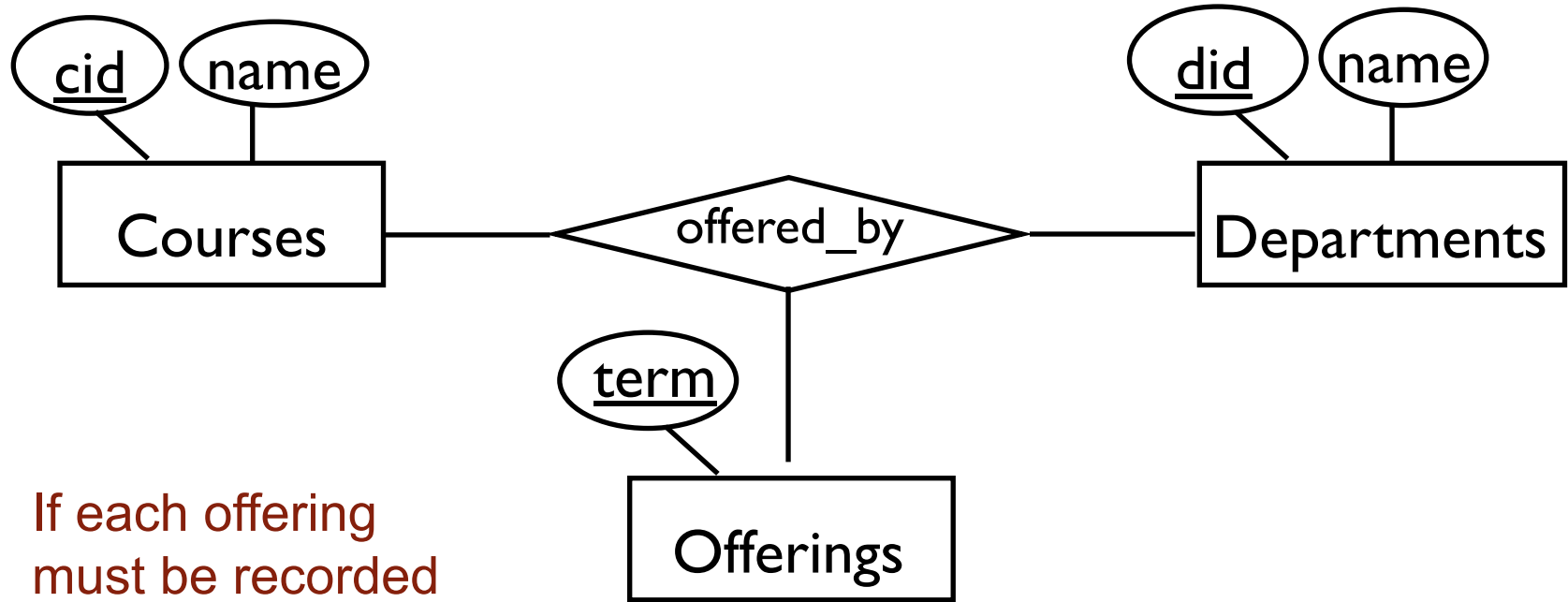
Courses are offered by departments

Courses may be offered in multiple terms

- 1) If each offering must be recorded
- 2) If only the most recent offering must be recorded
- 3) Only the first offering must be recorded

