LECTURE 2 EXERCISES
ENTITY-RELATIONSHIP (E-R) MODEL
AND DATA BASE DESIGN
EXERCISE 2: BUS COMPANY

We want to keep track of bus routes and schedules for a bus company.

- Each bus route has a unique route number, a departure station and a destination station.
- For each bus route, there is a schedule, which records all the departure times of buses.
- For each departure time of each route, a driver and a bus can be assigned; however, information about the driver or the bus may sometimes be missing.
- A driver has a unique employee id, a name and a phone number.
- A bus is identified by its license number and has a maximum seating capacity.

Construct an E-R diagram for the bus company application.
EXERCISE 2: BUS COMPANY—ENTITIES

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- For each bus route, there is a schedule, which records all the departure times of buses.
- For each departure time of each route, a driver and a bus can be assigned; however, information about the driver or the bus may sometimes be missing.
- A driver has a unique employee id, a name and a phone number.
- A bus is identified by its license number and has a maximum seating capacity.
**EXERCISE 2: BUS COMPANY—ATTRIBUTES OF ENTITIES**

- Each bus **route** has a unique **route number**, a **departure station** and a **destination station**.
- For each bus route, there is a **schedule**, which records all the **departure times** of buses.
- A **driver** has a unique **employee id**, a **name** and a **phone number**.
- A **bus** is identified by its **license number** and has a **maximum seating capacity**.

<table>
<thead>
<tr>
<th>Route</th>
<th>Departure</th>
</tr>
</thead>
<tbody>
<tr>
<td>routeNo</td>
<td>time</td>
</tr>
<tr>
<td>departureStation</td>
<td></td>
</tr>
<tr>
<td>destinationStation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Driver</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>empId</td>
<td>licenseNo</td>
</tr>
<tr>
<td>name</td>
<td>maxSeating</td>
</tr>
<tr>
<td>phoneNo</td>
<td></td>
</tr>
</tbody>
</table>
Each bus route has a unique route number, a departure station and a destination station.

For each bus route, there is a schedule, which records all the departure times of buses.

What should be related?

\[ \Rightarrow \text{Route related to Departure.} \]
EXERCISE 2: BUS COMPANY—RELATIONSHIPS (DRIVER, BUS)

- For each departure time of each route, a driver and a bus can be assigned; however, information about the driver or the bus may sometimes be missing.

What should be related?

⇒ Driver related to Bus.

How should they be related?
EXERCISE 2: WHAT IS A SCHEDULE?

**Route 1**
<table>
<thead>
<tr>
<th>Departure time</th>
<th>Driver</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>Bill</td>
<td>1</td>
</tr>
<tr>
<td>12:00</td>
<td>Sarah</td>
<td>2</td>
</tr>
<tr>
<td>13:00</td>
<td>Bill</td>
<td>5</td>
</tr>
</tbody>
</table>

**Route 2**
<table>
<thead>
<tr>
<th>Departure time</th>
<th>Driver</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Al</td>
<td>3</td>
</tr>
<tr>
<td>11:00</td>
<td>Cindy</td>
<td>4</td>
</tr>
<tr>
<td>13:00</td>
<td>Al</td>
<td>3</td>
</tr>
<tr>
<td>15:00</td>
<td>Mark</td>
<td>5</td>
</tr>
</tbody>
</table>

**Route 3**
<table>
<thead>
<tr>
<th>Departure time</th>
<th>Driver</th>
<th>Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>John</td>
<td>6</td>
</tr>
<tr>
<td>15:00</td>
<td>Sarah</td>
<td>2</td>
</tr>
</tbody>
</table>

**Diagram:**
- Routes 1, 2, and 3 are connected to drivers and buses.
- The routes are labeled as Route 1, Route 2, and Route 3.
- The departure times for each route are shown.
- Drivers and buses are connected to the corresponding routes.

**Legend:**
- Route
- Departure
- Bus
- Driver

© L2: E-R MODEL & DB DESIGN
EXERCISE 2: BUS COMPANY—RELATIONSHIPS (DRIVER, BUS)

- For each departure time of each route, a driver and a bus can be assigned; however, information about the driver or the bus may sometimes be missing.

What should be related?
  ➞ Driver related to Bus.

How should they be related?
  ➞ Through the Departure entity.
EXERCISE 2: BUS COMPANY—E-R DIAGRAM

Route
- routeNo
- departureStation
- destinationStation

Departure
- time

Driver
- empId
- name
- phoneNo

Bus
- licenseNo
- maxSeating

Driver
- AssignedTo

Route
- HasScheduled

Departure
- Uses

Bus
EXERCISE 2: BUS COMPANY—E-R DIAGRAM POSSIBLE REFINEMENT

Route
- routeNo

Departure
- time

Driver
- empId
- name
- phoneNo

Bus
- licenseNo
- maxSeating

Station
- name

Route
- HasDestination
- HasDeparture

Departure
- HasScheduled

Driver
- AssignedTo

Bus
- Uses
EXERCISE 2: BUS COMPANY—WHAT IS WRONG WITH THIS SCHEMA?

- An entity with no attributes $\implies$ nothing to store!
EXERCISE 2: BUS COMPANY—WHAT IS WRONG WITH THIS SCHEMA?

- Incorrect use of multivalued attribute. Why?

<table>
<thead>
<tr>
<th>Route 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departure time</td>
</tr>
<tr>
<td>9:00</td>
</tr>
<tr>
<td>15:00</td>
</tr>
</tbody>
</table>

Cannot tell who drives which bus at what time.
EXERCISE 2: BUS COMPANY—
WHAT IS WRONG WITH THIS SCHEMA?

- Incorrect relationship ⇒ Driver needs to be related to Departure. Why?

  ![Diagram of the schema]

  - **Driver** needs to be related to **Departure**. Why?

  - **Cannot tell to which Departure instance John/Mark are related.**

  - **Bus**
    - 6
    - 5
    - 4
    - 3
    - 2
    - 1

  - **Departure**
    - 15:00
    - 9:00
    - 15:00
    - 13:00
    - 11:00
    - 9:00
    - 13:00
    - 12:00
    - 11:00

  - **Driver**
    - John
    - Mark
    - Bill
EXERCISE 2: BUS COMPANY—WHAT IS WRONG WITH THIS SCHEMA?

- It is **not** necessary to relate Driver to Bus. **Why?**

Including the Drives relationship is redundant.
EXERCISE 2: BUS COMPANY—
WHAT IS WRONG WITH THIS SCHEMA?

- Driver and Bus are **not** a kind of Departure.
EXERCISE 2: BUS COMPANY—
WHAT IS WRONG WITH THIS SCHEMA?

- Incorrect use of composite attributes.