



# Database Administration Security

*Cybersecurity Department*

*Course Code: CBS 214*

*Theoretical Lecture 10: Database Backup and Recovery*

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# Agenda



- Definition & Importance
- Benefits
- Factors (Frequency, Urgency, Amount, Type)
- Backup Types (Full, Incremental, Differential)
- Backup Plan (5 Steps)
- Modern Solutions & How Backup Works
- Disadvantages (Cloud & Local)
- Frequency & Retention
- Restore & Recovery Techniques
- Backup vs. Recovery

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# Learning Outcomes

By the end of this lecture, students will be able to:

- Define database backup and explain its importance
- List the benefits (recovery, security, compliance, cost, etc.)
- Apply the four factors to choose a backup strategy
- Differentiate full, incremental, and differential backups
- Create a basic backup plan using RTO/RPO
- Compare local vs. cloud backup disadvantages
- Recommend backup frequency and retention periods
- Distinguish backup (proactive) from recovery (reactive)
- Describe six recovery techniques

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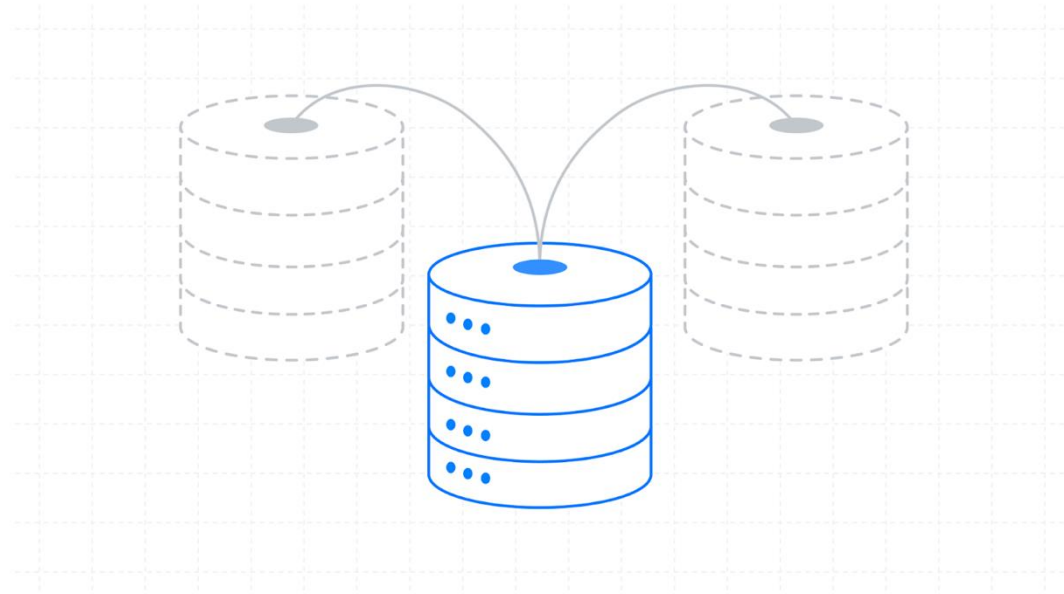
# Database Backup

- Database backup involves creating a copy of data in a database to protect against data loss. This process enables the recovery of data following an event where the original data may be lost or corrupted.
- Regular backups ensure that data can be restored to a specific point in time and provide protection against hardware failures, data corruption, or cyber-attacks.
- A well-implemented backup strategy is crucial for maintaining data integrity and business continuity in IT environments.
- Database backups can take various forms, such as full, incremental, or differential backups. These backups can be stored on different media, including cloud storage, local drives, or external devices.







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# Database Backup

Consistent backups are essential for minimizing downtime and ensuring that organizations can continue operations without significant data loss. The methodology and frequency of backups should align with business priorities and the criticality of the data involved.



# 6 benefits of database backups

-  Faster data recovery and replication
-  Stronger data security
-  Easier data management
-  Improved performance
-  Controlled costs
-  Better compliance



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# Benefits of database backup

- **Faster data recovery and replication**

A solid backup strategy includes seamless replication of new data between live and backup databases, making recovery just as seamless after an outage. This is critical for high-traffic applications like ecommerce sites, where even minutes of downtime can cost hundreds or thousands of dollars in lost revenue.



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## Benefits of database backup (cont.)

- **Stronger data security**

Reliable backups and quick recovery are cornerstones of data security, helping protect against cyberattacks such as data breaches and data sprawls. A good backup solution gets you back on your feet faster while safeguarding sensitive assets like customer, financial, and healthcare data, which also aids in maintaining regulatory compliance.