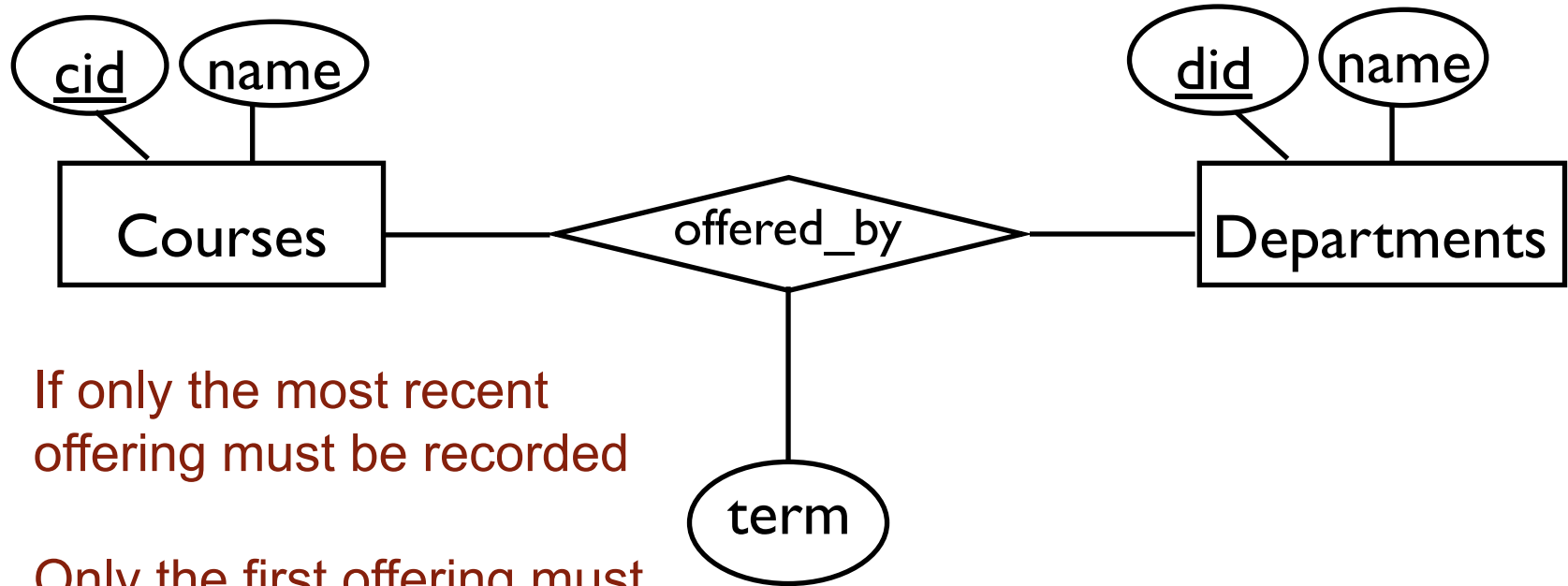


Example 3 (solution)



- 1) If each offering must be recorded

Example 3 (solution)



- 2) If only the most recent offering must be recorded
- 3) Only the first offering must be recorded

Example 4

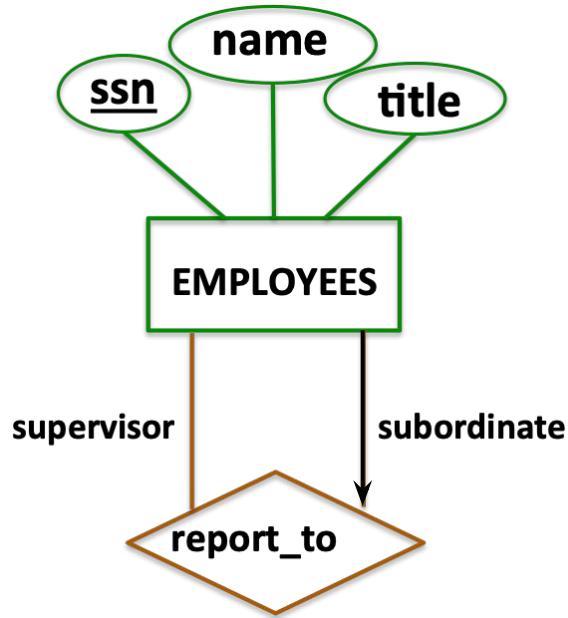
Employees are managed by managers

- 1) Each employee has at most one manager
- 2) A manager may manage any number of employees

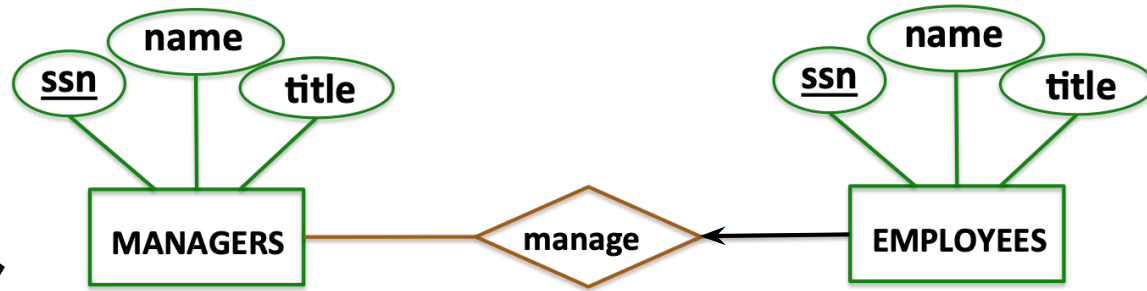


Clearly mark all key and participation constraints

Example 4 (solution)



or



(arrowhead, not bold)

