Chapter 1

Applications of Database

A business organisation that generates lots of transactional data

(From the business perspective) – What are the important information to know?

Which are the top 100 selling products?

Top 100 most profitable products?

What is the contribution(%) of each product to total profit?

Which items are always bought together?

What would be the programming effort required to write programs to answer the above question?

If you have a database system, all these questions could be answered rather quickly and easily.

(From the technical implementation perspective) – system must be efficient in supporting requirements

Amount of transaction per unit time?

No. of concurrent user support?

Duration of data storage?

Data warehousing requirement?

Database distribution strategy? (and much more…)

If you have a DBMS, all these questions could be implemented.

Lesson Outline

- **Applications of database**
  - DBMS in an enterprise system context
  - DBMS in application development environment

Lesson Objectives

- Examples of database applications
- Definitions of terms
- History and development of database processing
- Purpose of database applications

Importance of Databases to Economy

- Expanding use of databases in retail sales
  - Walmart, retail sales information tracking
  - Walmart worldwide no. of stores
  - **10,586 stores and clubs in 24 countries (2022)**
  - **1 million transaction per hour (how many per second?)**
- Examples of analyses – information for decision making
  - Sales of items
    - Comparisons between daily totals of items sold and items in inventory
    - Seasonal variations in sales of specific and similar items
    - Relative sales of similar items with different features
  - Market-basket collections (all items in a single purchase)
    - Average and variation in total purchase amount
    - Average and variation in number and price of items
    - Correlation between sales of items in a single purchase
  - Customer analysis
    - Behavior of average customer
    - Preferences of individual customers

Applications of database

DBMS in an enterprise system context

Application Areas of Database System

- **Airlines and railways:** Airlines and railways use online databases for reservation, and for displaying the schedule information.
- **Banking:** Banks use databases for customer inquiry, accounts, loans, and other transactions.
- **Education:** Schools and colleges use databases for course registration, result, and other information.
- **Telecommunications:** Telecommunication departments use databases to store information about the communication network, telephone numbers, record of calls, for generating monthly bills, etc.
- **Credit card transactions:** Databases are used for keeping track of purchases on credit cards in order to generate monthly statements.
- **E-commerce:** Integration of heterogeneous information sources (for example, catalogs) for business activity such as online shopping, booking of holiday package, consulting a doctor, etc.
- **Health care information systems and electronic patient record:** Databases are used for maintaining the patient health care details.
- **Digital libraries and digital publishing:** Databases are used for management and delivery of large bodies of textual and multimedia data.
- **Finance:** Databases are used for storing information such as sales, purchases of stocks and bonds or data useful for online trading.
- **Sales:** Databases are used to store product, customer and transaction details.
- **Human resources:** Organizations use databases for storing information about their employees, salaries, benefits, taxes, and for generating salary checks.