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# Benefits of database backup (cont.)

- **Easier data management**

Moving, managing, and storing large volumes of data is resource-intensive, but the right backup tool simplifies the process and improves overall data management. Solutions like Fivetran offer seamless high-volume data replication and change data capture, eliminating manual moves and freeing up network bandwidth, while also providing ETL/ELT, data transformations, and end-to-end security from a single platform.



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## Benefits of database backup (cont.)

- **Improved performance**

Although making backups consumes resources, automating backups with modern tools improves long-term system performance. Manual backups are time- and resource-heavy, often consuming large bandwidth to replicate entire databases. In contrast, technologies like change data capture (CDC) create real-time incremental backups, freeing resources and reducing data loss between rollbacks.

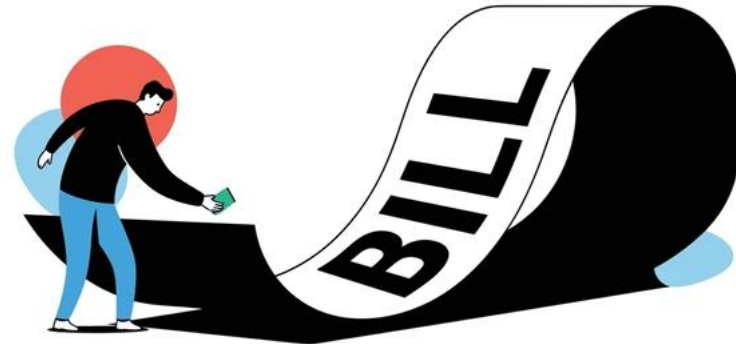


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## Benefits of database backup (cont.)

- **Controlled costs**

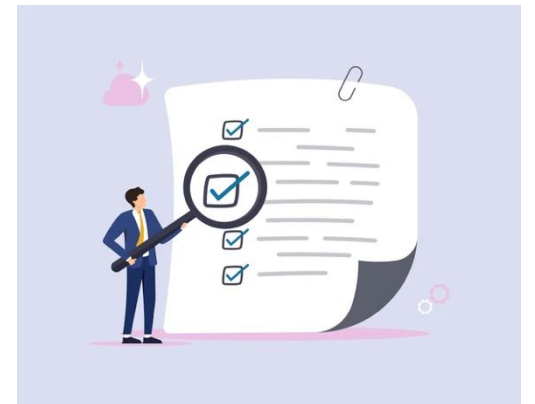
Quick data recovery helps avoid lost revenue and control costs by preventing or mitigating mishaps. While some backup platforms have upfront costs, they are small compared to the lost revenue and time from data loss. In mission-critical applications, backup tools can easily pay for themselves.



# Benefits of database backup (cont.)

- **Better compliance**

Security mandates such as GDPR and HIPAA emphasize proper data storage and management, with regular backups being a major requirement. Implementing a strong database backup strategy helps your organization meet a wide range of compliance obligations, which may be essential for staying in business and operating legally depending on your industry.



# 4 factors of database backups



## Frequency

How frequently does your database receive new data?



## Amount

How much data do you need to backup at a given time?



## Urgency

How urgently do you need the latest data?



## Type

What type of data are you backing up?

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# Factors of Database Backup

These four factors together determine your backup strategy and the specific backup types you will deploy.

- **Frequency:** How often new data arrives matters. If data loads once daily, backups can be less frequent. Real-time applications may need real-time backups.
- **Urgency:** How quickly you need the latest data after an outage defines your recovery point objective (RPO). High-urgency applications may need a backup after every change, even if changes are rare. Conversely, frequent but low-value data (e.g., raw social media feeds) may not require urgent backup.
- **Amount:** The volume of data to back up affects network bandwidth. For massive databases, administrators often use incremental backups that capture only recent changes.
- **Type:** Different data types (e.g., healthcare, financial) may require specific technologies, pipelines, and security measures due to regulatory compliance.

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# **Types of Database Backup Techniques**

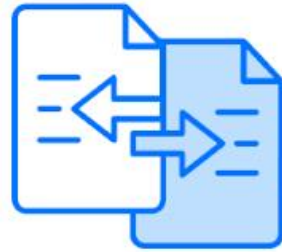
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## 3 types of database backups



### Full backups

Make a complete copy of the database every backup



### Incremental backups

Only copies recently changed data to help free up resources



### Differential backups

Stores multiple incremental backups between full backups

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# Types of database Backup techniques

Some of the most common types of database backup techniques include:

- **Full Backup:** This type of backup technique involves copying the entire database, including all data and schema objects. Full backups provide a comprehensive and complete copy of the database, but they require significant storage space and can take a long time to complete.
- **Incremental Backup:** This type of backup technique involves copying only the changes made to the database since the last backup. Incremental backups require less storage space and are faster than full backups, but they take longer to restore.

