

Introduction: Overview of Database Systems

COMP 3380 - Databases: Concepts and Usage

Department of Computer Science
The University of Manitoba
Fall 2018

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What is a Database?

- ❖ A **database (DB)** is an organized collection of related data, usually stored on disk
- ❖ A DB typically models some real-world enterprise (e.g., a university)
 - Entities - such as students (e.g., Adam), courses (e.g., comp3380)
 - Relationships - such as students' enrolment in courses (e.g., Adam is taking comp3380)

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What is a DBMS?

- ❖ A **database management system (DBMS)** is a software package designed to store & manage the DB
- ❖ A **database system** consists of (i) a DB & (ii) a DBMS
- ❖ DBMS is used to:
 - define a database
 - construct the database (i.e., store the data on some storage medium; provide loading, backup, & recovery)
 - manipulate a database (e.g., modify & query a DB)
 - share a database (e.g., control access, permit concurrent access, maintain integrity)
 - support additional data management functions

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What is a DBMS?

- ❖ DBMS provides an environment that is both *convenient* and *efficient* to use
- ❖ Applications:
 - Banking - all transactions
 - Airlines - reservations, schedules
 - Universities - registration, grades
 - Sales - customers, products, purchases
 - Manufacturing - production, inventory, orders, supply chain
 - Human resources - employee records, salaries, tax deductions

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Purposes of DBMS

- ❖ In early days:
 - Used **file systems** to store data
- ❖ Drawbacks of using file systems:
 1. Difficulty in accessing data
 - Need to write a new program to carry out each new task
 2. Data redundancy and inconsistency
 - Multiple file formats, duplication of information in different files

Purposes of DBMS

- ❖ Drawbacks of using file systems:
 3. Integrity problems
 - Integrity constraints (e.g., account balance ≥ 0) become part of program code
 - Hard to add new constraints or change existing ones
 4. Security problems
 5. Concurrent-access anomalies
 - Concurrent accesses needed for performance
 - Uncontrolled concurrent accesses can lead to inconsistencies (e.g., two people reading a balance and updating it at the same time)

Purposes of DBMS

- ❖ Drawbacks of using file systems:
 6. Atomicity of updates
 - Failures may leave database in an inconsistent state with partial updates carried out (e.g., transfer of funds from one account to another should either complete or not happen at all)
 7. Data isolation
 - Data are scattered in various files, & files may be in different formats

Why Use a DBMS?

1. **Data independence** and efficient access, reduced application development time
2. Control/Elimination of redundancy and inconsistency
3. Data integrity
4. Security (e.g., restriction of unauthorized access)
5. Concurrent access
6. Backup & recovery from crashes
7. Uniform data administration (centralized control)

Why Study Databases?

- ❖ Shift from *computation* to *information*
 - Unstructured data (e.g., notes, ad hoc files)
 - Semi-structured data (e.g., Web pages)
 - Databases (highly organized)
- ❖ Datasets increasing in diversity and volume
 - Digital libraries, interactive video, Human Genome project, NASA's Earth Observing System (EOS) project, etc.
 - **Amount of information in the world doubles approximately every 18 months**
- ❖ DBMS encompasses most of CS
 - OS, languages, theory, AI, multimedia, logic, etc.

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Data Models: Describing & Storing Data in DBMS

- ❖ A **data model** is a collection of concepts for describing data, data relationships, data semantics, data constraints
 - **High-level data description constructs that hide many low-level storage details**
- ❖ Examples:
 1. **Relational model - most widely used model**
 - **Relations** are basically tables with rows & columns
 2. **Entity-relationship model**
 - **Entities** are relations (i.e., tables with rows & column)
 - **Relationships** describe association between entities

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Example 1: Relational Model

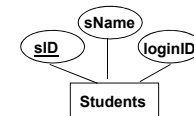
Students

sID	sName	loginID
3666	Adam	adam@cs
3688	Ben	ben@ece
3750	Carl	carl@math

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Example 1: ER Model



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