INFO-UB 23: Introduction to Programming and Data Science

Katherine Hoffmann Pham

July 25, 2018

NYU Stern, Department of Information Systems

Business Narratives to ERD

From Business Narratives to ER Diagrams

Typically, want to convert:

Business narrative

$\rightarrow$ Entity-Relationship Model

$\longrightarrow$ Relational Database

- How can we create an ER diagram from scratch?

- How can we go from an ER diagram to a design for a database?

Business Narratives to ERD
●○○○○○○○○○○○○

ERD to Databases
○○○○○○

SQL Overview
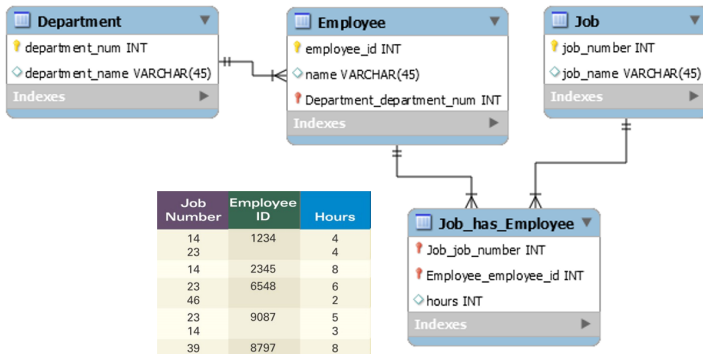○○○

Defining Entities and Primary Keys

- What entities/tables should we create?

- What primary keys for the report below?

- Are there fields that are redundant once you create the tables?

Employee ID	Name	Department Num	Department Name	Num of Employees	Job Number	Job Name	Hours
1234	Jones	43	Residential	3	14 23	Acct Sales	4 4
2345	Smith	15	Commercial	1	14	Acct	8
6548	Joslin	43	Residential	3	23 46	Sales Admin	6 2
9087	Mills	43	Residential	3	23 14	Sales Acct	5 3
8797	Jones	69	Non-profit	1	39	Maint	8

Business Narratives to ERD
○●○○○○○○○○○○○○

ERD to Databases
○○○○○○

SQL Overview
○○○

Business Narratives to ERD
oo●ooooooooooooo

ERD to Databases
oooooo

SQL Overview
ooo

From Narratives to ER Diagrams

The procedure for analysis:

1. Identify entities and attributes

2. Determine primary keys

3. Identify relationships

4. Determine relationship cardinalities

5. Refine the ERD

Example: Uber Business Narrative

- Drivers have a name, a phone number, and a car.

- Drivers provide trips.

- Customers have a name, a phone number, and an e-mail.

- Customers take trips.

- Each customer owns one or more credit cards.

- Trips are associated with a pickup time, an origin, a destination, a duration, and a cost.

- One or more credit cards may be used to pay for each trip; a balance is assigned to each credit card.

Steps 1 & 2: Identify Entities, Attributes, and Primary Keys

- Entities: Find nouns like people, places, things, events
- Attributes: Look for details about the entities
- Primary Keys:
  - Stable: never change once assigned
  - Each entity should have one and only one primary key
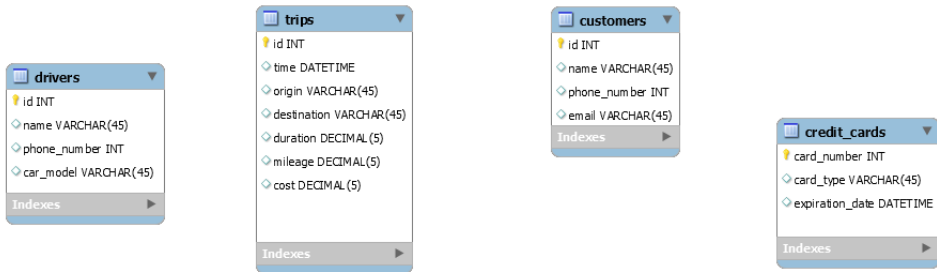   (good choice: automatically generated values)

Attribute or Entity?

- Simplicity principle: Consider as an attribute unless other details are presented
- Example: Should an address be an attribute or a separate entity? Advantages and disadvantages?

Example: Uber Business Narrative

- Drivers have a name, a phone number, and a car.

- Drivers provide trips.

- Customers have a name, a phone number, and an e-mail.

- Customers take trips.

- Each customer owns one or more credit cards.

- Trips are associated with a pickup time, an origin, a destination, a duration, and a cost.

- One or more credit cards may be used to pay for each trip; a balance is assigned to each credit card.

