

Database Management Systems (CS 20006)

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Lecture Note 01

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- ✓ Data can be defined as a **representation of facts, concepts, or instructions** in a formalized manner, which should be suitable for communication, interpretation, or processing by human or electronic machine.
- ✓ Generally data is **raw and unprocessed**.
- ✓ Data becomes information when it is processed, turning it into something meaningful.
- ✓ Information is organized or classified data, which has some meaningful values for the receiver. Information is the processed data on which decisions and actions are based.

Traditionally used “File System”



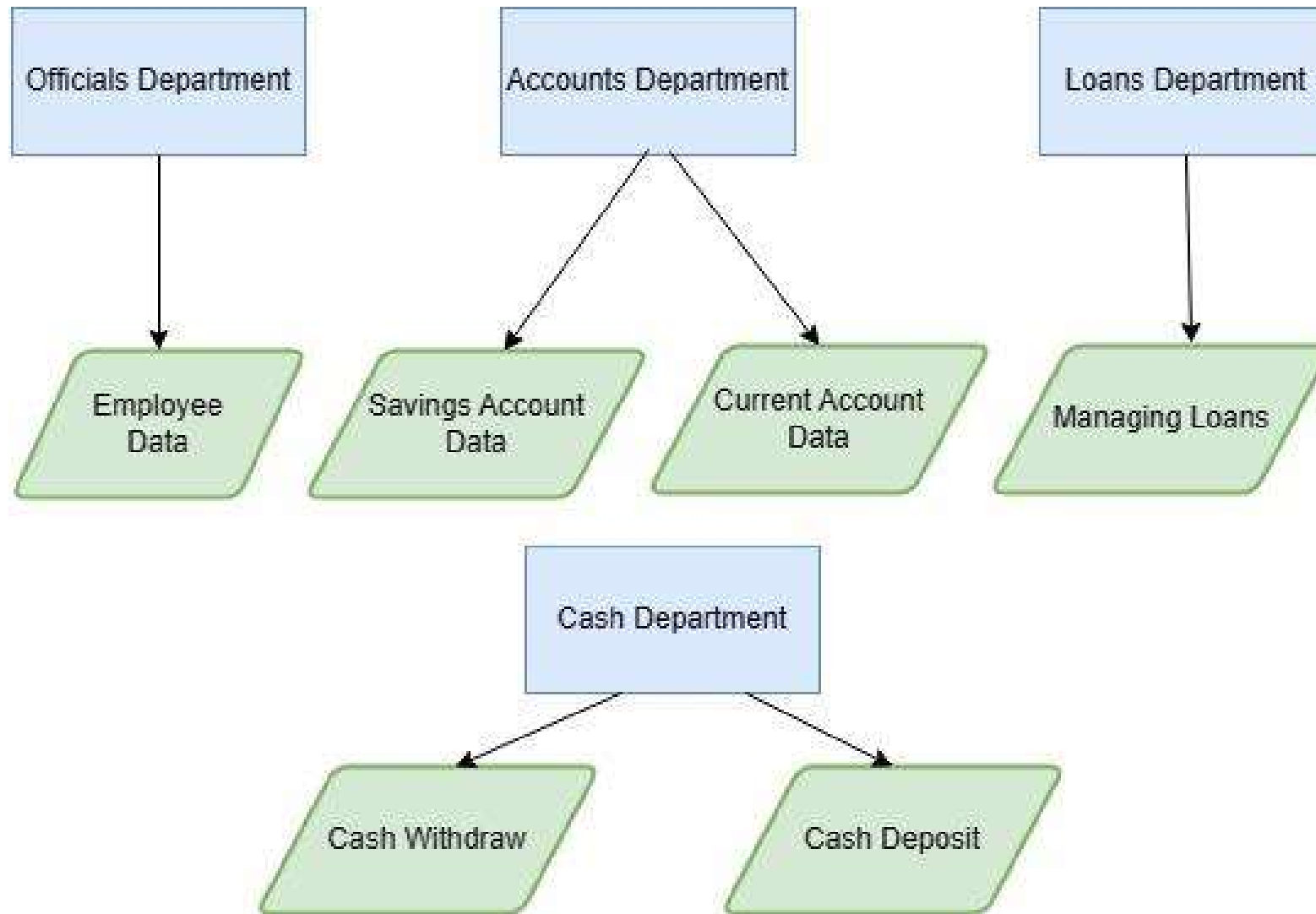
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- ✓ The traditionally used “File Systems” were nothing but a manual way of storing data as “Files”. Considering a scenario of a bank before the introduction of DBMS, for example, say someone went to the bank to deposit a certain amount in their account. So as the DBMS is not available so the bank employee has to manually register their account number, name, and amount in either a written manner or type and store them locally in the computer as a file.
- ✓ The problem which might arise that while writing if the employee mistakenly writes any digit of their account number or amount wrong then there would be a major issue and as there is no Database so it would be really hard to know what was the last state of that person’s account before this misshaped deposit.

