TU München, Fakultät für Informatik
Lehrstuhl III: Datenbanksysteme
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***Database System Concepts for Non-Computer Scientist* - WiSe 24/25**

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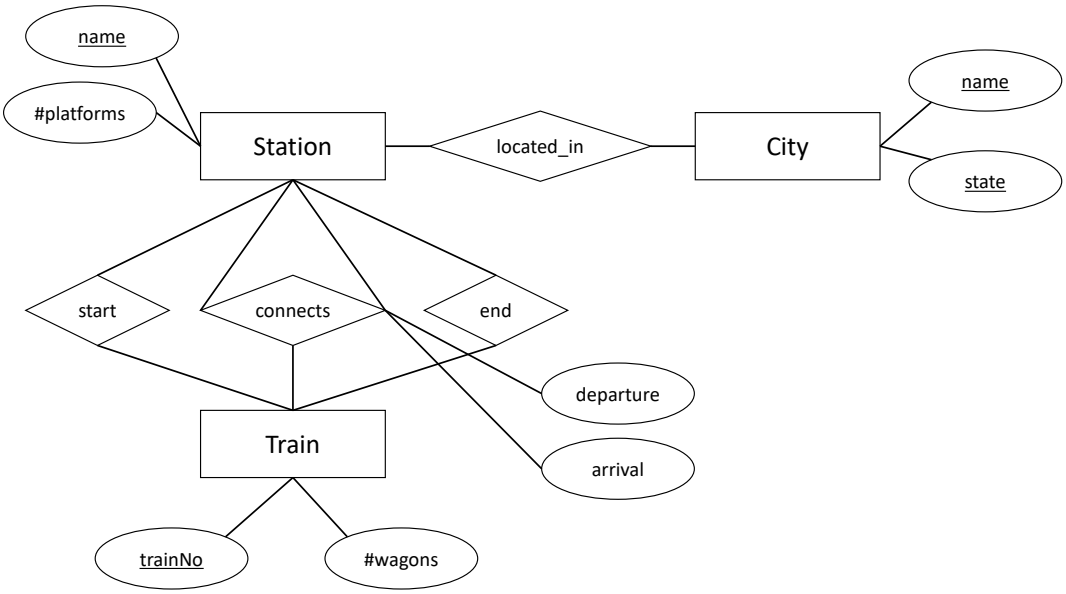
http://db.in.tum.de/teaching/ws2425/DBSandere/?lang=en

Sheet 02

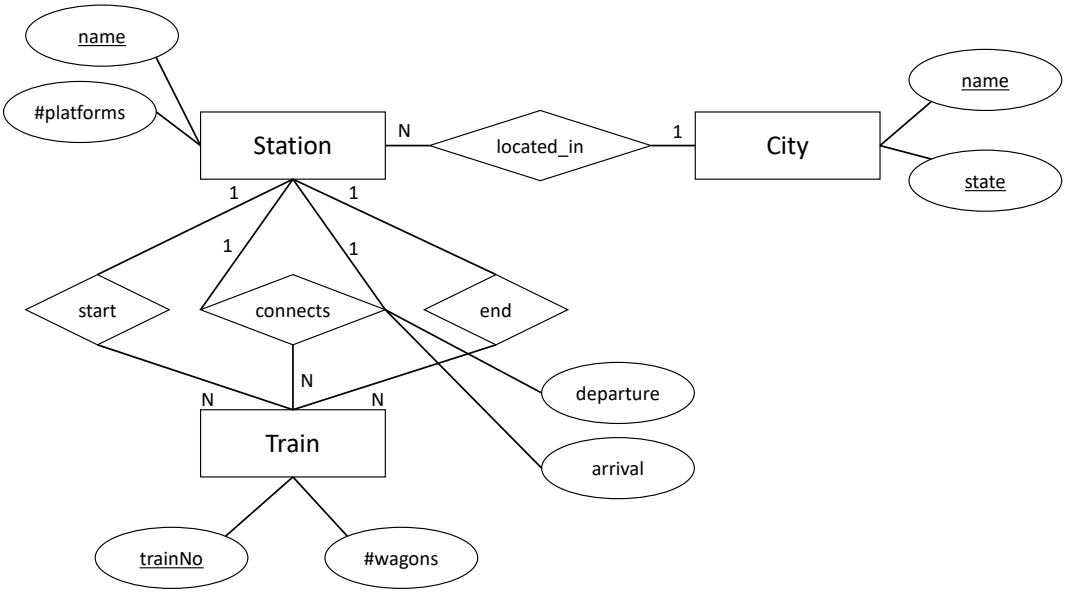
Exercise 1

Consider the entity relationship model of a train connection system (below). Note: The `connects` relationship models a direct connection between two stations. For example, the train starting (`start`) in Munich and ending (`end`) in Hamburg passes through several stations. Each of these route-sections (e.g., Munich → Nürnberg or Nürnberg → Würzburg) has an entry in the `connects` relation. Further, the train entity models a train line: The train line going from Munich to Hamburg, becomes a different train line (different *trainNo*) when returning.

