BENR2423

Database and Cloud System

Chapter 5:

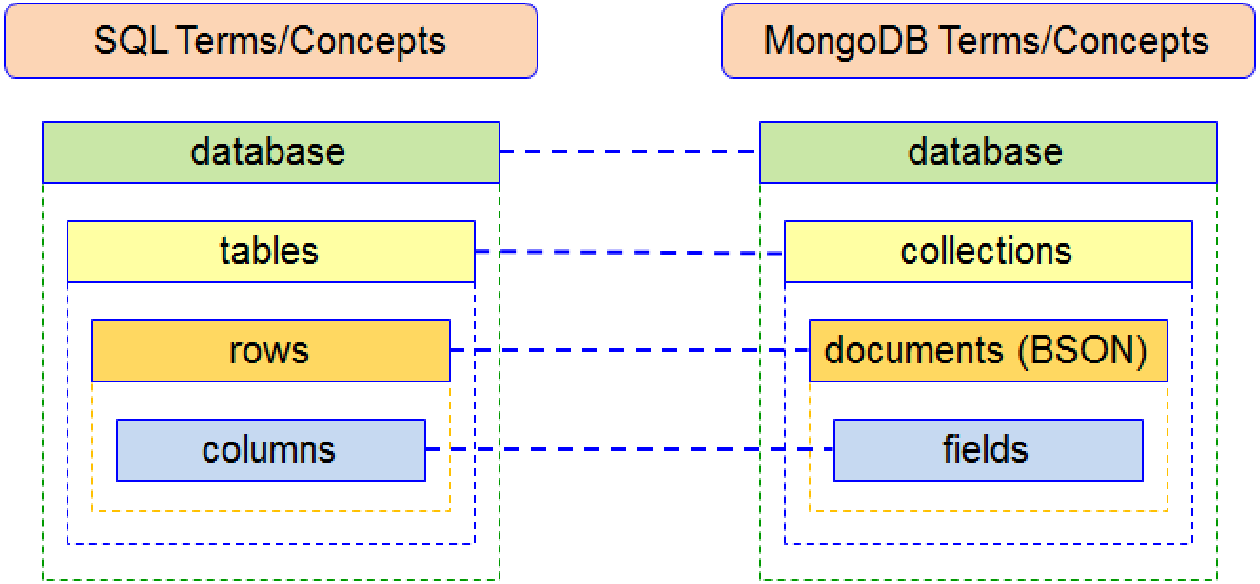
Data Modeling and Database Design

- To understand the basic concept in database modelling
- To model the database using entity relationship diagram

Learning Outcome

- Database
- Collection
- Document
- Schema
- Entity
- Relationship

Revision



SQL Terms/Concepts

database

tables

rows

columns

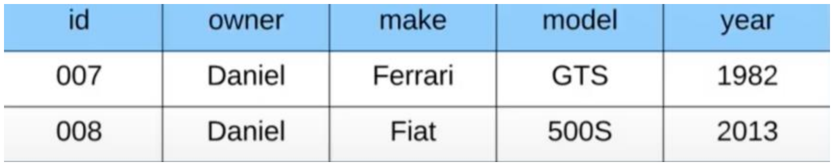
MongoDB Terms/Concepts

database

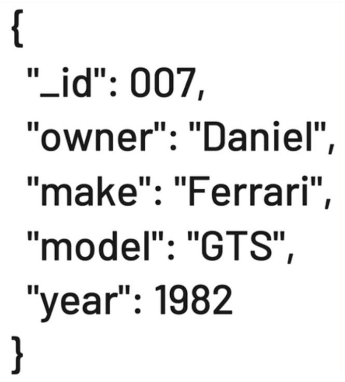
collections

documents (BSON)

fields



id	owner	make	model	year
007	Daniel	Ferrari	GTS	1982
008	Daniel	Fiat	500S	2013

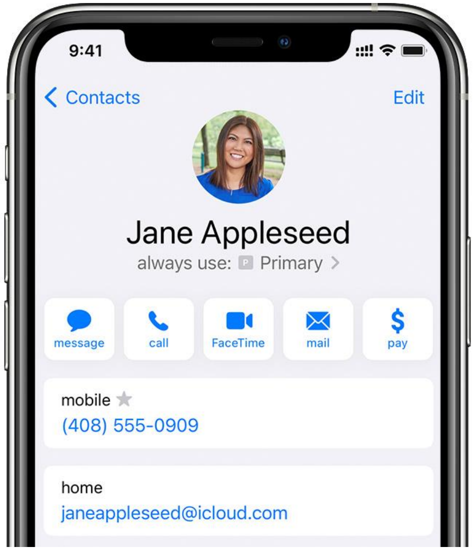


```
{
  "_id": 007,
  "owner": "Daniel",
  "make": "Ferrari",
  "model": "GTS",
  "year": 1982
}
```

MongoDB

Schema

- A schema is a JSON object that defines the the structure and contents of your data.
- Schemas are the specification for your application's data model.