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## Full database backups

- As the name suggests, a full database backup takes a “full” or “complete” copy of your entire database. While almost every backup strategy aims to create a full database backup, in this case, a “full database backup” refers to a single process. In other words, if your backup strategy uses a full database backup, you make a complete backup *every time* you backup your database.

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## Full database backups

- Pros: Making a complete copy of your database every time ensures all data is accounted for and shortens recovery times.
- Cons: Full database backups can be extremely resource-intensive, especially for frequent backups or on infrastructure with limited bandwidth.



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## Incremental database backup

- If a database only receives a few select updates between backups, it rarely makes sense to copy the entire database every time you create one.
- Incremental database backups solve this problem by creating backups in small parts or *increments* rather than all at once. These increments are simply the changes since the last backup, with most organizations utilizing the “modified” timestamp on files to check which data was changed.
- Incremental backups are usually the more efficient solution. Leading tools like Fivetran utilize CDC replication to move large datasets in near-real time.

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# Incremental database backup

- Pros: Incremental backups require very few resources, allowing for more frequent updates, real-time replication and less disk space.
- Cons: May present a small room for error if some changed data isn't captured. However, this is very rare.



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## Differential database backup

- Most organizations still make occasional full backups to ensure data integrity and accuracy. Differential backups make several incremental backups between each full backup to leverage the best of both worlds.
- Here, each incremental backup is saved until the next full backup, allowing for a complete record of changes over a certain period. This provides similar accuracy as full data backups without consuming the same number of resources.

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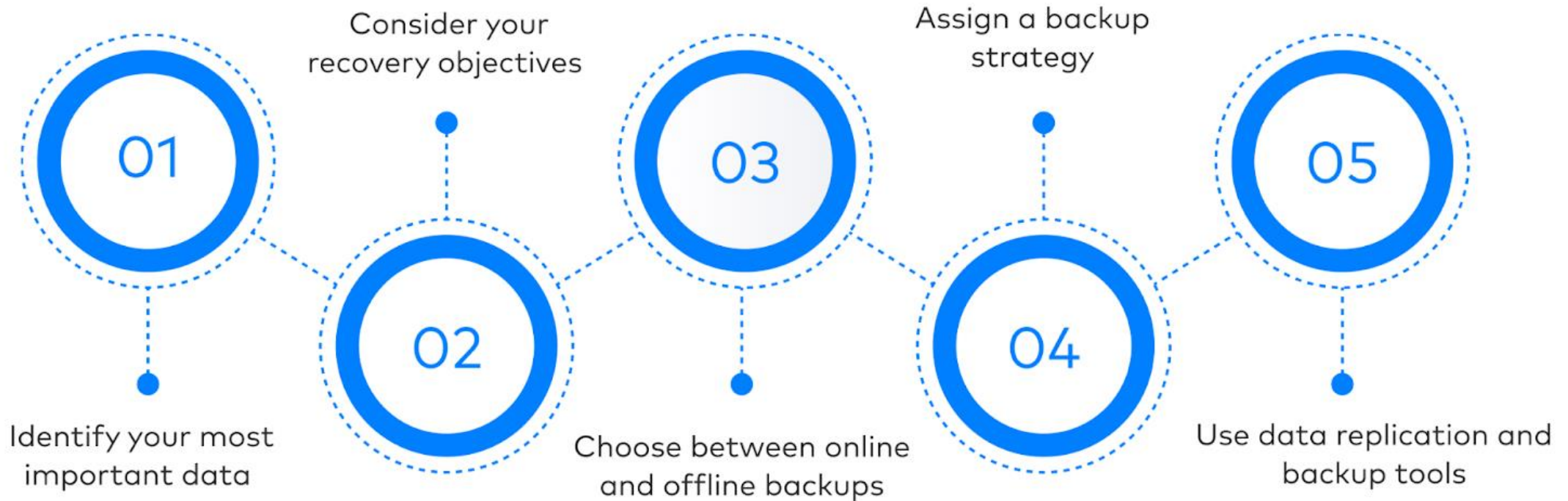
# Differential database backup

- Pros: Differential backups provide more detailed information about data changes without sacrificing as many resources as full backups.
- Cons: More backup copies still require more storage than incremental backups.