Examples of Database Applications

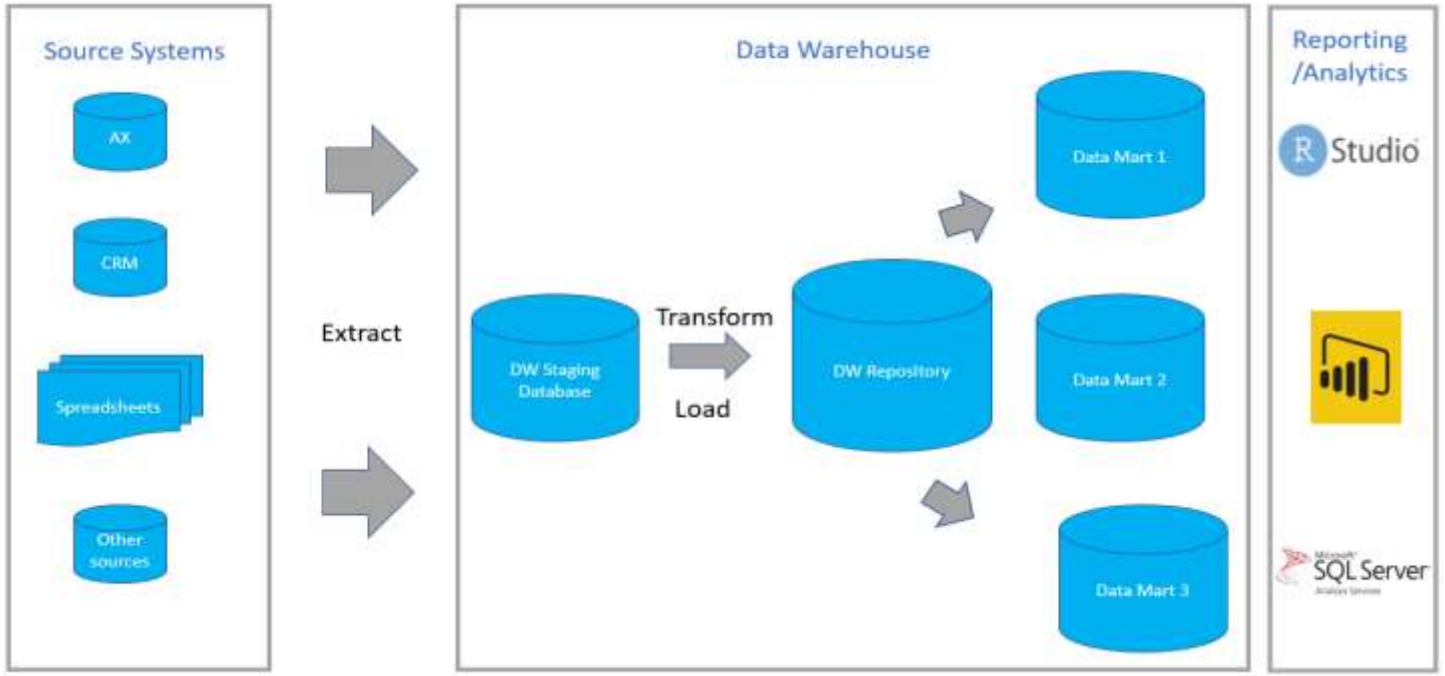
- Purchases from the supermarket
  - https://myaeon2go.com/
- Purchases using your credit card
  - www.amazon.com
- Booking a holiday at the travel agents
  - www.expedia.com.my
- Using the local library
  - https://pnm.overdrive.com/
- Property management
  - www.knightfrank.com.my
- Banking transaction
  - www.maybank2u.com.my

Main use of DBMS in Organizations

- Enterprise applications
  - Enterprise resource planning (ERP) systems
    - Enterprise Resource Planning (ERP) system integrates systems across an enterprise to streamline workflow, share information among different departments, and provide insight into a business's operations.

Main use of DBMS in Organizations

- Enterprise applications
  - Data warehousing implementations
    - Database used for reporting and data analysis. Integrating data from one or more disparate sources creates a central repository of data, a data warehouse



Source: Stoneridge software,2019

Main use of DBMS in Organizations

- Enterprise applications
  - Big Data Analytics
    - The process of collecting, organizing and analyzing large sets of data to discover patterns and useful information

Initial Vocabulary

- Data: raw facts about things and events
- Information: transformed data that has value for decision making
- Essential to organize data for retrieval and maintenance