Example 5

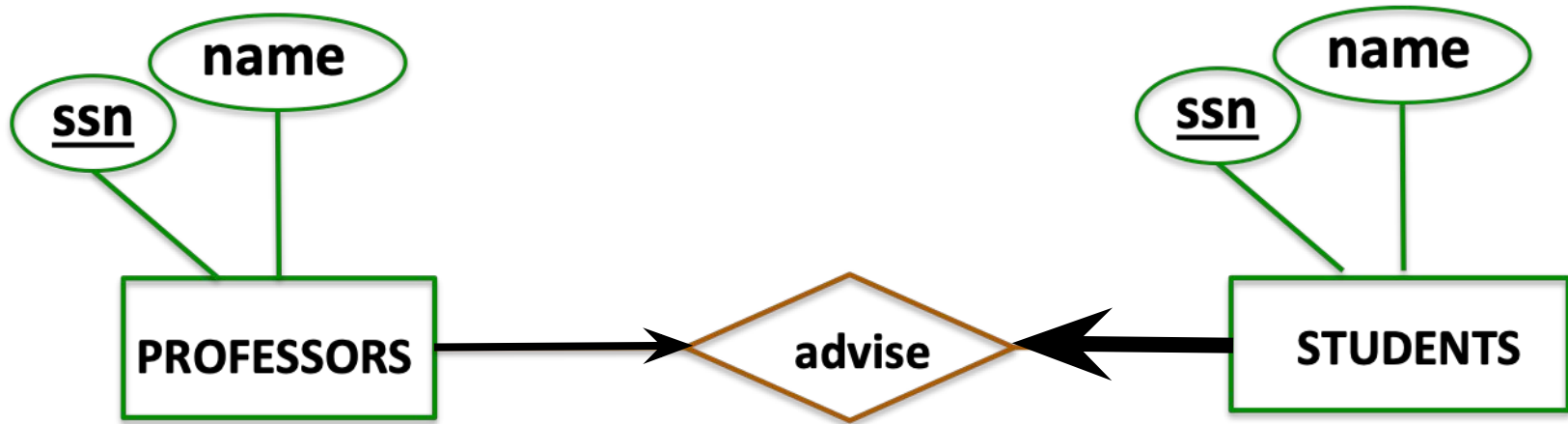
Professors advise students

- 1) Each professor has at most one student
- 2) Each student has exactly one advisor



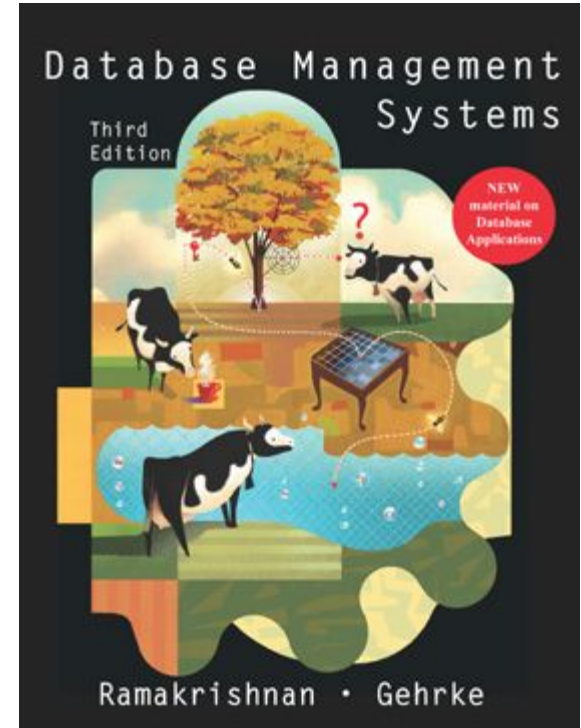
Clearly mark all key and participation constraints

Example 5 (solution)

