

Database Systems CS-220

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Lecture 1

What will you learn in this course

- What is a database and how it is widely used in the world
- Design a database schema that incorporates keys and integrity constraints
- Design a relational database schema using ERM (Entity relationship model)
- Apply normalization to relations
- Formulate SQL queries to retrieve information from a relational database

Database

A form of electronic storage in which data
is held

Databases



Banking



Healthcare



Shopping

Big Data



Database tasks

Store data

Form relationships

Filter data

Search data

Perform CRUD operations

Personal data



Name

Age

Email

Date of birth

Press **Esc** to exit full screen

Consumer data



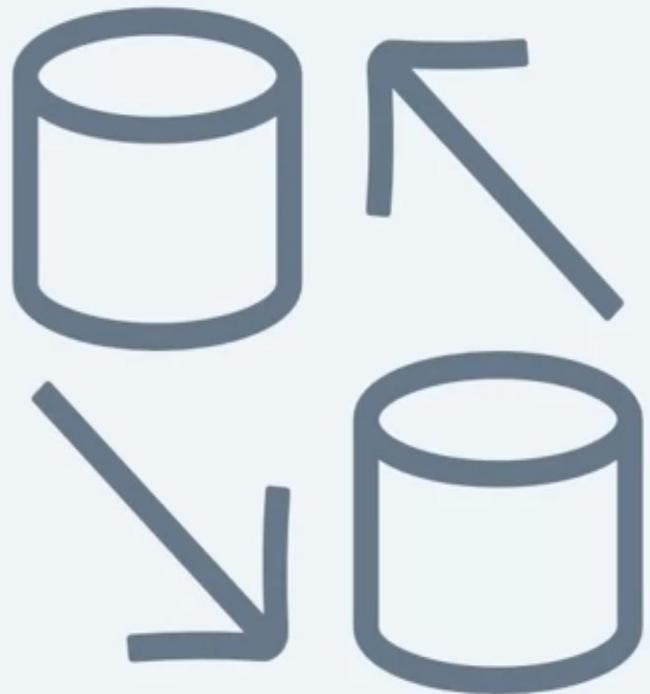
Order number

Description

Order quantity and date

Customer's email

Systematic data



Identifiable features or
attributes

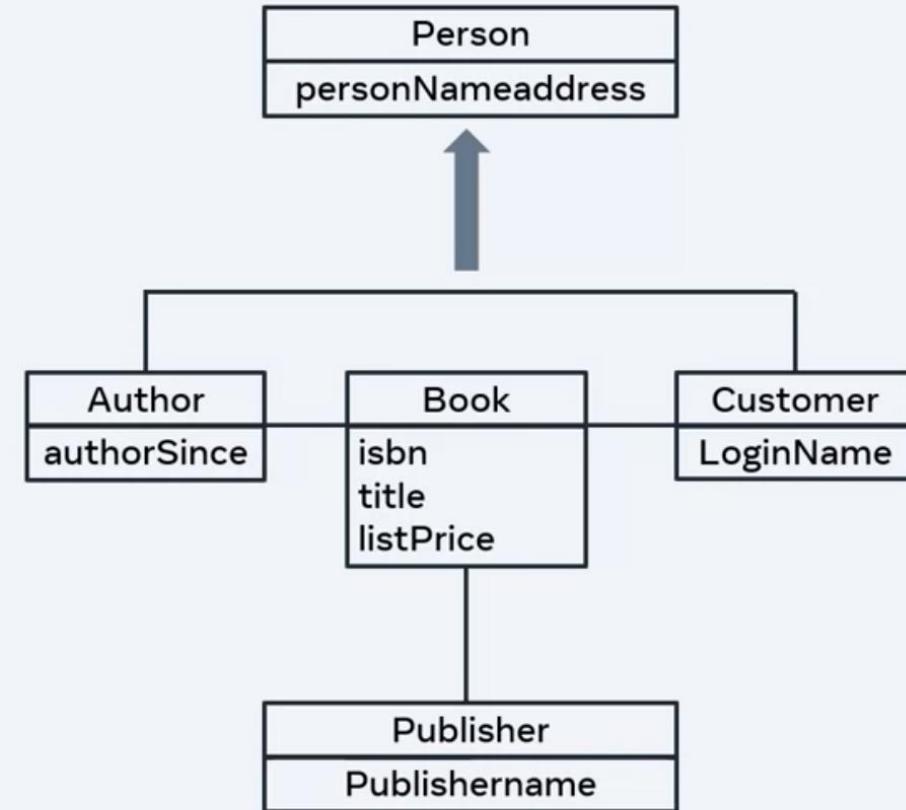
Stored in entities

Customer Entity

First name	Last name	Date of birth	Email
Sarah	Hogan	1990-02-01	shogan@email.com