Jane Appleseed
always use: Primary

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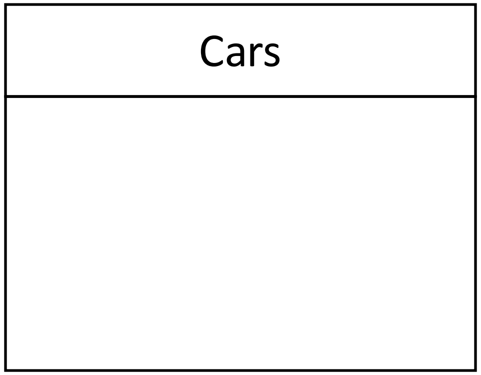
```
{
   "_id": ObjectId("612d1e835ebee16872a109a4"),
   "first_name": "soo",
   "last_name": "soo",
   "emails": [
      {
         "email": "soo@utem.edu.my",
         "type": "work"
      },
      {
         "email": "soo@gmail.com",
         "type": "home"
      }
   ]
}
```

Entities

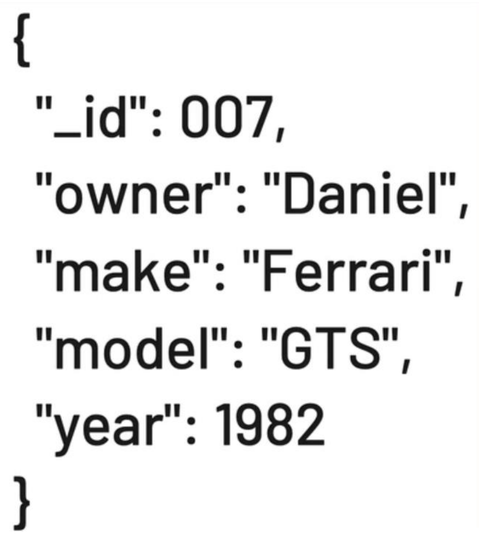
- An entity is something about which we want to store data
- An entity is a class of persons, places, objects, events, or concepts about which we need to capture and store data.
- An entity **instance** is a single occurrence of an entity.



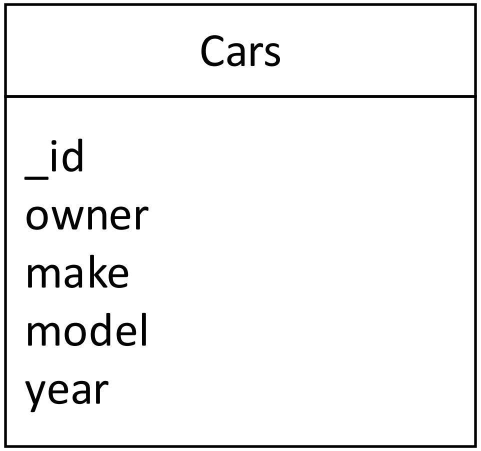
Cars

Attributes

- Attributes are data objects that either identify or describe entities



```
{
 "_id": 007,
 "owner": "Daniel",
 "make": "Ferrari",
 "model": "GTS",
 "year": 1982
}
```



- A relationship is an association that exists between one or more entities.
- All relationships are implicitly bidirectional, meaning that they can interpreted in both directions
- Relationships should be classified in terms of cardinality
  - one-to-one, one-to-many, many-to-many, etc

Relationships

Relationships

- One-to-One Relationship

```
{
  owner: "Daniel",
  make: "Ferrari",
  engine: {
    power: 660hp,
    consumption: 10mpg
  }
},
{
  owner: ”Ali",
  make: "Ferrari",
  engine: {
    power: 660hp,
    consumption: 10mpg
  }
},
```

Relationships

- One-to-Many Relationship

```
{
  owner: "Daniel",
  make: "Ferrari",
  engine: 123456789
},
{
  owner: ”Ali",
  make: "Ferrari",
  engine: 123456789
},
```

```
{
    _id: 123456789
    power: 660hp,
    consumption: 10mpg
},
```

