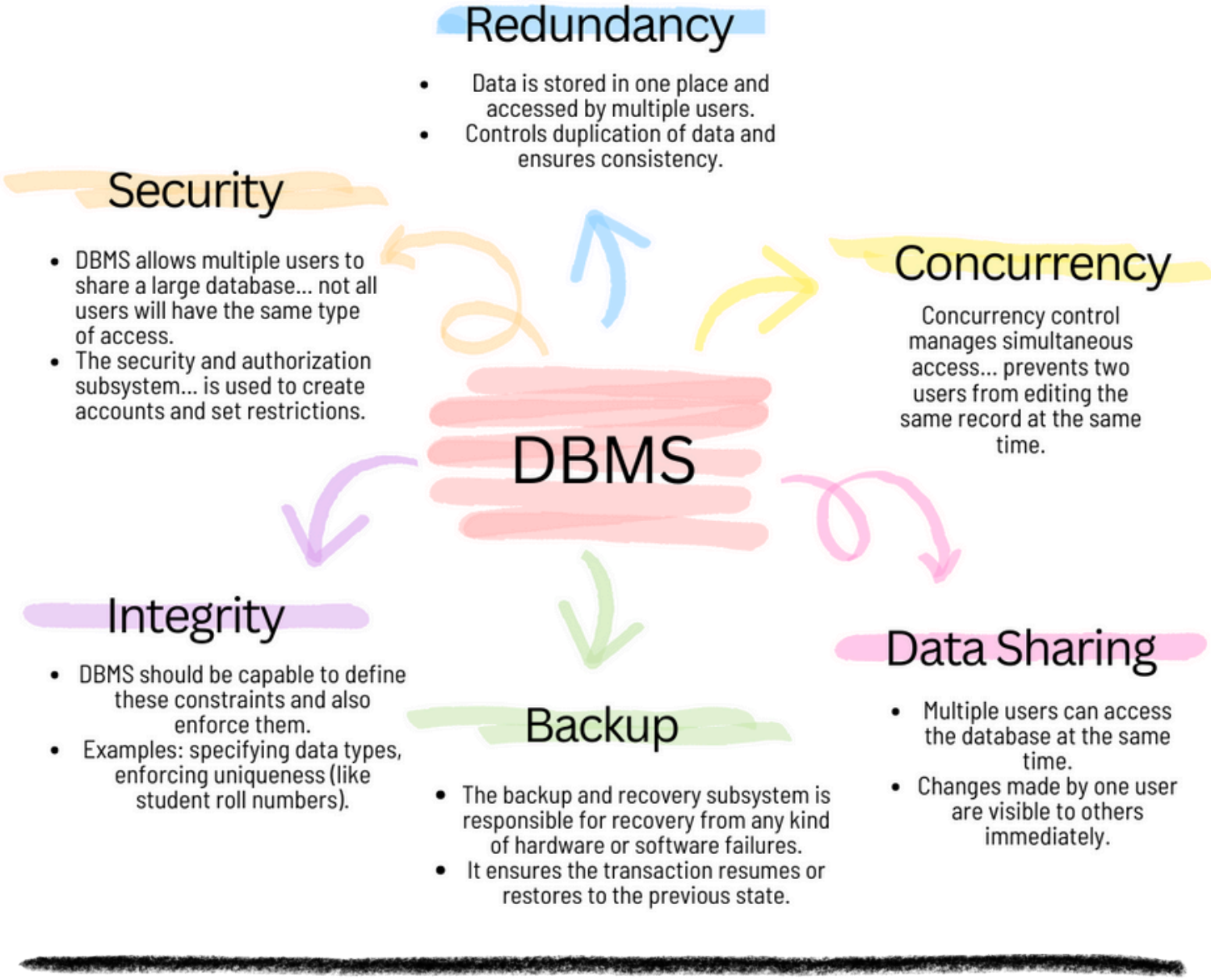
Database Search and Reporting

1) Flat File Systems vs. Relational Databases

	Flat files	Relational Databases
Structure	Single table. simple and structured format	highly structured format with tables, rows, and columns. Represented using Schema
Data Redundancy	High (data duplication)	Low (data is linked)
Relationships	no relationship between them	relationships established between tables through keys and indexes
Example Usage	CSV, TSV	MySQL, Oracle, SQL Server
Drawbacks	Increased data redundancy and inconsistency.	Time-consuming to set up

2) Advantages of Using a Database Management System



3) Types of Databases

📊 Relational Databases (RDBMS)

🔹 Structure

- Data is stored in tables (rows and columns).
- Tables are related to each other via primary keys and foreign keys.
- Each table focuses on one entity (e.g., Customer, Order).

🔹 Key Concepts

- Primary Key: Uniquely identifies a record in a table.
- Foreign Key: Connects records between related tables.
- Ensures structured, consistent, and connected data.

🔹 Advantages

- **Data Consistency**: Strong schema keeps data uniform.
- **Security**: Permissions and encryption at table level.
- **Ease of Backup & Recovery**: Consistent format simplifies restores.