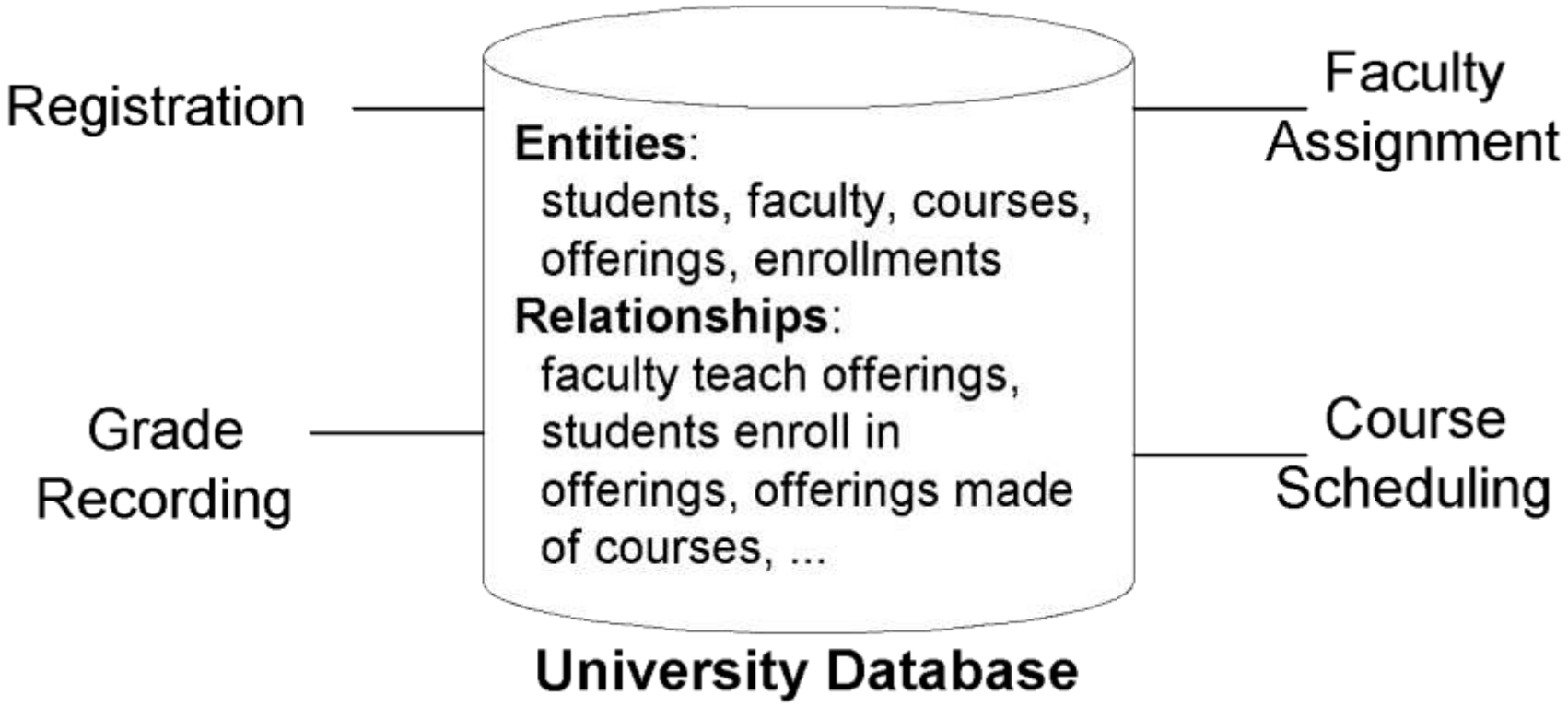
Which are the top 100 selling products?

