Introduction to Databases
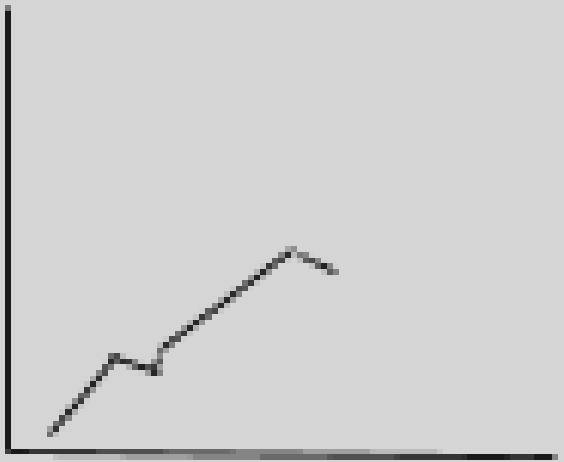
Databases

- It is important for all software developers to be able to access, manipulate and store data.

- Database: a large container of data, with the ability to order the data in multiple ways while providing easy access to the data itself.
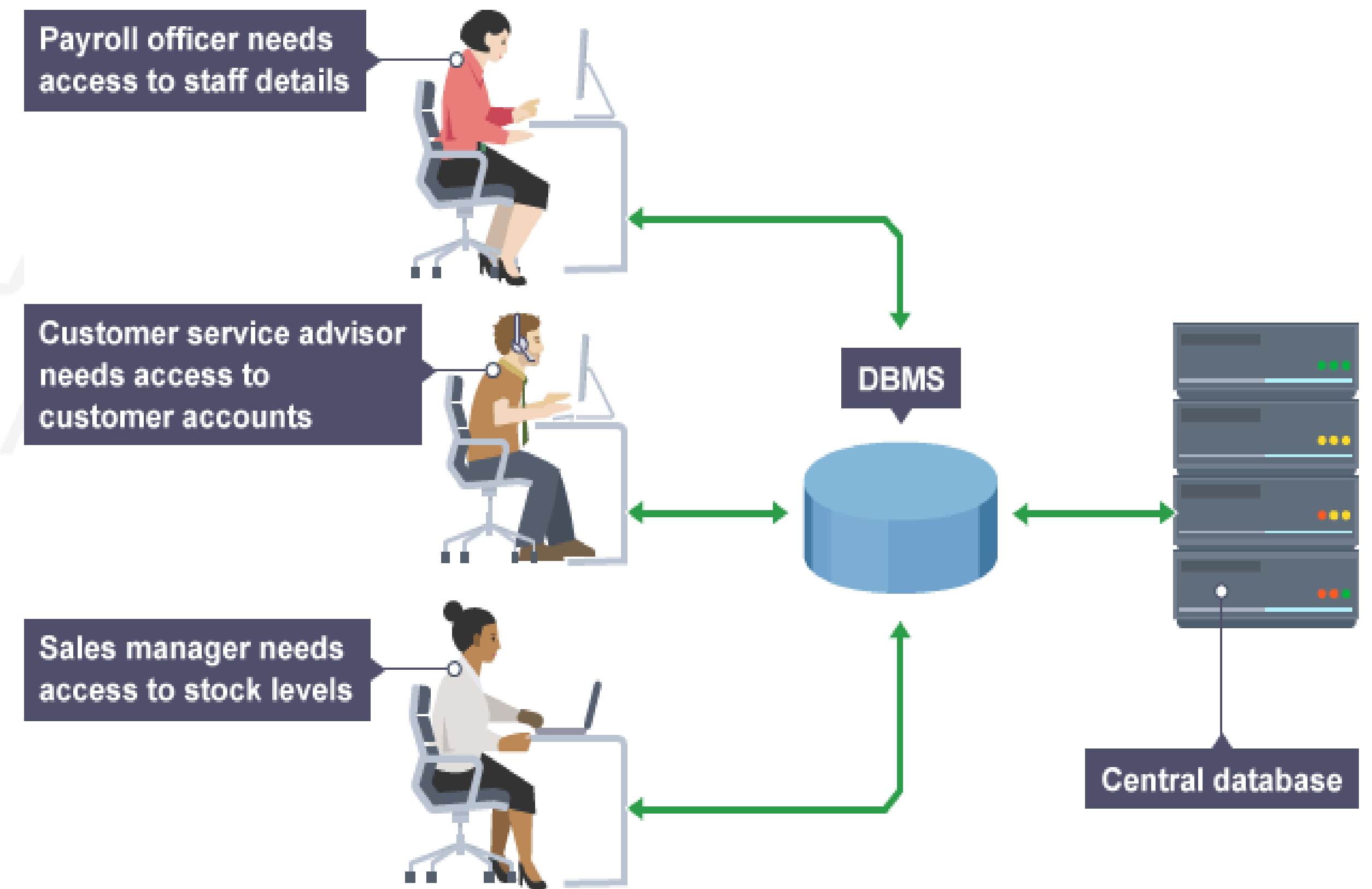
Data vs. Information

