NoSQL Database

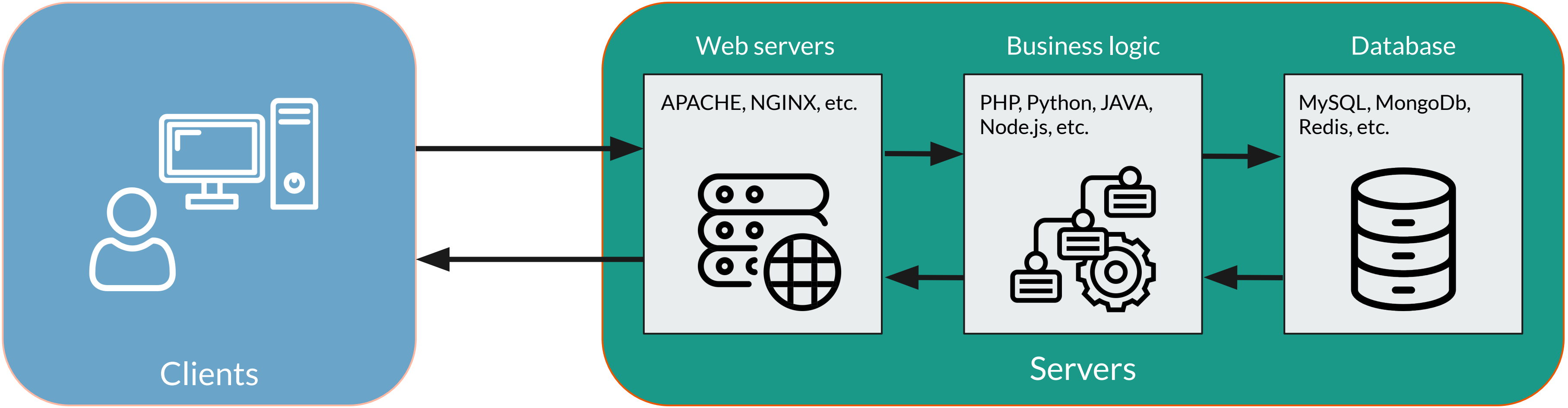
Introduction

1. What is a database?
2. SQL Database and ORM
3. SQL vs NoSQL

NoSQL database

What is a database?

Architecture



Web servers

APACHE, NGINX, etc.

Business logic

PHP, Python, JAVA, Node.js, etc.

Database

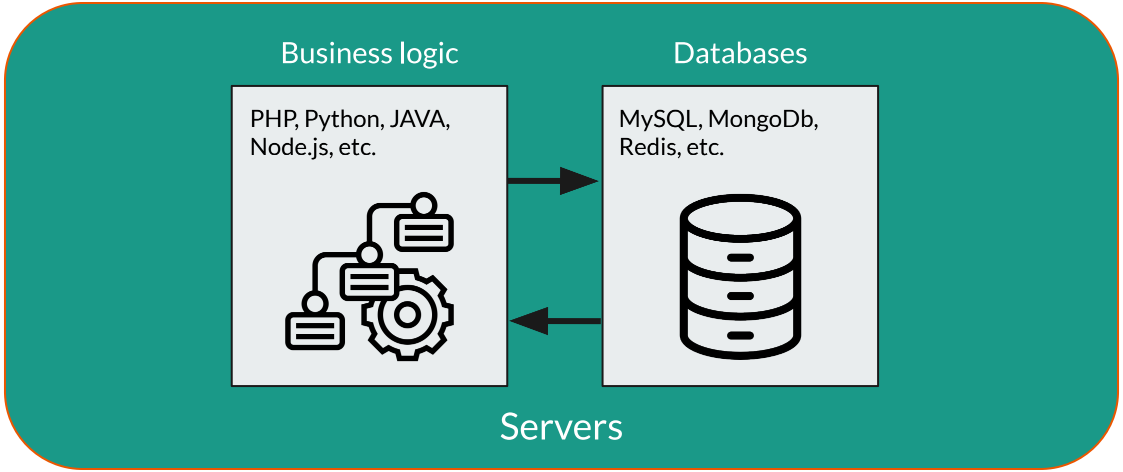
MySQL, MongoDb, Redis, etc.

Servers

Clients

What is a database?

Architecture



Business logic

PHP, Python, JAVA, Node.js, etc.

Databases

MySQL, MongoDb, Redis, etc.

Servers

What is a database?

SQL Database and ORM

SQL?

SQL is not a database, is a language to write database queries

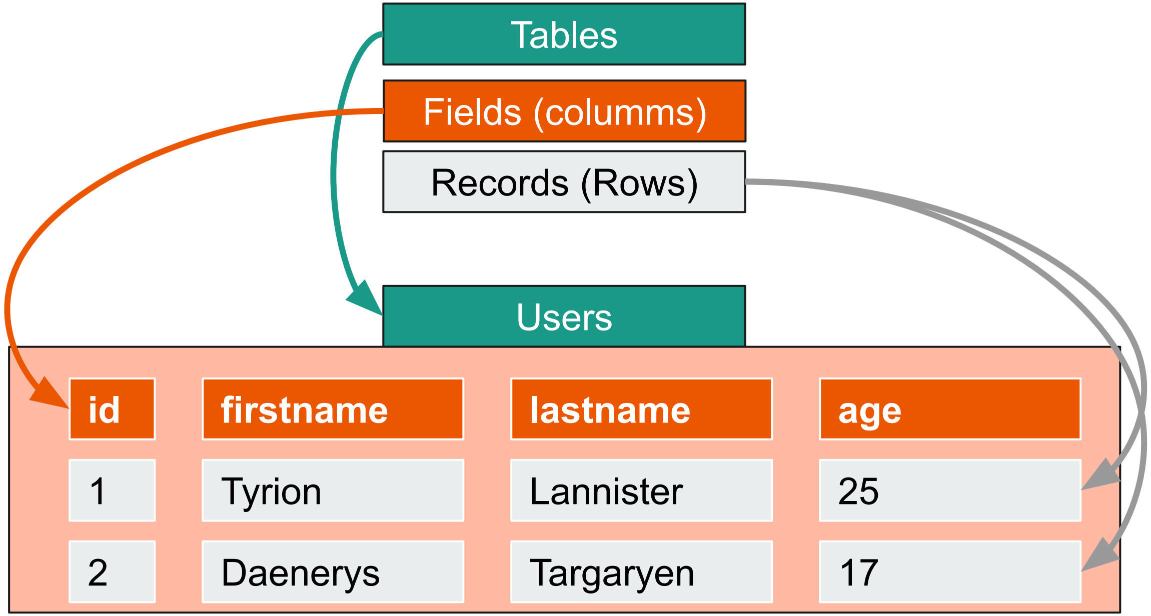
Structured Query Language

SELECT id, firstname, age **FROM** users

keywords: SELECT, INSERT, FROM, etc.

SQL database: relational database

Clear schemas with fixed Fields (columns)



Tables

Fields (columms)

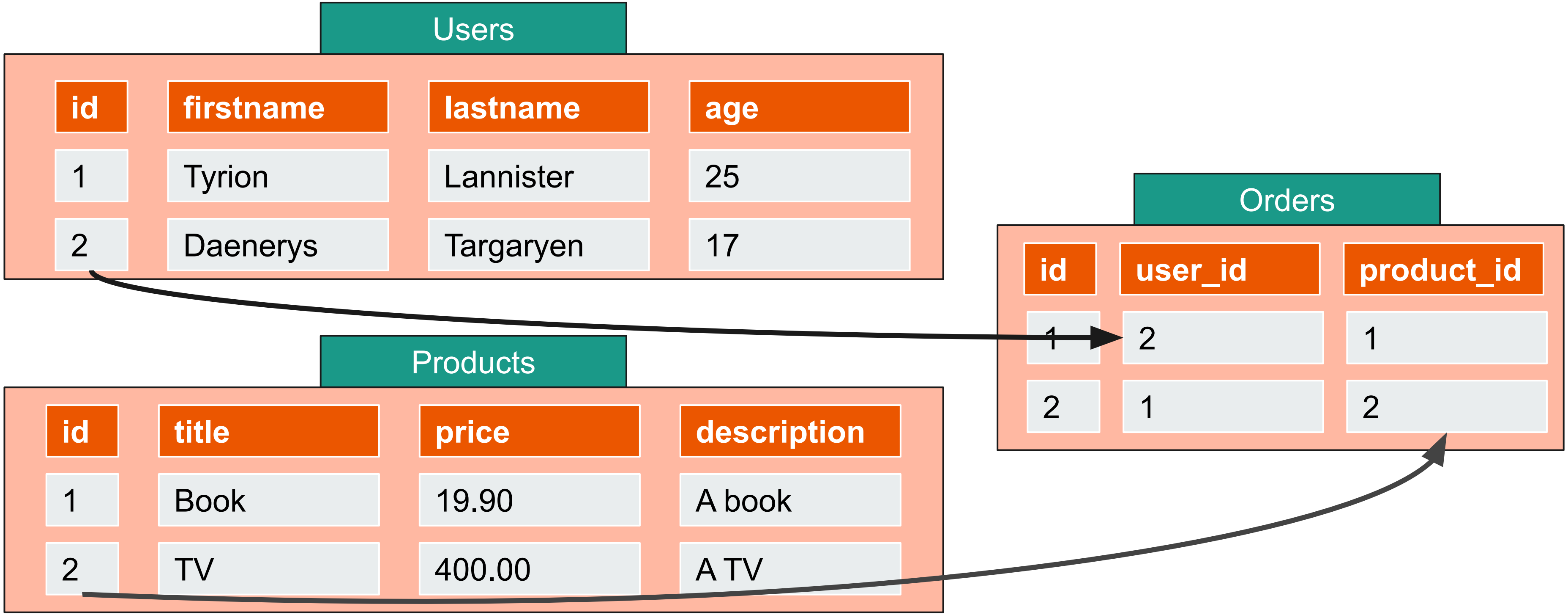
Records (Rows)