Traditional “Banking File System” - Example



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- ✓ The **data** of certain companies or organizations were **kept as “Files”**.
- ✓ The **files** stored in different departments **were independent of each other**, which caused severe data redundancy.
- ✓ Those files were developed using programming languages like COBOL, C, and C++.
- ✓ **Each file includes information for a particular department or region**, such as the library, tuition, and students’ exams.
- ✓ The traditional file system is way **less-flexible than DBMS** and has **many disadvantages**.
- ✓ The **maintenance** of those files was also of **high cost**.
- ✓ **Each of the units of “Files”** used to be known as **“Flat Files”**.

Drawbacks of File system



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- ✓ **Data Isolation:** Because data are scattered in various files, and files may be in different formats, writing new application programs to retrieve the appropriate data is difficult.
- ✓ **Duplication of data** – Redundant data. Due to the manual storing of data, the same data used to be present in multiple locations using the space in each of the Hard Disk, below are some following reasons for which Data Redundancy can be a major issue
 - Storing the same data multiple times not only wastes resources in every machine but also is costly to maintain and wastes time.
 - Loss of data integrity is another major issue of Data Redundancy, imagine someone's address is present in multiple systems and he has applied to update the address, in one system the address gets updated but in the rest of them it remains the same, so the if someone from any different department where the data is not updated tries to send them any letter or something then it would go to a wrong address.

Drawbacks of File system...



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- ✓ **Dependency on Application Programs** – Changing files would lead to change in application programs.
- ✓ **Dependence on Data** – Files and information were stored in a certain specific format in files which is hard coded by programmers in languages like C/C++, COBOL, etc. So if any of the file's format changes then the programmers need to update the code every time and the format of every piece of data stored in that file will be changed, which is a rigorous task for programmers.

Drawbacks of File system...