Increase prices all food product by 10% due to increase in price of sugar

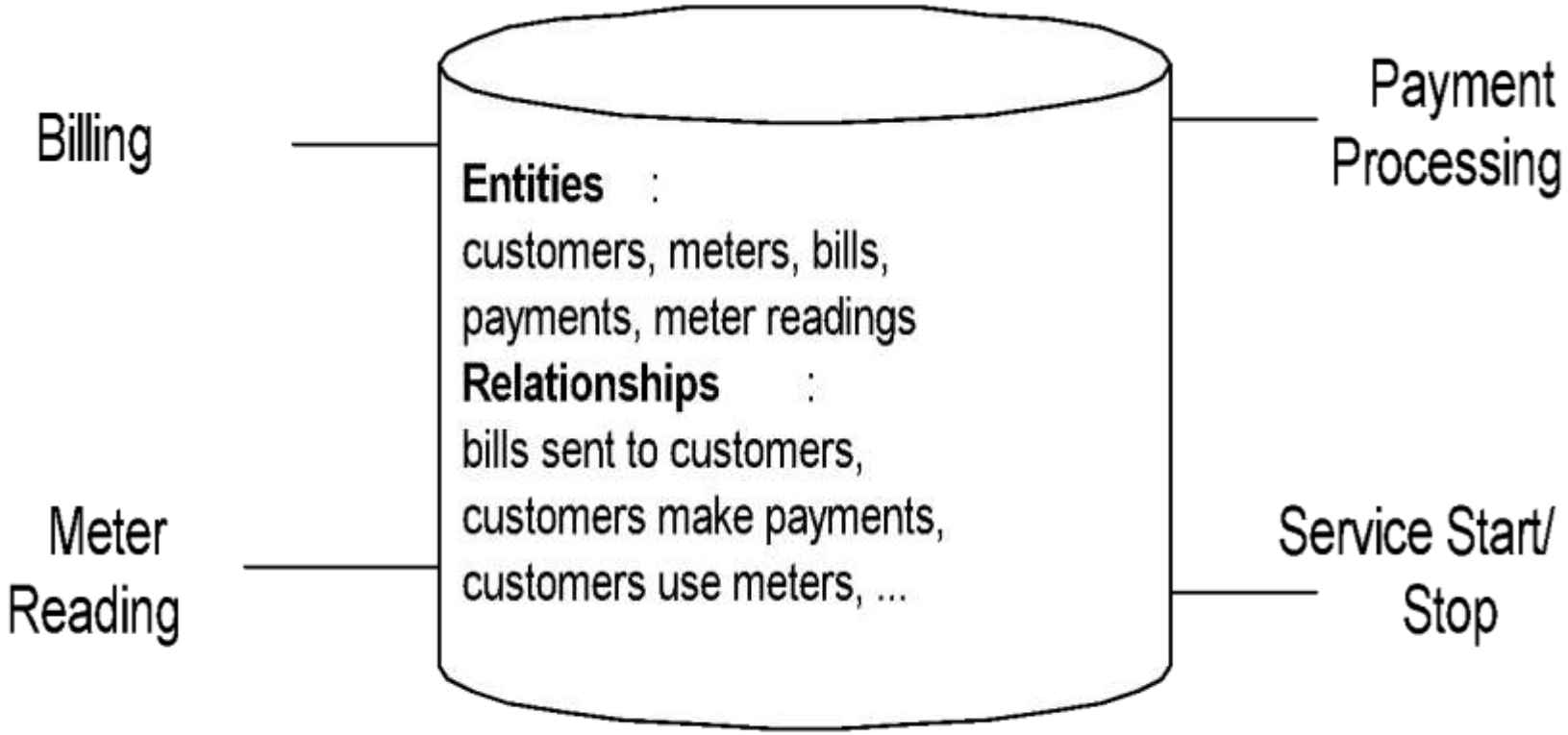
Database Characteristics

- Persistent
  - Lasts a long time (not transient)
  - Lasts longer than the execution of a computer program
  - Data is stored to a persistent media once a transaction is completed (committed) so that it can be retrieved when needed
- Inter-related
  - Stores entities and relationships among the entities
  - Entity: cluster of data about a topic (customer, student, loan)
  - Relationship: connection among entities
- Shared
  - Multiple uses: hundreds to thousands of data entry screens and reports
  - Multiple users: many people simultaneously use a database