Users

id	firstname	lastname	age
1	Tyrion	Lannister	25
2	Daenerys	Targaryen	17

SQL Database and ORM

Relations



Users

id	firstname	lastname	age
1	Tyrion	Lannister	25
2	Daenerys	Targaryen	17

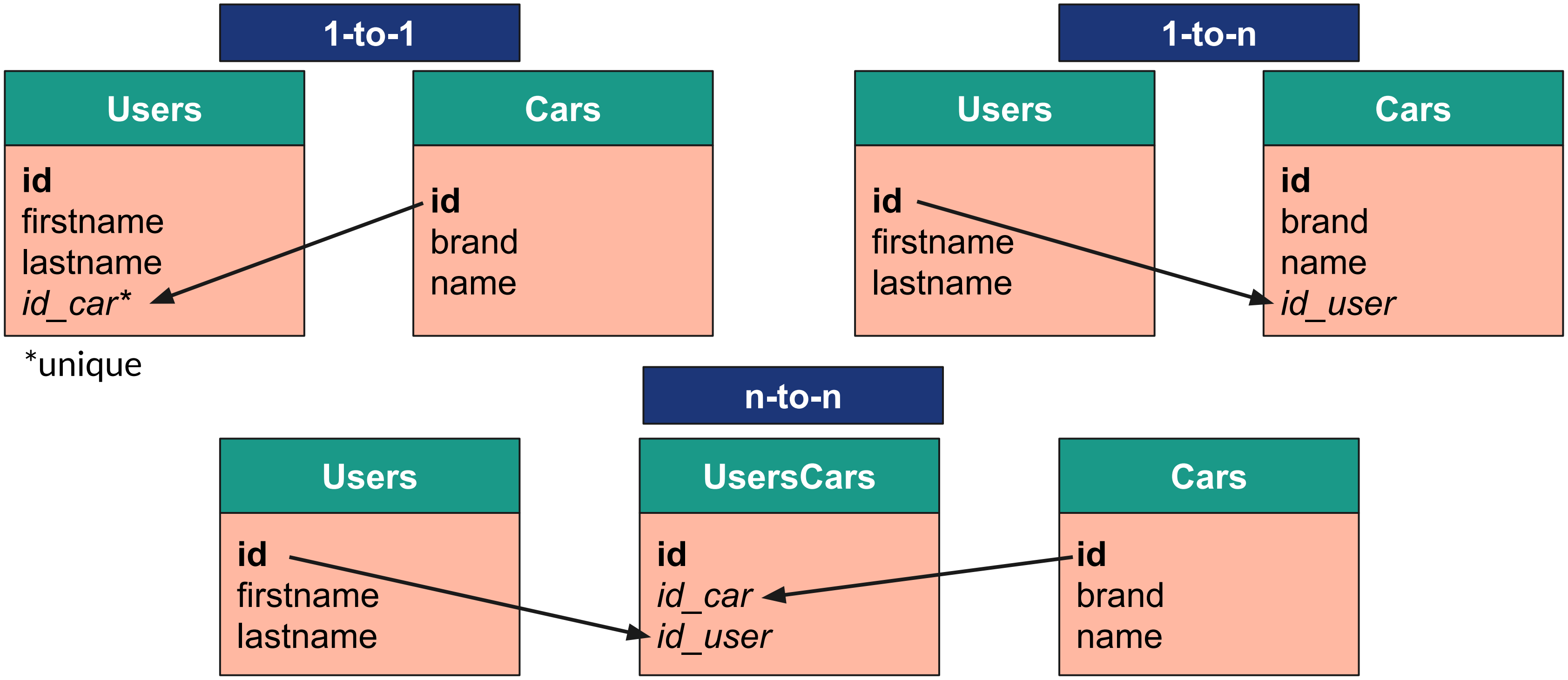
Orders

id	user_id	product_id
1	2	1
2	1	2

Products

id	title	price	description
1	Book	19.90	A book
2	TV	400.00	A TV

Types of Relations



1-to-1

Users

id
firstname
lastname
*id_car**

Cars

id
brand
name

*unique

1-to-n

Users

id
firstname
lastname

Cars

id
brand
name
id_user

n-to-n

Users

id
firstname
lastname

UsersCars

id
id_car
id_user

Cars

id
brand
name

SQL - characteristics

Strict schemas

and

Relations

+

Index

Project: MySql, Oracle, Sqlite, Postgres and MS-SQL.

What is an ORM?

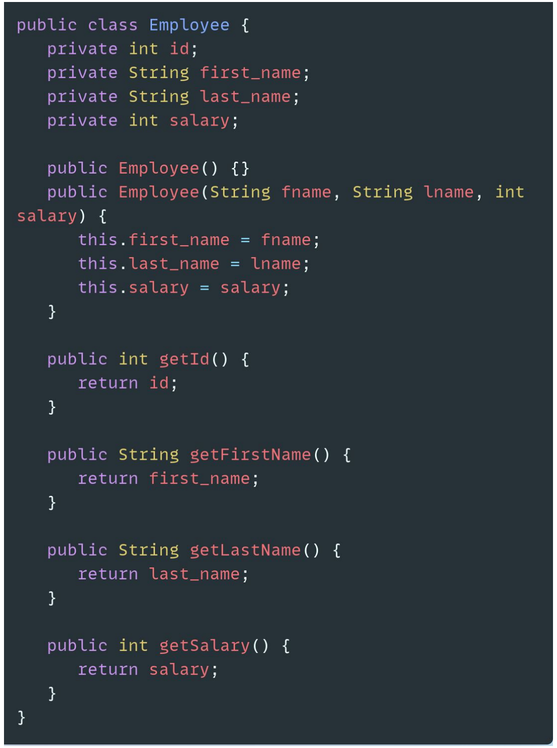
- **Object-Relational Mapping** or **ORM**

Makes the database relationship to Object Oriented

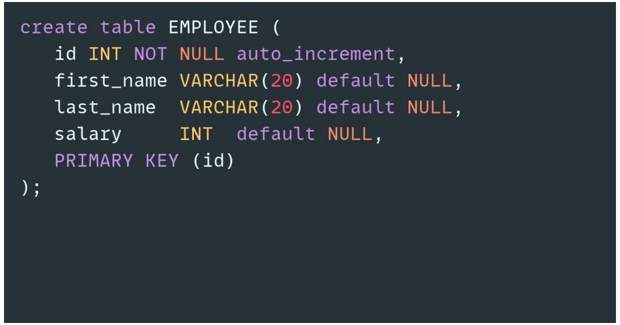
- Writing classes leads to the creation of tables
- No SQL query - use of methods
- It is the ORM that makes the requests.

- **Warning:** not always optimized

ORM in JAVA



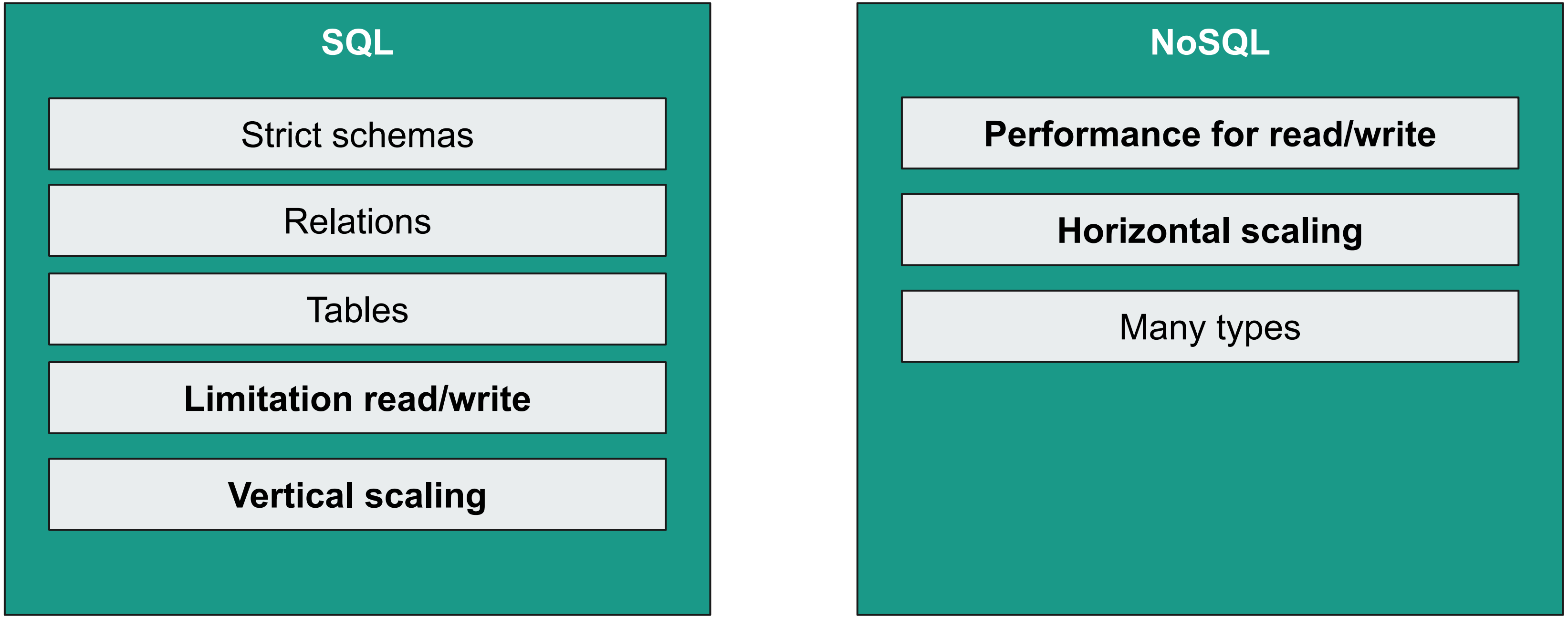
```java
public class Employee {
   private int id;
   private String first_name;
   private String last_name;
   private int salary;

   public Employee() {}
   public Employee(String fname, String lname, int
salary) {
      this.first_name = fname;
      this.last_name = lname;
      this.salary = salary;
   }

   public int getId() {
      return id;
   }

   public String getFirstName() {
      return first_name;
   }

   public String getLastName() {
      return last_name;
   }

   public int getSalary() {
      return salary;
   }
}
```



```sql
create table EMPLOYEE (
   id INT NOT NULL auto_increment,
   first_name VARCHAR(20) default NULL,
   last_name  VARCHAR(20) default NULL,
   salary     INT  default NULL,
   PRIMARY KEY (id)
);
```

SQL vs NoSQL

SQL vs NoSQL



SQL

- Strict schemas
- Relations
- Tables
- **Limitation read/write**
- **Vertical scaling**

