Advanced Database Management System

Relational, Object-Oriented, and Multidimensional Databases

What is a data model?

- Rules and standards that define how database organizes data
- Defines how users view organization of data
- Four popular data models
  - Relational
  - Object-oriented
  - Object-relational
  - Multidimensional

DATA MODELS FOR POPULAR DBMSs

Data Model	Popular DBMSs
Relational	Access Adabas Informix Ingres InterBase MySQL SQL Server Sybase Teradata
Object-oriented	FastObjects GemFire KE Texpress ObjectStore Versant
Object-relational	DB2 Oracle Polyhedra PostgreSQL Visual FoxPro Teradata
Multidimensional	D^3 Essbase Oracle Express Edition

Next

Relational, Object-Oriented, and Multidimensional Databases

What is a relational database?

- **Stores data in tables that consist of rows and columns**
  - Each row has primary key
  - Each column has unique name
- **Stores data relationships**
- **Uses specialized terminology**

DATA TERMINOLOGY

File Processing Environment	Relational Database Developer	Relational Database User
File	Relation	Table
Record	Tuple	Row
Field	Attribute	Column

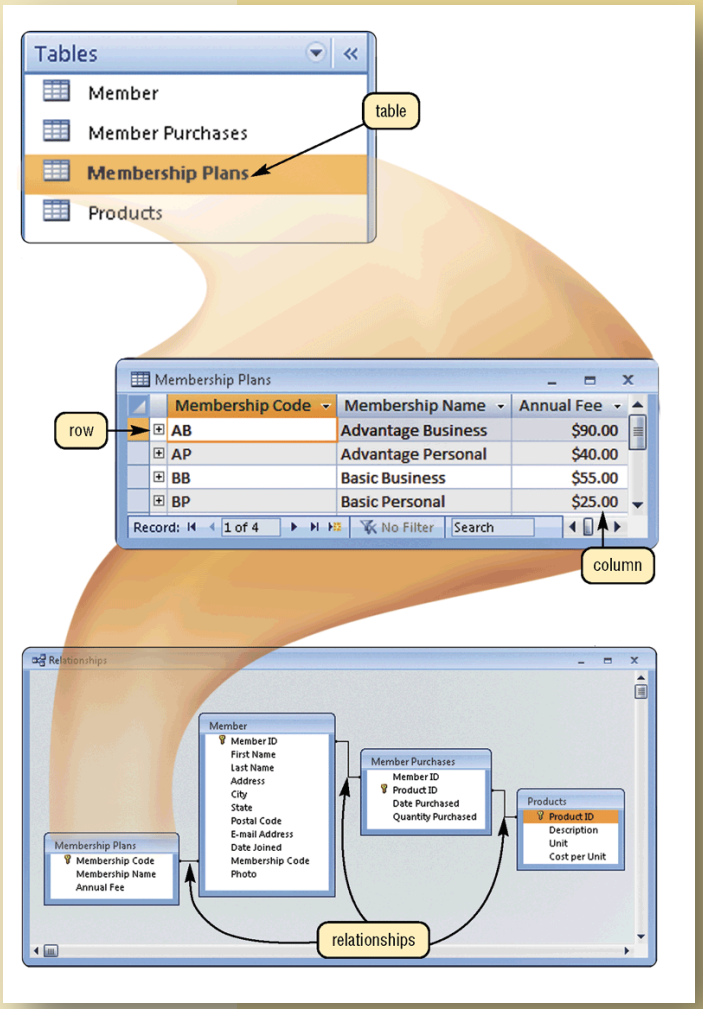
p. 533 Fig. 10-19

Next

Relational, Object-Oriented, and Multidimensional Databases

What is a relationship?

- Connection within data



p. 533 Fig. 10-20

Next

What is Structured Query Language (SQL)?

- Allows you to manage, update, and retrieve data
- Has special keywords and rules included in SQL statements

```
SELECT FIRST NAME, LAST NAME, ANNUAL FEE, ANNUAL FEE * .05
  AS EARLY PAY DISCOUNT
FROM MEMBER, MEMBERSHIP PLANS
WHERE MEMBER.MEMBERSHIP CODE =
  MEMBERSHIP PLANS.MEMBERSHIP CODE
ORDER BY LAST NAME
```

First Name	Last Name	Annual Fee	EarlyPayDiscount
Milton	Brewer	$90.00	$4.50
Louella	Drake	$40.00	$2.00
Elena	Gupta	$55.00	$2.75
Adelbert	Ruiz	$25.00	$1.25
Benjamin	Tu	$25.00	$1.25

Next

What is an object-oriented database (OODB)?