- Data: raw, unprocessed facts

- Information: the result of processing the raw data to reveal its meaning

Data	vs	Information
27413948596		Tel: 27413948596
17, 25, 20, 24, 21, 27, 30, 29, 27		Avg. Temp vs Year (graph)

DBMS

Database Management System: a collection of programs that manage the database structure and controls access to the data stored in the database.

Payroll officer needs access to staff details

Customer service advisor needs access to customer accounts

Sales manager needs access to stock levels

DBMS

Central database

The DBMS manages the interaction between the end user and the database (bbc.co.uk)

DBMS

DBMS helps make data management more efficient and effective and provides advantages:

- Improved data sharing

- Better data integration

- Minimized data inconsistency

- Improved data access

- Improved decision-making

- Increased end user productivity

Types of Databases: Based on users supported

- **Single-user:** only supports one user at a time

- **Multi-user:** supports a relatively small number of users (usually less than 50) or a specific department within an organisation

- **Enterprise:** supports many users (more than 50) and is used by the entire organisation, across many departments

Types of Databases: Based on location

- Centralized: supports data located at a single site

- Distributed: supports data distributed across several different sites.

Types of Databases: How it is used

- Operational: designed to primarily support a company's day-to-day operations. They are also known as online transaction processing (OLTP), transactional or production databases.

Types of Databases: Structure of data

- Unstructured: data that exist in their original, or raw, state

- Structured: the result of formatting unstructured data to facilitate storage, use and the generation of information

Types of Databases: Other

- **Analytical:** focus on storing historical data and business metrics used exclusively for tactical or strategic decision making

  - Typically comprise of two components:

    - Data warehouse: focuses on storing data used to generate information required to make tactical or strategic decisions