- Many-to-Many Relationship

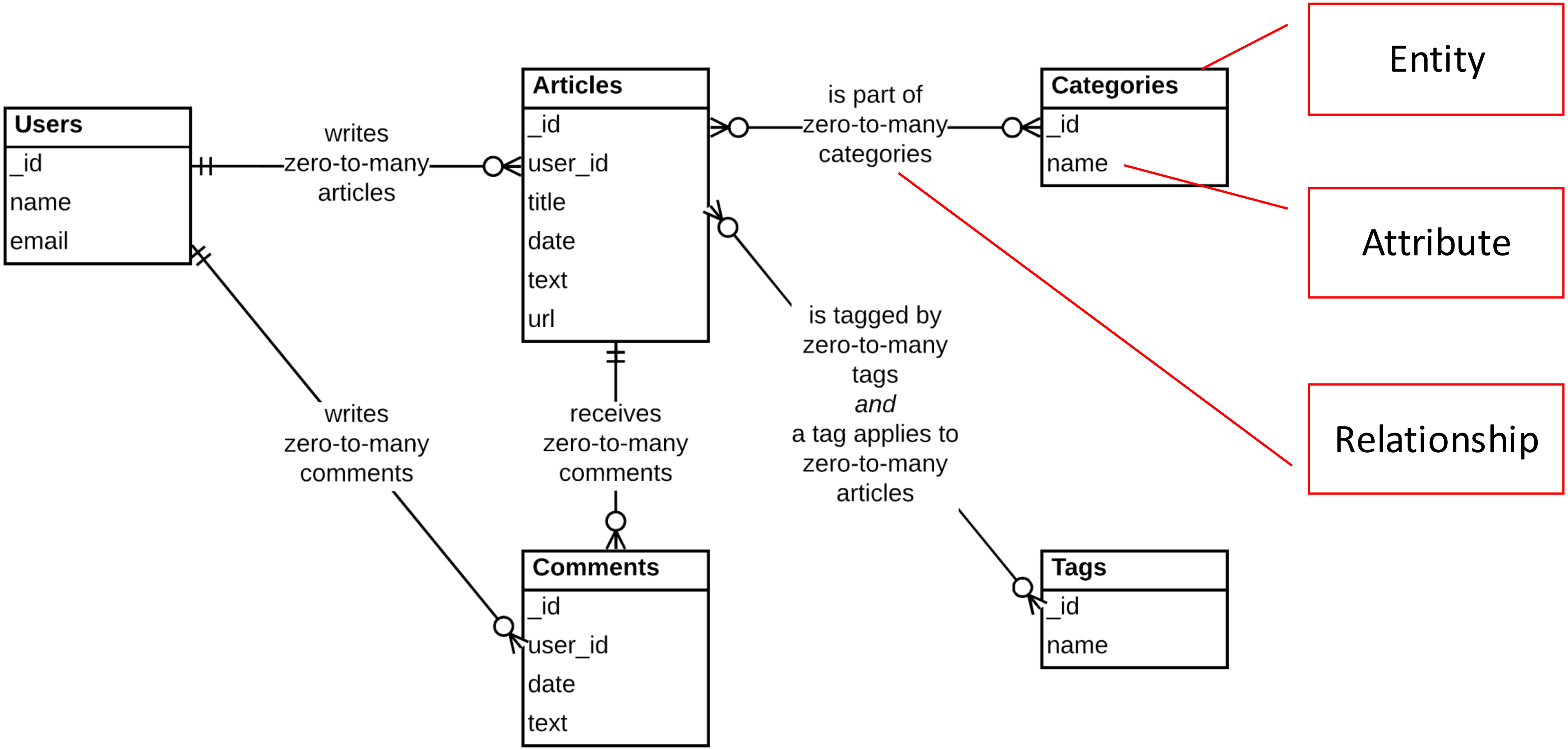
```
{
  owner: "Daniel",
  make: "Ferrari",
  parts: [
     123456780,
     123456781,
     123456782,
     123456783,
   ]
},
```

```
{
    _id: 123456780
    name: door,
},
{
     _id: 123456781
    name: wheel,
},
{
     _id: 123456782
    name: window,
}
```

Relationships

- A data modeling technique used in software engineering to produce a conceptual data model of an information system
- Standard method to illustrate the logical structure of databases
- Process:
    - Groups the nouns to common themes (entity)
    - Additional description for each themes (attribute)

Entity Relationship Diagram



Users
_id
name
email

writes zero-to-many articles

Articles
_id
user_id
title
date
text
url

is part of zero-to-many categories

Categories
_id
name

is tagged by zero-to-many tags *and* a tag applies to zero-to-many articles

Tags
_id
name

writes zero-to-many comments

receives zero-to-many comments

Comments
_id
user_id
date
text

Entity

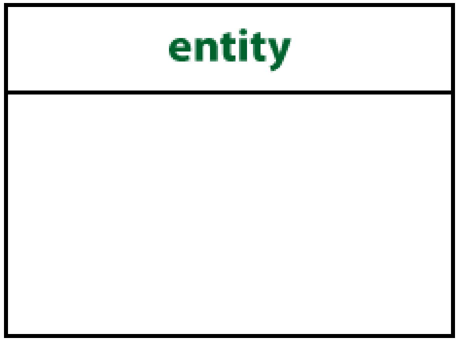
Attribute

Relationship

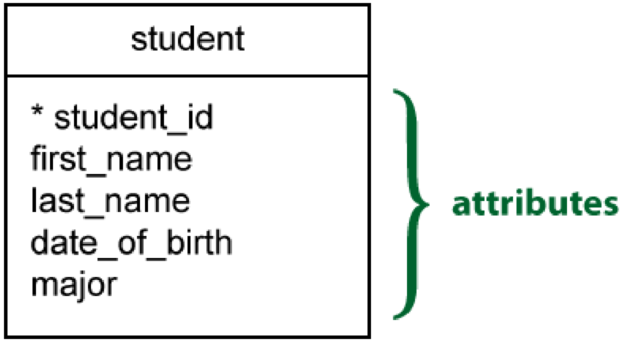
Entity Relationship Diagram

Crow’s Foot Notation

- Entity: Represented by a rectangle, with its name on the top.
- Every entity must have an identifier which is an attribute and should be a unique value for each entity instance.