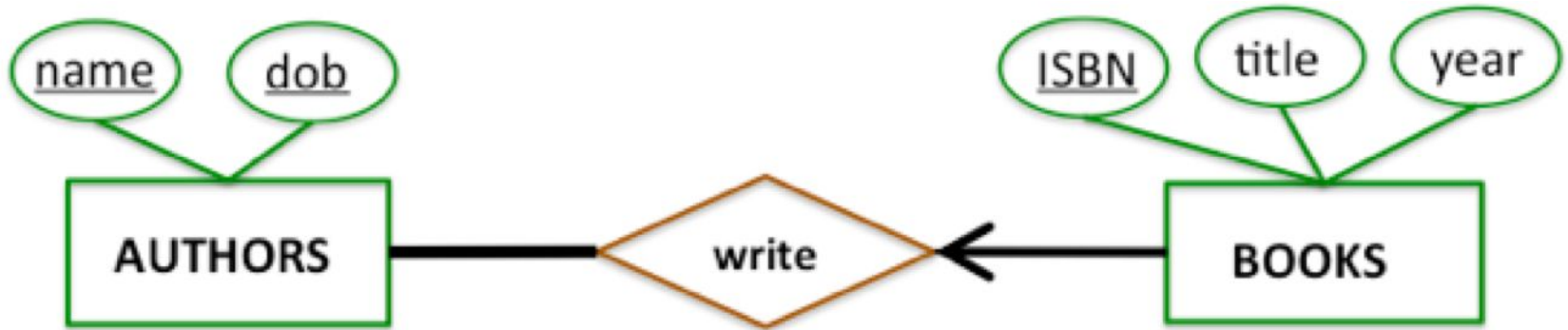


Example 6

- 1) An author is described by a name and a date of birth (dob). No two authors have the same combination of name and dob.
- 2) A book is described by an ISBN, a title and the year when it was written. No two books have the same ISBN number.
- 3) A book is written by exactly one author.
- 4) An author is only included in the database if they have authored at least one book.



Example 6 (solution)