University Database



Water Utility Database



Database Technology Evolution

GENERATION	TIME	DATA MODEL	EXAMPLES	COMMENTS
First	1960s–1970s	File system	VMS/VSAM	Used mainly on IBM mainframe systems Managed records, not relationships
Second	1970s	Hierarchical and network	IMS, ADABAS, IDS-II	Early database systems Navigational access
Third	Mid-1970s	Relational	DB2 Oracle MS SQL Server MySQL	Conceptual simplicity Entity relationship (ER) modeling and support for relational data modeling
Fourth	Mid-1980s	Object-oriented Object/relational (O/R)	Versant Objectivity/DB DB2 UDB Oracle 12c	Object/relational supports object data types Star Schema support for data warehousing Web databases become common
Fifth	Mid-1990s	XML Hybrid DBMS	dbXML Tamino DB2 UDB Oracle 12c MS SQL Server	Unstructured data support O/R model supports XML documents Hybrid DBMS adds object front end to relational databases Support large databases (terabyte size)
Emerging Models: NoSQL	Early 2000s to present	Key-value store Column store	SimpleDB (Amazon) BigTable (Google) Cassandra (Apache) MongoDB Riak	Distributed, highly scalable High performance, fault tolerant Very large storage (petabytes) Suited for sparse data Proprietary application programming interface (API)