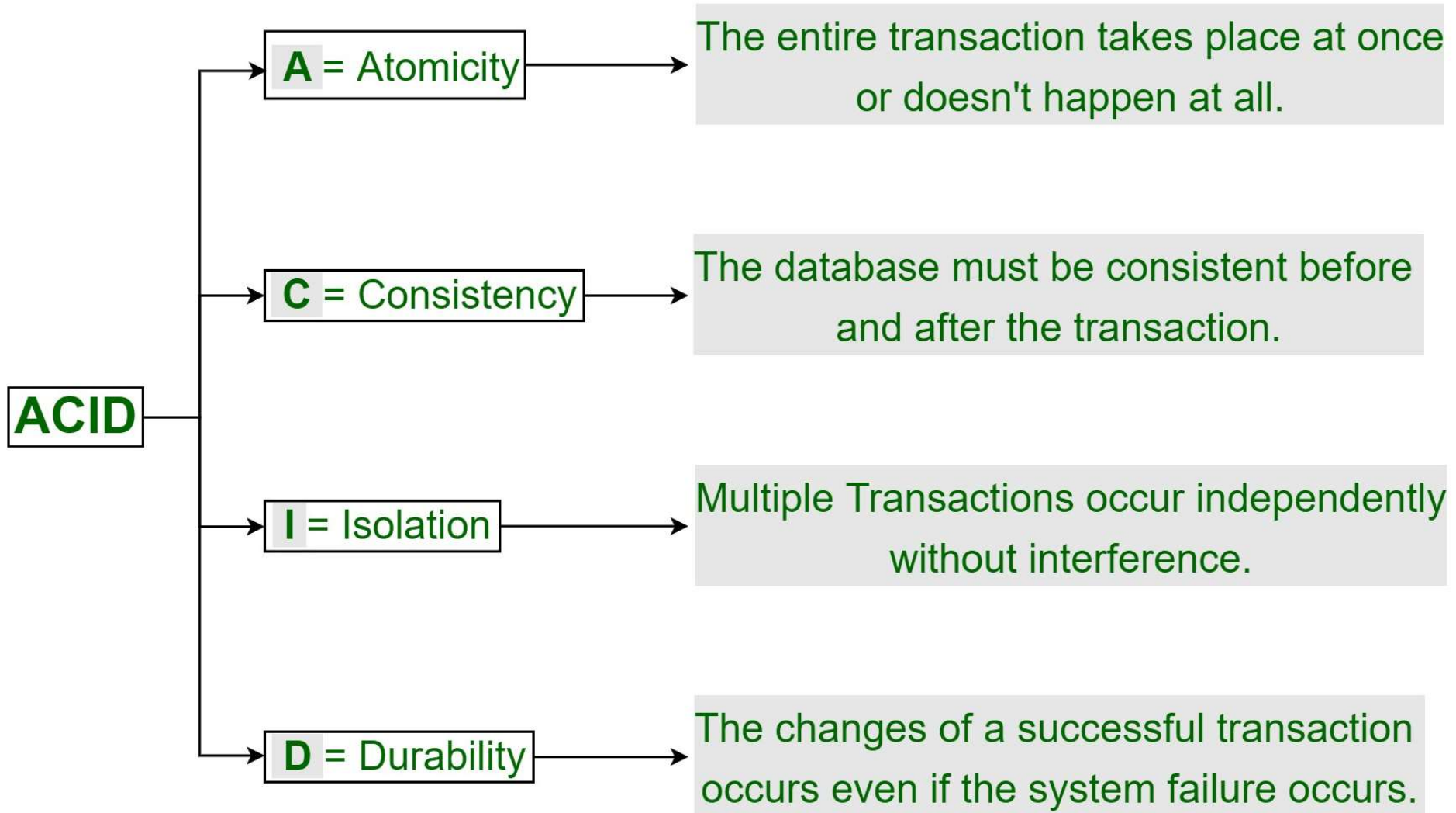
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- ✓ **Different File Types** – The file structure would vary based on the programming language that was used to store them, for example, if a system used COBOL to store certain data then the structure of that data would differ from the one written in C/C++.
- ✓ **Data Protection** – Data protection was very less due to different reasons like Data Redundancy, manual storing of data, easy access of confidential data by unauthorized parties, etc.
- ✓ **Issues with Transactions** – It didn't follow the ACID (Atomicity, Consistency, Isolation, and Durability) properties, for that if in the middle of any transaction the system crashed then it would leave the system in an inconsistent state.
- ✓ **Concurrent issues** – Two or more users can view the same file simultaneously, but the problem arises when they try to update the same file simultaneously.

ACID Properties



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What is Database Management Systems ?



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- ✓ **DBMS** stands for Database Management System. We can break it like this
DBMS = Database + Management System.
- ✓ Database is a collection of data and Management System is a set of programs to store and retrieve those data. Based on this we can define DBMS like this:

DBMS is a collection of inter-related data and set of programs to store & access those data in an easy and effective manner.

- ✓ For example: The college Database organizes the data about the admin, staff, students and faculty etc.

What is the need of DBMS ?



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- ✓ Database systems are basically developed for large amount of data. When dealing with huge amount of data, there are two things that require optimization: **Storage of data and retrieval of data.**
 - **Storage:** According to the principles of database systems, the data is stored in such a way that it acquires lot less space as the redundant data (duplicate data) has been removed before storage.
 - **Fast Retrieval of data:** Along with storing the data in an optimized and systematic manner, it is also important that we retrieve the data quickly when needed. Database systems ensure that the data is retrieved as quickly as possible.