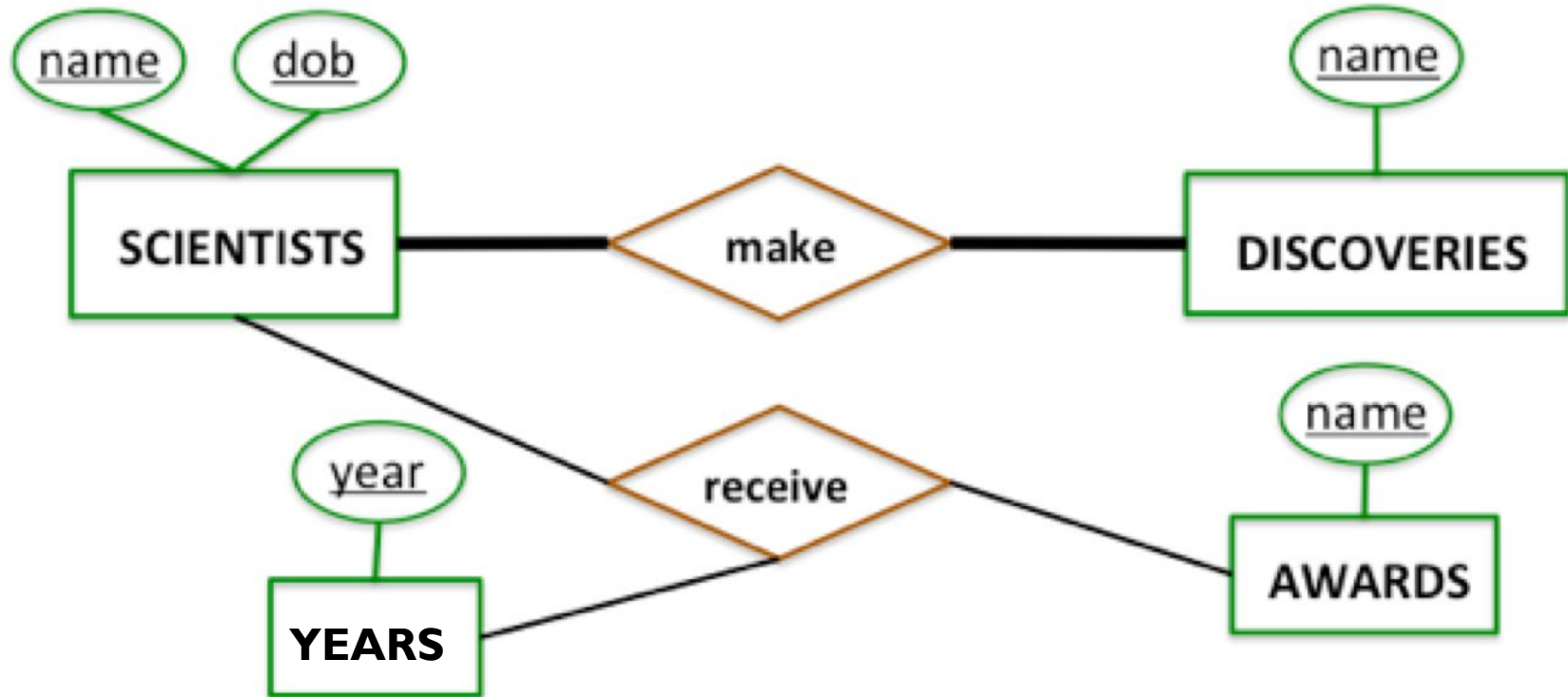


Example 7

- 1) A scientist is described by a name, a field of study, and a date of birth (dob). No two scientists have the same combination of name and dob.
- 2) A discovery has a name. No two discoveries have the same name.
- 3) An award has a name that uniquely identifies it.
- 4) Scientists make discoveries. A discovery is made by one or several scientists. A scientist who made no discoveries is not tracked in our database.
- 5) Scientists receive awards. A scientist may receive the same award more than once for different years. All years in which a scientist received a particular award must be recorded.



Example 7 (solution)

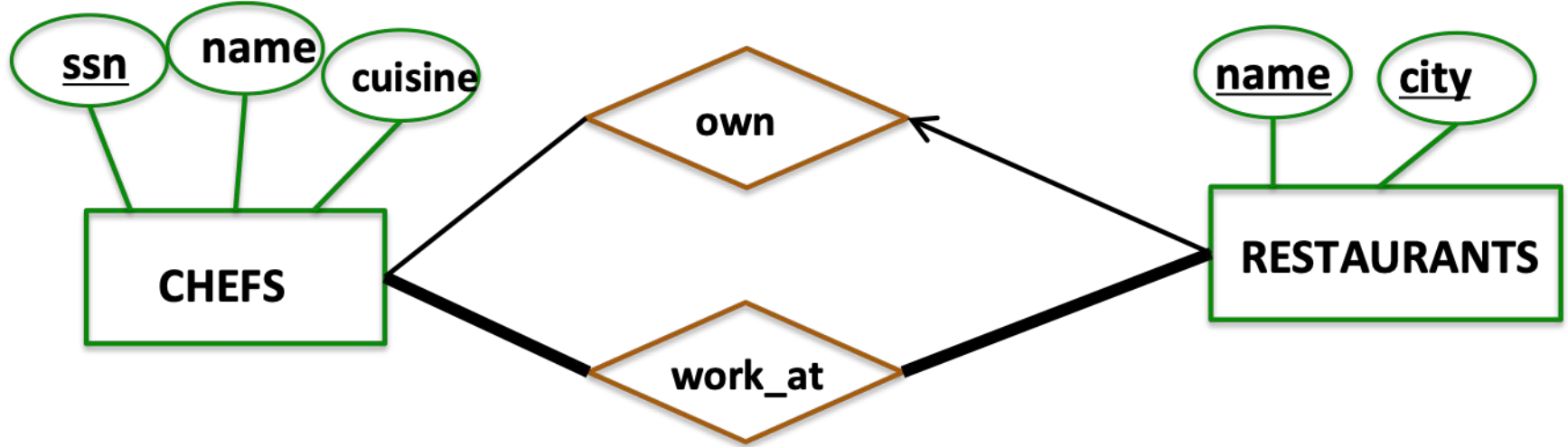


Example 8

- 1) Chefs work at restaurants.
- 2) A chef is uniquely identified by an SSN and is described by a name, as well as a cuisine in which they specialized in.
- 3) A restaurant is uniquely identified by a combination of name and city.
- 4) Each chef works in at least one restaurant and each restaurant must have at least one chef working at it.
- 5) Some chefs own restaurants and if a chef owns a restaurant - they are the sole owner.



Example 8 (solution)