Database Systems: Design, Implementation, & Management, 12th Edition, Rob & Coronel

Additional Reading: What is DBMS Advantages and Disadvantages of DBMS.htm

Purpose of Database System

- Prior to the availability of DBMSs, database applications were built on top of file systems – coded from the ground up.

- Drawbacks of this approach:
  - Difficult to reprogram sophisticated processing, i.e., concurrency control, backup and recovery, security
  - Re-inventing the wheel can be expensive and error-prone
    - "We need a truck, lets design and build our own truck."
    - i.e. Need to rewrite code for a program/system that is already working but not compatible with the current system
- This leads to:
  - Data redundancy and inconsistency
  - Multiple files and formats
  - A new program to carry out each new task
  - Integrity constraints (e.g. account balance > 0) become embedded throughout program code, etc.
- Database systems offer proven solutions for the above problems.

Applications of database

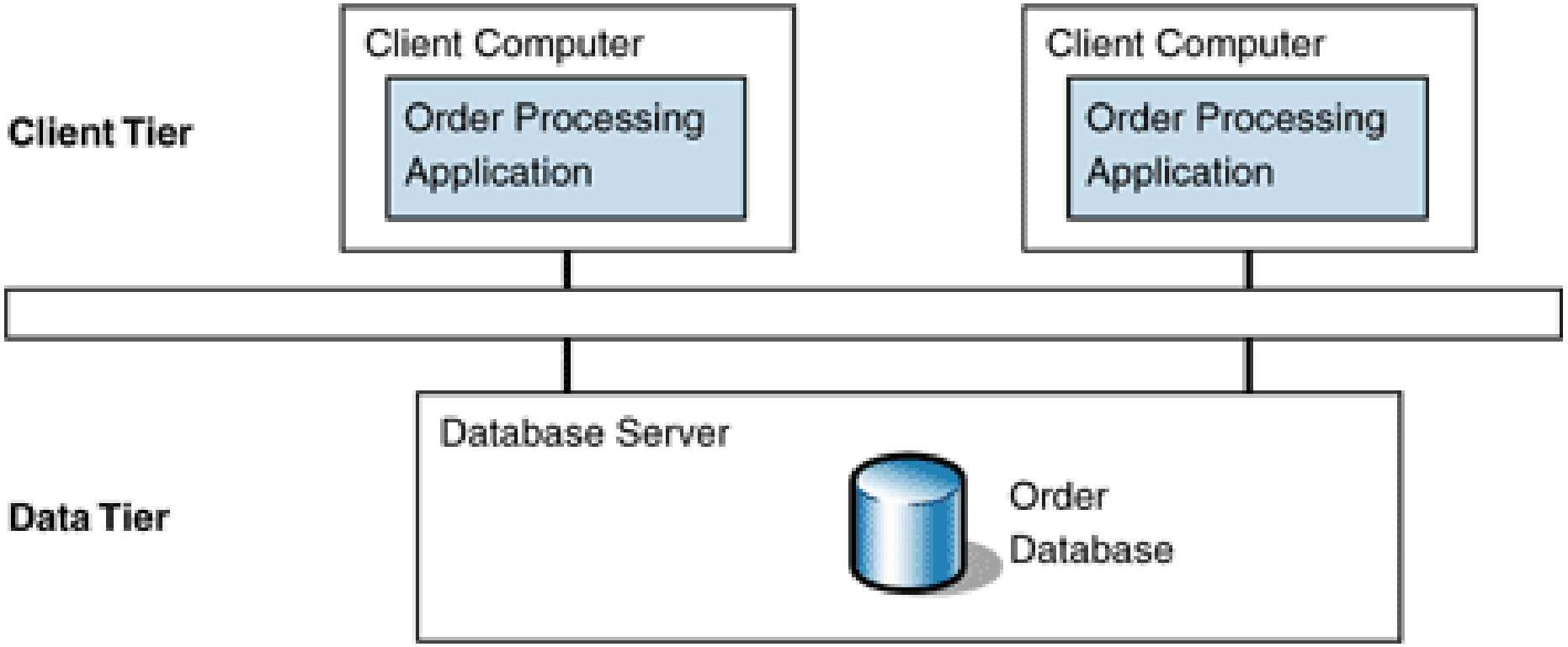
DBMS in application development environment