Key: entities, attributes

Example: Uber Business Narrative

drivers
- id INT
- name VARCHAR(45)
- phone_number INT
- car_model VARCHAR(45)

Indexes

trips
- id INT
- time DATETIME
- origin VARCHAR(45)
- destination VARCHAR(45)
- duration DECIMAL(5)
- mileage DECIMAL(5)
- cost DECIMAL(5)

Indexes

customers
- id INT
- name VARCHAR(45)
- phone_number INT
- email VARCHAR(45)

Indexes

credit_cards
- card_number INT
- card_type VARCHAR(45)
- expiration_date DATETIME

Indexes

Steps 3 & 4: Identify Relationships and Cardinalities

- Relationships:
    - Associations among nouns representing entity types
    - Look for verbs defining connections among entities
- Cardinalities:
    - Identify minimum and maximum

Example: Uber Business Narrative

- Drivers have a name, a phone number, and a car.
- Drivers provide trips.
- Customers have a name, a phone number, and an e-mail.
- Customers take trips.
- Each customer owns one or more credit cards.
- Trips are associated with a pickup time, an origin, a destination, a duration, and a cost.
- One or more credit cards may be used to pay for each trip; a balance is assigned to each credit card.

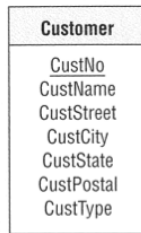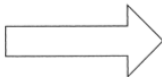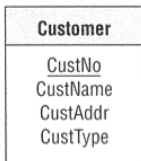Key: entities, attributes, relationships

Example: Uber Business Narrative

Business Narratives to ERD
○○○○○○○○○○○○●○

ERD to Databases
○○○○○○

SQL Overview
○○○
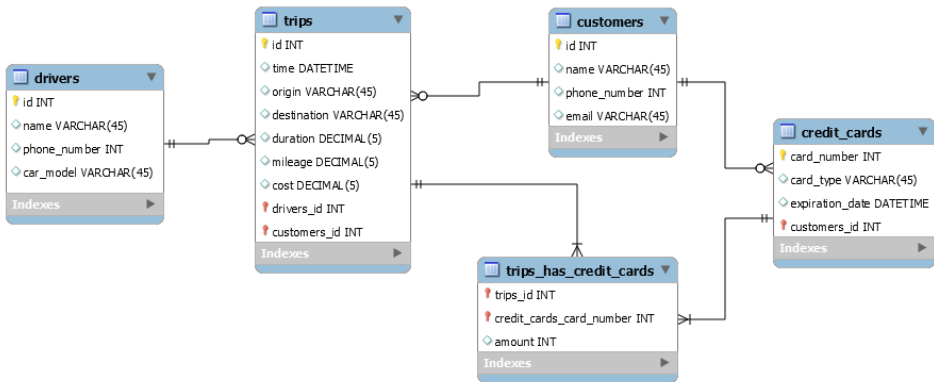
Step 5: Refinements

Typical refinements include:

- Converting attributes to entities
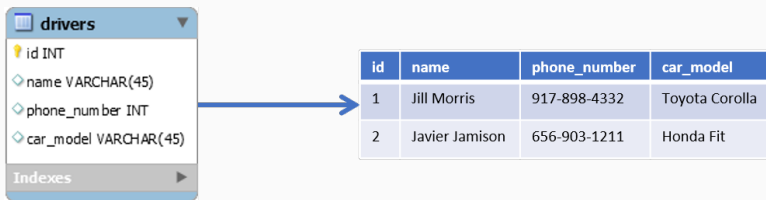- Splitting compound attributes
  - e.g. Customer address

ERD to Databases

From ERD to Relational Databases

1. Entities $\longrightarrow$ tables

2. Attributes $\longrightarrow$ columns

3. Instances $\longrightarrow$ rows

4. Relationships $\longrightarrow$ foreign keys (FK)

Business Narratives to ERD
ooooooooooooooo

ERD to Databases
●ooooo

SQL Overview
ooo

Example: Uber Business Narrative

1. Entities $\longrightarrow$ tables
2. Attributes $\longrightarrow$ columns
3. Instances $\longrightarrow$ rows

🔲 drivers ▼
🔑 id INT
🔶 name VARCHAR(45)
🔶 phone_number INT
🔶 car_model VARCHAR(45)
Indexes ▶

id	name	phone_number	car_model
1	Jill Morris	917-898-4332	Toyota Corolla
2	Javier Jamison	656-903-1211	Honda Fit

Relationships to Foreign Keys
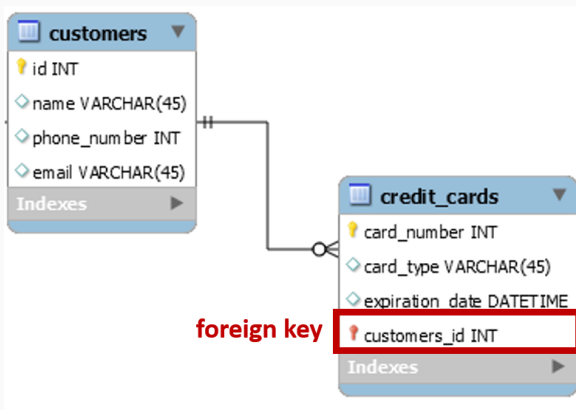
One-to-one relationship:

- Add foreign key to either table, or merge tables
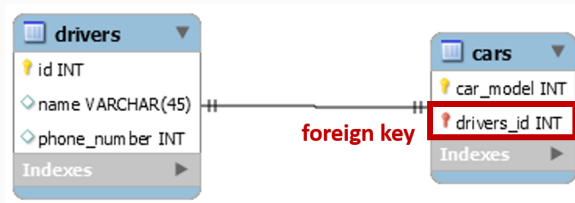
Relationships to Foreign Keys
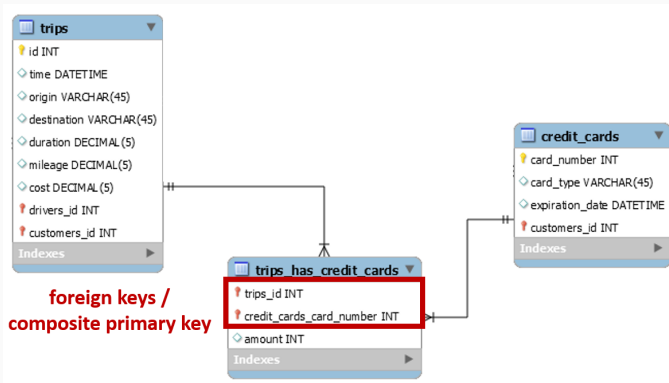
One-to-many relationship:

- Add foreign key to table corresponding to "many" entity

Relationships to Foreign Keys

Many to many relationship:

- Introduce a bridge table
- Composite primary key with two foreign keys, pointing to participating entities

foreign keys / composite primary key

Summary of ER Modeling

- ER model is popular for conceptual design
  - Expressive, intuitive and graphical
  - Key constructs: entities, attributes, and relationships (cardinalities)

- ER modeling is subjective!
  - There are often many ways to model a given scenario!
  - Analyzing alternatives is key

- ER modeling is iterative!
  - Resulting diagram should be analyzed, refined

Business Narratives to ERD
○○○○○○○○○○○○○

ERD to Databases
○○○○○●

SQL Overview
○○○

SQL Overview

Introduction

- SQL or "sequel" = Structured Query Language

- Supported by all major commercial database management systems (DBMS)

- Standardized

- Declarative

- Accessed via:

  - Graphical User Interface (GUI)

  - Command line

  - Embedding in other programs (e.g. Python)

Terminology

- Data Definition Language (DDL)
    - Create / drop tables
    - Indexes
- Data Manipulation Language (DML)
    - Select
    - Insert, Delete, Update
- Other:
    - Constraints
    - Triggers
    - Views

Business Narratives to ERD
00000000000000

ERD to Databases
000000

SQL Overview
0●0

Creating Tables

```
CREATE TABLE newtable
(
id INT,

numvar DECIMAL(n),  → n=precision, e.g. 5
datevar DATE,
stringvar VARCHAR(n),  → n=size, e.g. 20




);
```

Creating Tables

```
CREATE TABLE newtable
(
id INT,

numvar DECIMAL(n),  → n=precision, e.g. 5
datevar DATE,
stringvar VARCHAR(n),  → n=size, e.g. 20
PRIMARY KEY (id),  → define primary key



);
```

Creating Tables

```
CREATE TABLE newtable
(
id INT,
foreign_id INT
numvar DECIMAL(n),
datevar DATE,
stringvar VARCHAR(n),
PRIMARY KEY (id),




);
```

→ n=precision, e.g. 5

→ n=size, e.g. 20

→ define primary key

Creating Tables

```
CREATE TABLE newtable
(
id INT,
foreign_id INT
numvar DECIMAL(n), → n=precision, e.g. 5
datevar DATE,
stringvar VARCHAR(n), → n=size, e.g. 20
PRIMARY KEY (id), → define primary key

FOREIGN KEY (foreign_id) → link to another table
    REFERENCES foreign_table(id)
);
```

Creating Tables

```
CREATE TABLE newtable
(
id INT,
foreign_id INT
numvar DECIMAL(n),  → n=precision, e.g. 5
datevar DATE,
stringvar VARCHAR(n),  → n=size, e.g. 20
PRIMARY KEY (id),  → define primary key
UNIQUE (foreign_id),  → maximum cardinality 1
FOREIGN KEY (foreign_id)  → link to another table
    REFERENCES foreign_table(id)
);
```

Creating Tables

```
CREATE TABLE newtable
(
id INT,
foreign_id INT NOT NULL, → minimum cardinality 1
numvar DECIMAL(n), → n=precision, e.g. 5
datevar DATE,
stringvar VARCHAR(n), → n=size, e.g. 20
PRIMARY KEY (id), → define primary key
UNIQUE (foreign_id), → maximum cardinality 1
FOREIGN KEY (foreign_id) → link to another table
    REFERENCES foreign_table(id)
);
```