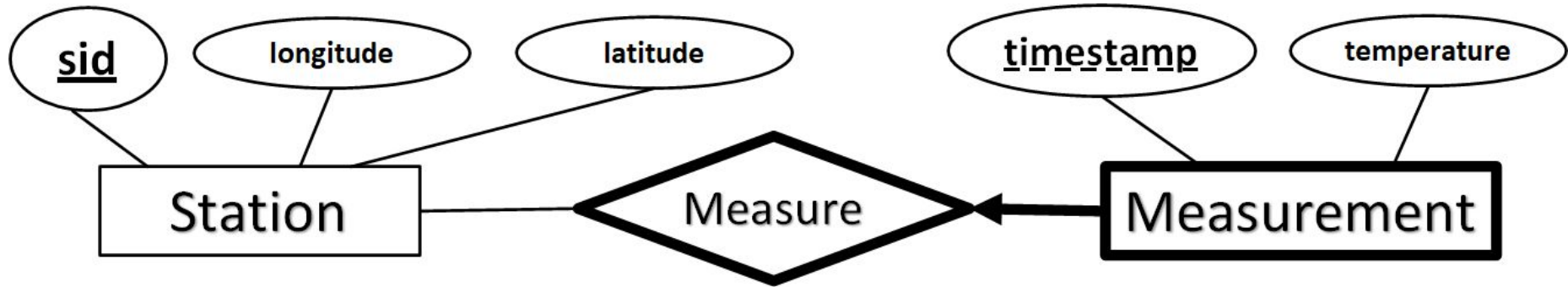


Example 9

- 1) A weather station is defined by an sid and longitude and latitude coordinates.
- 2) A station may perform measurements at regular or irregular time intervals. For each measurement, store a timestamp and temperature.
- 3) A measurement will **not** occur independently of a weather station. If the weather station is no longer recorded in the database then we do not track the measurement.

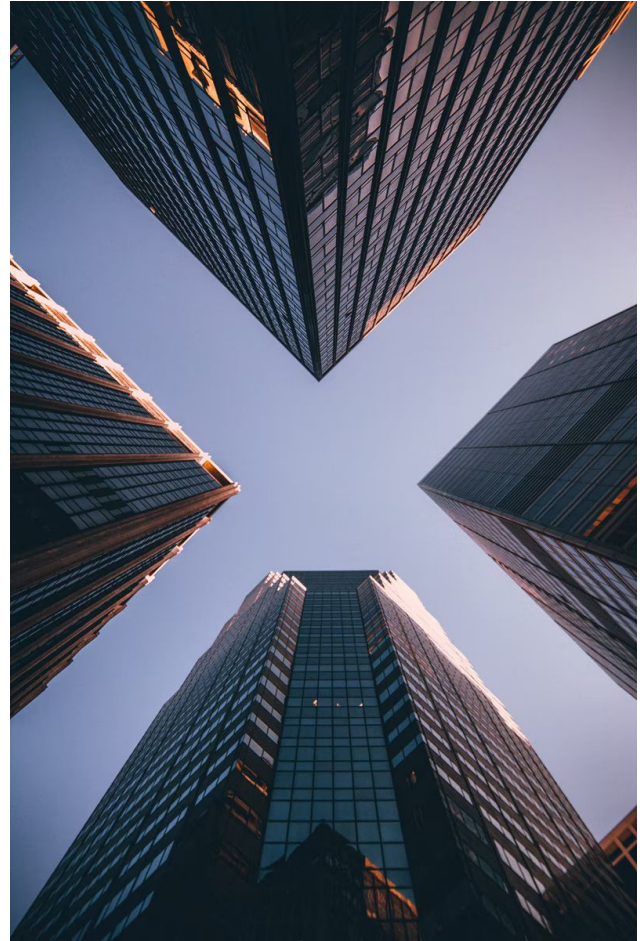


Example 9 (weak entity solution)

