Relational Databases Introduction

Big Data Systems

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Discussion

Assume you are hired to develop a system that manage an e-commerce store

- Keep track of the users
- Keep track of the items
- Keep track of the purchases

How would you do it?

Wix is not an option :)

Easily…

- Create a program that saves the data into text files
  - `/store/users.txt`
  - `/store/items.txt`
  - `/store/purchases.txt`

- Update the files according to the application logic
  - If a new user register, add her to `users.txt`
  - If user purchase an item, update `purchases.txt` with the basket
  - …

Stuff to consider

- What happens if a user updates her name?
- What happens if a user updates her credit card?
- What happen if we expend to different countries?

(more) Stuff to consider

- There is a need from the management to know:
  - What is the average order amount?
  - How many users bought items worth more than $1k?
  - Which are the most popular items (in the last week)?
  - Who are the users who haven’t purchased anything in the last 3 months, but spent over $100 before?
  - …
- Is it still that easy?

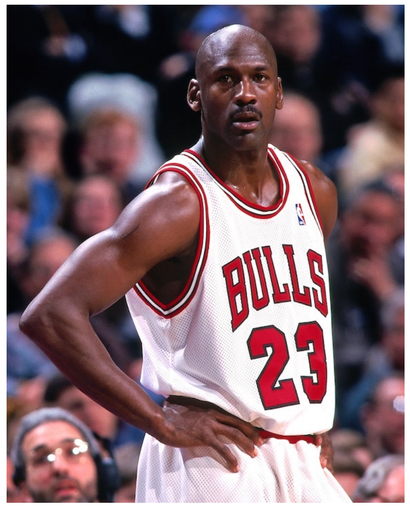
(more more) Stuff to consider

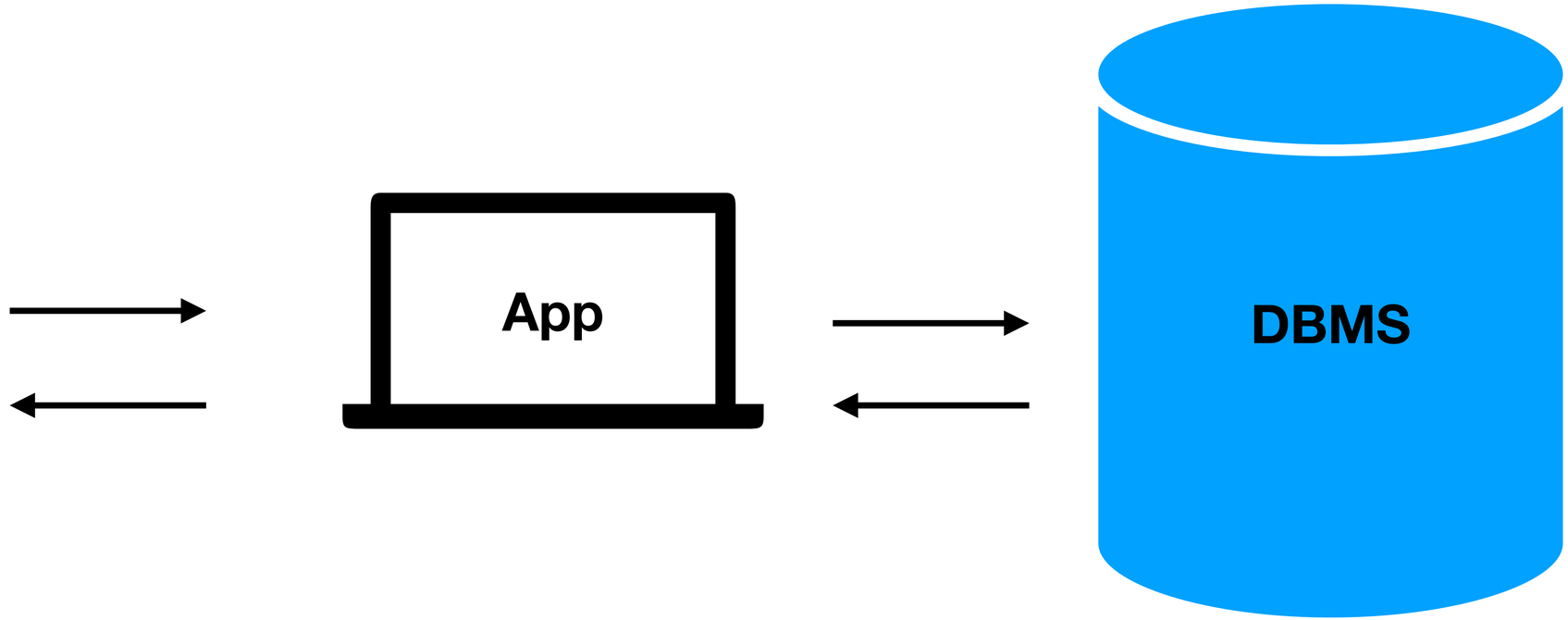
- How to backup the data?
- How to handle concurrency?
- What happens if the system crash in the middle of a purchase operation(s)?
  (the credit card is charged but the data was not added to the purchases file)

