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Exercise ER-1

Identify the type of relationship and also find its cardinality (min and max) for the following relationships in just the given direction. State any assumptions made.

1. **Husband to wife**

Type of Relationship: 一对一（One-to-One）每个丈夫只有一个妻子，反之每个妻子也只有一个丈夫（假设是单配偶制）。
Cardinality:
最小基数：1（每个丈夫至少有一个妻子，每个妻子至少有一个丈夫）。
最大基数：1（每个丈夫最多有一个妻子，每个妻子最多有一个丈夫）。

2. **Student to degree**

Type of Relationship: 一对多（Many-to-Many）每个学生可以获得多个学位，但每个学位可能有多个学生获得。
Cardinality:
最小基数：1（每个学生必须获得一个学位）。
最大基数：N。

3. **Child to parent**

Type of Relationship: 一对多（One-to-Many）每个父母可以有多个孩子，但每个孩子只能有一个父母。
Cardinality:
最小基数：1（每个孩子至少有一个父母）。
最大基数：2（每个孩子有最多两个父母）。

4. **Player to team**

Type of Relationship: 多对多（Many-to-Many）一个球员可以加入多个球队，一个球队可以有多个球员。
Cardinality:
最小基数：1（每个球员至少加入一个队伍）。
最大基数：N（一个球员可以加入多个队伍）。

5. **Student to course**

Type of Relationship: 多对多（Many-to-Many）一个学生可以选修多个课程，一个课程可以有多个学生。
Cardinality:
最小基数：1。
最大基数：N。

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Exercise ER-2

For each of the following pairs of rules, identify two entity types and the relationship. State the cardinality and type of the relationship in each case. If you think that enough information is not available to understand clearly, then state an assumption that makes it clear. Draw the ER diagram. ER diagram 见第八题后面

1. **A department employs many persons. A person is employed by, at most, one department.**

Entities type:

Department： strong

Person： weak

Relationship:

Employs

Cardinality:

Department to Person: (1, N)

Person to Department: (0, 1)

Type of Relationship:

One-to-Many (from Department to Person)

Many-to-One (from Person to Department)

2. **A manager, manages at most, one department. A department is managed by, at most, one manager.**

Entities type:

Manager weak

Department strong

Relationship:

Manages

Cardinality:

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Manager to Department: (0, 1)A manager can manage at most one department (or no department at all).

Department to Manager: (0, 1)A department can have only one manager.

Type of Relationship:

One-to-One

3. **An author may write many books. A book may be written by many authors.**

Entities type:

Author strong

Book weak

Relationship:

Writes

Cardinality:

Author to Book: (0, N)An author can write many books, or potentially no books.

Book to Author: (1, N)A book can be written by many authors, but each book must have at least one author.

Type of Relationship:

Many-to-Many

4. **A team consists of many players. A player plays for only one team.**

Entities type:

Team strong

Player weak

Relationship:

Consists of

Cardinality:

Team to Player: (1, N)A team can consist of many players.

Player to Team: (1, 1)A player can only play for one team.

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Type of Relationship:

One-to-Many (from Team to Player)

5. **A lecturer teaches, at most, one course. A course is taught by exactly one lecturer.**

Entities type:

Lecturer strong

Course strong

Relationship:

Teaches

Cardinality:

Lecturer to Course: (0, 1)A lecturer can teach at most one course.

Course to Lecturer: (1, 1)A course must have exactly one lecturer.

Type of Relationship:

One-to-One

6. **A flight-leg connects two airports. An airport is used by many flight-legs.**

Entities type:

Flight-Leg weak

Airport strong

Relationship:

Connects

Cardinality:

Flight-Leg to Airport: (2, 2)Each flight-leg connects exactly two airports.

Airport to Flight-Leg: (0, N)An airport can be used by many flight-legs.

Type of Relationship:

Many-to-Many (from Airport to Flight-Leg)

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7. **A purchase order may be for many products. A product may appear on many purchase orders.**

Entities:

Purchase Order strong

Product strong

Relationship:

Contains

Cardinality:

Purchase Order to Product: (0, N)A purchase order may contain many products, or potentially no products.

Product to Purchase Order: (0, N)A product can appear in many purchase orders.

Type of Relationship:

Many-to-Many

8. **An Employee can use many skills on any one of the many projects and each project has many employees with various skill sets.**

Entities type:

Employee strong

Skill strong

Project strong

Relationship:

Uses / Has

Cardinality:

Employee to Skill: (0, N)An employee can use many skills.

