3. What are Databases?
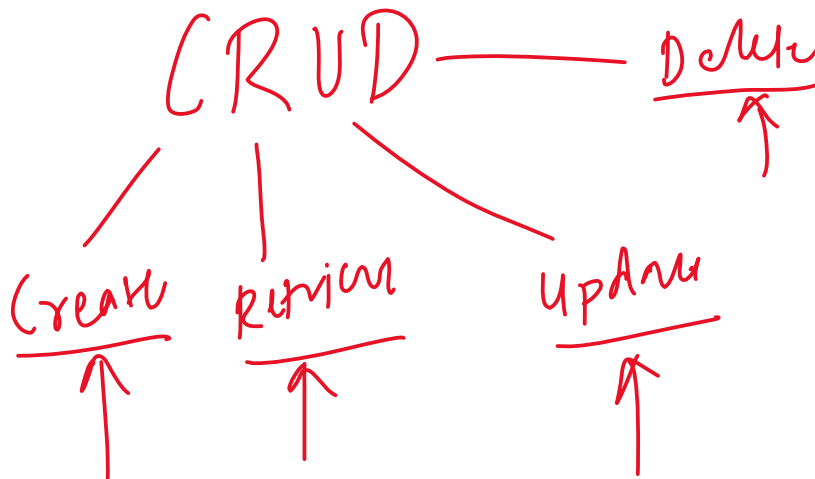
A Database is a shared collection of logically related data and description of these data, designed to meet the information needs of an organization

Data Storage: A database is used to store large amounts of structured data, making it easily accessible, searchable, and retrievable.

Data Analysis: A database can be used to perform complex data analysis, generate reports, and provide insights into the data.
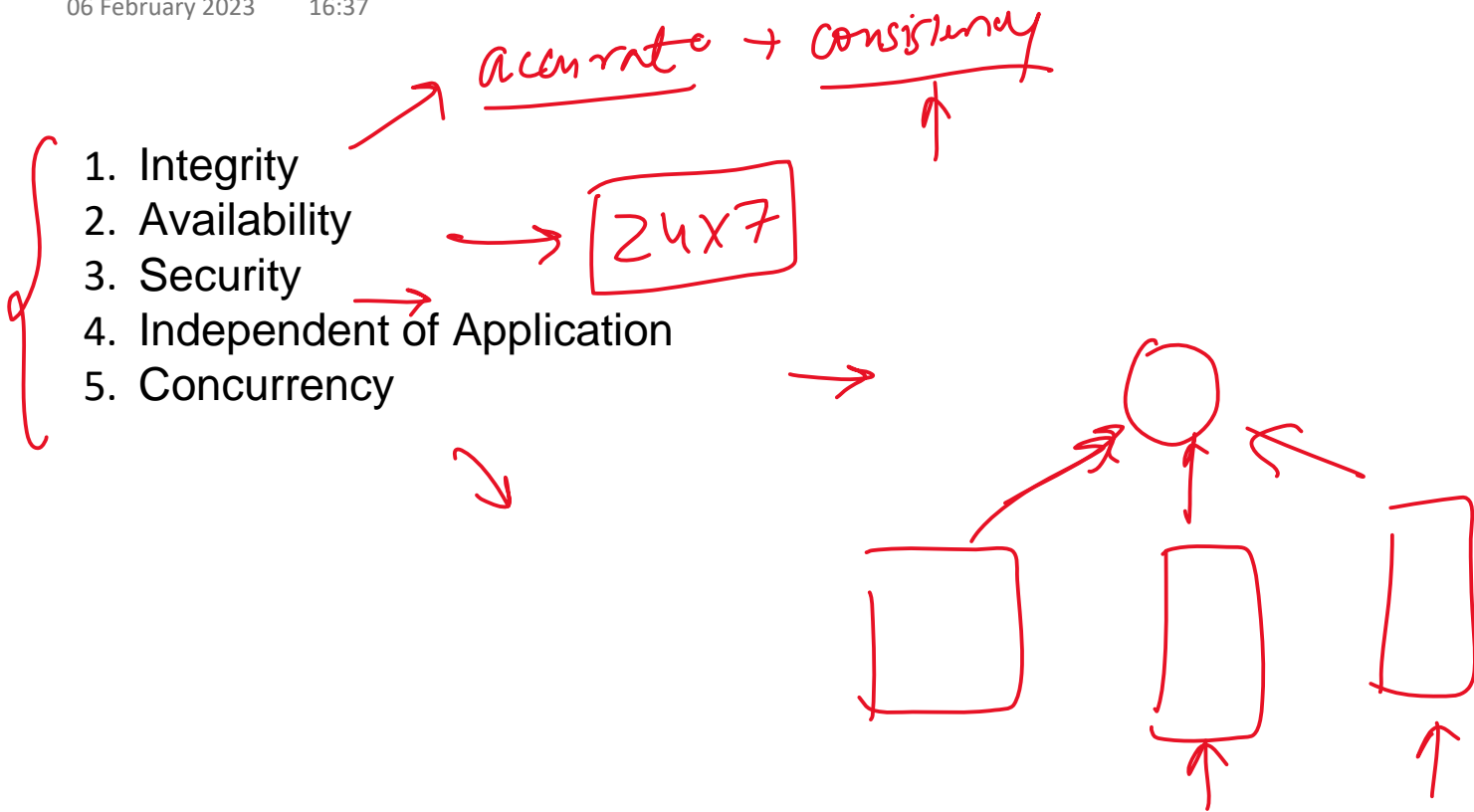
Record Keeping: A database is often used to keep track of important records, such as financial transactions, customer information, and inventory levels.