Edris	Morgan	1982-03-31	emorgan@email.com
Jonathan	Duggan	1995-06-22	jduggan@email.com
Katrina	Langley	1977-08-18	klangley@email.com
Mish	Taleb	2002-04-30	mtaleb@email.com

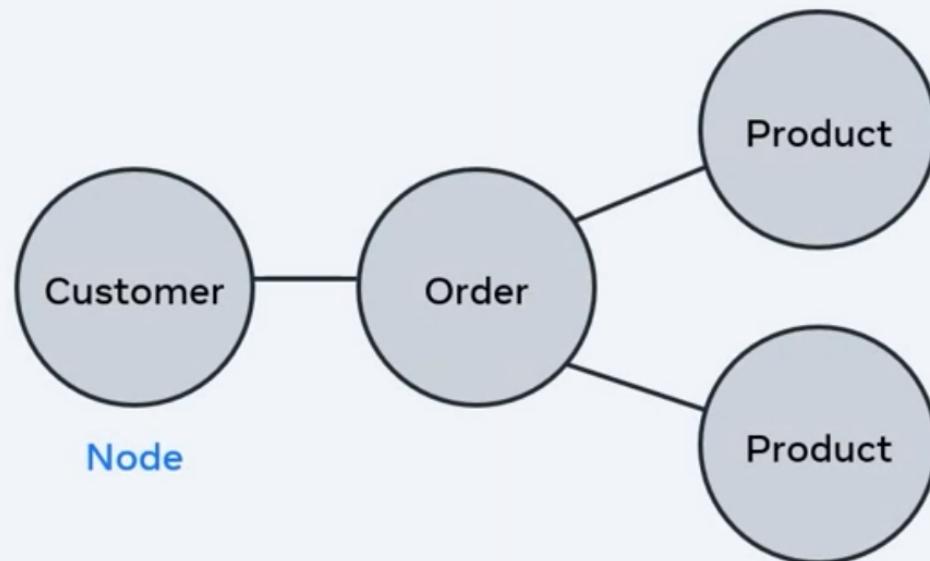
Object oriented databases

Data stored in the form of objects



Graph databases

Data stored in the form of nodes



Document databases

Data stored as JSON objects

Collection: Customers

Document: Customer_1

```
{  
  "FirstName": "John"  
  "LastName": "Smith"  
}
```

Document: Customer_2

```
{  
  "FirstName": "Sarah"  
  "LastName": "Murphy"  
}
```

Collection: Orders

...

Collection: Products

...

Dedicated machine

Host a database on-site

Cloud hosting

Host a database on the cloud

Cloud hosting

Store, manage and retrieve data

Access data via internet

Low-cost option

Data versus Information

- **Data:** Stored representations of objects and events that have meaning and importance in the user's environment.
- **Information:** Data that have been processed in such a way as to increase the knowledge of the person who uses the data
- For example, consider the following list of facts:

Doyle	324917628
Baker	476193248
Lewis	551742186
McFerran	409723145

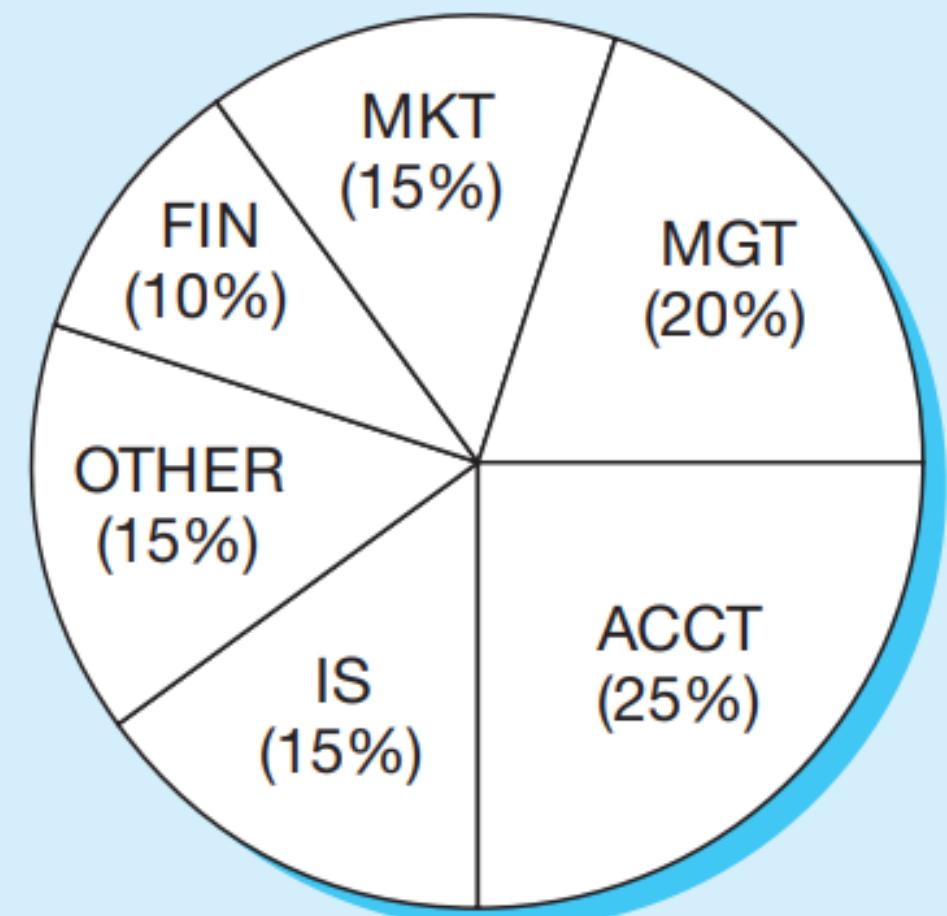
Class Roster

Course: MGT 500
Business Policy

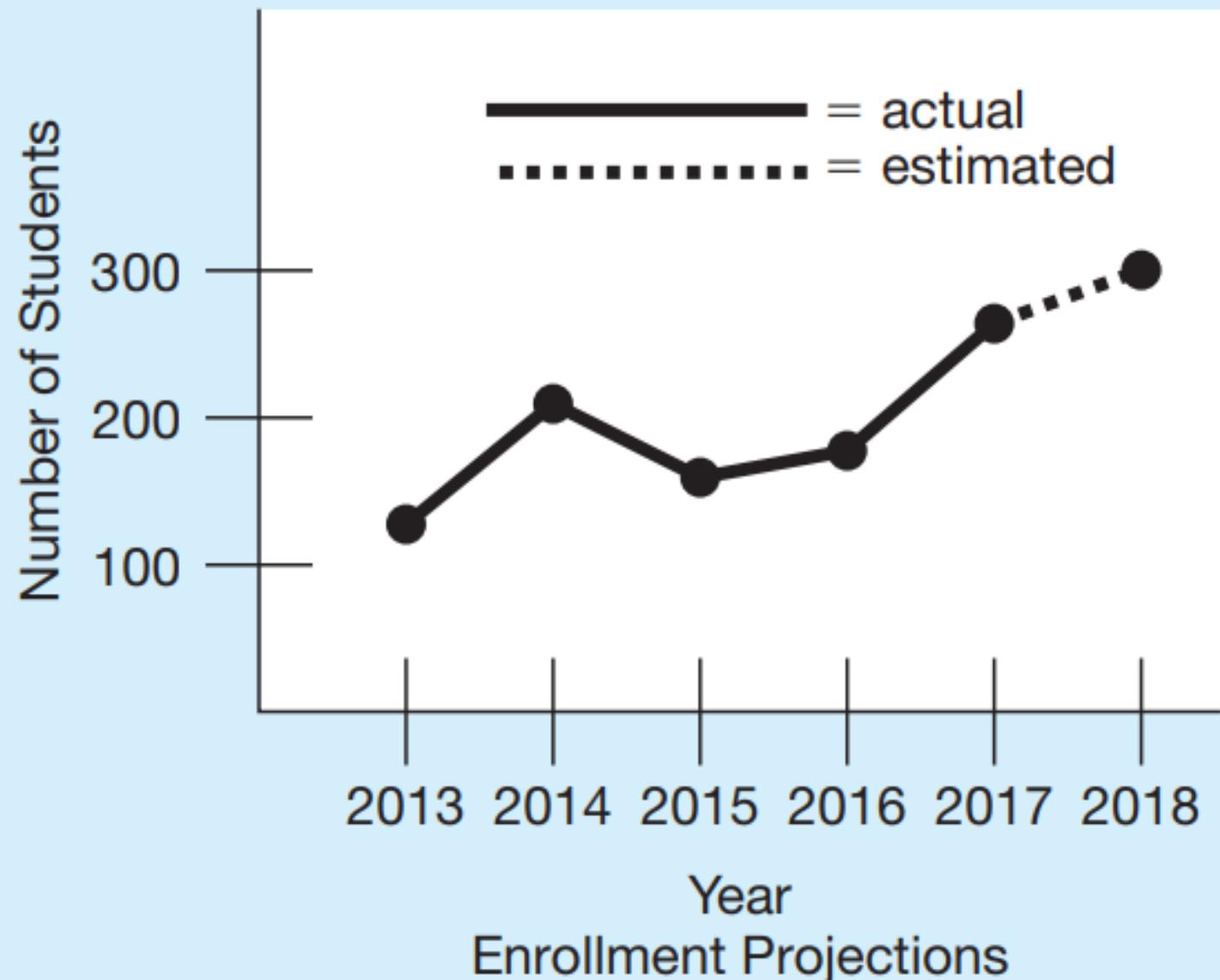
Semester: Spring 2018

Section: 2

Name	ID	Major	GPA
Baker, Kenneth D.	324917628	MGT	2.9
Doyle, Joan E.	476193248	MKT	3.4
Finkle, Clive R.	548429344	PRM	2.8
Lewis, John C.	551742186	MGT	3.7
McFerran, Debra R.	409723145	IS	2.9
Sisneros, Michael	392416582	ACCT	3.3



Percent Enrollment by Major (2018)



