ER DIAGRAM CLASS WORK

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**

   relationship：1to1

   min:1   max:1

   一个丈夫有且仅能有一个妻子。

2. **Student to degree**

   relationship：1toN

   min:0   max:N

   一个学生可以同时或先后攻读多个学位，也可以不攻读任何学位。

3. **Child to parent**

   relationship：MtoN

   min:0   max:N

   一个孩子可能没有已知的父母，例如孤儿；但一个孩子也可以有多个法定监护人，例如在收养情况下。

4. **Player to team**

   relationship：Nto1

   min:0   max:1

   一个球员在同一时间最多只能服役于一支球队，也可能不服役于任何球队

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5. **Student to course**

   relationship：MtoN

   min:0   max:N

一个学生可以在一个学期内选修多门课程，也可能不修任何课程。一门课程可以被多个学生选修。

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.

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

Entity types：
Department
Person

Relationship：Employs
Department to Person：1:N; min:0 max:N
A department employs many persons.
Person to Department：N:1; min:0 max:1
A person is employed by, at most, one department.

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

   Entity type:
   Manager
   Department

Relationship:Manages
Manager to Department：1:1; min:1 max:1
A manager, manages at most, one department.
Department to Department：1:1；min:0 max:1
A department is managed by, at most, one manager.

```
Manager  ──○ 0,1 ──── Manages ──── 1,1 ──┤  Department
```

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

Entity type:
Author
Books

Relationship:Writes
Author to Books:M:N; min:0 max:N
An author may write many books.
Books to Author:M:N; min:1 max:N
A book may be written by many authors.

```
Author  ├< 1,n ──── Writes ──── 0,n >○  Books
```

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

Entity type:
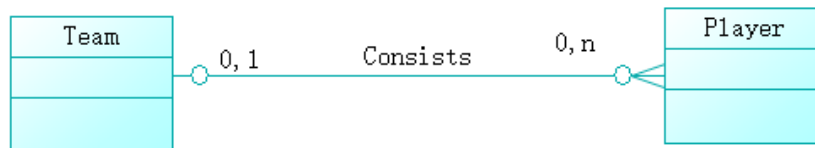**Team**
Player

Relationship:Consists
Team to Player：1:N, min:0 max:N
A team consists of many players.
Player to Team: N:1, min:0 max:1
A player plays for only one team.

| Team | | 0, 1 | Consists | 0, n | Player |

5. A lecturer teaches, at most, one course. A course is taught by exactly one lecturer.
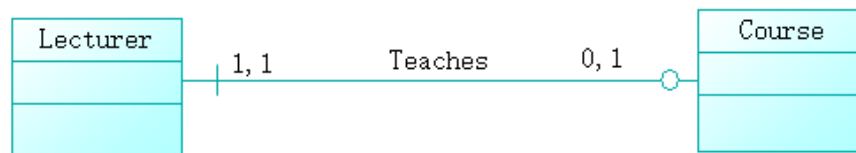
Entity type:
Lecturer
Course

Relationship: Teaches
Lecturer to Course:1:1;min:0 max:1
A lecturer teaches, at most, one course.
Course to Lecturer:1:1;min:1 max:1
A course is taught by exactly one lecturer.

| Lecturer | | 1, 1 | Teaches | 0, 1 | Course |

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

Entity type:
Flight-leg
Airport

Relationship: Connects
Flight-leg to Airport:1:N min:N max:N
A flight-leg connects two airports.
Airport to Flight-leg:1:N min:0 max:N

```
Flight-leg                                         Airport
            ─○ 0,n      Connects      1,n ─<
```

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

Entity type:
Purchase order
Product

Relationship:Includes
Purchase order to Product:M:N;min:1 max:N
A purchase order may be for many products.
Product to Purchase order:M:N;min:0 max:N
A product may appear on many purchase orders.

```
Purchase order                                     Product
            >─○ 0,n      Includes      1,n ─<
```