Web Applications: Databases are an essential component of many web applications, providing dynamic content and user management.

CRUD —— Delete

Create   Retrieve   Update

4. Properties of an Ideal Database

accurate + consistency

1. Integrity
2. Availability
3. Security
4. Independent of Application
5. Concurrency

24x7

5. Types of Databases

06 February 2023   16:42

1. Relational Databases -
   Also known as SQL databases, these databases use a relational model to organize data into tables with rows and columns.

2. NoSQL Databases -
   These databases are designed to handle large amounts of unstructured or semi-structured data, such as documents, images, or videos. (MongoDB)

3. Column Databases -
   These databases store data in columns rather than rows, making them well-suited for data warehousing and analytical applications. (Amazon Redshift, Google BigQuery)
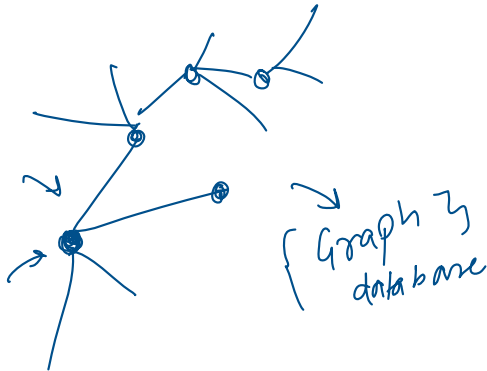
4. Graph Databases -
   These databases are used to store and query graph-structured data, such as social network connections or recommendation systems. (Neo4j, Amazon Neptune)

5. Key-value databases -
   These databases store data as a collection of keys and values, making them well-suited for caching and simple data storage needs (Redis and Amazon DynamoDB)
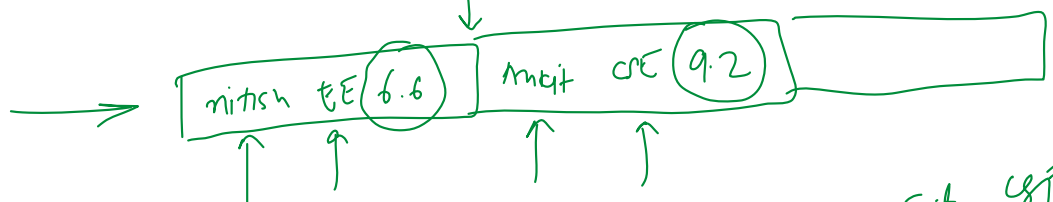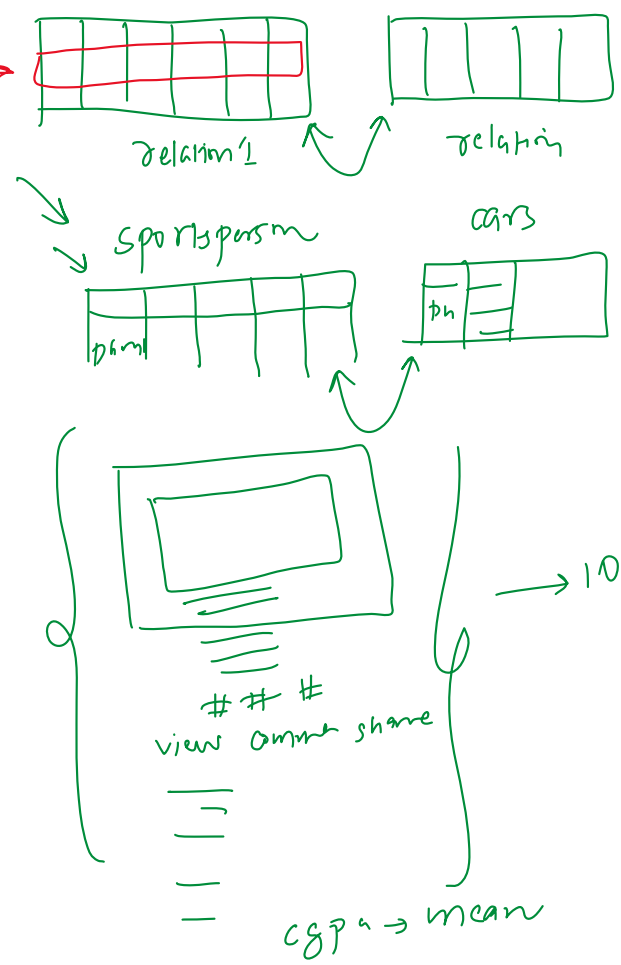
Which one should you use?