    - Online analytical processing (OLAP) front end

- **Relational:** organizes data into tables. Links them based on defined relationships that enable you to retrieve/combine data from tables with a single query
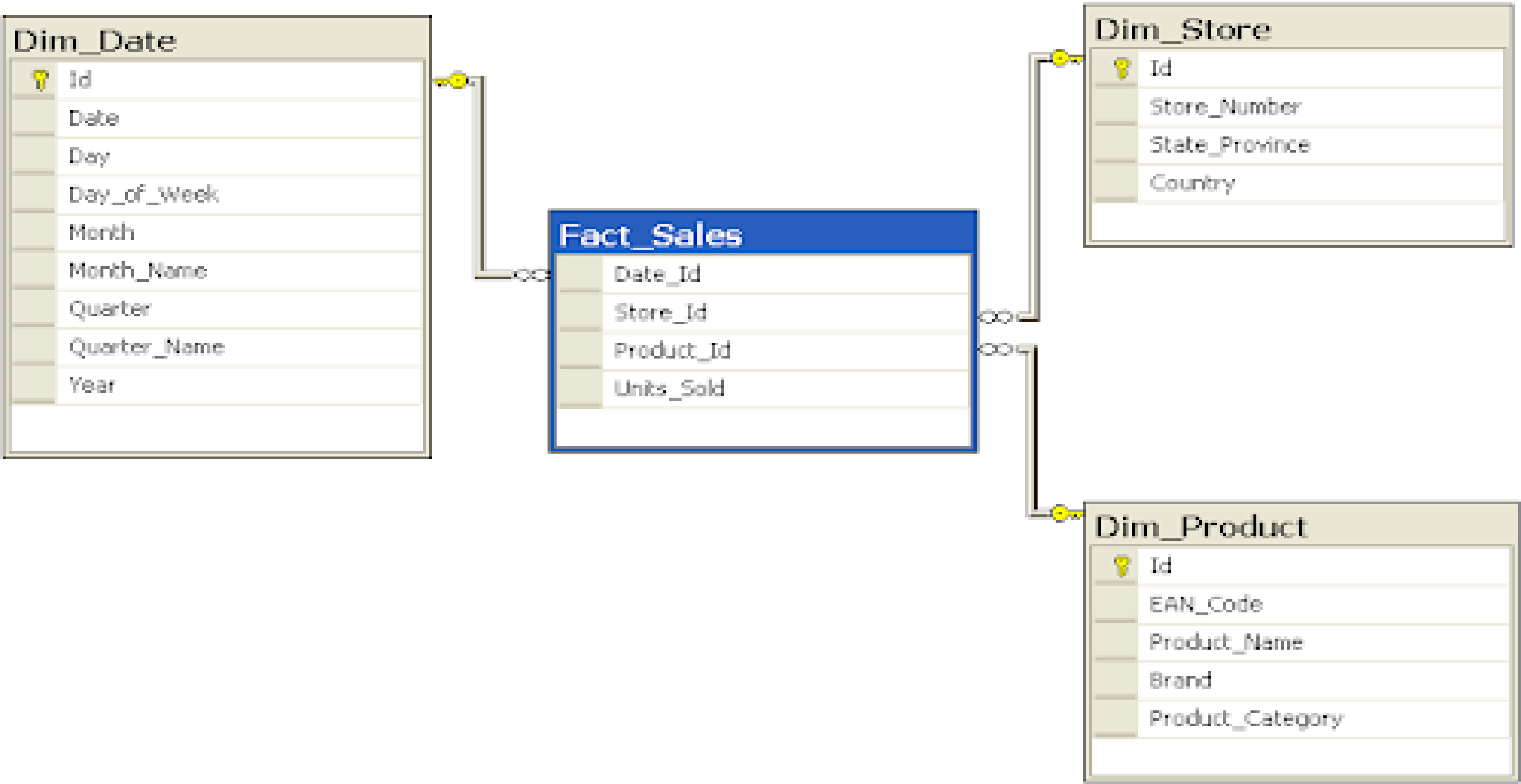
Relational Databases

Image source: https://en.wikipedia.org/wiki/Star_schema#/media/File:Star-schema-example.png

Relational Databases

C_NAME	C_PHONE	C_ADDRESS	C_POSTCODE	A_NAME	A_PHONE	TP	AMT	REN
Alfred Smith	082 345 2341	207 Willow St, Port Elizabeth	6390	Leah Hahn	084 259 2073	T1	R100.00	05-Apr-2021
Kathy Dunne	083 567 9012	556 Bad St, Cape Town	7100	Alex Alby	085 785 3938	S2	R250.00	16-Jun-2021
Paul Farris	076 782 1232	2148 High St,Benoni	1522	Leah Hahn	084 259 2073	T2	R850.00	22-sep-2021