entity

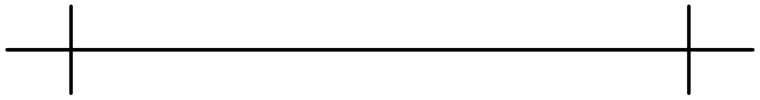


student

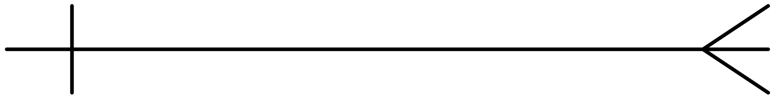
* student_id
first_name
last_name
date_of_birth
major

attributes

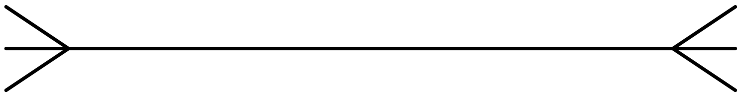
- Basic Cardinality Type
  - One-to-One



  - One-to-Many



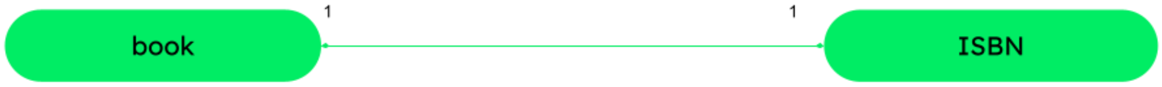
  - Many-to-Many



Crow’s Foot Notation

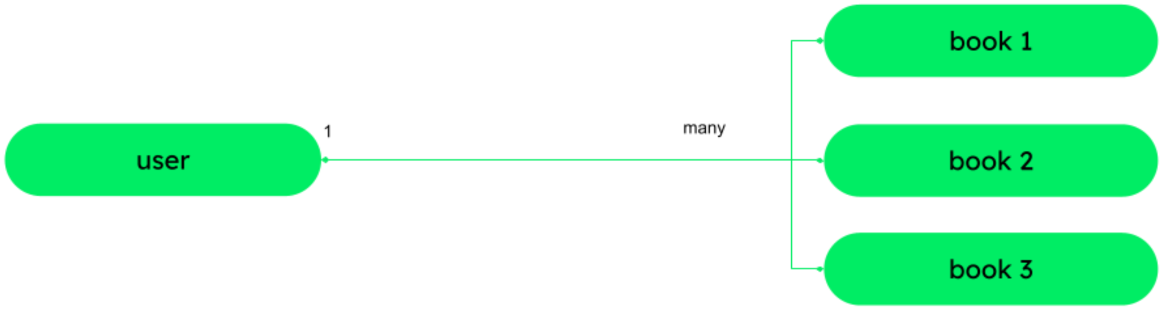
One-to-One

- One to one (1-1): In this relationship, one field is associated with only one document. Another way of thinking about this example can be with the term *value – entity*.
- For example, a book can have only one ISBN.



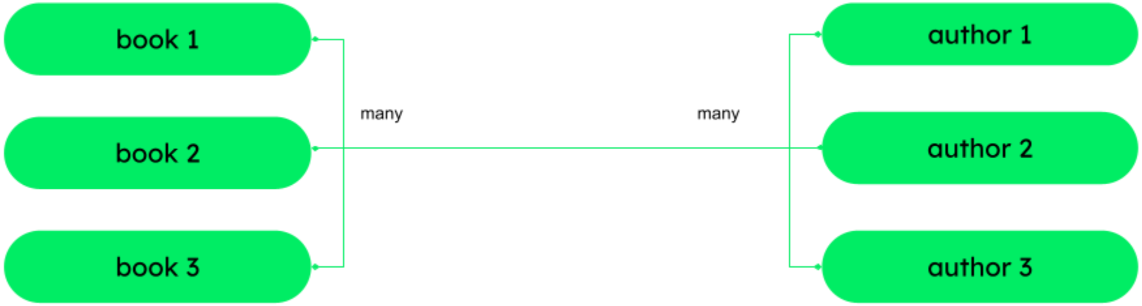
One-to-Many

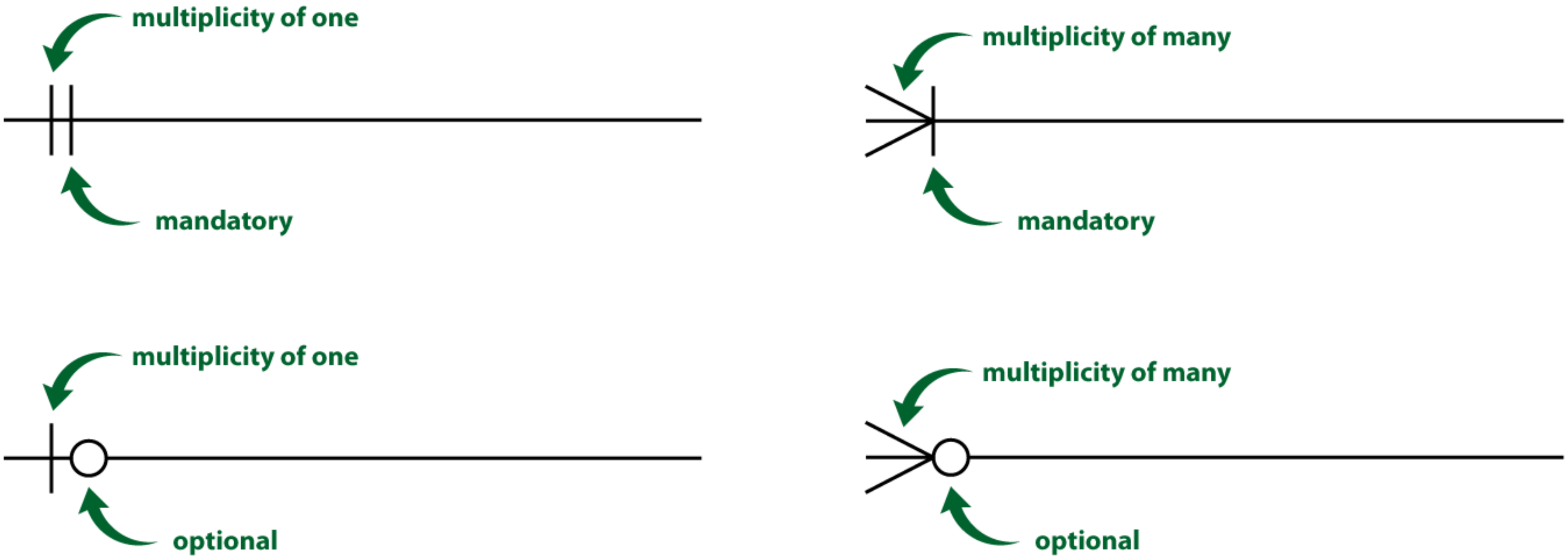
- One to many (1-N): Here, one value can be associated with more than one document or value. Another way of thinking about this is with the term *value – value* or *entity – entity*.
- For example, a user can borrow more than one book at a time.