Skill to Employee: (0, N)A skill can be used by many employees.

Employee to Project: (0, N)An employee can work on many projects.

Project to Employee: (0, N)A project can have many employees.

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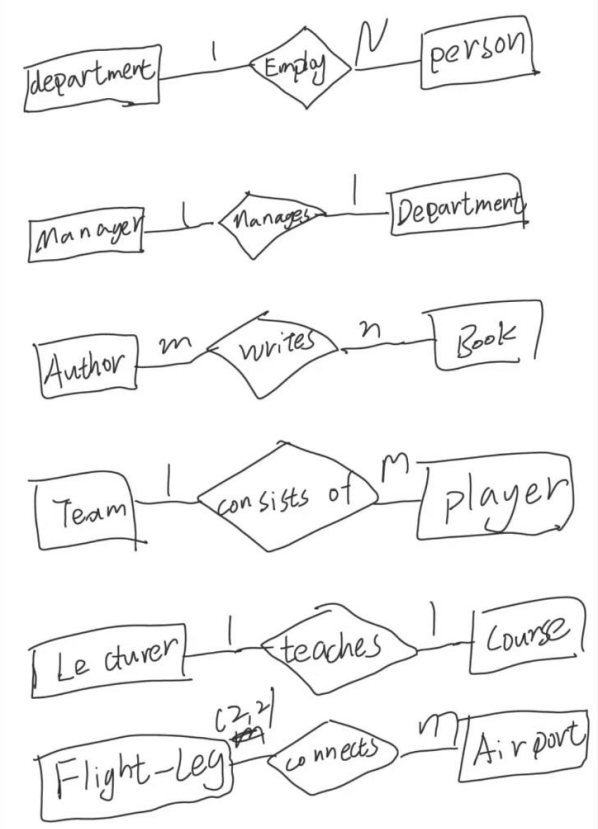
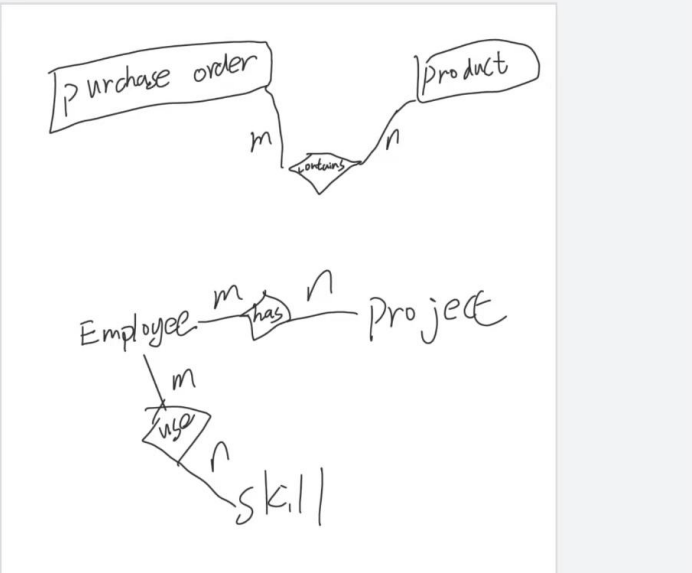
Type of Relationship:

Many-to-Many between Employee and Skill

Many-to-Many between Employee and Project





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9. A Country Bus Company owns a number of buses. Each bus is allocated to a particular route, although some routes may have several buses. Each route passes through a number of towns. One or more drivers are allocated to each stage of a route, which corresponds to a journey through some or all of the towns on a route. Some of the towns have a garage where buses are kept and each of the buses are identified by the registration number and can carry different numbers of passengers (since the vehicles vary in size and can be single or double-decked). Each route is identified by a route number and information is available on the average number of passengers carried per day for each route. Drivers have an employee number, name, address, and a telephone number.

Solution:

First Step: Identify Entities

Entities

- Bus - Company owns buses and will hold information about them.
- Route - Buses travel on routes and will need to be described by stages.
- Town - Buses pass through towns and need to know about them
- Driver - Company employs drivers, personnel will hold their data.
- Stage - Routes are made up of stages
- Garage - Garage houses buses, and need to know where they are.

Second Step: Identify Attributes

Attributes for each entity

- Bus (reg-no, make, size, deck, no-pass)
- Route (route-no,avg-pass)
- Driver (emp-no,name,address,tel-no)
- Town (GPS,name)
- Stage (stage-no,town)
- Garage (Name,Location)

Third Step: Identify relationship and cardinality

Relationships

- A bus is allocated to a route and a route may have several buses.
- Bus-route (1:m) is serviced by one or more stages
- One or more drivers are allocated to each stage.