The Range of Database Applications

- Personal databases

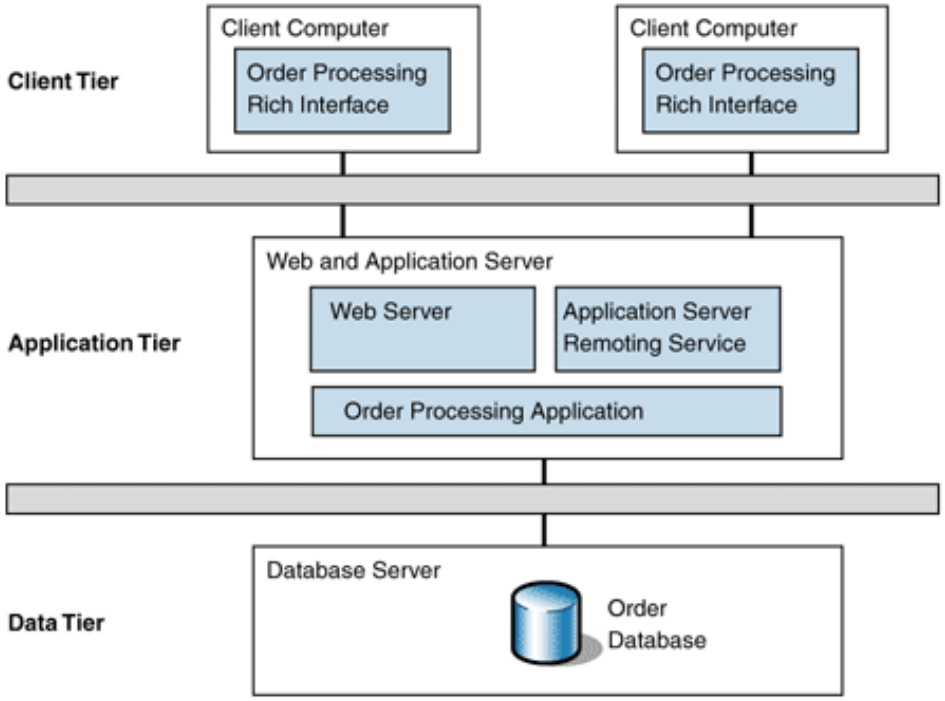
The Range of Database Applications

- Two-tier Client/Server databases

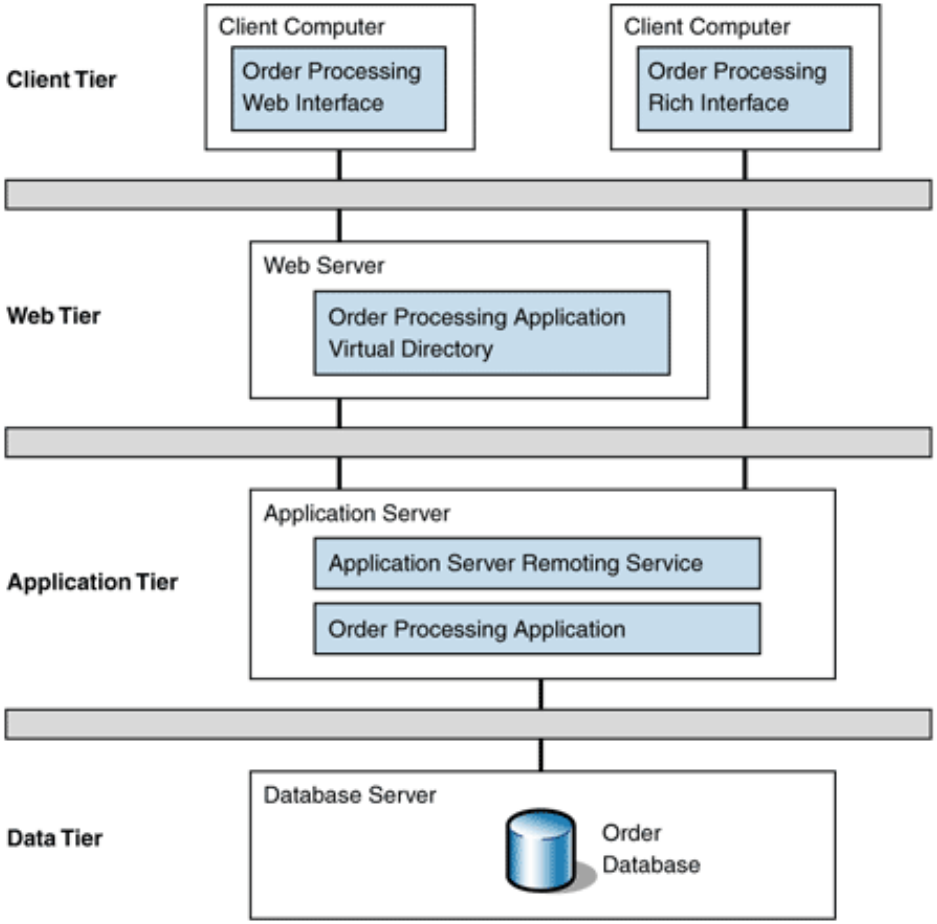


The Range of Database Applications

- Multitier Client/Server databases



3-tier



4-tier

Applications, the DBMS, and SQL

- **Applications** are the computer programs that users work with.
- The **Database Management System (DBMS)** is a software suite that creates, processes, and administers databases.
- **Structured Query Language (SQL)** is an internationally recognized standard database language that is used by all commercial DBMSs.