Many-to-Many

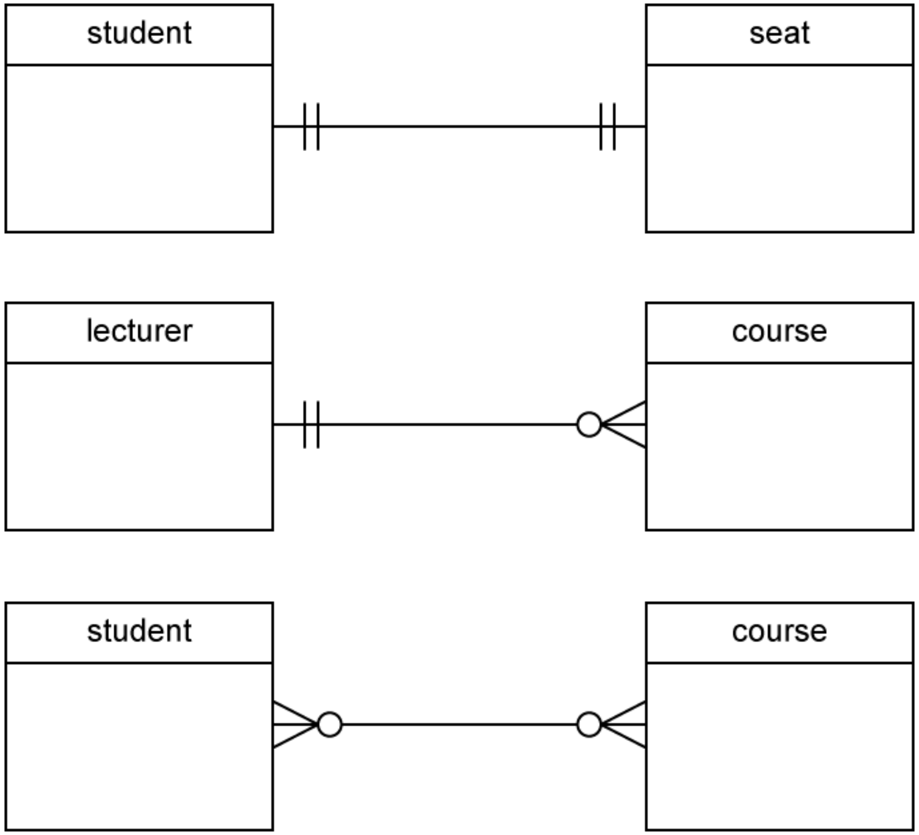
- Many to many (N-N): In this type of model, multiple documents can be associated with each other.
- For example, a book can have many authors, and one author can write many different books. The relationship between author and book is many to many.