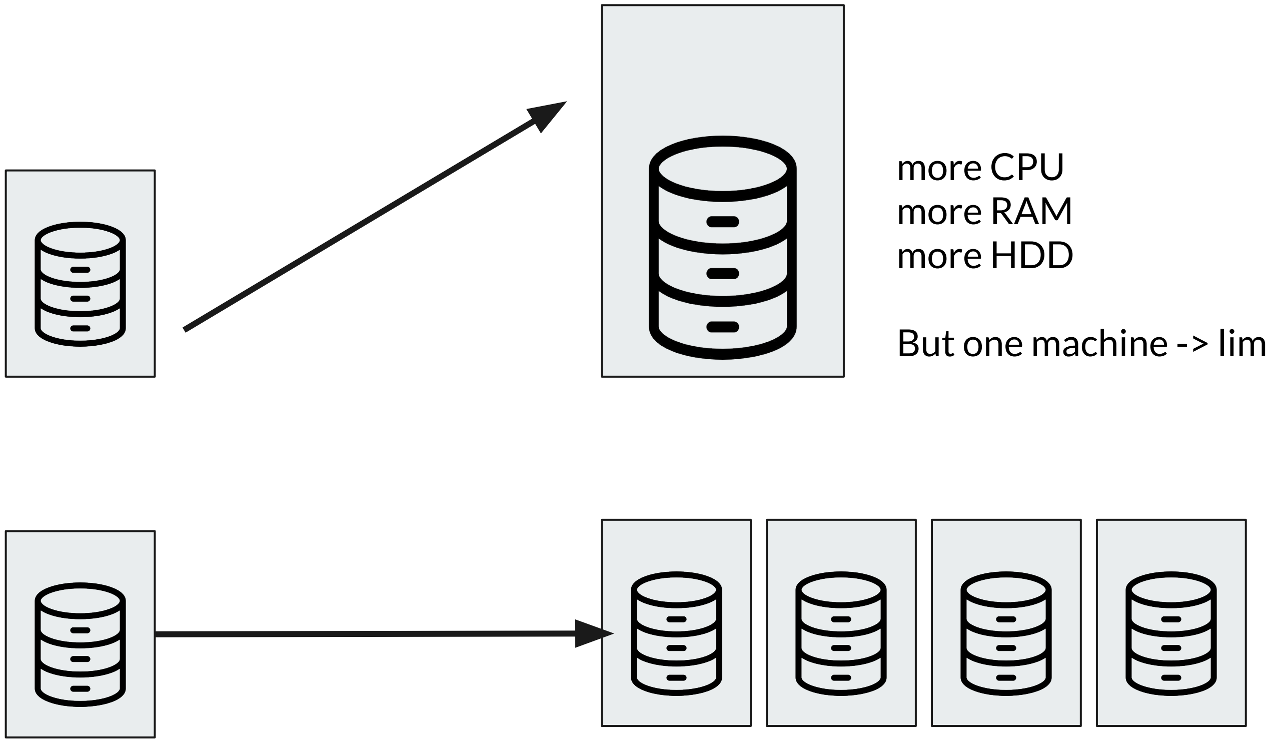
NoSQL

- **Performance for read/write**
- **Horizontal scaling**
- Many types

SQL vs NoSQL

Scaling

Scaling



Vertical Scaling
SQL database

more CPU
more RAM
more HDD

But one machine -> limits

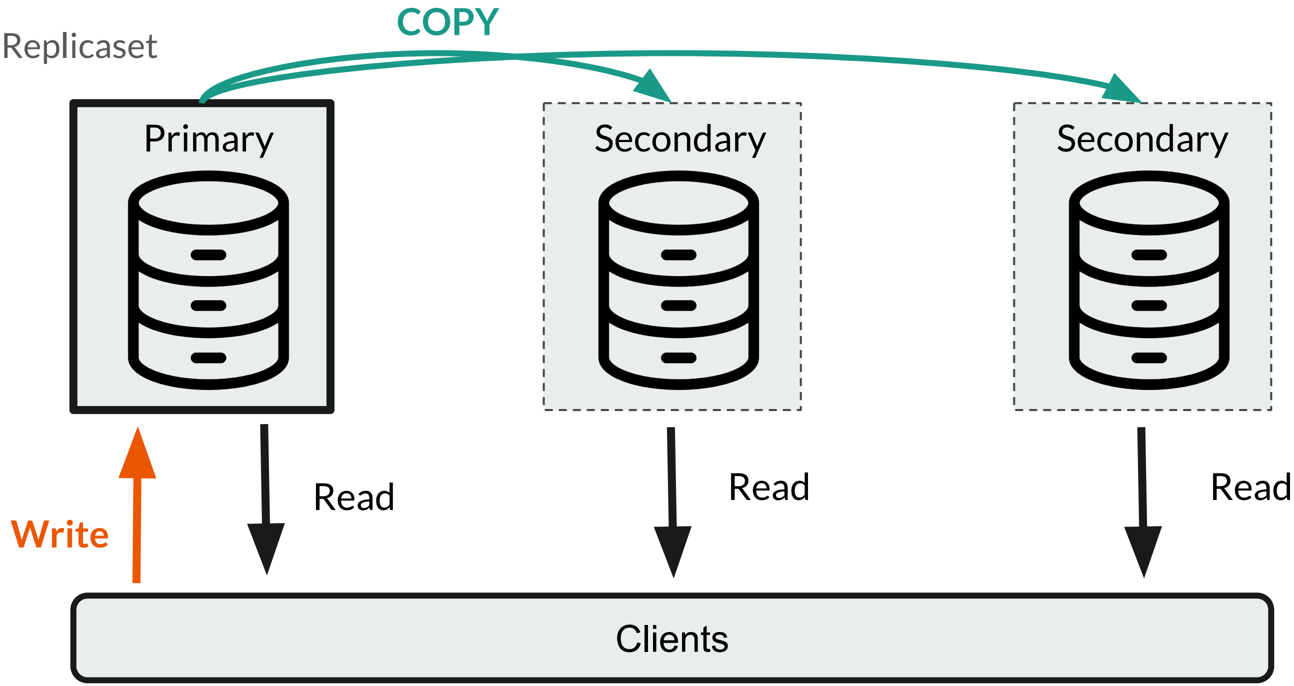
Horizontal Scaling
NoSQL database

more machines: no limits

Scaling

Advantages of Horizontal Scaling

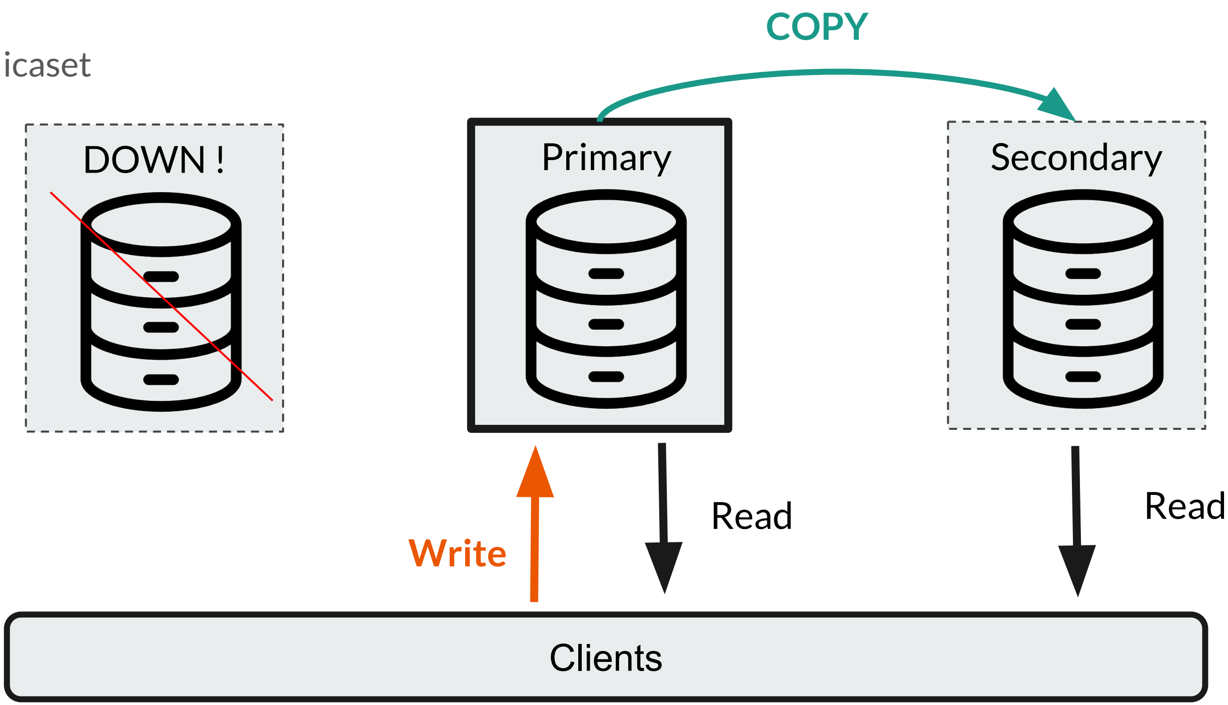
1. Replicaset



Scaling

Advantages of Horizontal Scaling

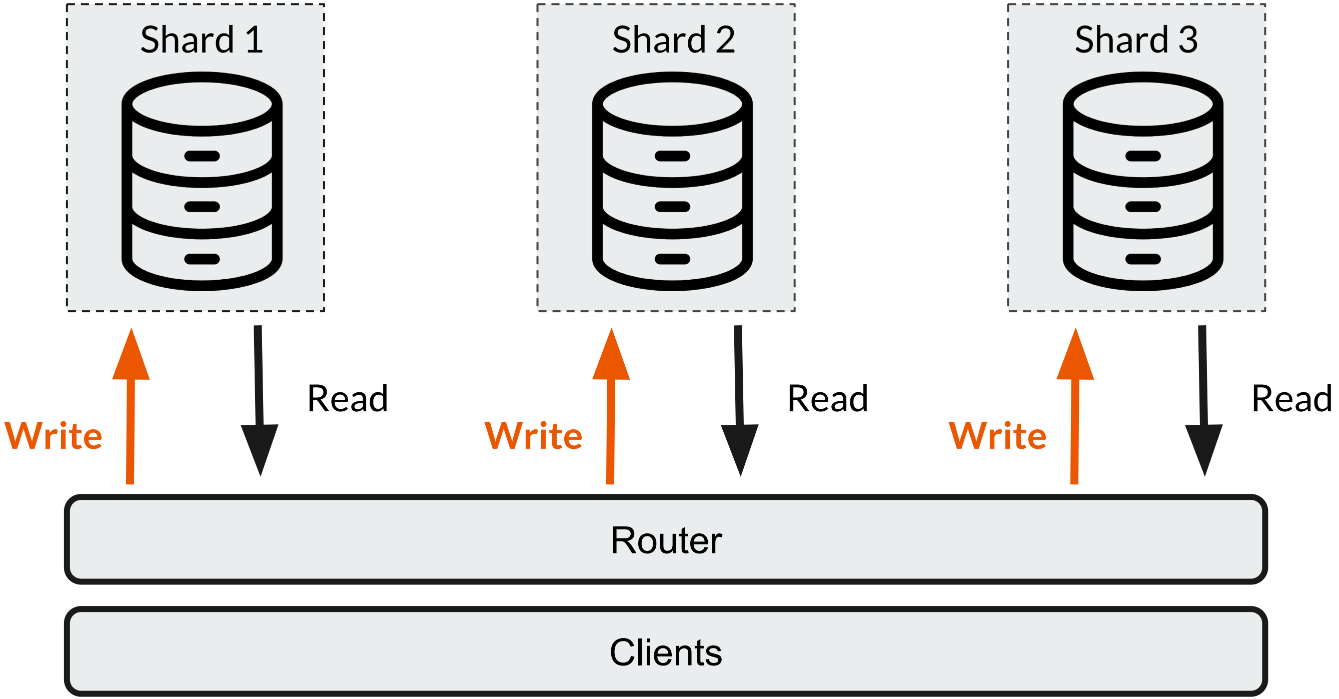
1. Replicaset



Scaling

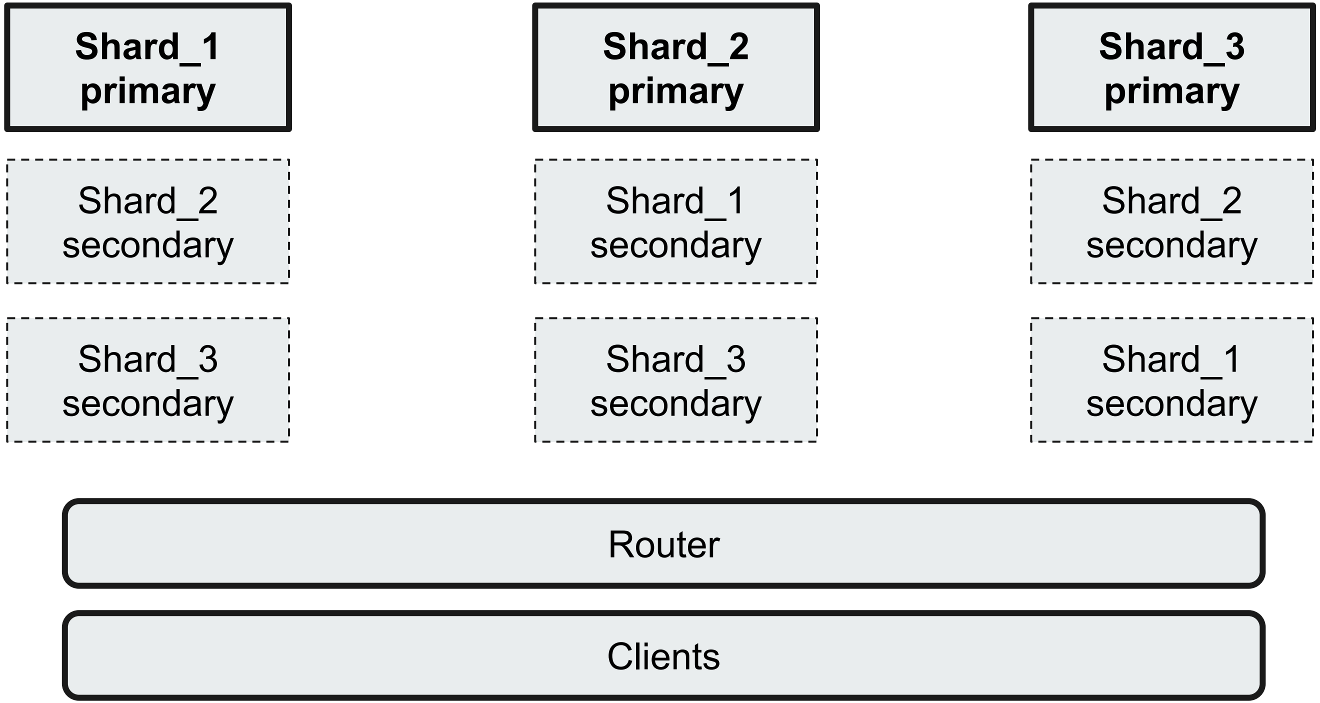
Advantages of Horizontal Scaling

2. Sharded: by region, id, other