Enrollment Projections

Metadata

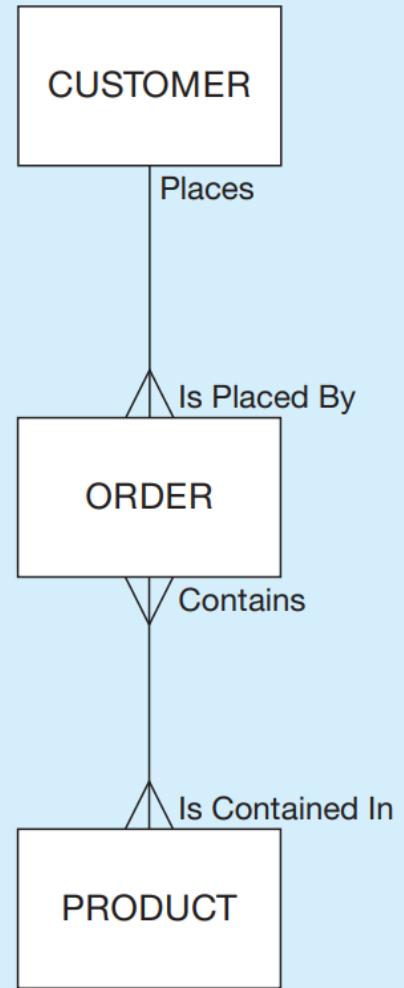
- Metadata are data that describe the properties or characteristics of end-user data and the context of that data.
- Some of the properties that are typically described include data names, definitions, length (or size), and allowable values.
- Metadata describing data context include the source of the data, where the data are stored, ownership (or stewardship), and usage.
- think of metadata as “**data about data**.”