🔹 Use Cases

- Point-of-sale systems
- Medical records
- Financial applications
- Any system requiring structured, transactional data

🧩 Non-Relational Databases (NoSQL)

🔹 Structure

- Data is stored in flexible formats, not tables.
- No fixed schema — more adaptable to change.

🔹 Types

1. **Key-Value Stores** – e.g., Redis
   - Example: "user123": "John Doe"
2. **Document Stores** – e.g., MongoDB
   - Store data in JSON-like documents
   - Grouped into collections
3. **Column Stores** – e.g., Cassandra
   - Store data by **columns** for high-performance queries
4. **Graph Databases** – e.g., Neo4j
   - Represent entities and relationships as nodes and edges

🔹 Advantages

- **Flexibility**: No rigid schema — ideal for evolving apps.
- **Scalability**: Easily scale **horizontally** (across servers).
- **Cost Effectiveness**: Fewer resources needed for scaling.

🔹 Use Cases

- Real-time analytics
- Social networks
- Internet of Things (IoT)
- Applications with rapidly changing data structures

🏛️ Centralized Systems

🔹 Definition

A system where a **single node (or small number of tightly controlled nodes)** handles all processing and control.
E.g., a website hosted on one web server connected to one database.

🔹 Key Features

- One central **point of control**
- Communication is usually **synchronous** (e.g., client-server model)
- All components are **tightly coupled**

🔹 Advantages

- Simple to design and develop
- Always consistent (one copy of data)
- Low latency (less network overhead)

🔹 Disadvantages

- **Single point of failure**
- Poor scalability (limited to vertical scaling)
- Performance degrades for geographically distant users

🔹 Use Cases

- Traditional client-server applications
- Systems with single database
- Small internal business applications

🌐 Distributed Systems

🔹 Definition

A system with multiple independent nodes that work together but can function separately.
E.g., microservices architecture with services for order, inventory, and finance.

🔹 Key Features

- Multiple **autonomous nodes**
- Use of **asynchronous** communication or **eventual consistency**
- Nodes may be **geographically distributed**

🔹 Advantages

- **Scalability**: Easily scale horizontally
- **Fault Tolerance**: One node can fail without system crashing
- **High concurrency**: Nodes can process in parallel

- **Geographical distribution** improves global performance

🔹 Disadvantages

- **High complexity** in design and development
- **Latency** due to inter-node communication
- **Low consistency**: Data sync might lag
- **Hard to debug** due to distributed nature

🔹 Use Cases

- **Microservices**-based architectures
- **Distributed databases**
- **Cloud-native applications**
- **Content delivery networks (CDNs)**

🌐 What is a Cloud Database?

A cloud database is a type of database that is hosted on a cloud platform such as:

- **Amazon Web Services (AWS)**
- **Microsoft Azure**
- **Google Cloud Platform (GCP)**

It is accessed and managed over the internet, not stored on local hardware. 💻📡

🔹 Why Do We Need Cloud Databases?

🔹 Advantages of Cloud Databases

1. **Increased Scalability**
2. **Improved Flexibility**
3. **Enhanced Reliability: Managed by cloud experts with high availability and uptime.**
4. **Reduced Costs**
   - **No upfront hardware**
   - **Pay only for what you use**
5. **Remote Access Support**

🔹 Disadvantages of Cloud Databases

1. **Depends on Internet Connectivity**
2. **Limited Control: Managed by third-party, so you have less control.**
3. **Vendor Lock-in:Switching providers may be difficult and costly.**

🔹 Popular Cloud Databases

   - **Amazon RDS**
   - **Google Cloud SQL**

- **Azure SQL Database**
- **MongoDB Atlas**
- **Amazon DynamoDB**
- **Google Cloud Firestore**

☁️ Relationship Between Cloud Storage and Databases

What is Cloud Storage?

Cloud storage refers to the process of saving data to an offsite storage system or to state more technically, stashing data on a hardware in a remote physical location, which can be accessed from any device via the internet.

🔹 **Connection to Databases**:

- Hosting database backups
- Storing database logs or data files

🔹 **Advantages of Cloud-Based Databases**

- **Scalability**
- **Cost Efficiency**
- **Automatic Maintenance**
- **High Availability & Reliability**
- **Global Access**
- **Security**

🔹 Challenges of Cloud-Based Databases

- **Internet Dependency:** If your internet goes down, so does your access to the database — that's a major limitation for some businesses.
- **Vendor Lock-In:** Once you're set up with one cloud provider, switching to another can be tricky and expensive.
- **Limited Customization:** Because the provider manages the backend, you might not have as much control over settings or configurations as you would with your own system.
- **Hidden Costs:** Costs can sneak up on you — like charges for storage, data transfers, or extra features you didn’t realize you were using.
- **Compliance & Data Rules:** If your business has to follow specific data laws, like where the data is stored or how it’s protected, managing that in the cloud can be a bit more complex.