- ✓ Here are some examples of popular DBMS used these days:
 - **MySql**
 - **Oracle**
 - **SQL Server**
 - **IBM DB2**
 - **PostgreSQL**
 - **Amazon SimpleDB (cloud based) etc**

- ❑ Depending on the **number of users accessing** the database, a database system may be classified as
 - **Single-user Database System:** It supports only one user at a time. When a single-user database runs on a personal computer, it is also called a desktop database system
 - **Multi-User Database System:** It supports multiple users at the same time. When a multi-user database supports relatively small number of users, it is called as a workgroup database system. If the database is used by many users across globe, it is known as enterprise database system.
- ❑ Depending on the **location of the database**, a database system may be classified as:
 - **Centralized Database System:** It supports data located at a single site or single place
 - **Distributed Database System:** It supports data distributed across several different sites. Here, the same database can be replicated and stored in another computer so that when ever the original server goes down; the data can be available to the user from the replicated data from other servers.

- ✓ **Banking** : for customer information, accounts and loans and banking transactions.
- ✓ **Universities** : for student registrations and grades.
- ✓ **Airlines** : for reservations and schedule information.
- ✓ **Library Management System** : maintain all the information relate to book issue dates, name of the book, author and availability of the book.
- ✓ **Telecommunications** : for keeping records of call made, generating monthly bills, maintaining balances on prepaid calling cards.
- ✓ **Sales** : for customer, product and purchase information.
- ✓ **Finance** : for storing information about holdings, sales, and purchases of financial instruments such as stocks and bonds.
- ✓ **Human Resource** : for information about employees, salaries, payroll taxes and benefits
- ✓ **Manufacturing** : for management of supply chain and for tracking production of items in factories, inventories of items and orders for items.
- ✓ **Medical Sector**
- ✓ **Military**
- ✓ **Airline Reservation system**

Advantage of DBMS over file system



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- ✓ **Controlling of Redundancy** : Data redundancy refers to the duplication of data (i.e. storing same data multiple times). In a database system, by having a centralized database and centralized control of data by the DBA the unnecessary duplication of data is avoided. It also eliminates the extra time for processing the large volume of data. It results in saving the storage space
- ✓ **Improved Data Sharing** : DBMS allows a user to share the data in any number of application programs
- ✓ **Data Integrity** : Integrity means that the data in the database is accurate. Centralized control of the data helps in permitting the administrator to define integrity constraints to the data in the database. For example: in customer database we can enforce an integrity that it must accept the customer only from Noida and Meerut city.
- ✓ **Security** : Having complete authority over the operational data, enables the DBA in ensuring that the only mean of access to the database is through proper channels. The DBA can define authorization checks to be carried out whenever access to sensitive data is attempted.
- ✓ **Efficient Data Access** : In a database system, the data is managed by the DBMS and all access to the data is through the DBMS providing a key to effective data processing

Advantage of DBMS over File System



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- ✓ **Data Consistency** : By eliminating data redundancy, we greatly reduce the opportunities for inconsistency. For example: if a customer address is stored only once, we cannot have disagreement on the stored values. Also updating data values is greatly simplified when each value is stored in one place only. Finally, we avoid the wasted storage that results from redundant data storage.
- ✓ **Data Independence** : In a database system, the database management system provides the interface between the application programs and the data. When changes are made to the data representation, the meta data obtained by the DBMS is changed but the DBMS continues to provide the data to application program in the previously used way. The DBMS handles the task of transformation of data wherever necessary.
- ✓ **Enforcing Integrity Constraints**
- ✓ **Providing Backup & Recovery**
- ✓ **Providing Storage Structures for efficient query processing**

- ✓ **Increased Complexity**
- ✓ **Requirement of New and Specialized Manpower**
- ✓ **Large Size of DBMS**
- ✓ **DBMS implementation cost is high compared to the file system**
- ✓ **Performance:** Database systems are generic, making them suitable for various applications. However this feature affect their performance for some applications

DBMS vs. File System



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| DBMS | File System |
|--|--|
| •Minimal data redundancy problem in DBMS | •Data Redundancy problem exists |
| •Data Inconsistency does not exist | •Data Inconsistency exist here |
| •Accessing database is easier | •Accessing is comparatively difficult |
| •The problem of data isolation is not found in database | •Data is scattered in various files and files may be of different format, so data isolation problem exists |
| •Transactions like insert, delete, view, updating, etc are possible in database | •In file system, transactions are not possible |
| •Concurrent access and recovery is possible in database | •Concurrent access and recovery is not possible |
| •Security of data | •Security of data is not good |
| •A database manager (administrator) stores the relationship in form of structural tables | •A file manager is used to store all relationships in directories in file systems. |

**THANK
YOU!**