nitsn anci naw.. EE CSc ... – 66 9,2 . . . – .

Relational
DB

OLTP

rows

Column

OLAP

Data ware
house

Analysis

website

tweets (2K)   followers (2M)

2001   2002

Key

Pre
calculate

Redis

RAM

6. Relational Databases

Also known as SQL databases, these databases use a relational model
to organize data into tables with rows and columns.

table → relation

Attributes   columns / fields

Domain
{ICP, ETA, IVS}

4 →

ID	ENAME	SALARY	BONUS	DEPT
1	James Potter	75000	1000	ICP
2	Ethan McCarty	90000	2000	ETA
3	Emily Rayner	25000		ETA
4	Jack Abraham	30000	1000	ETA

Rows / records / tuples

No of records / rows / tuples:
Cardinality of the relation

No of attributes / columns / fields:
Degree of the relation

NULL

Relation is usually represented as:
Employee(ID, ENAME, SALARY, BONUS, DEPT)
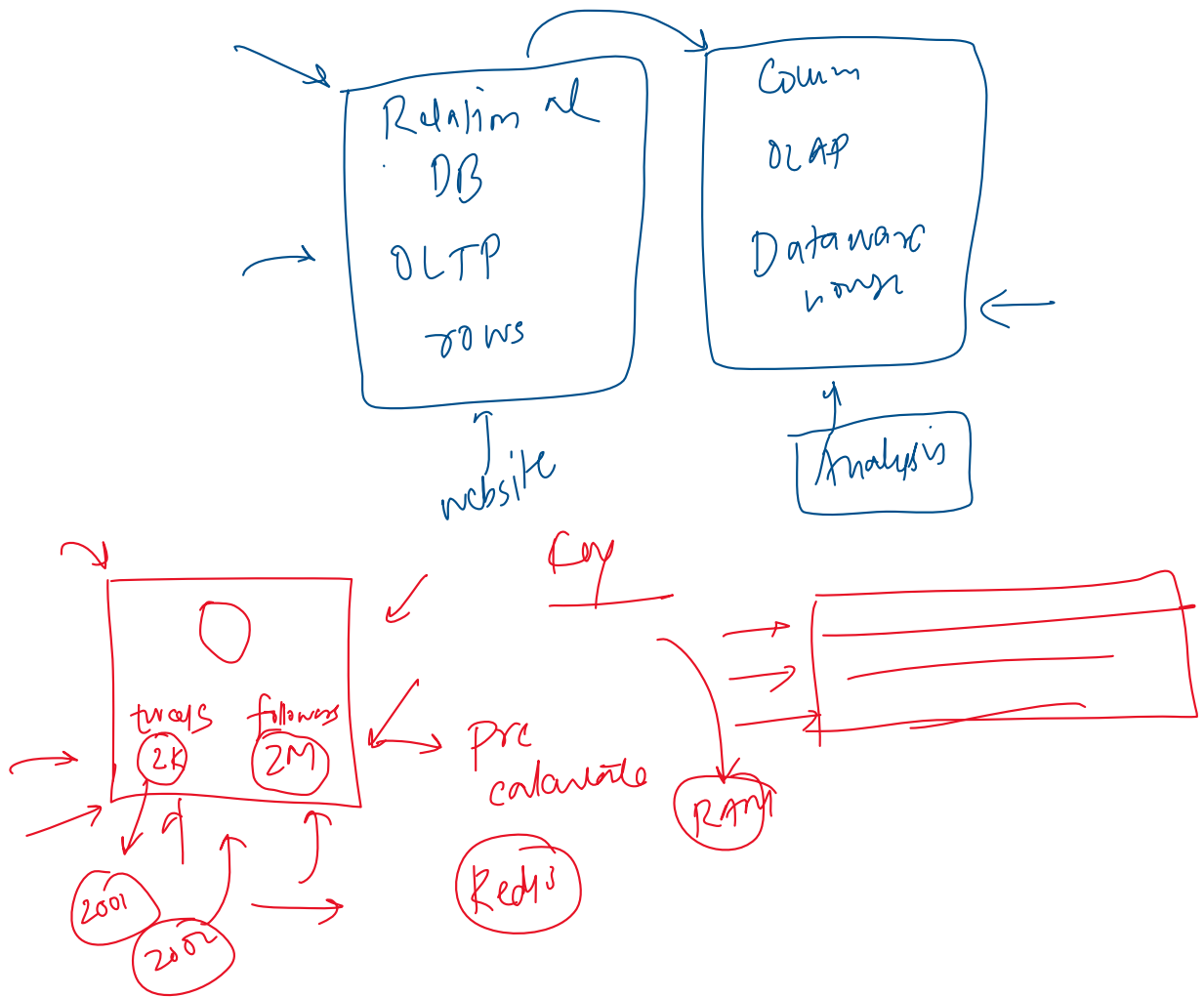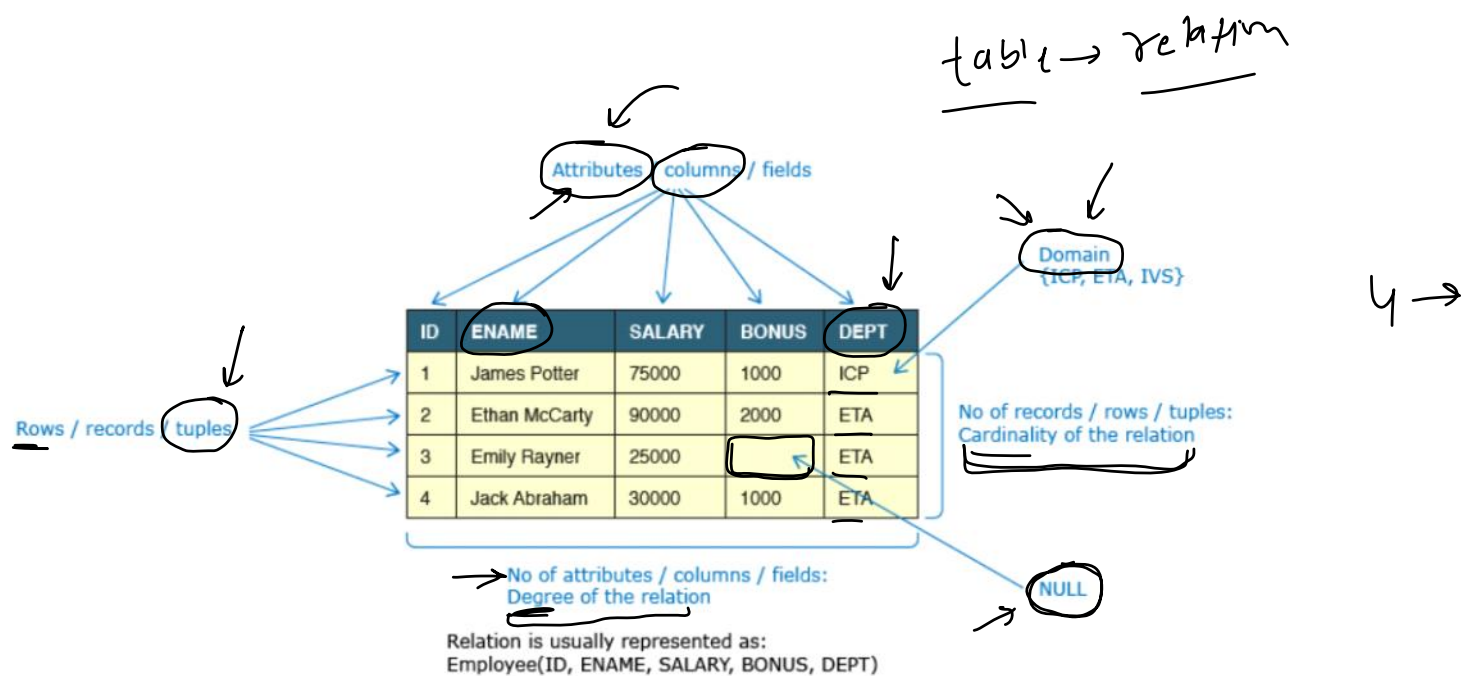
7. What is a DBMS

A database management system (DBMS) is a software system that provides the interfaces and tools needed to store, organize, and manage data in a database. A DBMS acts as an intermediary between the database and the applications or users that access the data stored in the database.