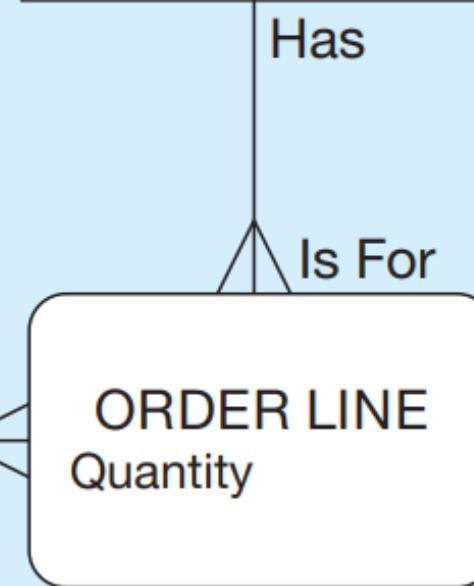
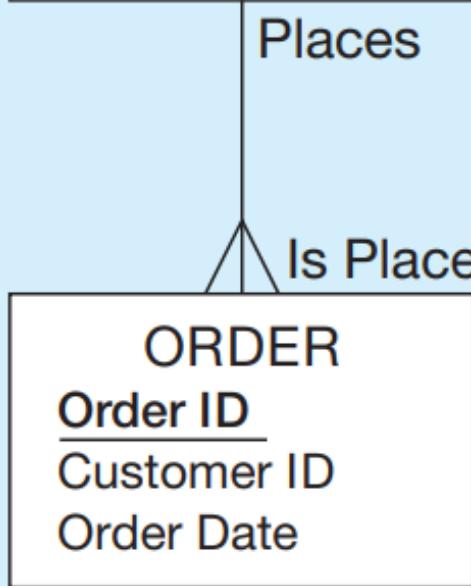
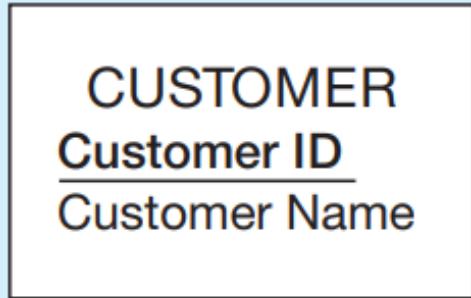
TABLE 1-1 Example Metadata for Class Roster

Data Item		Metadata				
Name	Type	Length	Min	Max	Description	Source
Course	Alphanumeric	30			Course ID and name	Academic Unit
Section	Integer	1	1	9	Section number	Registrar
Semester	Alphanumeric	10			Semester and year	Registrar
Name	Alphanumeric	30			Student name	Student IS
ID	Integer	9			Student ID (SSN)	Student IS
Major	Alphanumeric	4			Student major	Student IS
GPA	Decimal	3	0.0	4.0	Student grade point average	Academic Unit

Data Models

- **Data models** capture the nature of and relationships among data and are used at different levels of abstraction as a database is conceptualized and designed. They include Entities and relationships
- **Entity:** A person, a place, an object, an event, or a concept in the user environment about which the organization wishes to maintain data.
- A well-structured database establishes the relationships between entities that exist in organizational data so that desired information can be retrieved. Most relationships are **one-to-many** (1:M) or **many-to-many** (M:N).





Places

Has

Is Placed By

Is For

Contains

Is Contained In

Order table

Order ID	Customer ID	Order Date	Delivery Date
01	C1	02-03-2022	07-03-2022
02	C2	02-03-2022	10-03-2022
03	C3	02-03-2022	14-03-2022
04	C4	02-03-2022	08-03-2022
05	C5	02-03-2022	22-03-2022

Customer table

Customer ID	First Name	Last Name	Email
C1	Sarah	Hogan	sarahhog@email.com
C2	Edris	Morgan	edmor@email.com
C3	John	Duggan	jondugg@email.com
C4	Katrina	Langley	katlang@email.com
C5	Mish	Taleb	mishtal@email.com