Advantages of Horizontal Scaling

IRL



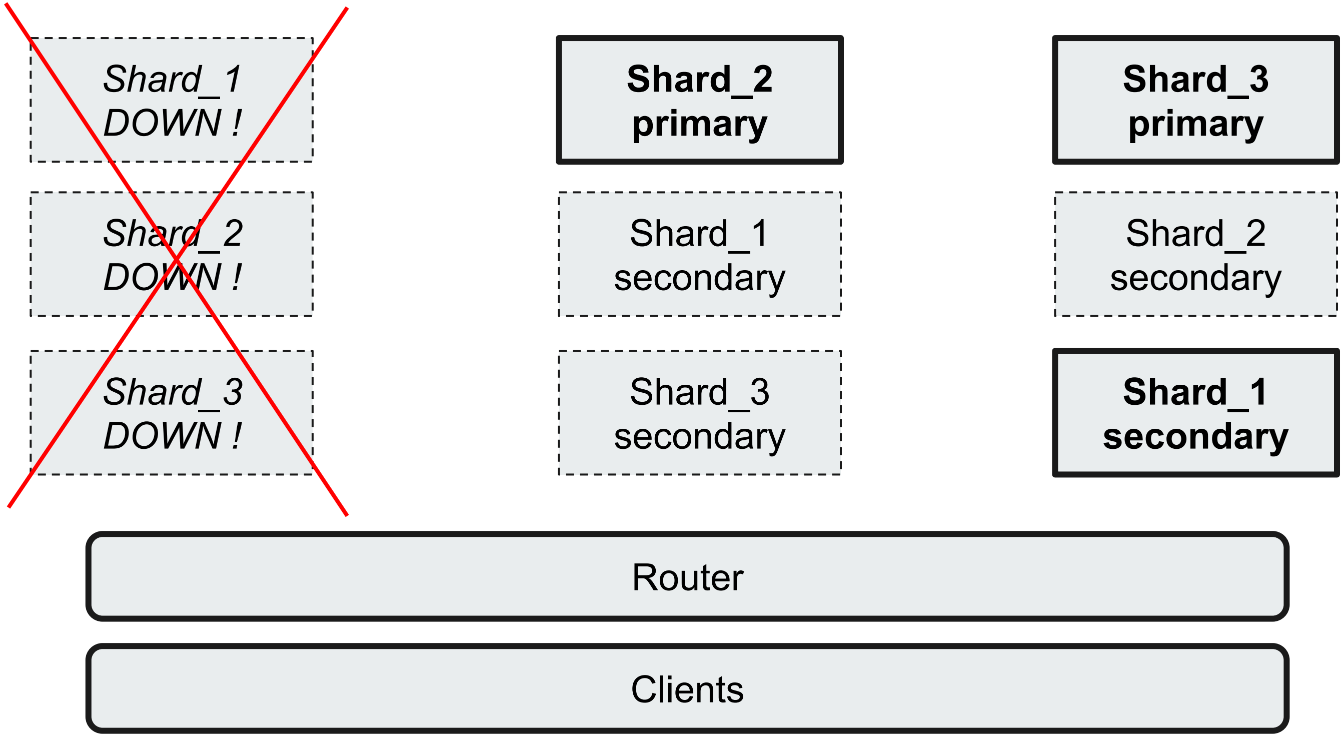
Shard_1 primary	**Shard_2 primary**	**Shard_3 primary**
Shard_2 secondary	Shard_1 secondary	Shard_2 secondary
Shard_3 secondary	Shard_3 secondary	Shard_1 secondary

Router

Clients

Advantages of Horizontal Scaling

IRL

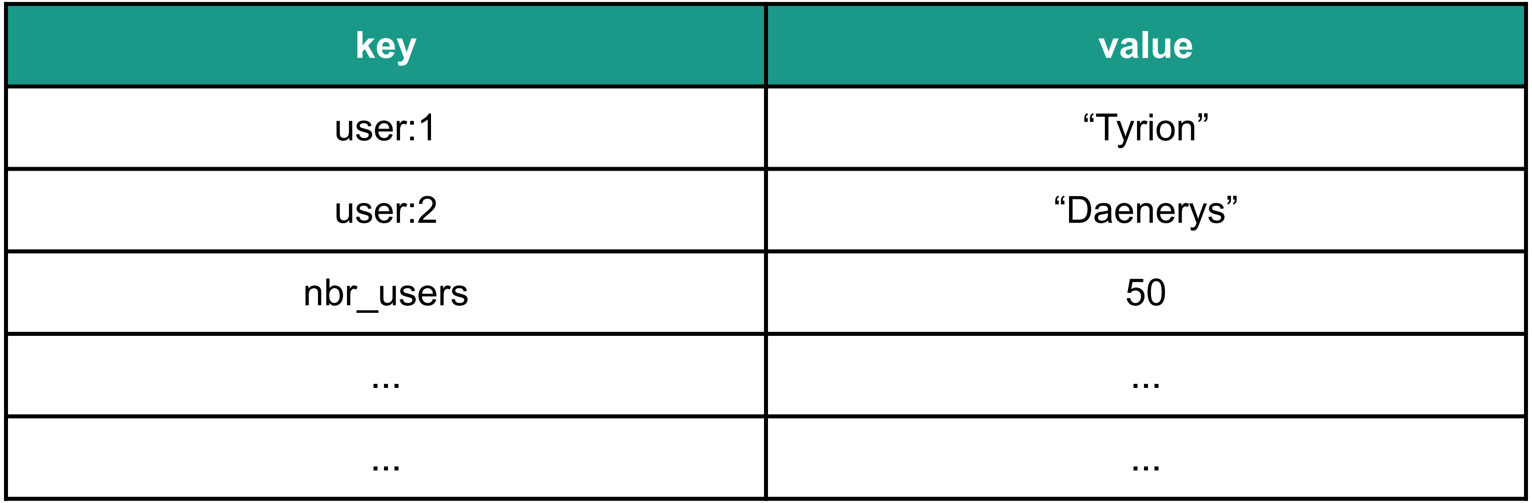


NoSQL
Key-value, columns, document, graph

NoSQL

1. keys-values

Key-Value database



key	value
user:1	“Tyrion”
user:2	“Daenerys”
nbr_users	50
...	...
...	...

Key-Value database

Key-Value database

- Use RAM for storage

- not always persistent DATA

- Use for
  - catching DATA
  - temporary code
  - USER session
  - ….