HDD SBD

Har → OS → DB → DBMS → Users
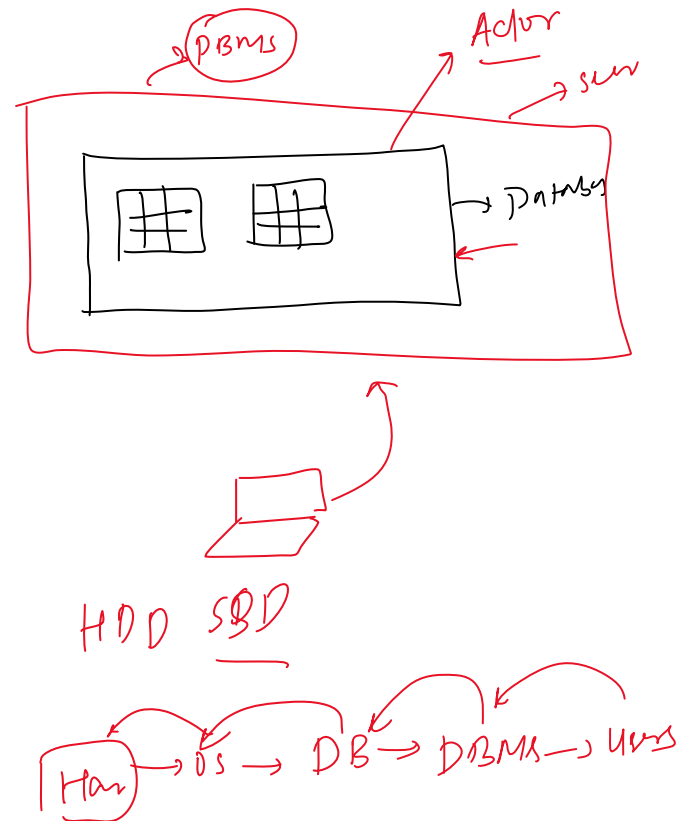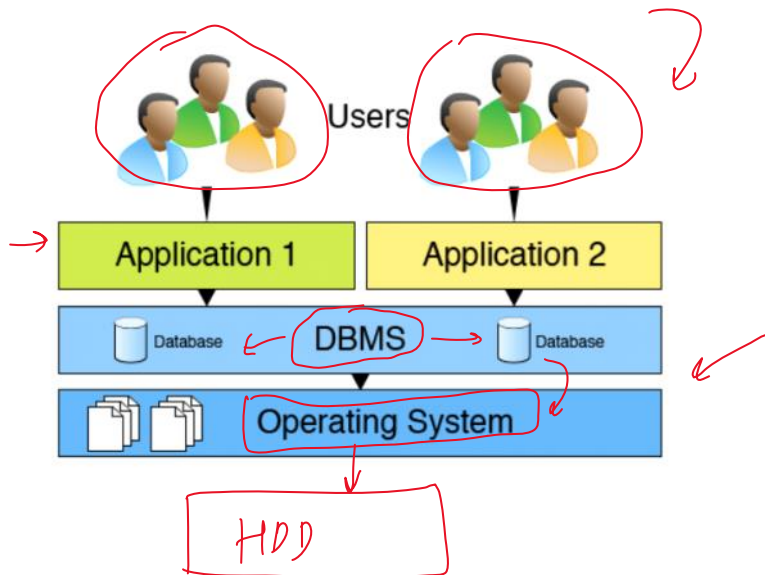
Functions of DBMS