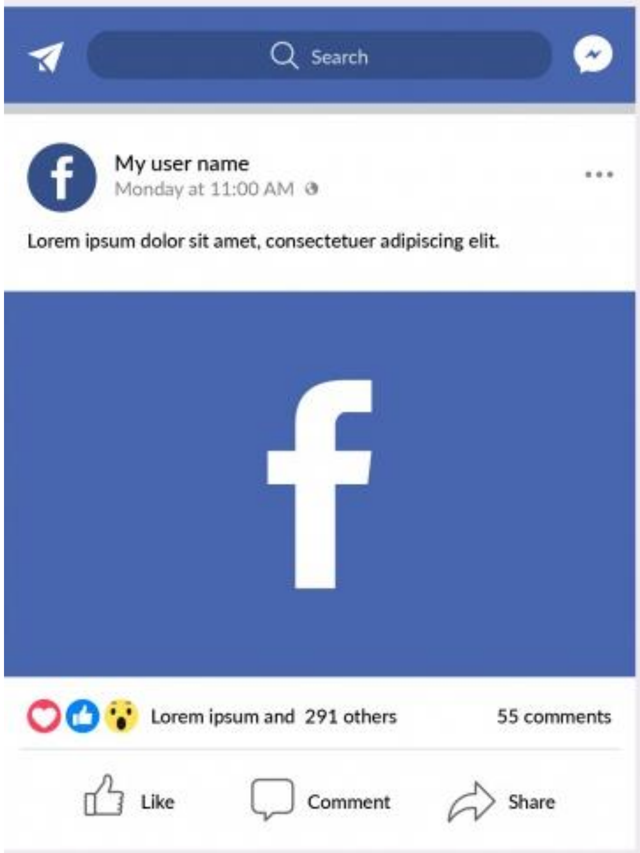
Crow’s Foot Notation

- Examples



Crow’s Foot Notation

- Exercise



My user name

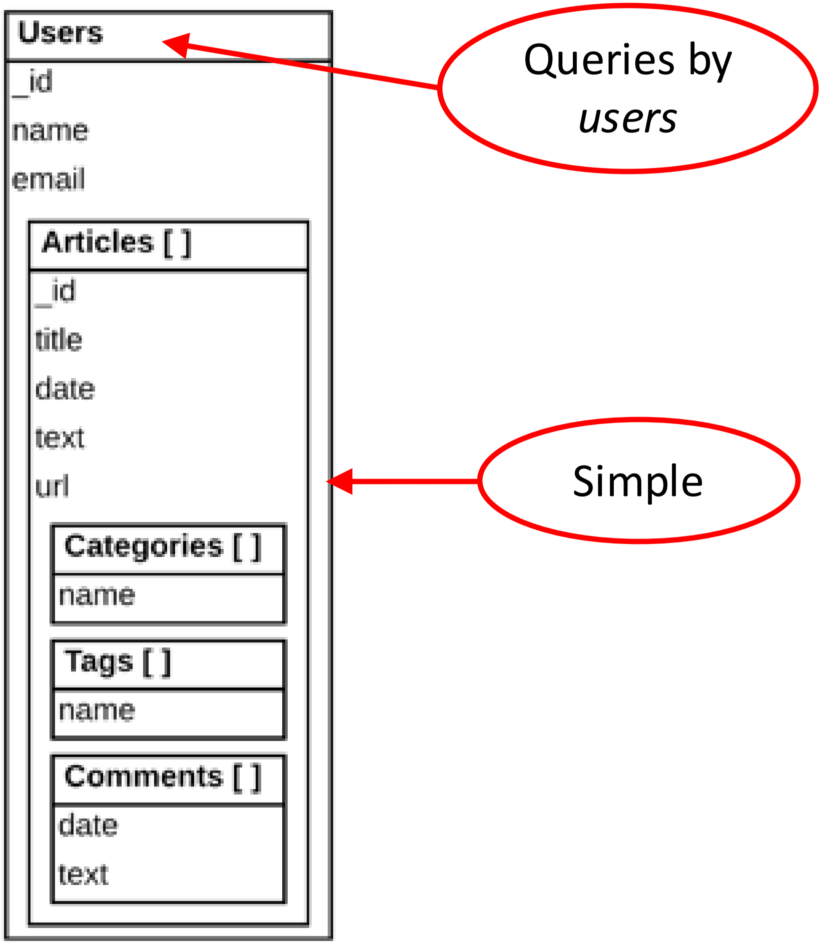
Monday at 11:00 AM

Lorem ipsum dolor sit amet, consectetuer adipiscing elit.

Lorem ipsum and 291 others

55 comments

Crow’s Foot Notation



Users

_id

name

email

Articles [ ]

_id

title

date

text

url

Categories [ ]

name

Tags [ ]

name

Comments [ ]