Relational Databases

C_NAME = customer name

C_PHONE = customer phone

C_ADDRESS = customer address

C_POSTCODE = customer postcode

A_NAME = agent name

A_PHONE = agent phone

TP = insurance type

AMT = insurance policy amount in thousands of R

REN = Insurance renewal date

The CUSTOMER table contains 3 records. Each record is composed of 9 fields: C_NAME, C_PHONE, C_ADDRESS, C_POSTCODE, A_NAME, A_PHONE, TP, AMT and REN. Each record describes a specific customer.
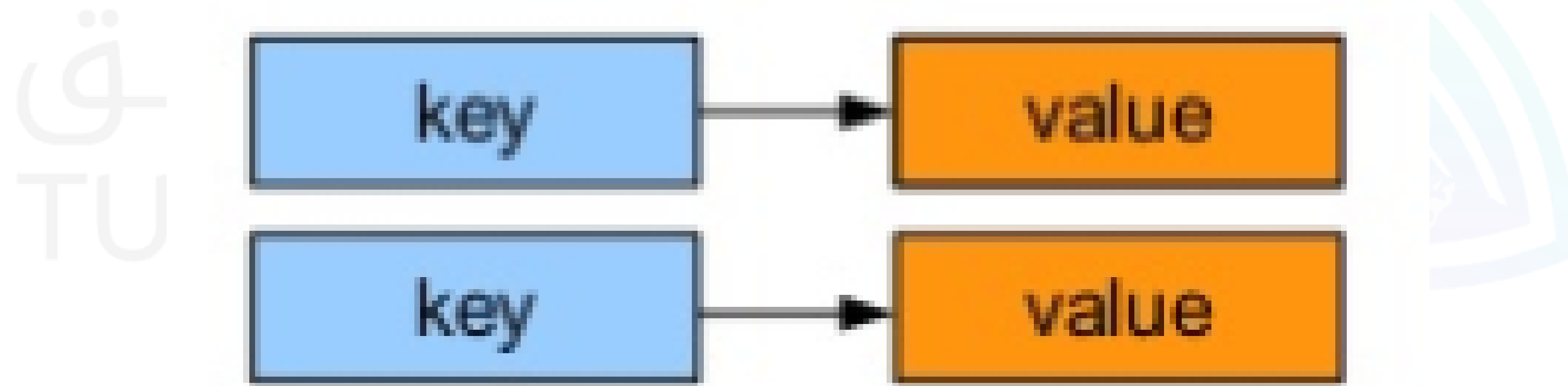
NoSQL Databases

NoSQL databases generally have these characteristics:

- They are not based on the relational model

- They support distributed database architectures i.e. servers in different areas

- They provide high scalability, high availability and fault tolerance

- They support very large amounts of sparse data

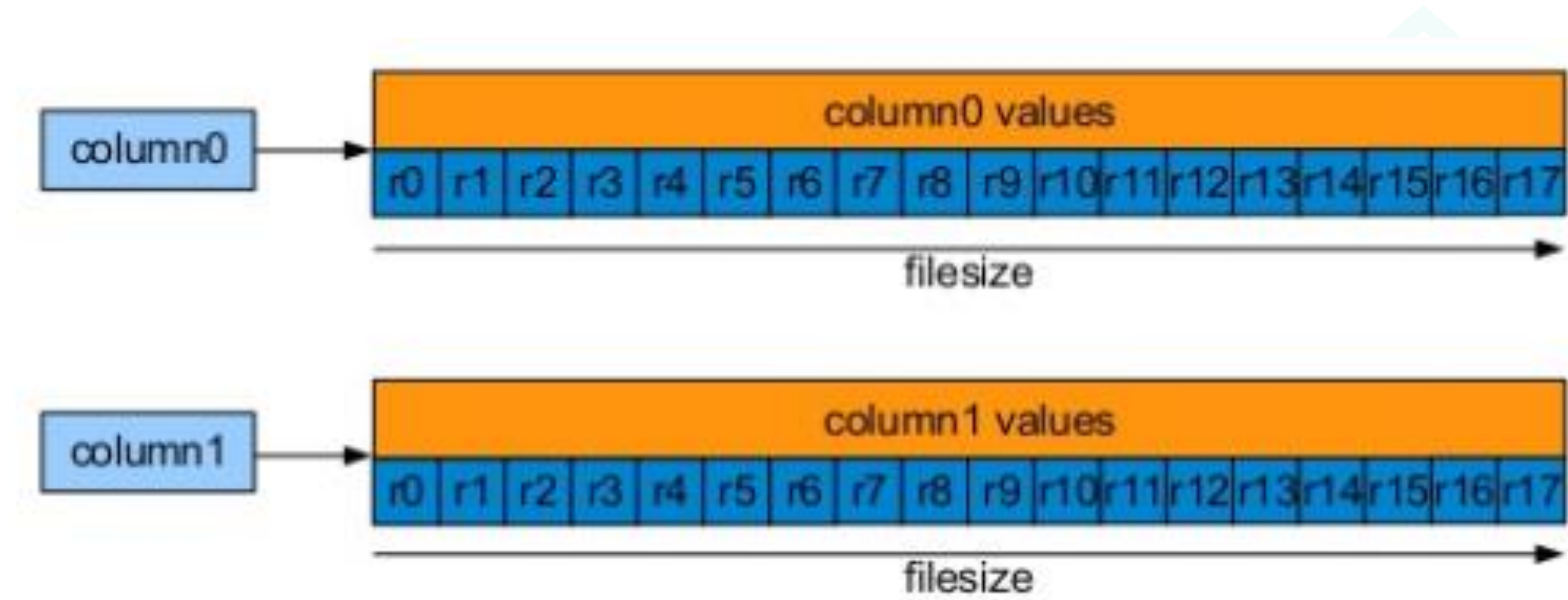- They are geared toward performance rather than transaction consistency