Data Management - Store, retrieve and modify data

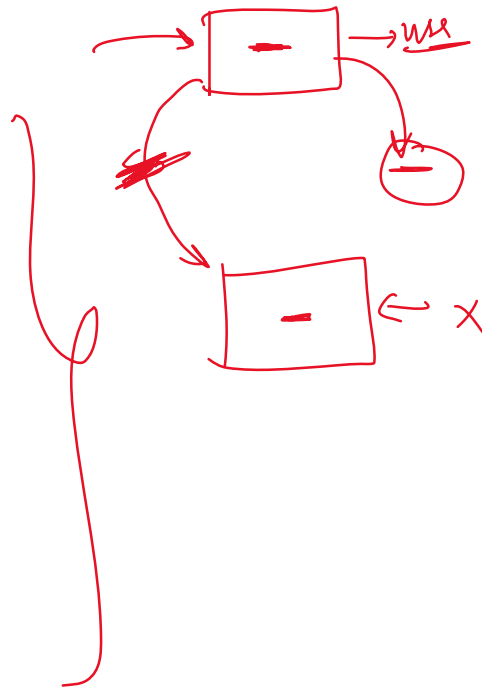**Integrity** - Maintain accuracy of data

Concurrency - Simultaneous data access for multiple users

Transaction - Modification to database must either be successful or must not happen at all

Security - Access to authorized users only

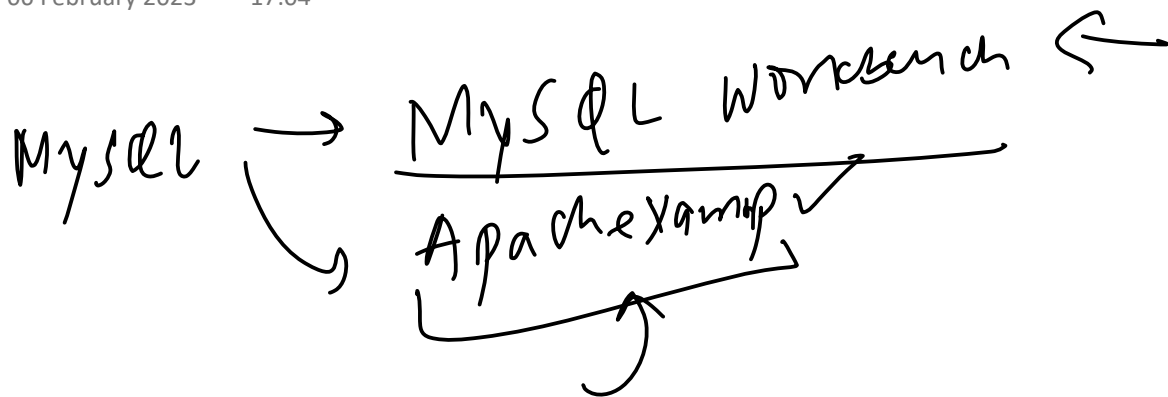**Utilities** - Data import/export, user management, backup, logging

9. Practical

06 February 2023   17:04

MySQL $\longrightarrow$ MySQL Workbench $\longleftarrow$

Apache Xampp

10. Database Keys

A key in a database is an attribute or a set of attributes that uniquely identifies a tuple (row) in a table. Keys play a crucial role in ensuring the integrity and reliability of a database by enforcing unique constraints on the data and establishing relationships between tables.

1. **Super Key** - → janta
   A Super key is a combination of columns that uniquely identifies any row within a relational database management system (RDBMS) table

2. **Candidate key** → ummeadw
   A candidate key is a minimal Super key, meaning it has no redundant attributes. In other words, it's the smallest set of attributes that can be used to uniquely identify a tuple (row) in the table
   view

3. **Primary Key**
   A primary key is a unique identifier for each tuple in a table. There can only be one primary key in a table, and it cannot contain null values.