Key-Value database

exemple: REDIS

- SIMPLE
- Structured DATA: List, Set, Map, SortedSet
- Can have persistent DATA (store every x write or log)
- MASTER - SLAVE (real time copy)

Key-Value database

REDIS: DATA type

	Keys	Values
String	user:123	{ “firstname”: “Tyrion” }
List	Page:view	[nic, tom, nic, bob, anna, nic]

Hash	user:Romain	firstname => Romain
		lastname => Tribout

Set	student:ISEN	{nic, tom, anna}

SortedSet	votes:NoSQL	{ bob => 5
		tom => 8
		anna => 6 }

Key-Value database

Key-Value database

REDIS: basic instructions

Instructions	Description
SET <key> <value>	Create key-value
GET <key>	Read key-value
INCR <key> or DECR <key>	Increment or decrement value
TTL <key>	Get time to live
EXPIRE <key> <ttl>	Set time to live

Key-Value database

REDIS: list

Instruction	Description
RPUSH <key> <value> or LPUSH <key> <value>	Push data right or left in list
LRANGE <key> <from_index> <to_index>	get list data
LLEN <key>	Size of list
LPOP <key> or RPOP <key>	Remove right or left dat in list

Key-Value database

REDIS: SET (like LIST with unique)

Instruction	Description
SADD <key>	Add data to the SET
SMEMBERS <key>	Get all data
SREM <key> <value>	Remove data to the SET
SISMEMBERS <key> <value>	Data is in SET
SUNION <key1> <key2>	Union of two SET

NoSQL

2. Columns databse

Columns database

- Similar to SQL database: structured data

- Distributed (plusieurs noeuds) - big cluster = security

- Query language look like SQL

- Scalability

Columns Database

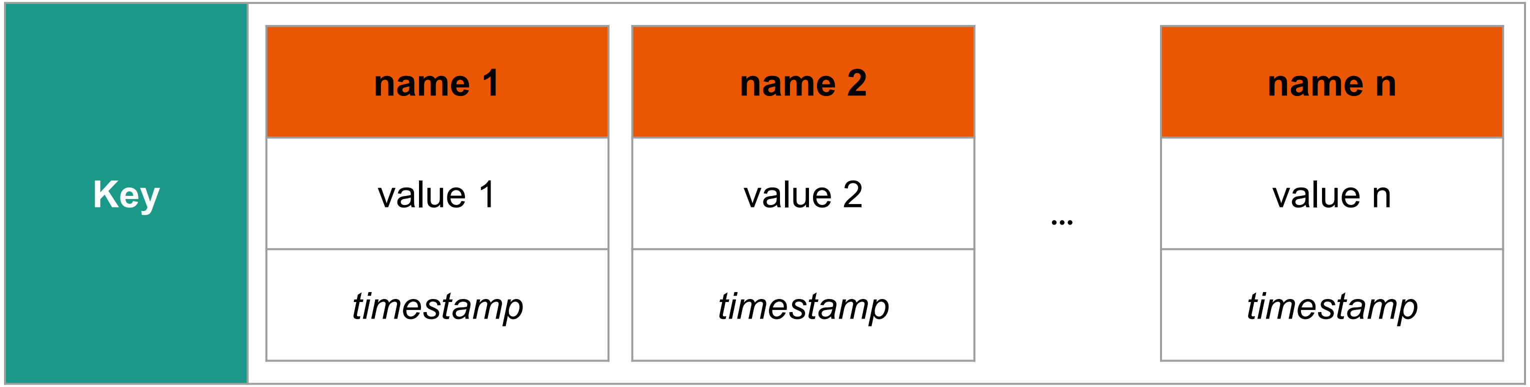
Column

name
value
timestamp

Columns database

Columns Database

Row



Key

name 1

value 1

timestamp

name 2

value 2

timestamp

...

name n

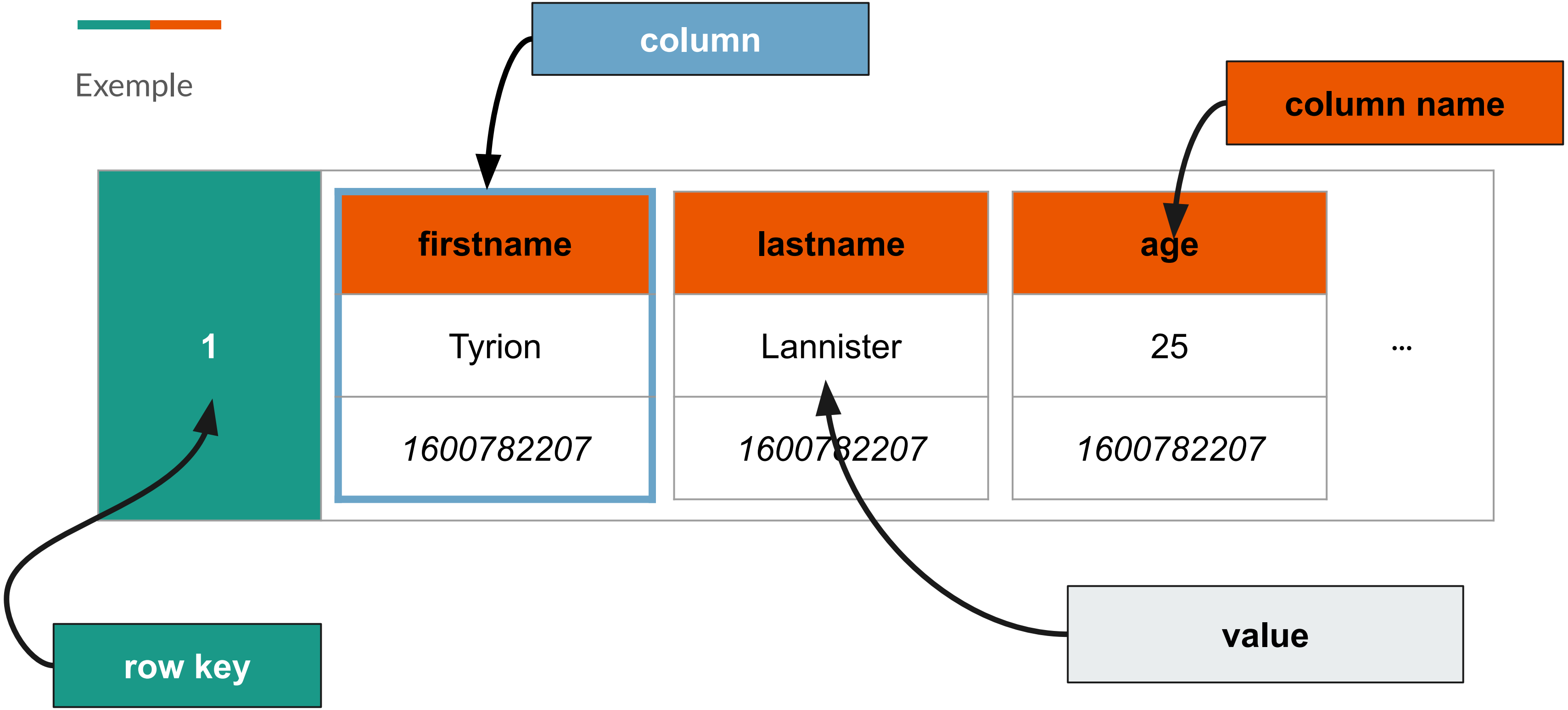
value n

timestamp

Columns database

Columns Database

Exemple



column

column name

	firstname	lastname	age	
1	Tyrion	Lannister	25	...
	1600782207	*1600782207*	*1600782207*	

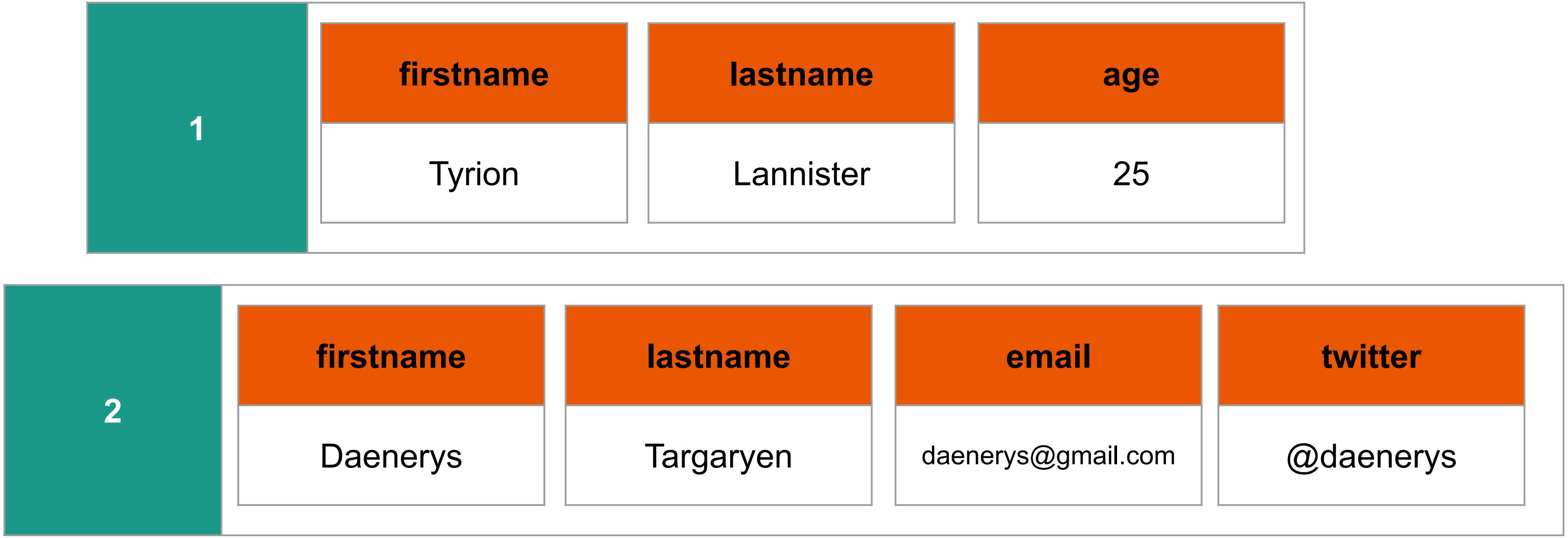
row key

value

Columns database

Columns Database

liberty but comparator/validator



	firstname	lastname	age
1	Tyrion	Lannister	25

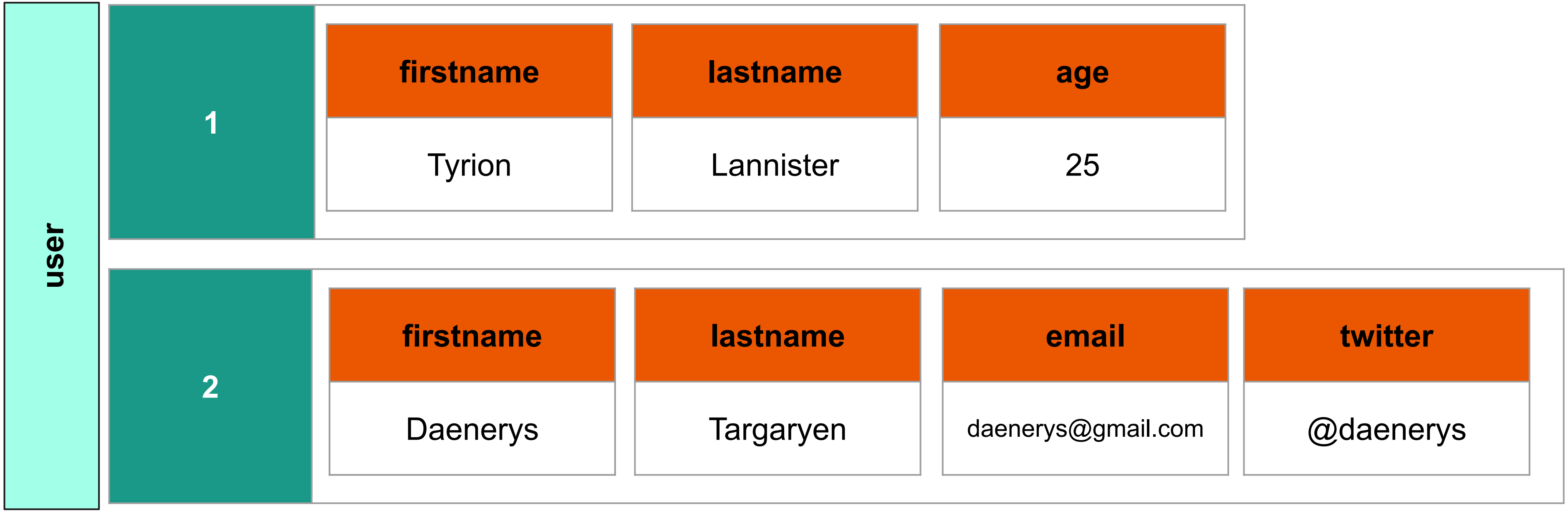
	firstname	lastname	email	twitter
2	Daenerys	Targaryen	daenerys@gmail.com	@daenerys