date

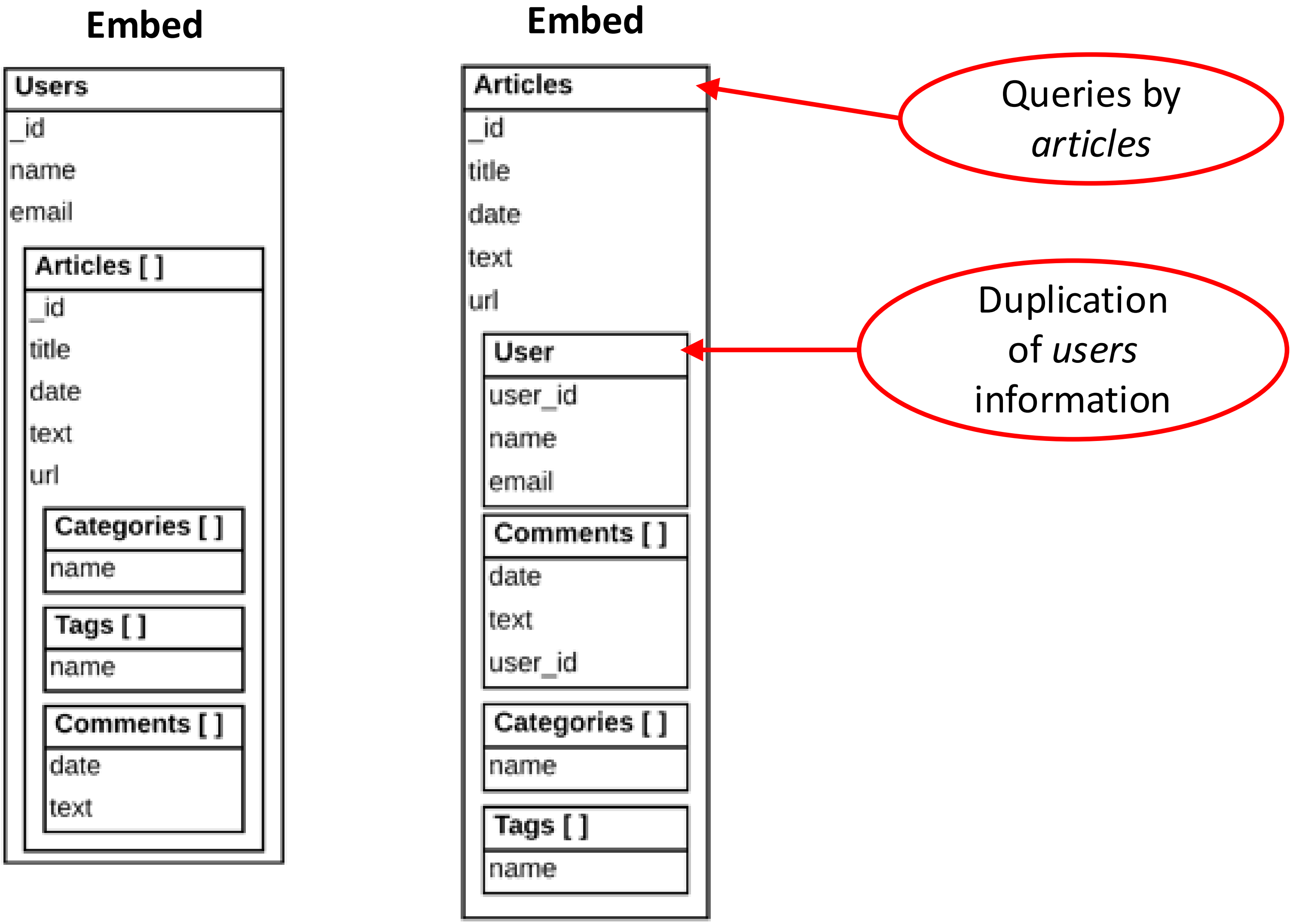
text

Queries by *users*

Simple

How your followers query the articles you posted ?