DBMS
database management system

DBMS

- A software that capture and analyze data by interactions with other applications





Modern DBMS supports

- Different data types
- User defined queries
- Transactions
- Query engine / optimization
- Storage management
- Access management
- …

Database types

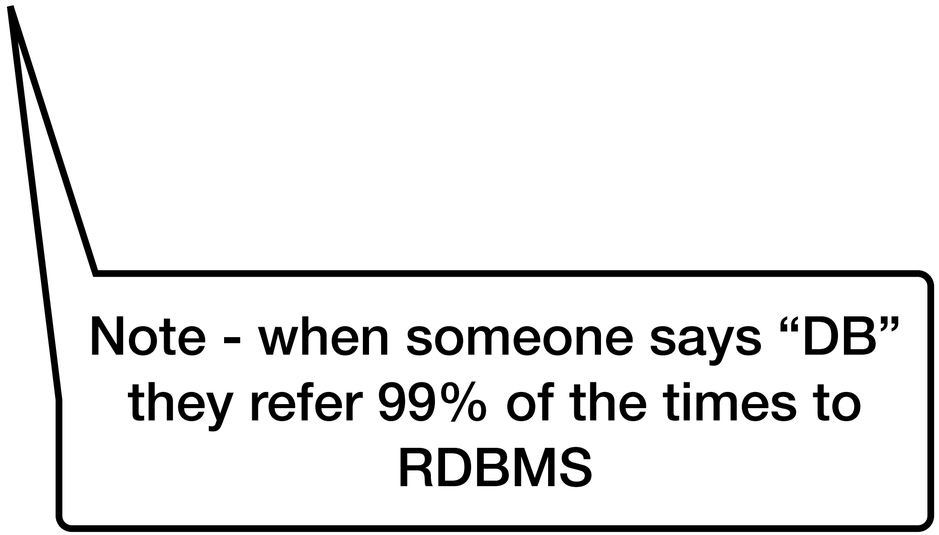
Databases are classified based on their data model