Columns database

Columns Database

Column Family

user['1']['age'] = 25



user

1

firstname	lastname	age
Tyrion	Lannister	25

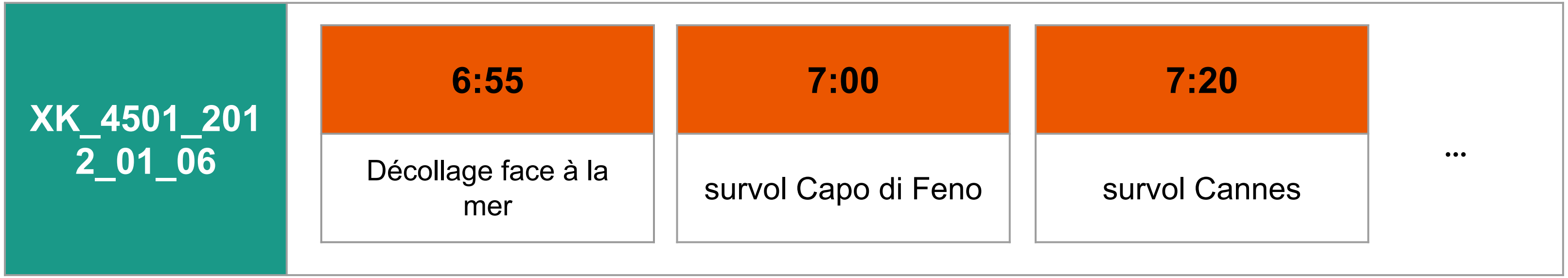
2

firstname	lastname	email	twitter
Daenerys	Targaryen	daenerys@gmail.com	@daenerys

Columns database

Columns Database

Pattern: column name can be a value



XK_4501_2012_01_06

6:55

Décollage face à la mer

7:00

survol Capo di Feno

7:20

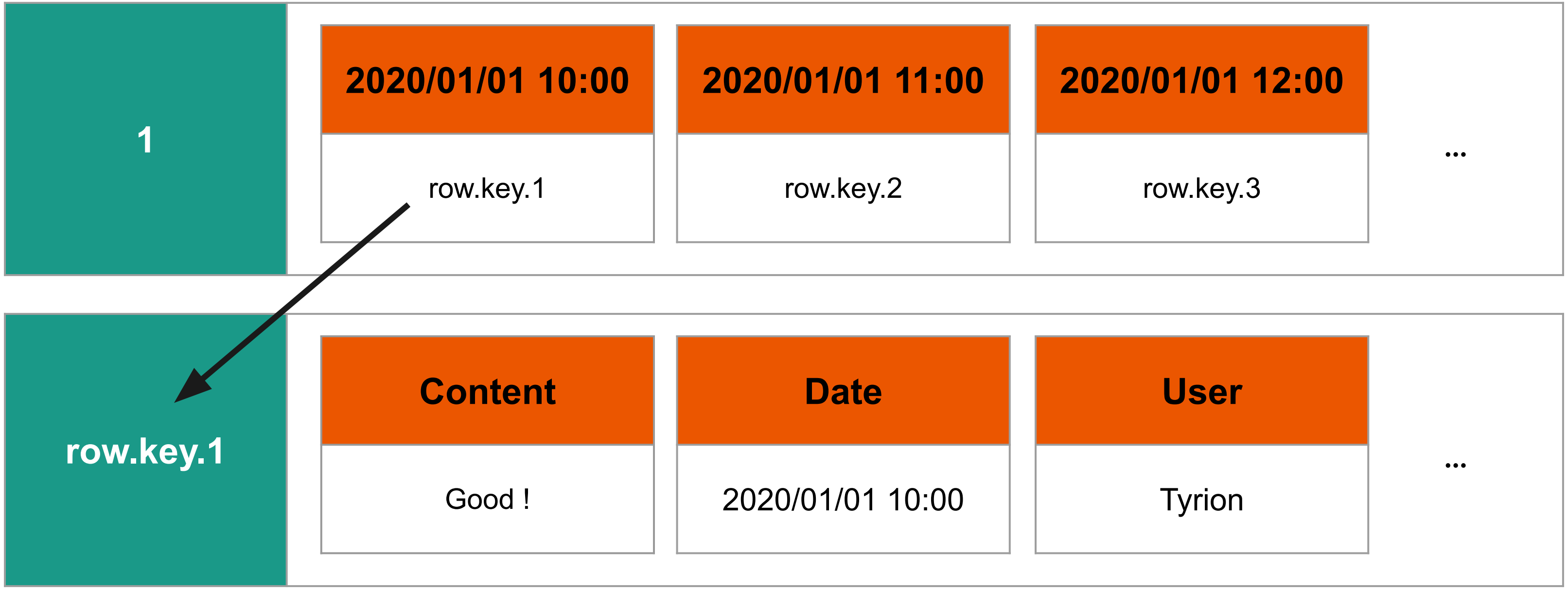
survol Cannes

...

Columns database

Columns Database

Pattern: manual relation



	2020/01/01 10:00	2020/01/01 11:00	2020/01/01 12:00	
1	row.key.1	row.key.2	row.key.3	...

	Content	Date	User	
row.key.1	Good !	2020/01/01 10:00	Tyrion	...

Columns database

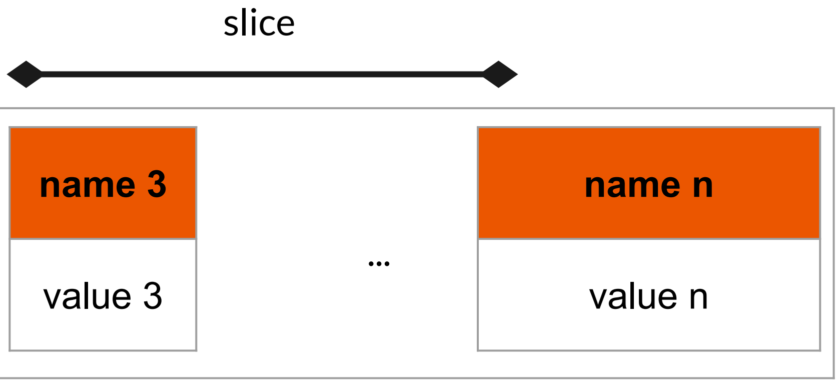
Columns Database

Queries

on skinny rows

GET: get user[‘1’][‘firstname’]; or select user where country = ‘fr’;

on wide row



Columns database

Columns database

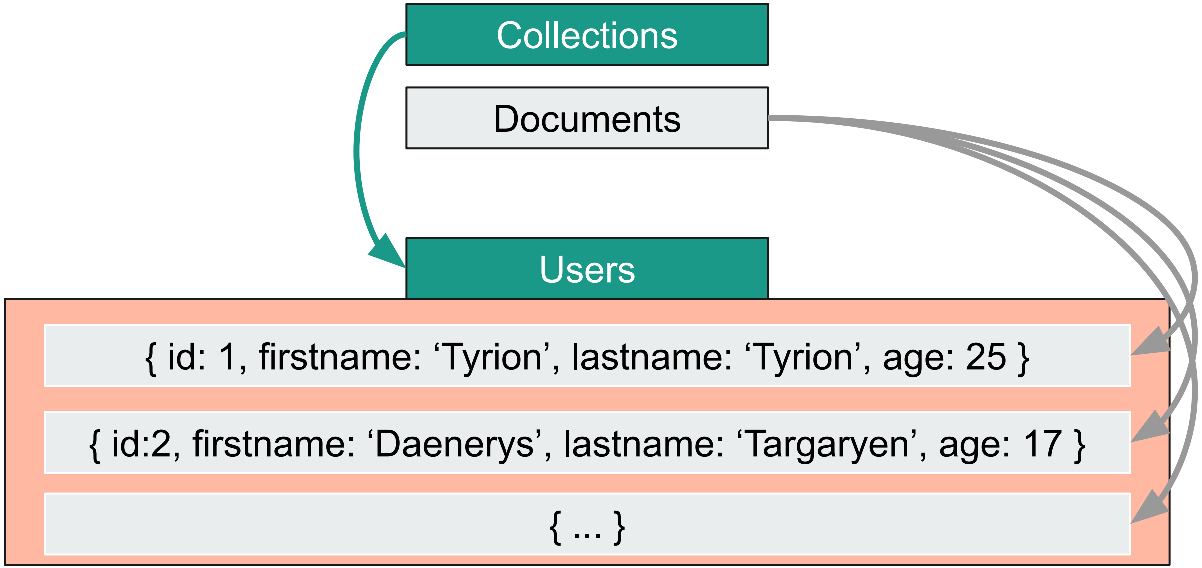
Cassandra: created by Facebook

- apple 70k nodes
- netflix 2.5k nodes

NoSQL

3. Document-oriented database

How it works



Collections

Documents

Users

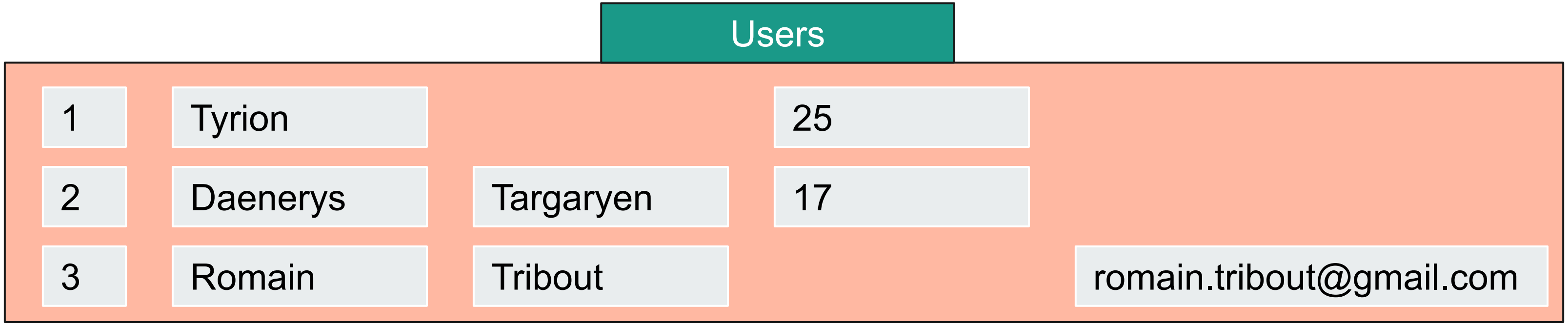
{ id: 1, firstname: ‘Tyrion’, lastname: ‘Tyrion’, age: 25 }

{ id:2, firstname: ‘Daenerys’, lastname: ‘Targaryen’, age: 17 }

{ ... }

Document-oriented database

Data structure: No Schema !