4. **Alternate Key** -
   An alternate key is a candidate key that is not used as the primary key.
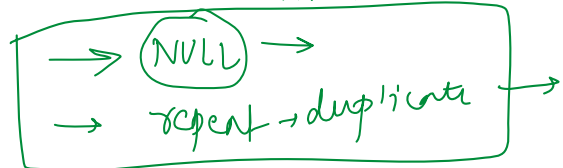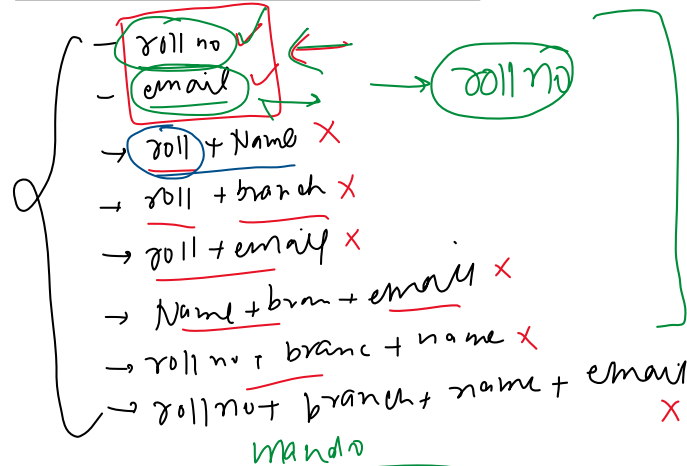
5. **Composite Key** -
   A composite key is a primary key that is made up of two or more attributes. Composite keys are used when a single attribute is not sufficient to uniquely identify a tuple in a table.
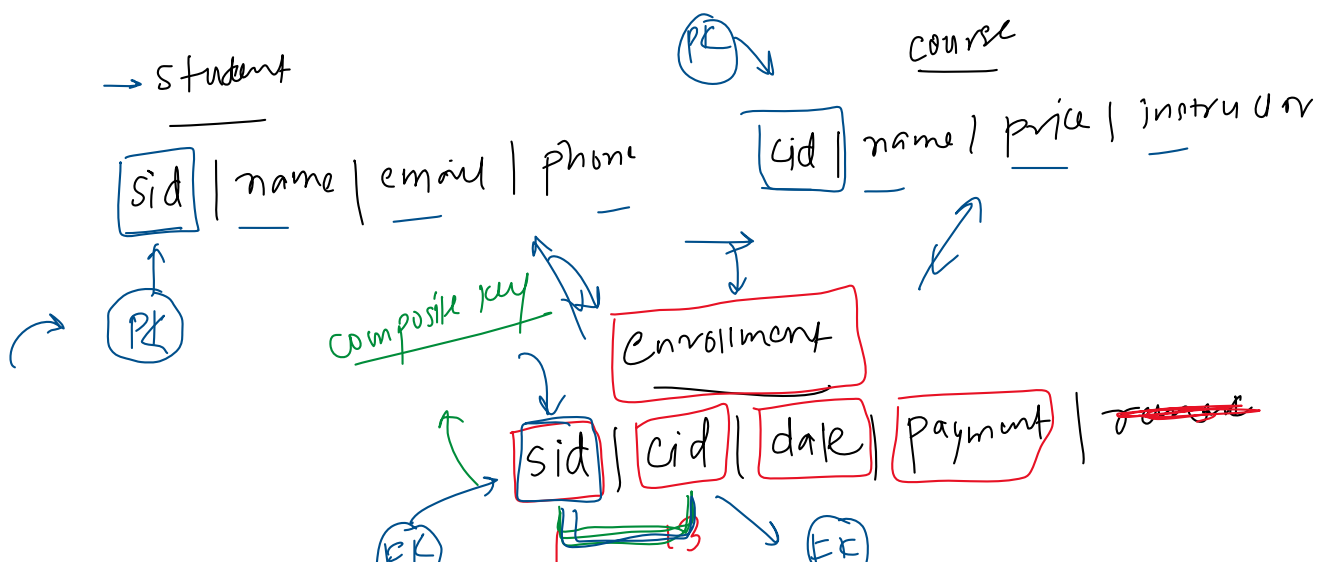
6. **Surrogate Key** -

7. **Foreign Key**
   A foreign key is a primary key from one table that is used to establish a relationship with another table.

Roll no	Name	Branch	Email
1	Nitish Singh	CSE	nitish@gmail.com
2	Ankit Sharma	EEE	ankit@gmail.com
3	Neha Verma	ME	neha@gmail.com

- roll no ✓
- email ✓   → roll no
- → roll + Name ✗
- → roll + branch ✗
- → roll + email ✗
- → Name + bran + email ✗
- → roll no + branc + name ✗
- → rollno + branch + name + email ✗

mando

→ NULL →
→ rpent → duplicate

good to have
→ numerials →
→ small →
→ constant

CK − PK = AK

→ student

[sid | name | email | phone]

PK

composite key

PK

enrollment

[sid | cid | date] | Payment | ~~~~~

FK   FK

course

[cid | name | price | instructor]