- **Table (Relational)**
- Key Value
- Graph
- Document
- Wide column
- …

NoSQL

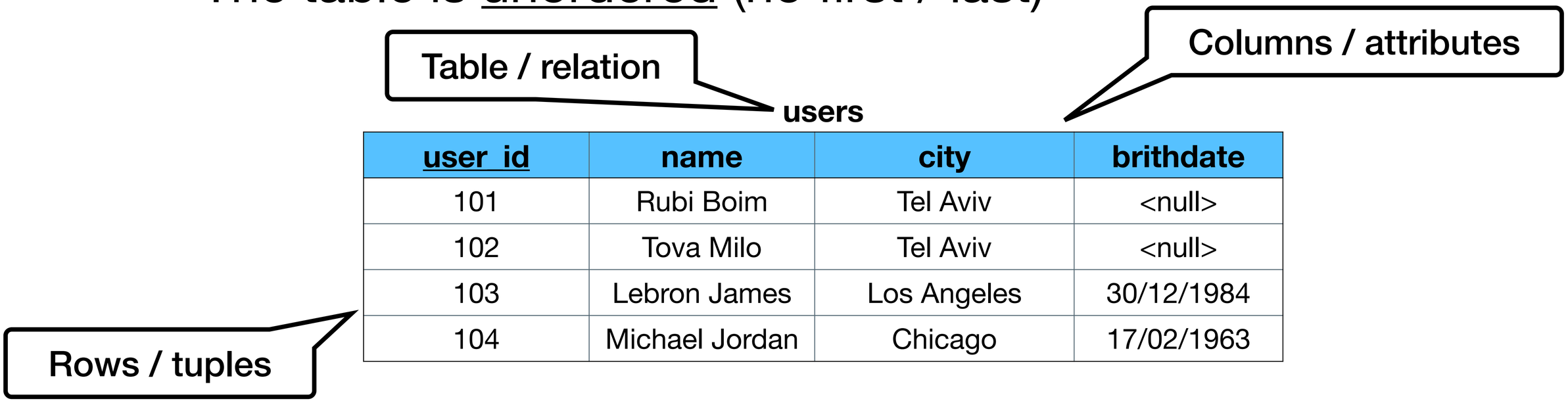
Spoiler alert - we will discuss Wide column extensively in the course

Relational DBMS



Relational model

- Data is stored in tables of columns and rows
- A unique key identify each row
  a table without a primary key - anti pattern
- The table is unordered (no first / last)



Data types (sample)

Only atomic types - no sets / lists / maps…

- Characters: `char, varchar, text…`
- Numbers: `bit, int, bigint, float…`
- Time: `date, datetime, timestamp …`

- Each DB (MySQL, SQLServer…) has a slightly different implementation

Table schema

users

user_id	name	city	brithdate
101	Rubi Boim	Tel Aviv	<null>
102	Tova Milo	Tel Aviv	<null>
103	Lebron James	Los Angeles	30/12/1984
104	Michael Jordan	Chicago	17/02/1963

`users(user_id, name, city, birthdate)`

Discussion:
can the title or company act as the key?

items

item_id	title	company	price
2003	iPad	Apple	$499
2004	iPhone	Apple	$899
2005	55’ LED TV	Samsung	$1549
2006	USB charger	Logitech	$29

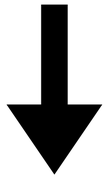
`items(item_id, title, company, price)`

SQL as API

users

user_id	name	city	brithdate
101	Rubi Boim	Tel Aviv	<null>
102	Tova Milo	Tel Aviv	<null>
103	Lebron James	Los Angeles	30/12/1984
104	Michael Jordan	Chicago	17/02/1963

```
SELECT user_id, name
FROM users
WHERE city = "Tel Aviv"
ORDER BY name
```



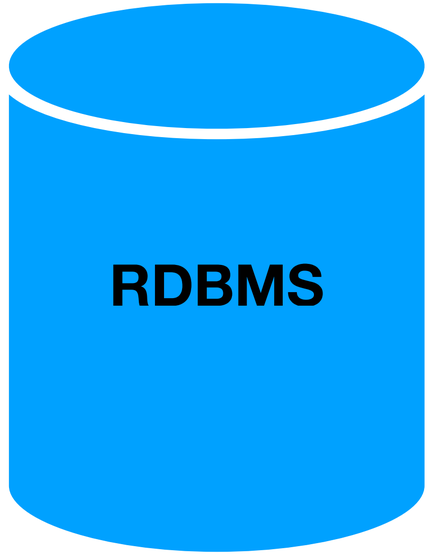
user_id	name
101	Rubi Boim
102	Tova Milo

Data integrity in RDBMS

- Referential integrity support
  primary and foreign keys
- ACID transactions support
  Atomicity, **C**onsistency, **I**solation, **D**urability

- **One of the best features of RDBMS**
  compared to NoSQL

RDBMS is a swiss pocket knife



You can implement almost anything with it.
But sometimes it is better to use a dedicated tool