Crow’s Foot Notation



Embed

Users
_id
name
email

Articles [ ]
_id
title
date
text
url

Categories [ ]
name

Tags [ ]
name

Comments [ ]
date
text

Embed

Articles
_id
title
date
text
url

User
user_id
name
email

Comments [ ]
date
text
user_id

Categories [ ]
name

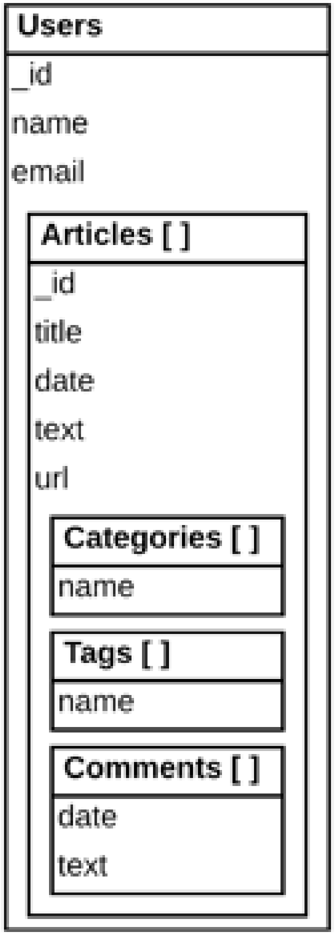
Tags [ ]
name

Queries by *articles*

Duplication of *users* information

Crow’s Foot Notation

Embed



Users
_id
name
email

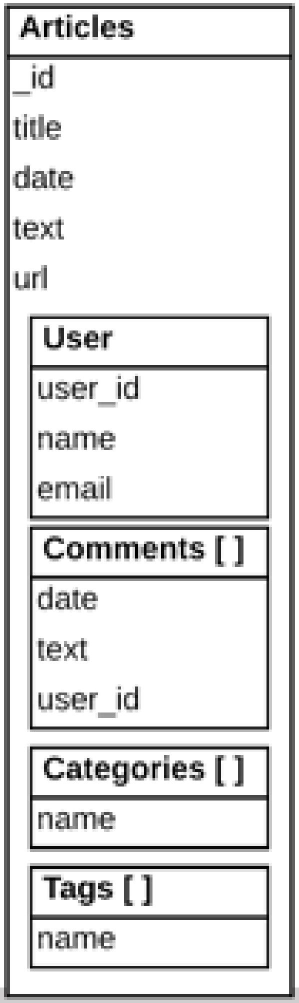
Articles [ ]
_id
title
date
text
url

Categories [ ]
name

Tags [ ]
name

Comments [ ]
date
text

Embed



Articles
_id
title
date
text
url

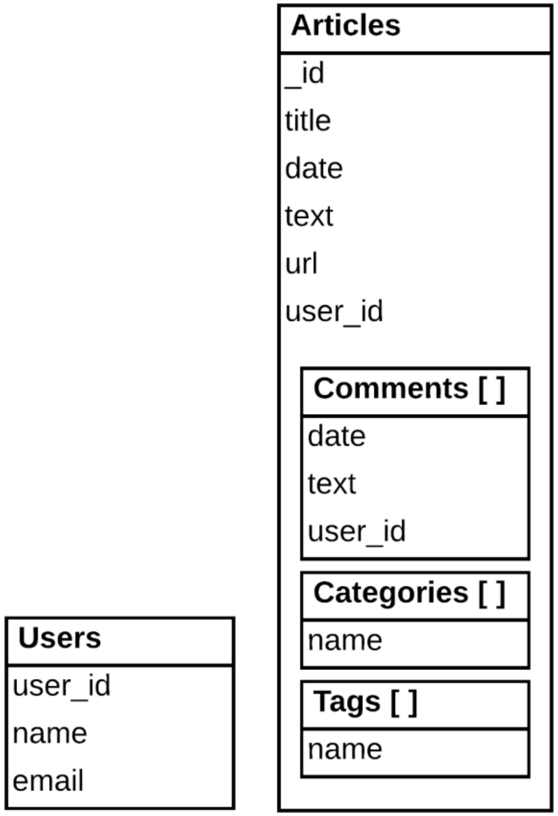
User
user_id
name
email

Comments [ ]
date
text
user_id

Categories [ ]
name

Tags [ ]
name

Reference



Users
user_id
name
email

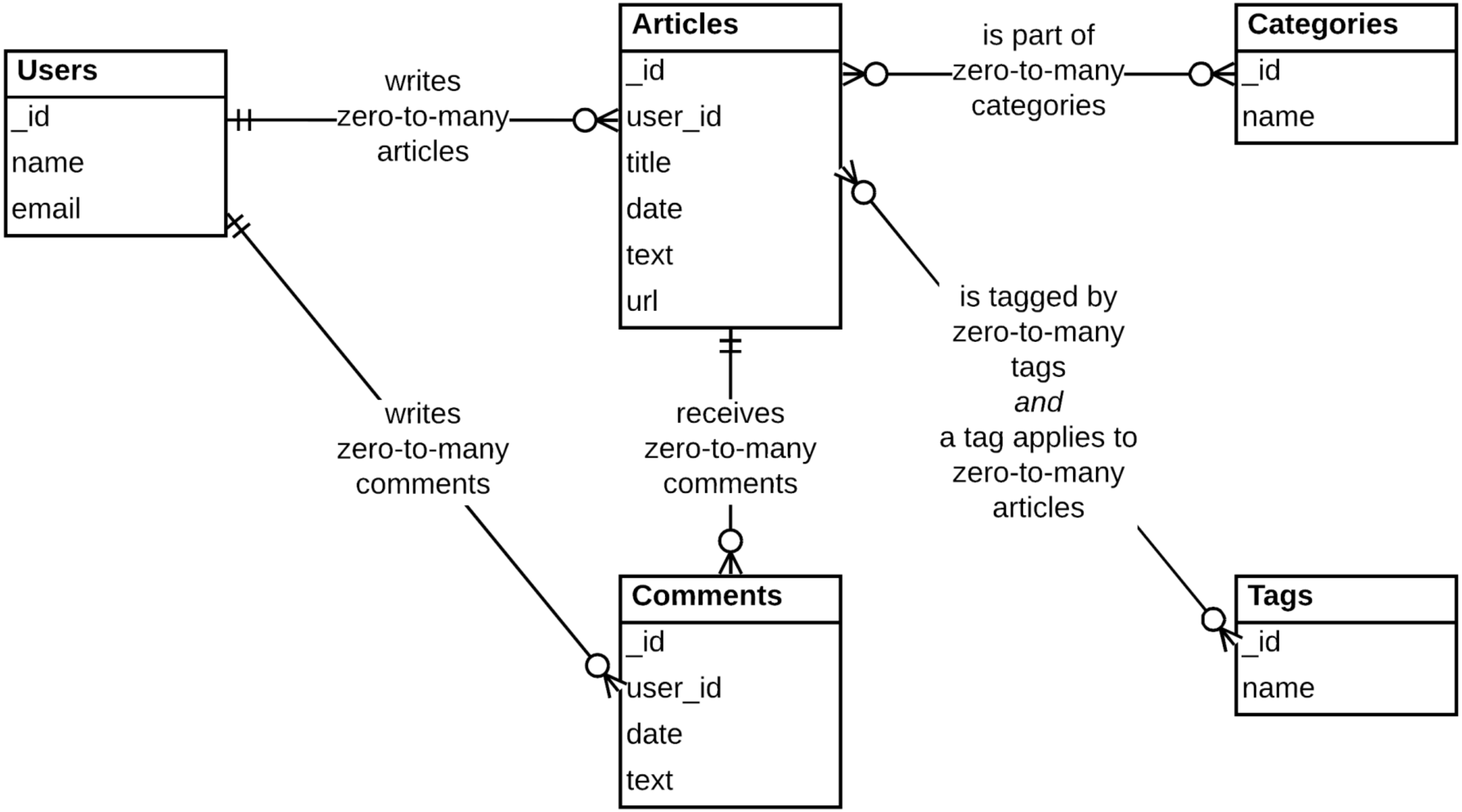
Articles
_id
title
date
text
url
user_id

Comments [ ]
date
text
user_id

Categories [ ]
name

Tags [ ]
name

Crow’s Foot Notation



Users

- _id
- name
- email

writes
zero-to-many
articles

Articles

- _id
- user_id
- title
- date
- text
- url

is part of
zero-to-many
categories

Categories

- _id
- name

is tagged by
zero-to-many
tags
and
a tag applies to
zero-to-many
articles

writes
zero-to-many
comments

receives
zero-to-many
comments

Comments

- _id
- user_id
- date
- text

Tags

- _id
- name

Crow's Foot Notation