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# 5 steps to create a database backup plan



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# How to create a database backup plan

- **Step 1: Identify your most important data:** Prioritize what to back up based on business value and regulatory requirements. For example, an ecommerce company can lose analytics data but not customer payment information.
- **Step 2: Consider your recovery objectives:** Define your RTO (maximum recovery time) and RPO (maximum acceptable data loss). These determine which backup strategy is appropriate.
- **Step 3: Choose between online or offline backups:** Offline backups offer higher security but require physical device maintenance. Online cloud backups are more flexible and affordable, making them the preferred choice for most businesses.

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## How to create a database backup plan (cont.)

- **Step 4: Assign a backup strategy based on system capabilities:** Your choice of online vs. offline influences the backup method. Incremental or differential backups work well for most applications.
- **Step 5: Use data replication and backup tools:** The right tools, especially for real-time data replication, save resources and improve efficiency.

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# The Need for Modern Database Backup Solutions

- Many businesses today rely on multiple databases to support different functions. For instance, an accounting department might use Oracle, while inventory control runs on a separate system like MySQL or NoSQL. This diversity means that a single backup approach rarely fits all needs.
- Databases also come in various structural forms, including relational models (e.g., Microsoft SQL, SAP HANA), distributed databases (e.g., Hadoop, Cassandra), and Software-as-a-Service platforms (e.g., Microsoft 365, Azure, AWS). Each type has unique backup requirements, adding further complexity.

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## The Need for Modern Database Backup Solutions (Cont.)

- Traditionally, database backup solutions came from multiple vendors using mixed manual and automated processes on aging infrastructure. This led to fragmented data management, slow recovery times, and increased risks.
- Legacy methods cause data fragmentation, incompatible tools, and operational disruptions, often compromising compliance. That's why a modern, unified database backup solution is essential it handles diverse database types, speeds up recovery, and ensures data integrity across the organization.

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# Why is Database Backup Important?

No organization is immune to data threats. Power outages, hardware failures, human errors, and cyberattacks can all lead to data loss. In 2021 alone, ransomware attacks surged by 105%, with criminals locking systems and demanding payment to restore access.

- A robust database backup strategy is essential because it:
- **Safeguards against data loss and disasters:** Protects from accidental deletion, corruption, hardware failures, and cyberattacks, ensuring business continuity.
- **Enables fast, reliable recovery:** Minimizes downtime and costly data recreation by allowing you to restore specific files or entire databases.
- **Supports regulatory compliance:** Helps meet legal requirements (e.g., GDPR, HIPAA) and data protection laws, making backups a legal and commercial necessity.

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# How Database Backup Works

- **Method depends on business size, technology, and data type:** Small, simple businesses may copy files manually to an external drive or cloud folder, while larger enterprises need automated solutions.
- **Offsite storage is critical:** Keeping a backup copy in a separate physical location protects against fire, floods, theft, or other on-site disasters.
- **Physical backups (tapes, external drives) require manual transport:** You must carry the device offsite and physically retrieve it for restoration, making the process slow, labor-intensive, and less reliable.

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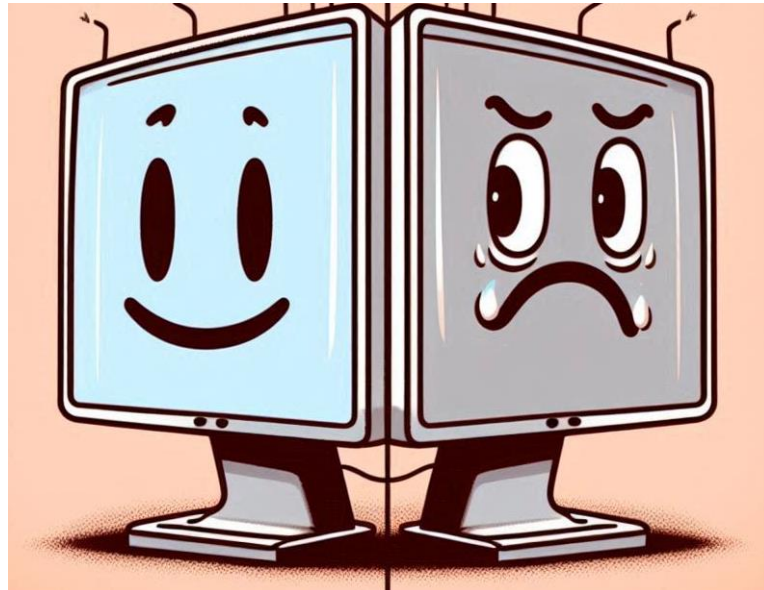
## How Database Backup Works (cont.)