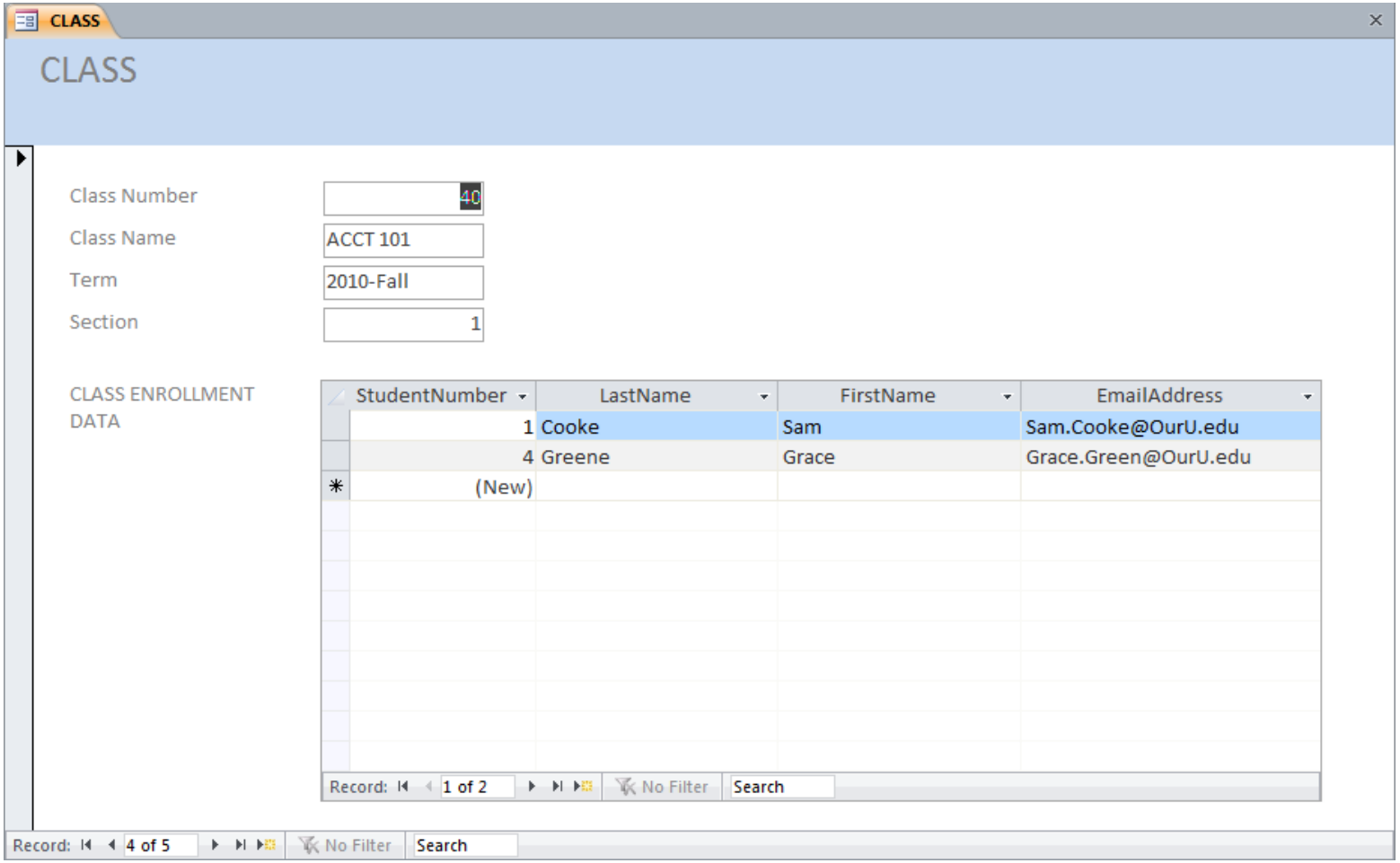
Database Applications

A DBMS has features to:

- Create and process forms
- Process user queries
- Create and process reports
- Execute application logic
- Control application

(you will learn some of these features in the lab practical and in other courses)

Database Applications—Forms



A very useful reporting tool

Database Applications—Queries

```
SELECT     LastName, FirstName, EmailAddress
FROM       STUDENT
WHERE      StudentNumber > 2;
```

Very simple English-like phrases that can be easily understood even by the end-users

Database—Reports

Class Grade Report

ClassNumber	ClassName	Term	Section	LastName	FirstName	Grade
10	CHEM 101	2010-Fall	1			
				Cooke	Sam	3.7
20	CHEM 101	2010-Fall	2			
				Lau	Marcia	3.7
30	CHEM 101	2011-Spring	1			
				Harris	Lou	3.1
40	ACCT 101	2010-Fall	1			
				Cooke	Sam	3.5
				Greene	Grace	3.0
50	ACCT 101	2011-Spring	1			
				Greene	Grace	3.5

Reports in a variety of formats can be created in an ad-hoc manner

Summary

- Examples of database applications
- Definitions of terms
- History and development of database processing
- Purpose of database applications

Please refer to reference books and additional reading materials for more knowledge and information.