NoSQL Databases

- **Key-value store** databases:

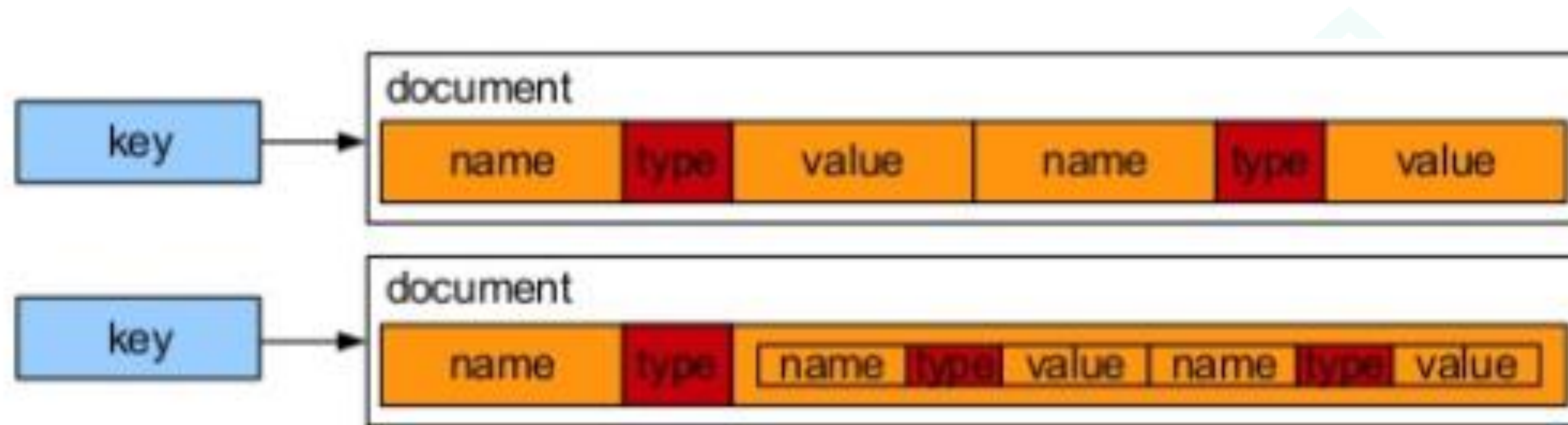Img src: https://www.slideshare.net/arangodb/introduction-to-column-oriented-databases

NoSQL Databases

- Column-oriented databases:

Img src: https://www.slideshare.net/arangodb/introduction-to-column-oriented-databases

NoSQL Databases

- Document store databases:

Img src: https://www.slideshare.net/arangodb/introduction-to-column-oriented-databases
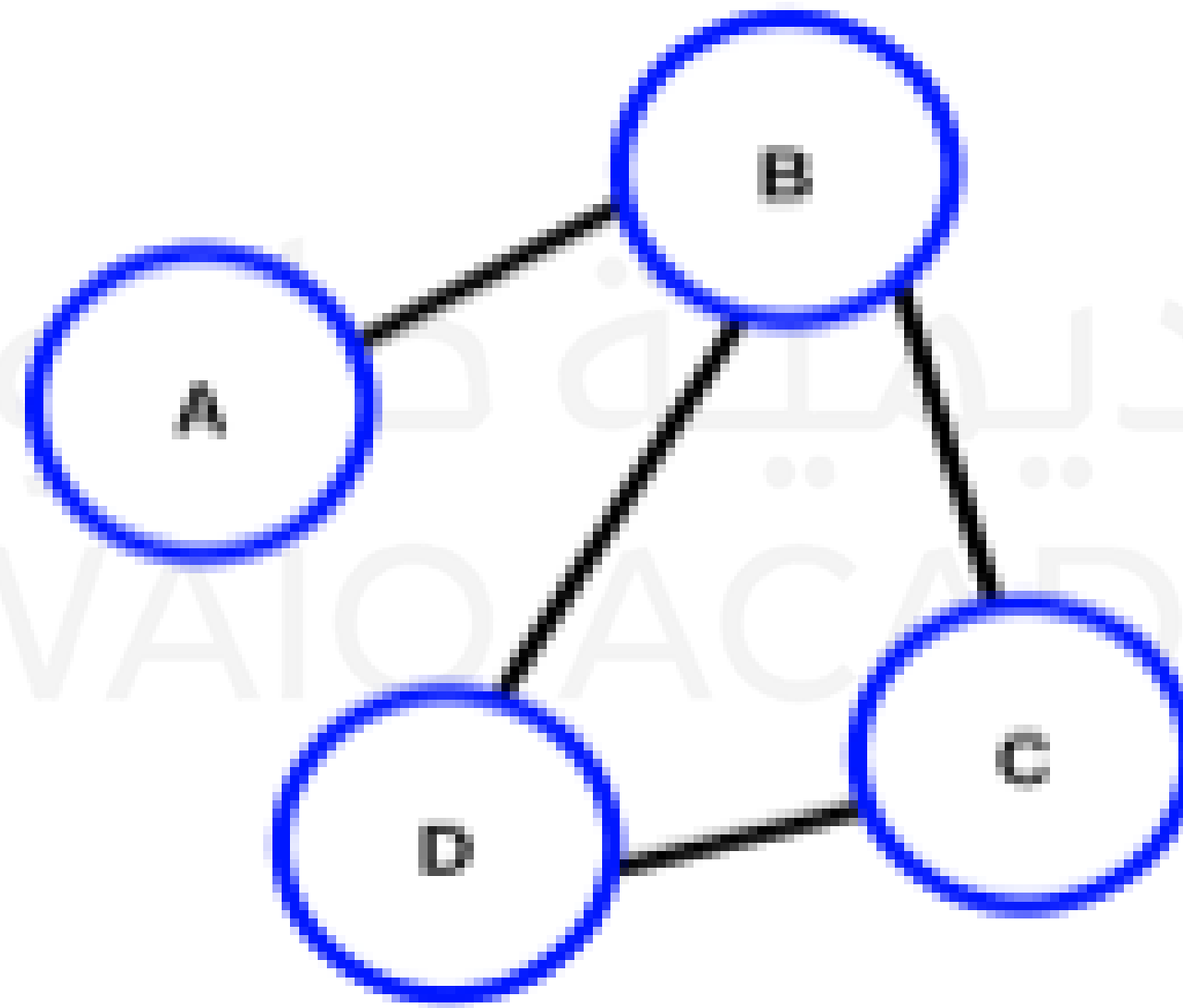
NoSQL Databases

- Graph databases:

- Object-oriented databases

MongoDB

- MongoDB: document store, NoSQL database made up of collections and documents.

- Collection: a group of documents. It is similar to an entity or table when working with relational databases.

- Documents: In relational databases, records are stored in tables. MongoDB uses BSON (Binary JSON) documents instead of records (or rows in a table) to store data
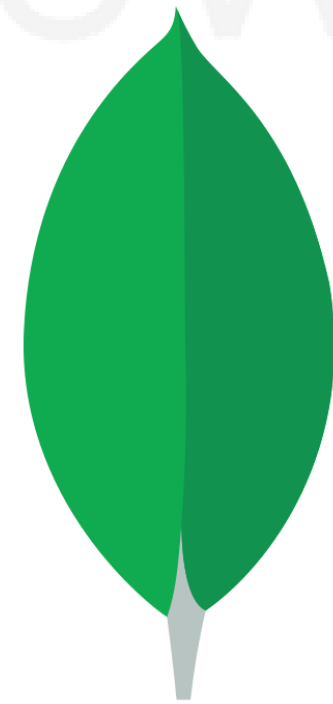
MongoDB

```
{
    name    : "Joe Drumgoole",                              Strings
    title : "Director of Developer Advocacy",
    Address : {
                    address1 : "Latin Hall",                Nested Document
                    address2 : "Golden Lane",
                    eircode : "D09 N623",
    }
    expertise: [ "MongoDB", "Python", "Javascript" ],       Array
    employee_number : 320,                                  Integer
    location : [ 53.34, -6.26 ]                             Geo-spatial Coordinates
```

MongoDB in Full Stack Web Application