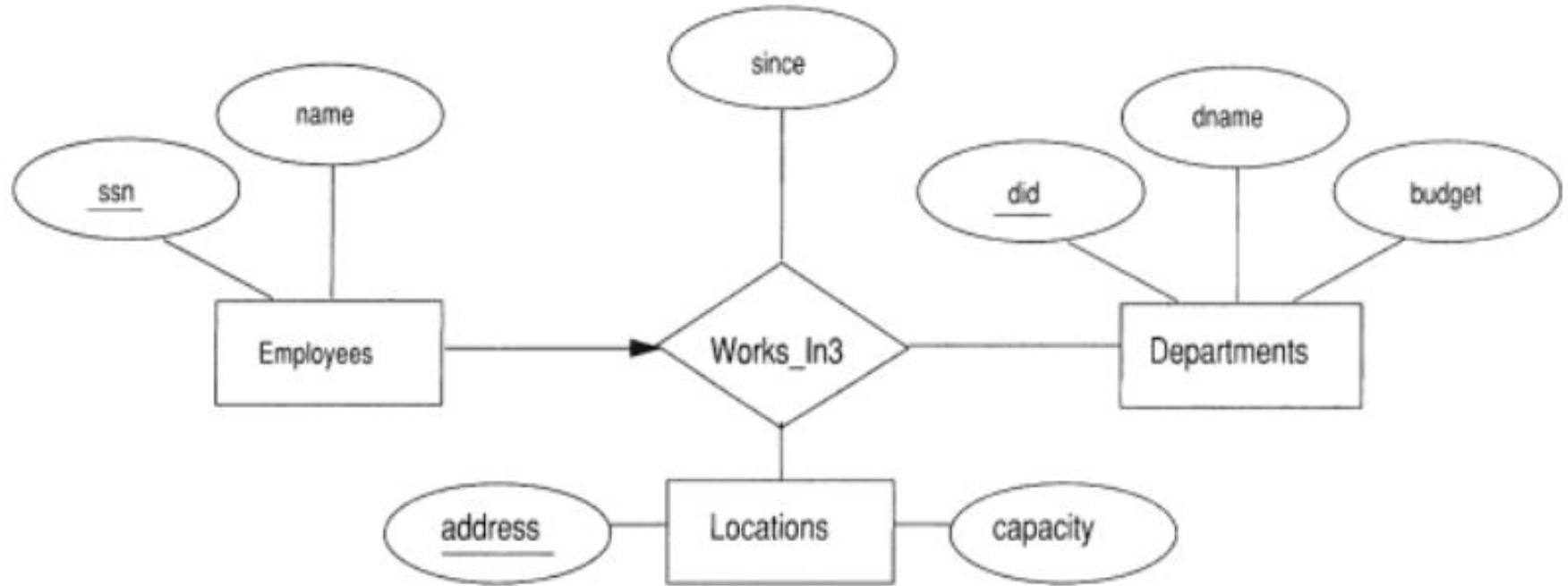


Example 10

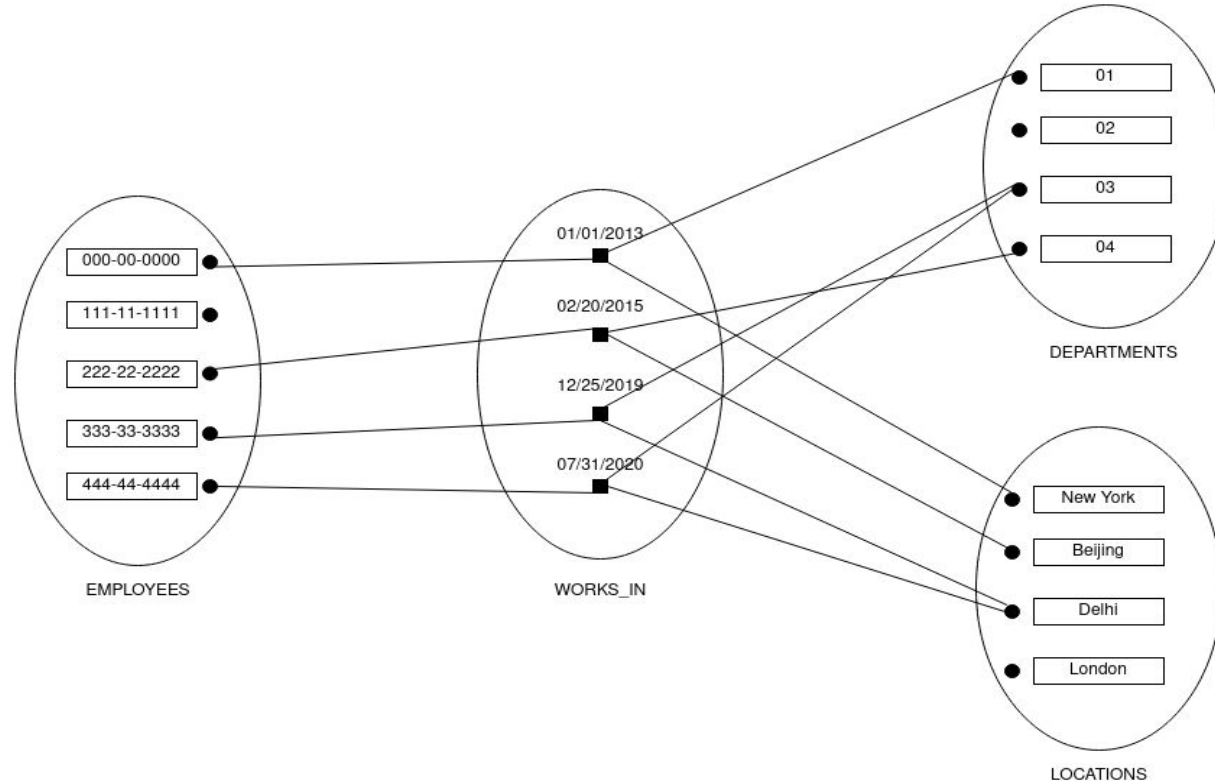
- 1) A company database stores information about employees and departments.
- 2) Employees are identified by an SSN and a name.
- 3) Departments are identified by a unique id and also have a name and a budget.
- 4) Locations are uniquely identified by an address and we also record their capacity – the number of employees that can work there.
- 5) Each department may be associated with several employees and locations. Each location may be associated with several departments and employees. However, each employee, if they have started working, works in at most one department and at a single location of that department.