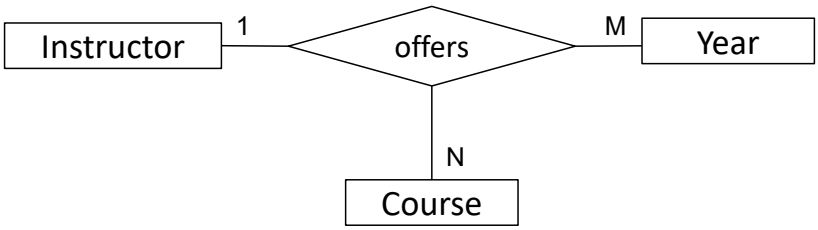
Task: Add functionalities to the shown ER diagram.



Solution:



Exercise 2



For now, ignore the functionalities in the diagram and answer the following questions:

- How many partial functions ($A \times B \to C$) are possible in a ternary relationship (ignore permutation on the left side of the partial function when counting).
- List **all** possible partial functions of the „offers“ relationship.
- For each partial function, try to describe in natural language which constraints it would enforce (not all of them make sense in the real world).

Now, considering the functionalities:

- Which partial function actually hold?
- What does the absence of the other partial functions allow for? (no need to create an exhaustive list).

Solution:

There are three **possible** partial functions:

$$Instructor \times Year \to Course \quad (1)$$

$$Instructor \times Course \to Year \quad (2)$$

$$Course \times Year \to Instructor \quad (3)$$

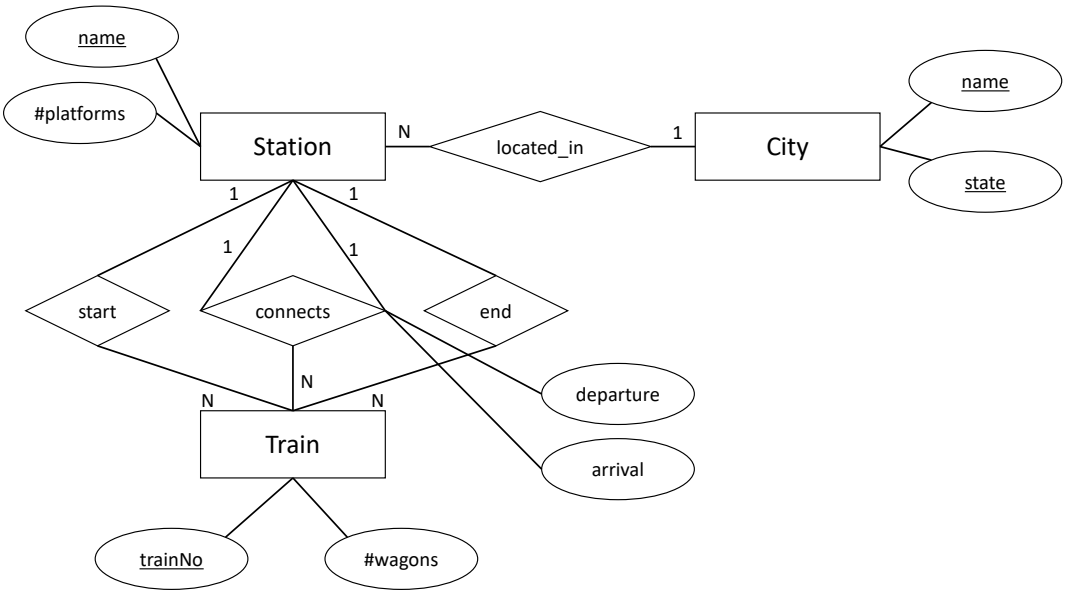
- (1) would imply that a given instructor may only offer one (or zero) course(s) per year. I.e., an instructor can not do two courses in one year.
- (2) would imply that a given instructor may offer a course only in one year (or not at all). I.e., an instructor can not offer a course twice.
- (3) would imply that a given course is only offered by one (or no) instructor in a certain year. I.e., a course can not be offered twice in one year.

Now, considering the functionalities:

- The functionalities shown in the figure only enforce 3.
- Not having the other two partial functions allows an instructor to offer multiple courses per year and also reuse a course multiple times (in different years).

Exercise 3

Consider the entity relationship diagram from exercise sheet 2:



Create a relational schema out of the ER-Diagram. Underline keys and find appropriate data types.