FK

Sid
Surrogate

name ↔ branch ↔ egpa
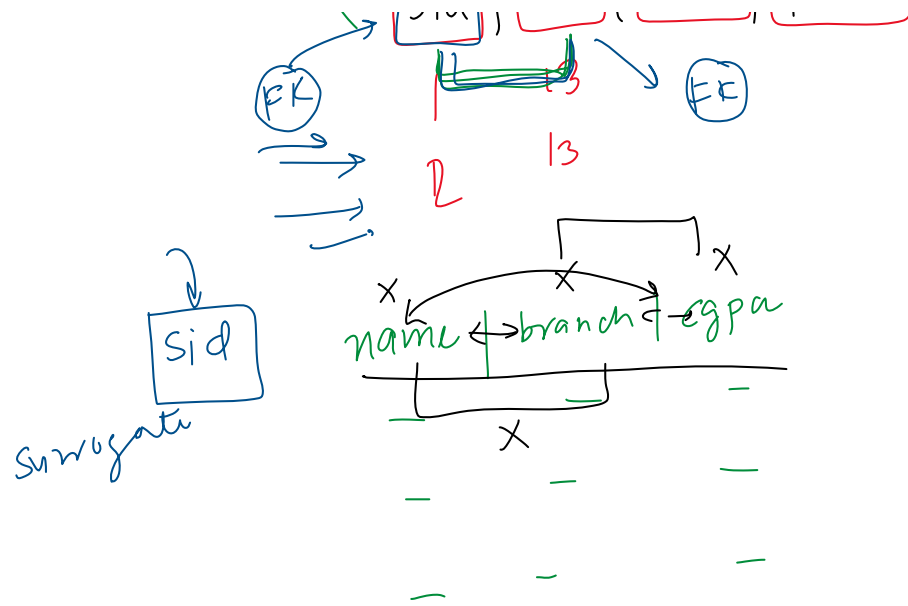
11. Cardinality of Relationships

06 February 2023   16:43
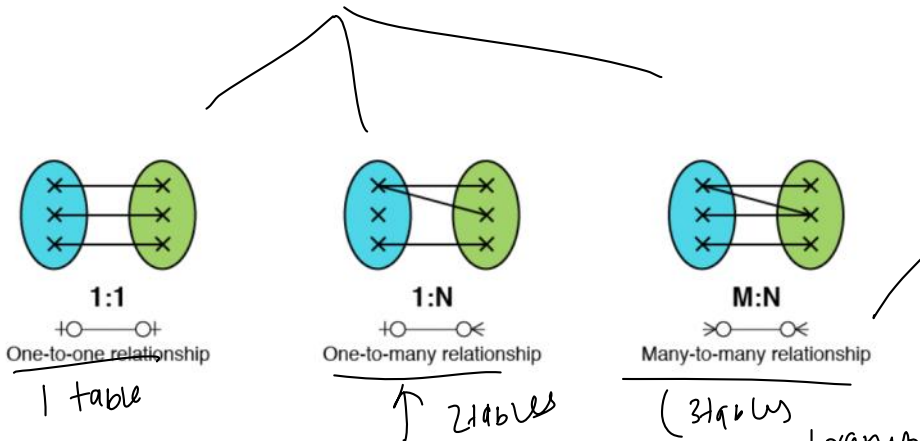
Cardinality in database relationships refers to the number of occurrences of an entity in a relationship with another entity. Cardinality defines the number of instances of one entity that can be associated with a single instance of the related entity.

entity
↓
table

name | DLno

1:1
One-to-one relationship
+O——O+
1 table

1:N
One-to-many relationship
+O——O←
↑ 2 tables

M:N
Many-to-many relationship
≫O——O←
(3 tables)

Examples

1. Person -> Driving License Number
2. Student -> college branch
3. Restaurants -> orders
4. Restaurants -> menu
5. Students -> courses

branch

bid	name	hod
1	CSE	=
2	EEE	—

Student

sid	name	bid	FK
1	xyz	1	
2	Amit	1	

sid | name

cid | course | DATA

sid | cid | data

12. Drawbacks of Databases

06 February 2023   16:39

Complexity: Setting up and maintaining a database can be complex and time-consuming, especially for large and complex systems.

Cost: The cost of setting up and maintaining a database, including hardware, software, and personnel, can be high.

Scalability: As the amount of data stored in a database grows, it can become more difficult to manage, leading to performance and scalability issues.

Data Integrity: Ensuring the accuracy and consistency of data stored in a database can be a challenge, especially when multiple users are updating the data simultaneously.

Security: Securing a database from unauthorized access and protecting sensitive information can be difficult, especially with the increasing threat of cyber attacks.

Data Migration: Moving data from one database to another or upgrading to a new database can be a complex and time-consuming process.

Flexibility: The structure of a database is often rigid and inflexible, making it difficult to adapt to changing requirements or to accommodate new types of data.