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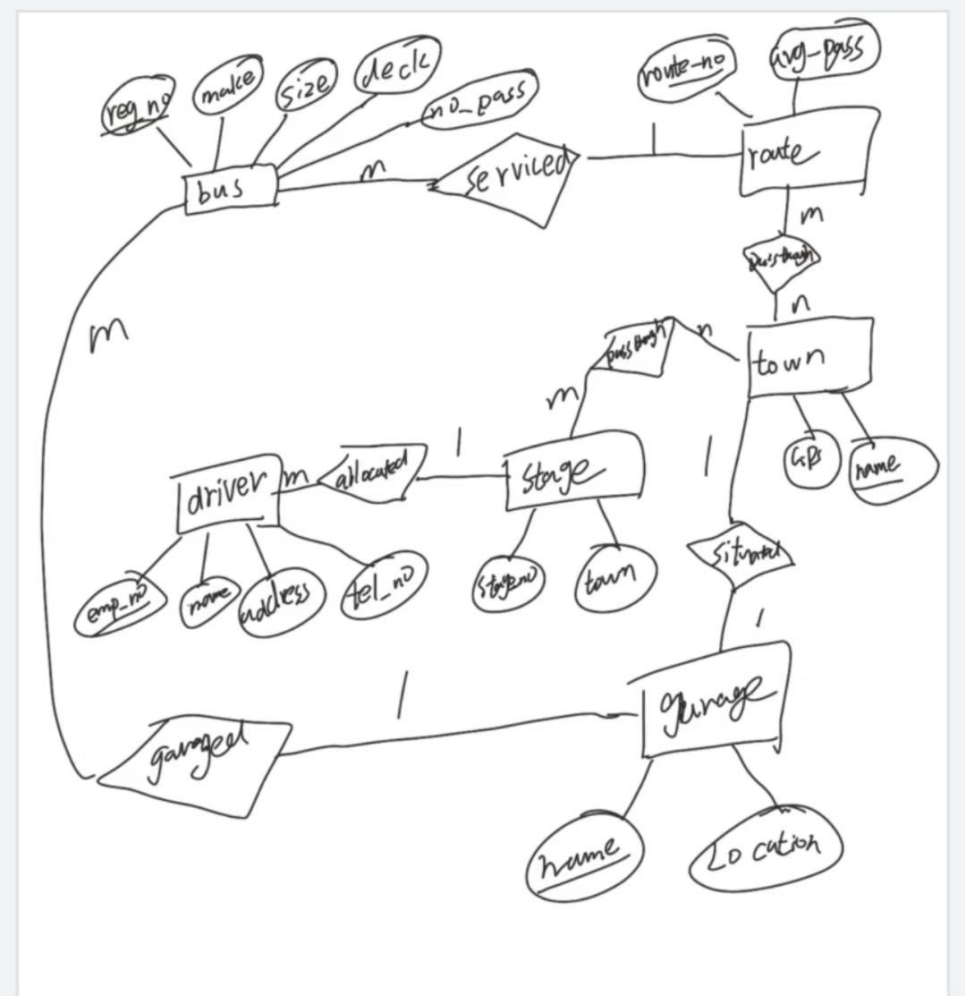
- Driver-Stage (m:1) is allocated
- A stage passes through some or all of the towns on a route.
- stage-town (m:n) passes-through
- A route passes through some or all of the towns
- route-town (m:n) passes-through
- Some of the towns have a garage
- garage-town (1:1) is situated
- A garage keeps buses and each bus has one `home' garage
- garage-bus (m:1) is garaged

Fourth Step: Draw ER Diagram



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Fifth Step: Convert the ER diagram into Relation and check if it's in BCNF

table1: bus

bus (reg_no, make, size, deck, no_pass)

table 2: route

route (route_no, avg_pass)

table 3: serviced

serviced (reg_no, route_no)

table 4: garge

garge (h_name, Location)

table 5: garged

garged (name, reg_no)

table 6: town

town (town_name, GPS)

table 7: pass_through1

pass_through1 (town_name, route_no)

table 8: pass_through2

pass_through2 (stage_no, town_name)

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table 9: staye

staye (staye_no, town)

table 10: allocated

allocated (staye_no, emp_no)

table 11: driver

driver (emp_no, driver_name, address, tel_no)

table 12 Situated

situated (town_name, garage_name),