Customer table

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Customer table

Primary key field

CustomerID	FirstName	LastName	Email
C1	Sarah	Hogan	sarahog@email.com
C2	Edris	Morgan	edmor@email.com
C3	Johnathan	Duggan	jondugg@email.com
C4	Katrina	Langley	katlang@email.com
C5	Mish	Taleb	mishtal@email.com

Order table

Foreign key field

OrderID	CustomerID	OrderDate	DeliveryDate
01	C1	2022-03-02	2022-03-07
02	C2	2022-03-02	2022-03-10
03	C3	2022-03-02	2022-03-14
04	C4	2022-03-02	2022-03-08
05	C5	2022-03-02	2022-03-22

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Customer table

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C5	Mish	Taleb	mishtal@email.com

NoSQL databases

Provide a flexible structure for storing and scaling data

Types of NoSQL databases

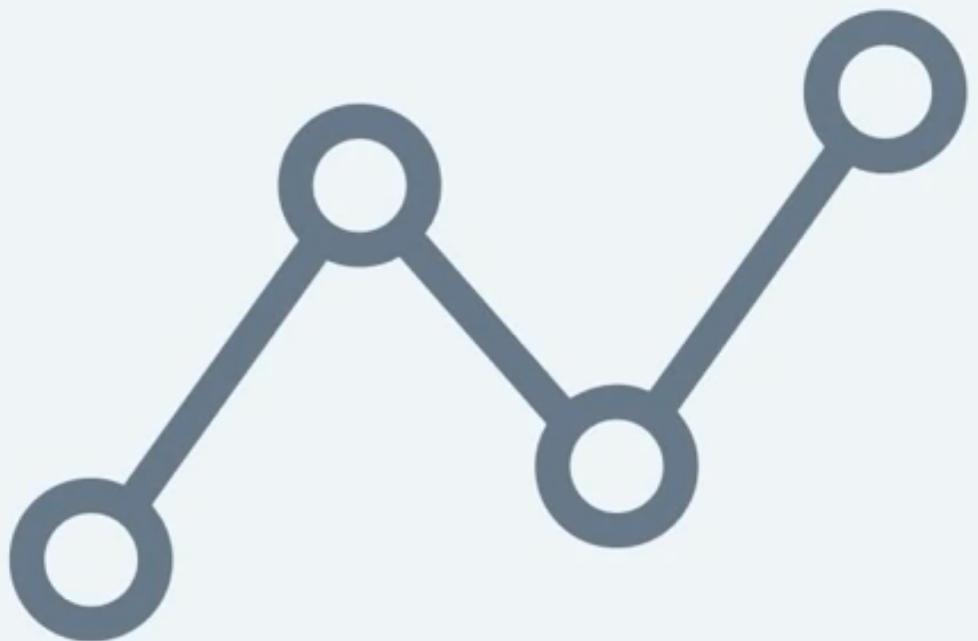
Document databases

Key-value databases

Graph databases

Big data

Complex data that grows
exponentially with time



Big data



Types of data

Combination of structured, semi-structured and unstructured data



Data power

More powerful than traditional data when solving problems



Data insights

Provides unique insights to help improve decision making

Manufacturing sector



Monitor equipment

Review production

Interact with customers

Anticipate demand

Retail



Meet demand

Improve customer
experience

Learn about customer
behavior

Telecommunications



Plan investments

Design new services

Analyze service quality

Plan business

Cloud hosting

Lack of infrastructure, maintenance and storage costs

Many services available

More affordable solution

Business Intelligence



Aspect	Business Intelligence (BI)	Relational Databases	NoSQL Databases
Purpose	Analyzing and presenting data for decision-making	Storing and managing structured data	Storing and managing structured, semi-structured, or unstructured data
Functionality	Advanced analytics, data visualization, reporting	Data storage and retrieval, transaction processing	Scalability, flexibility in data modeling, support for diverse data types
User Interaction	Business users, analysts, decision-makers	Database administrators, developers	Developers, data engineers, data scientists
Scope	Integration, analysis, presentation of data	Transactional data management	Handling various data types, scalability
Examples	Tableau, Power BI, QlikView	MySQL, PostgreSQL, Oracle	MongoDB, Cassandra, Redis