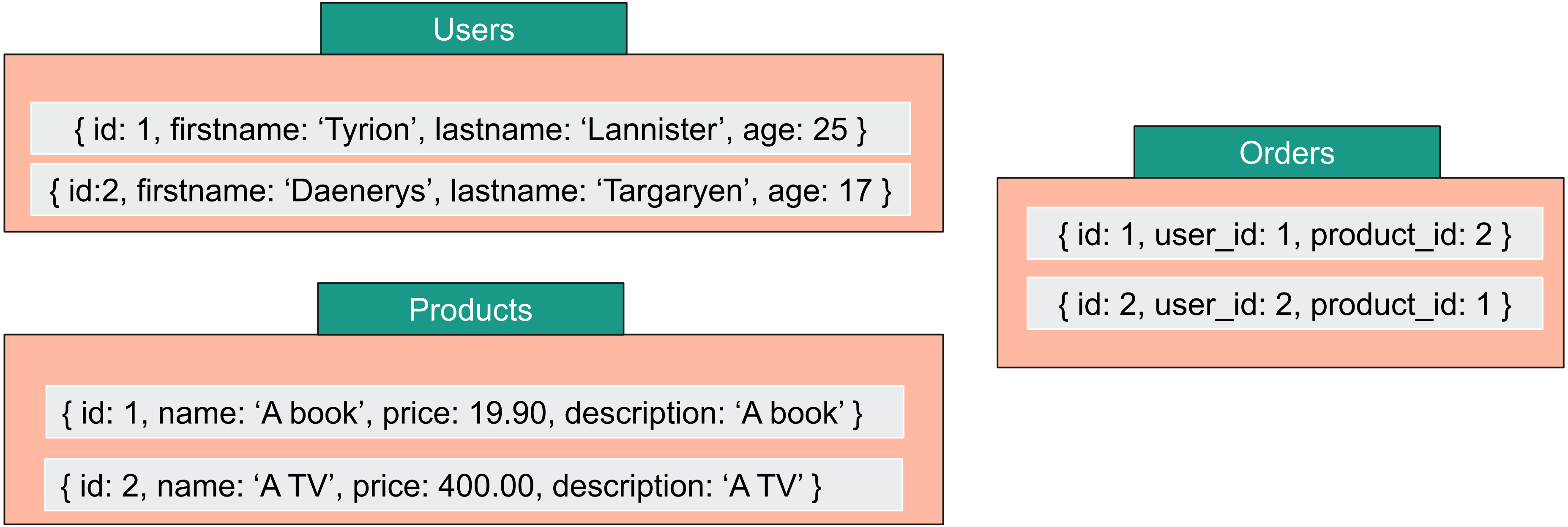
Users

1	Tyrion		25	
2	Daenerys	Targaryen	17	
3	Romain	Tribout		romain.tribout@gmail.com

Document-oriented database

No few Relations

Relations must be done manually (none-native)



Users

{ id: 1, firstname: ‘Tyrion’, lastname: ‘Lannister’, age: 25 }

{ id:2, firstname: ‘Daenerys’, lastname: ‘Targaryen’, age: 17 }

Orders

{ id: 1, user_id: 1, product_id: 2 }

{ id: 2, user_id: 2, product_id: 1 }

Products

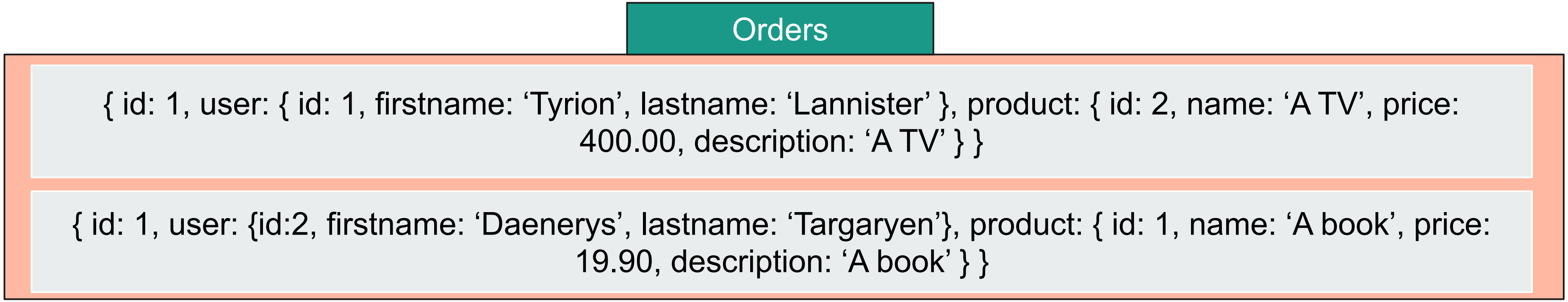
{ id: 1, name: ‘A book’, price: 19.90, description: ‘A book’ }

{ id: 2, name: ‘A TV’, price: 400.00, description: ‘A TV’ }

Document-oriented database

No few Relations

Relations must be done manually (none-native)



Orders

{ id: 1, user: { id: 1, firstname: ‘Tyrion’, lastname: ‘Lannister’ }, product: { id: 2, name: ‘A TV’, price: 400.00, description: ‘A TV’ } }

{ id: 1, user: {id:2, firstname: ‘Daenerys’, lastname: ‘Targaryen’}, product: { id: 1, name: ‘A book’, price: 19.90, description: ‘A book’ } }

Document-oriented database

Characteristics

Flexible !