Example 10 (solution- Ternary Relationship)



An instance of WORKS_IN



A night at the opera

“I love the opera. Let me develop a useful application for this domain.”

What are the entities?

What are the relationships?

What are the business rules?



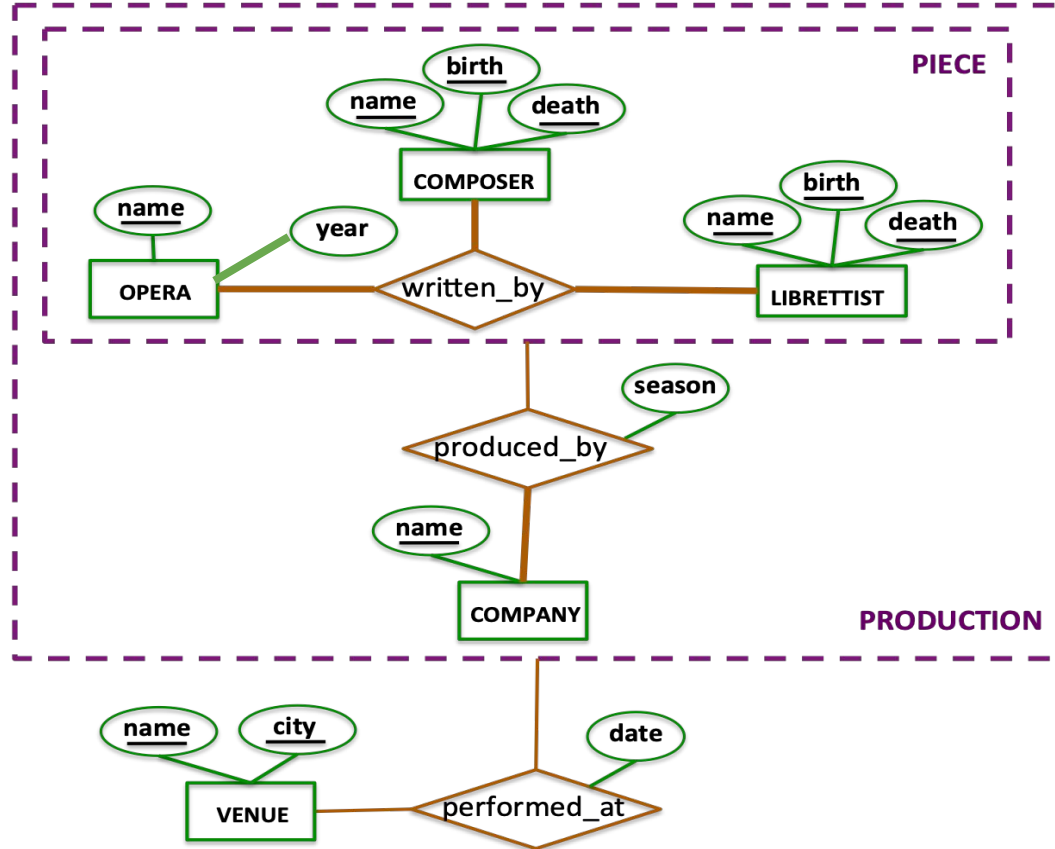
Opera: entity sets

- Opera(title, year) - may have more than one opera by the same title, but not in the same year (e.g., Otello - Verdi 1887 / Rossini 1816)
- Composer (name, birth, death) - may have more than one composer with the same name, but not also with the same birth and death years
- Librettist (name, birth, death)
- Company (name)
- Venue (name, city)
- Production - an entity set or a relationship set, linking Piece and Company?
- Performance - an entity set or a relationship set, linking Production and Venue

Opera: relationship sets

- Opera is written by Composer / Librettist
 - each Composer composed at least one Opera
 - each Librettist wrote the libretto for at least one Opera
 - an Opera by the same name may be written by a different (Composer, Librettist) pair
- A piece is produced by a Company
- A production is performed at a Venue

Opera: the model



Example 11

- 1) A consulting company works on projects (identified by id, started_on, budget)
- 2) Each project is sponsored by one or more departments (identified by id, name, budget)
- 3) An employee might be assigned to monitor the sponsorship.
- 4) Hint: Employees should be monitoring the whole sponsorship rather than a single project or department.



Example 11 (solution- Entity Clustering)