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

Entity type:
Employee
Skill
Project

Relationship:Uses; Has
Employee to Skill:M:N;min:0 max:N
An Employee can use many skills on any one of the many projects
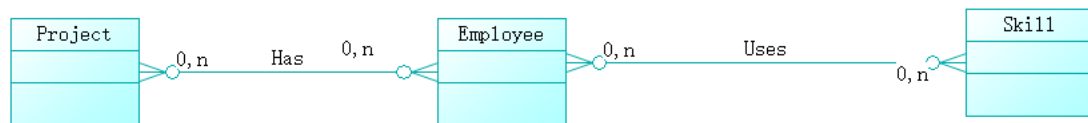**Skill to Employee:M:N;min:0 max:N**
A skill may be used by many employee.
Project to Employee:M:N;min:0 max:N
Each project has many employees with various skill sets.
Employee to Project:M:N;min:0 max:N
A employee may take part in many projects.

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.

Student ID:

Student Name:
- 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.
- 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

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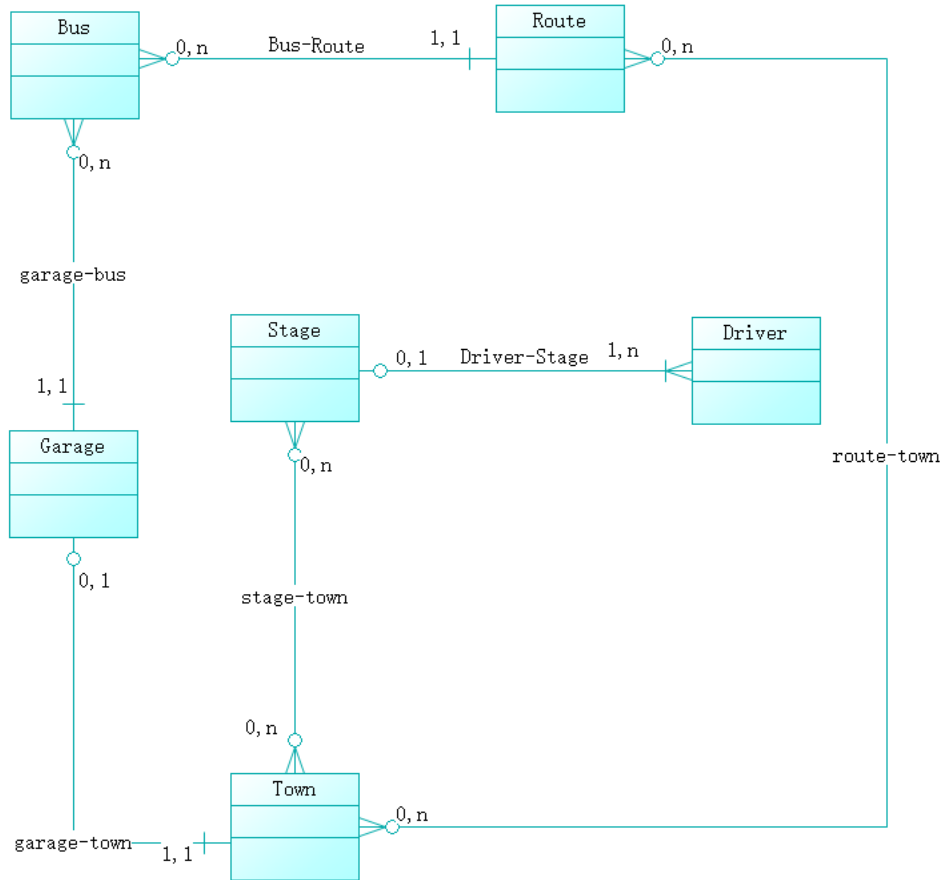
Fifth Step: Convert the ER diagram into Relation and check if it's in BCNF

- 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)

Is in BCNF