Solution:

The un-refined translation yields the following relations for the entities in the model:

$$\text{City} : \{[\underline{\text{name} : \text{string}, \text{state} : \text{string}}]\} \tag{4}$$

$$\text{Station} : \{[\underline{\text{name} : \text{string}}, \#\text{platforms} : \text{integer}]\} \tag{5}$$

$$\text{Train} : \{[\underline{\text{trainNo} : \text{integer}}, \#\text{wagons} : \text{integer}]\} \tag{6}$$

For the relationships in the model, we create the following relations:

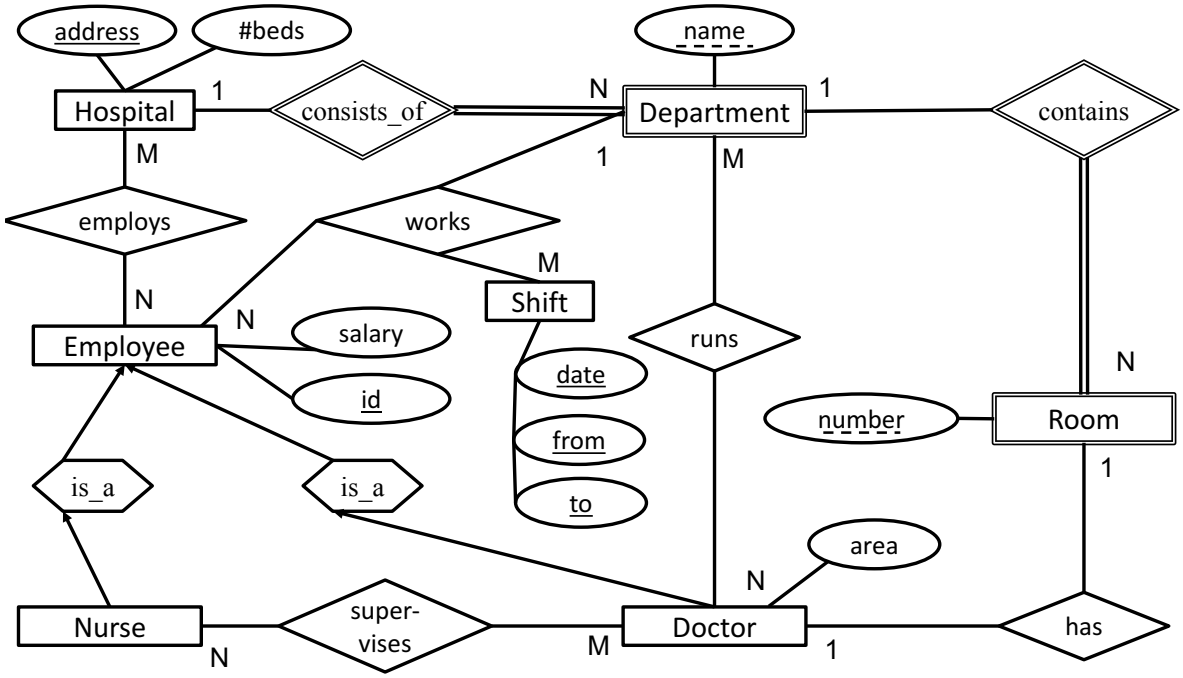
$$\begin{aligned}
\text{located_in} &: \{[\underline{\text{stationName} : \text{string}}, \text{cityName} : \text{string}, \text{cityState} : \text{string}]\} && (7)\\
\text{start} &: \{[\underline{\text{trainNo} : \text{integer}}, \text{stationName} : \text{string}]\} && (8)\\
\text{end} &: \{[\underline{\text{trainNo} : \text{integer}}, \text{stationName} : \text{string}]\} && (9)\\
\text{connects} &: \{[\underline{\text{fromStationName} : \text{string}}, \text{toStationName} : \text{string}, && (10)\\
&\quad \underline{\text{trainNo} : \text{integer}}, \text{departure} : \text{date}, \text{arrival} : \text{date}]\}
\end{aligned}$$

Homework 4

Consider the following description of a hospital and create an entity relationship diagram. Use generalization when appropriate.

- Hospitals consist of departments. Each hospital has an address (which can be used to identify it) and a number of beds. Departments have a name, which is unique only within a hospital.
- Departments in turn consist of rooms which are numbered. Such a number is unique within a department.
- Every hospital has employees who receive a salary. Each member of the staff can be employed in various hospitals.
- Employees are identified by a personnel number and can be divided into doctors and nurses. A doctor can supervise several nurses, but a nurse is supervised by only one doctor. A nurse can not be a doctor and vice versa.
- A department can be run by several doctors. A doctor can also run several departments. It is also known whether a doctor has a room and if she does, the room number is known. No doctor has to share her office with another doctor.
- Shifts are used to organize work. A shift can be uniquely identified by date and time period. Employees can work in shifts at a department. An employee can only work in one department in a given shift.

Solution:


address
#beds
name
Hospital
1
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Department
1
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M
1
M
employs
works
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Shift
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Employee
salary
id
runs
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date
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area
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Nurse
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