- **Most businesses prefer modern software-based backup:** Automated software eliminates manual steps, improves security, and enables remote management.
- **Backup as a Service (BaaS) explained:** An online/cloud solution where the provider manages all backup infrastructure, software, and support. You simply send data to the cloud.
- **BaaS saves time and money:** It frees your IT staff and equipment from backup chores, reduces capital expenses, and improves the bottom line.

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# Disadvantages of Database Backup

Database backup requires time and labor costs associated with establishing procedures, defining schedules, and monitoring the related processes. This is because databases are typically used to hold critical business data, like customer records or product inventory, and require clear processes.



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## Disadvantages of Database Backup (cont.)

Cloud backup comes with many pros, but also cons, such as:

- You can't access your data if you don't have Internet access.
- You have to deal with bandwidth issues to back up large chunks of data.
- While cloud recovery of small quantities of data is fast and easy, full data recovery could take some time.
- Likewise, cloud entry level with a small amount of data is inexpensive, while large quantities of data can steadily increase costs.

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# Main Disadvantages of Backing Up Data Locally

If hackers and cybercriminals can access your live operational files, they may also try to corrupt your database backups. It's much safer to back up in the cloud or some other remote location than on-premises. The drawbacks of a local backup are:

- Higher costs compared to cloud backup
- Scalability concerns
- Increased maintenance
- Enhanced cybersecurity issues
- More vulnerable to events like fires and floods

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# How often should you back up your database?

- How often you back up your database depends on the nature of your business and database backup strategy. The best rule is “as often as you’re changing your files.”
- If your business requires that you minimize work-loss exposure, consider taking incremental backups every 15 to 30 minutes, for example. Many businesses schedule full backups weekly, with incremental or differential backups daily.



# How often should you back up your database?

It's a good business practice to periodically review your procedures. Analysis of growth, data volumes, and experience with threats or actual disruptions may prompt changes to your database backup procedures or frequency.



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# How long to keep database backups?

- **Retention depends on business needs:** How long you keep backups varies based on your data, operations, and industry requirements.
- **Regulatory compliance may require longer retention:** Older backups help meet legal reporting obligations and can reconstruct transaction history.
- **Consider privacy policies and update frequency :** Your published data retention policies and how often database transactions change also influence backup retention.
- **Review policies regularly:** Proactive planning is better than scrambling after a data problem or business disruption.

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# Restore Backup Files

A database backup restore can also be done manually or automatically:

- **Has your database been corrupted?**
- **Did someone mistakenly delete some isolated data that can be easily identified and restored?**
- **Will you need to restore the whole database?**

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## Restore Backup Files (cont.)

Small-scale recovery restores specific files or tables, while major events like cyberattacks or disasters require a full database restore. A strong disaster recovery strategy minimizes downtime, data loss, and overall damage. A robust disaster recovery strategy is critical to helping organizations:

- Minimize downtime
- Minimize data loss
- Mitigate overall damage

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# Types of database recovery techniques

- **Rollback Recovery:** Undoes changes made since the last commit point; used for transaction failures or system crashes.
- **Forward Recovery:** Reapplies changes made since the last commit point; used when a failure occurs mid-transaction or during a crash.
- **Point-in-Time Recovery:** Restores the database to a specific moment before a logical error (e.g., accidental data deletion).
- **Online Recovery:** Recovers the database while it remains in use, minimizing downtime.
- **Parallel Recovery:** Uses multiple processors or servers to recover in parallel, reducing total recovery time.
- **Image Copy Recovery :** Restores from a physical copy stored on a separate device; used for hardware failures or total database loss.

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# Database Backup vs. Database Recovery

- **Database Backup:** The *process of copying and storing* database data (full, incremental, or differential) to a separate location (disk, tape, cloud) as a safeguard. It is a **proactive, preventive** measure.
- **Database Recovery:** The *process of restoring* a database from a backup and applying changes (e.g., transaction logs) to bring it back to a usable state after a failure or data loss. It is a **reactive, corrective** measure.

# Database Backup vs. Database Recovery

Aspect	Backup	Recovery
Action	Copying data	Restoring data
Timing	Done regularly before failure	Done after failure occurs
Goal	Preserve data for future use	Resume operations with minimal loss
Effort	Planned, scheduled, automated	Urgent, time-sensitive, often manual

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**Any**  
**Question**