Performance for big queries

Project: MongoDB, CouchDB, DocumentDB

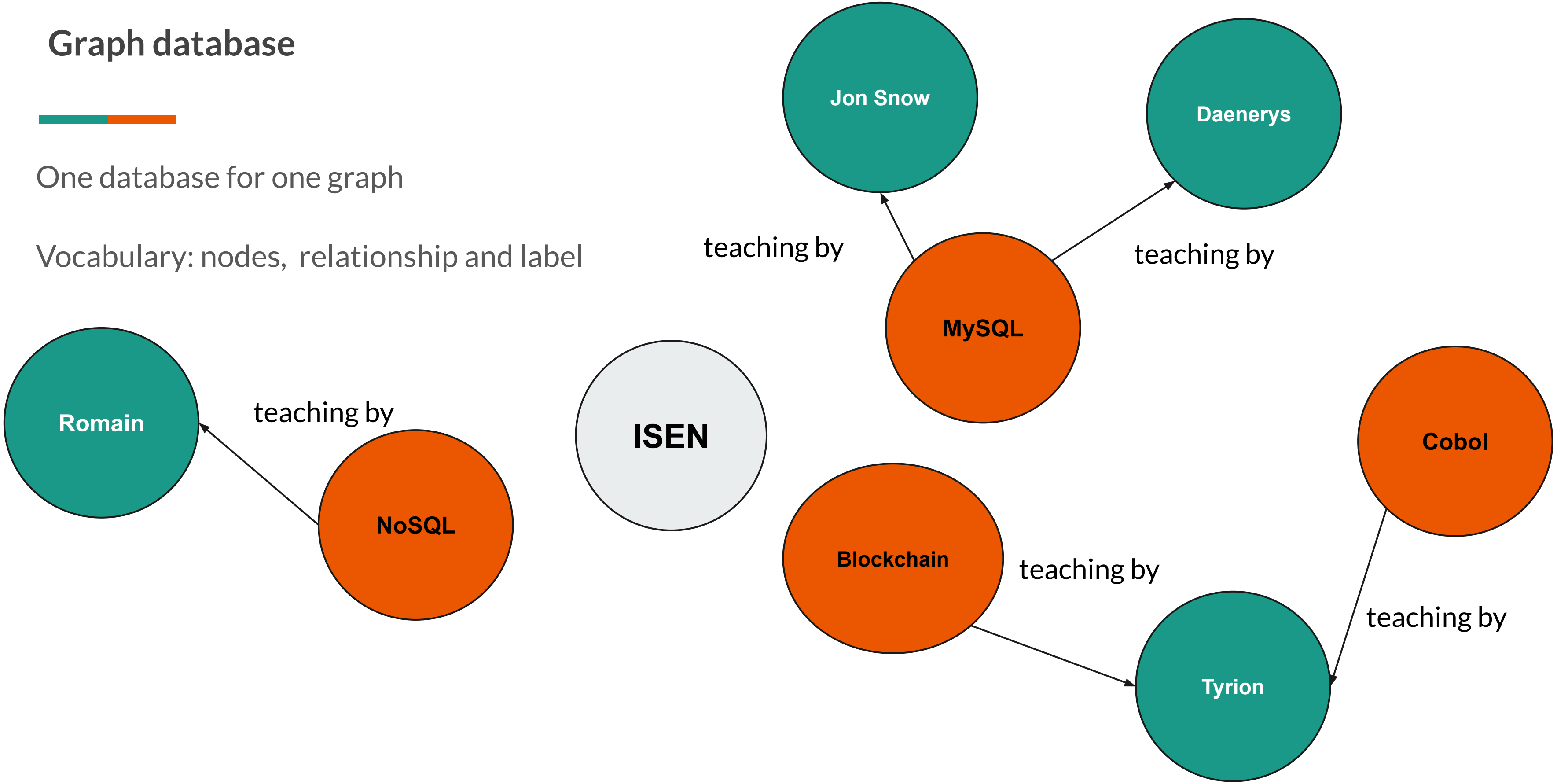
NoSQL

4. Graph database

Graph database

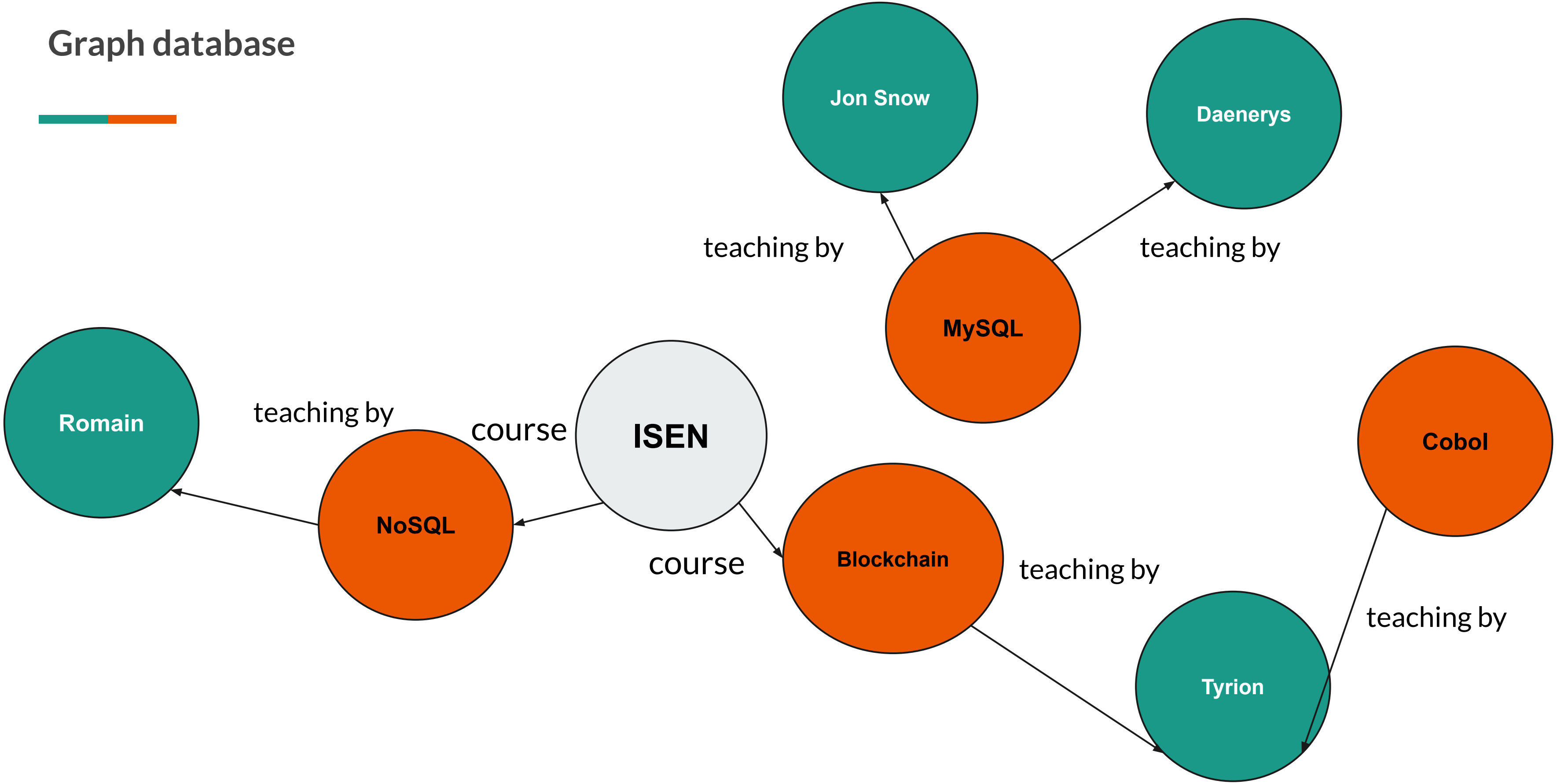
One database for one graph

Vocabulary: nodes, relationship and label



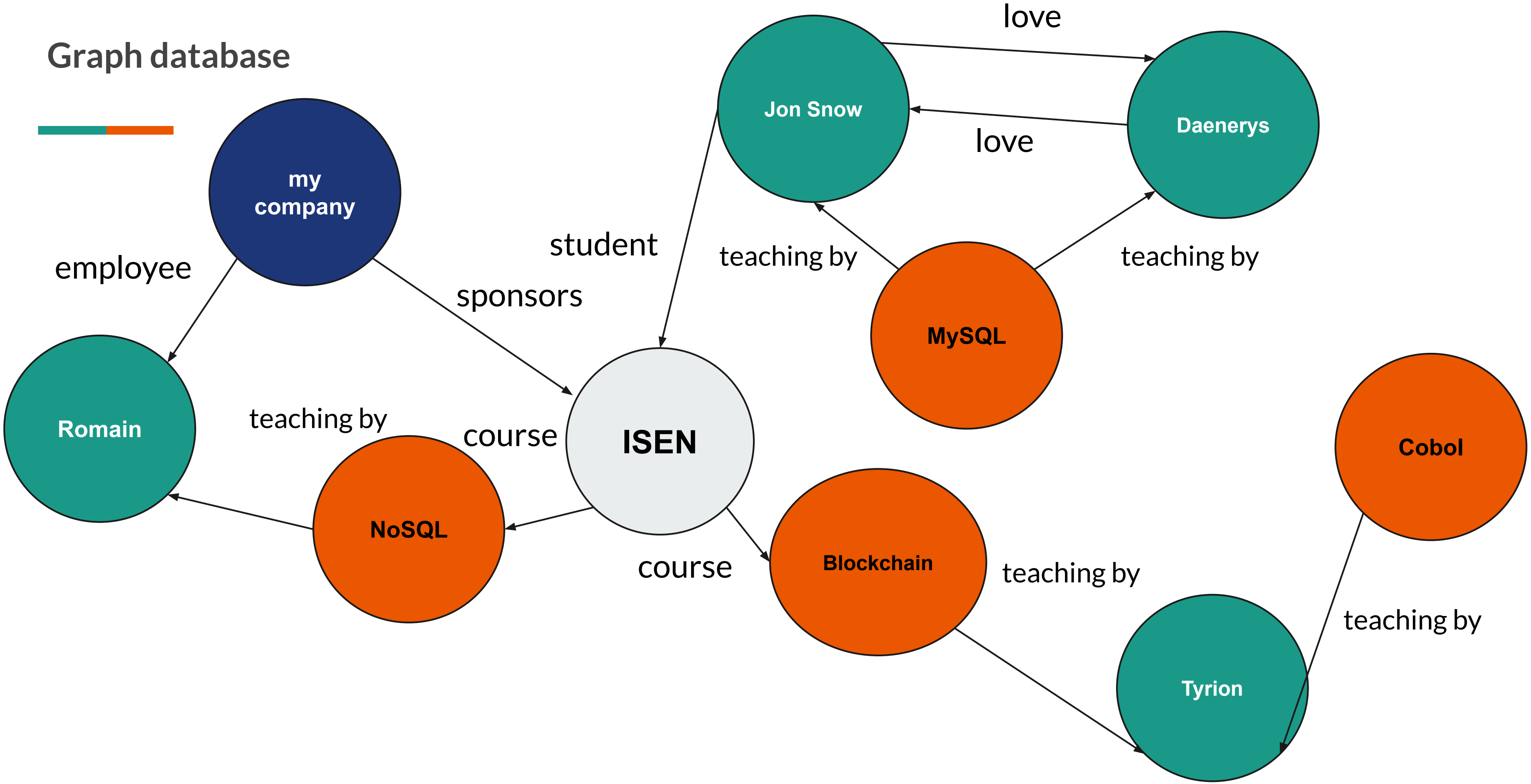
Graph database

Graph database



Graph database

Graph database



Graph database

Graph database

Request with pattern

```
(LEO:PERSON)-[rel:LOVES]->(LEA:PERSON)
```

```
MATCH (foo:PERSON)-[rel:LOVES]->(bar:PERSON)
WHERE rel.duration > 5
RETURN foo.name bar.name rel.duration
```

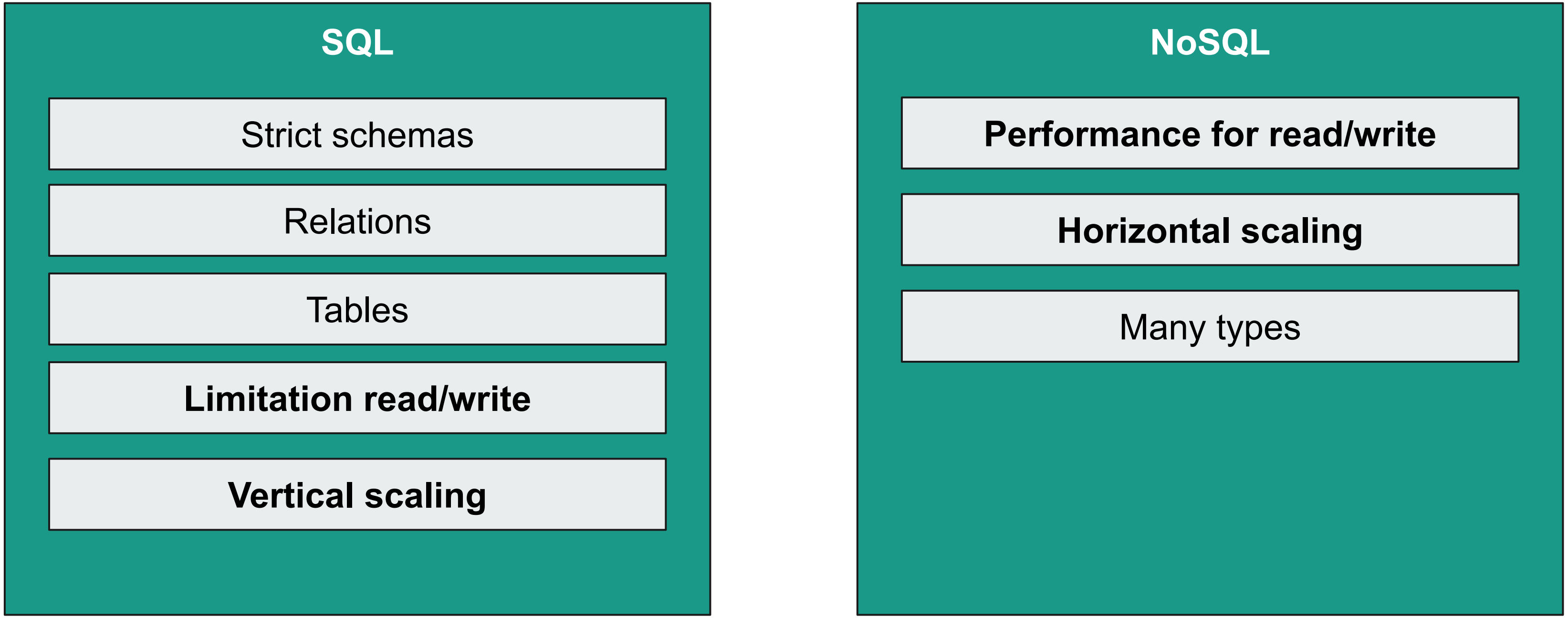
Graph database

project: **Neo4j**, OrientDB

Use cases

- sfr -> network graph
- meetic -> recommendations
- walmart -> recommendations
- ebay -> delivery

SQL vs NoSQL



SQL

- Strict schemas
- Relations
- Tables
- **Limitation read/write**
- **Vertical scaling**

NoSQL

- **Performance for read/write**
- **Horizontal scaling**
- Many types

SQL vs NoSQL