Stores data in objects

Object is item that contains data, as well as actions that read or process data

Advantages

- Can store more types of data
- Can access data faster
- Programmers can reuse objects

Often uses object query language (OQL)

Next

Relational, Object-Oriented, and Multidimensional Databases

What are examples of applications appropriate for an object-oriented database?

Multimedia databases

Store images, audio clips, and/or video clips

Groupware databases

Store documents such as schedules, calendars, manuals, memos, and reports

Computer-aided design (CAD) databases

Store data about engineering, architectural, and scientific designs

Hypertext databases

Contain text links to other documents

Web databases

Link to e-form on Web page

Next

What is a data warehouse?

Huge database system that stores and manages data required to analyze historical and current transactions

Quick and efficient way to access large amounts of data

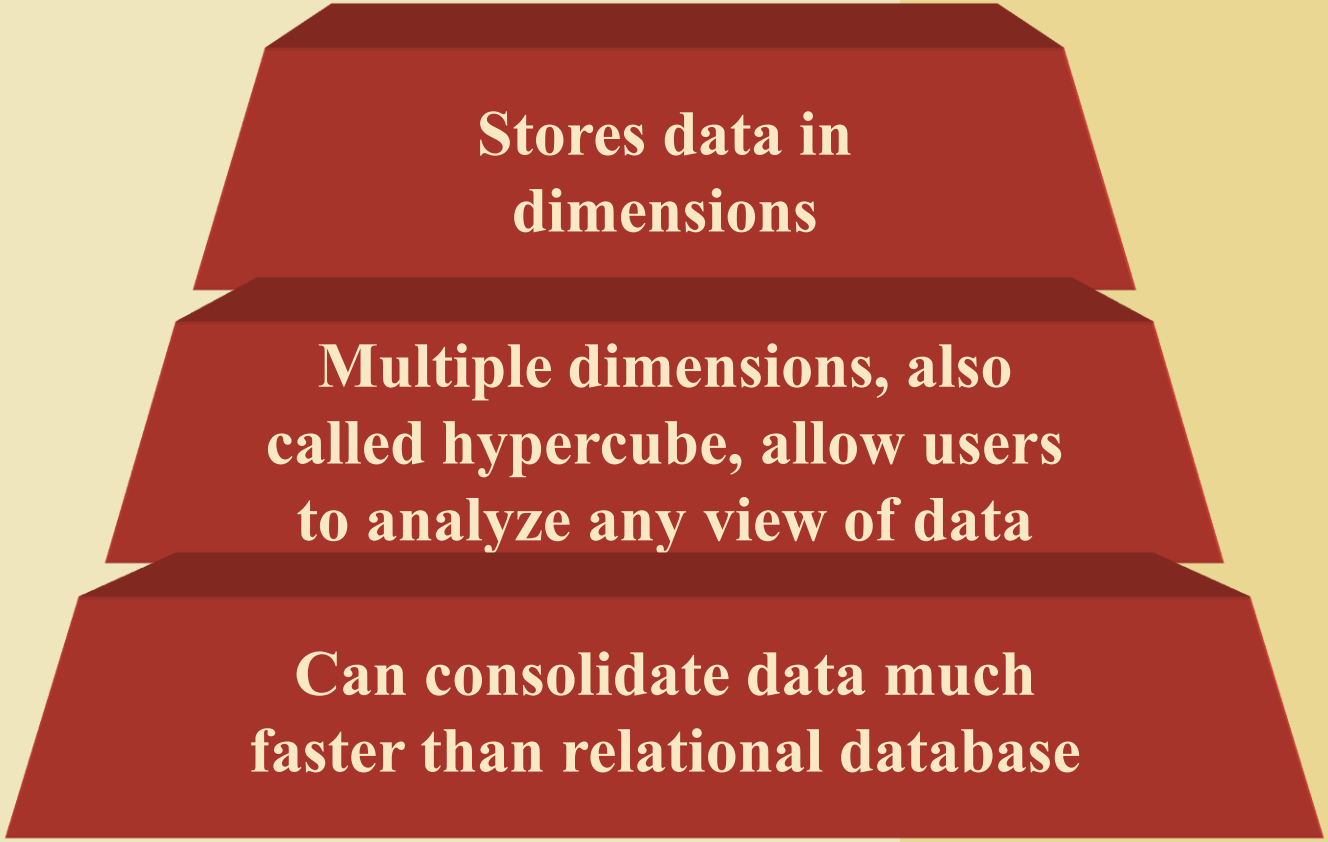
Often uses a process called data mining to find patterns and relationships among data

Uses multidimensional databases

Data mart is smaller version of data warehouse

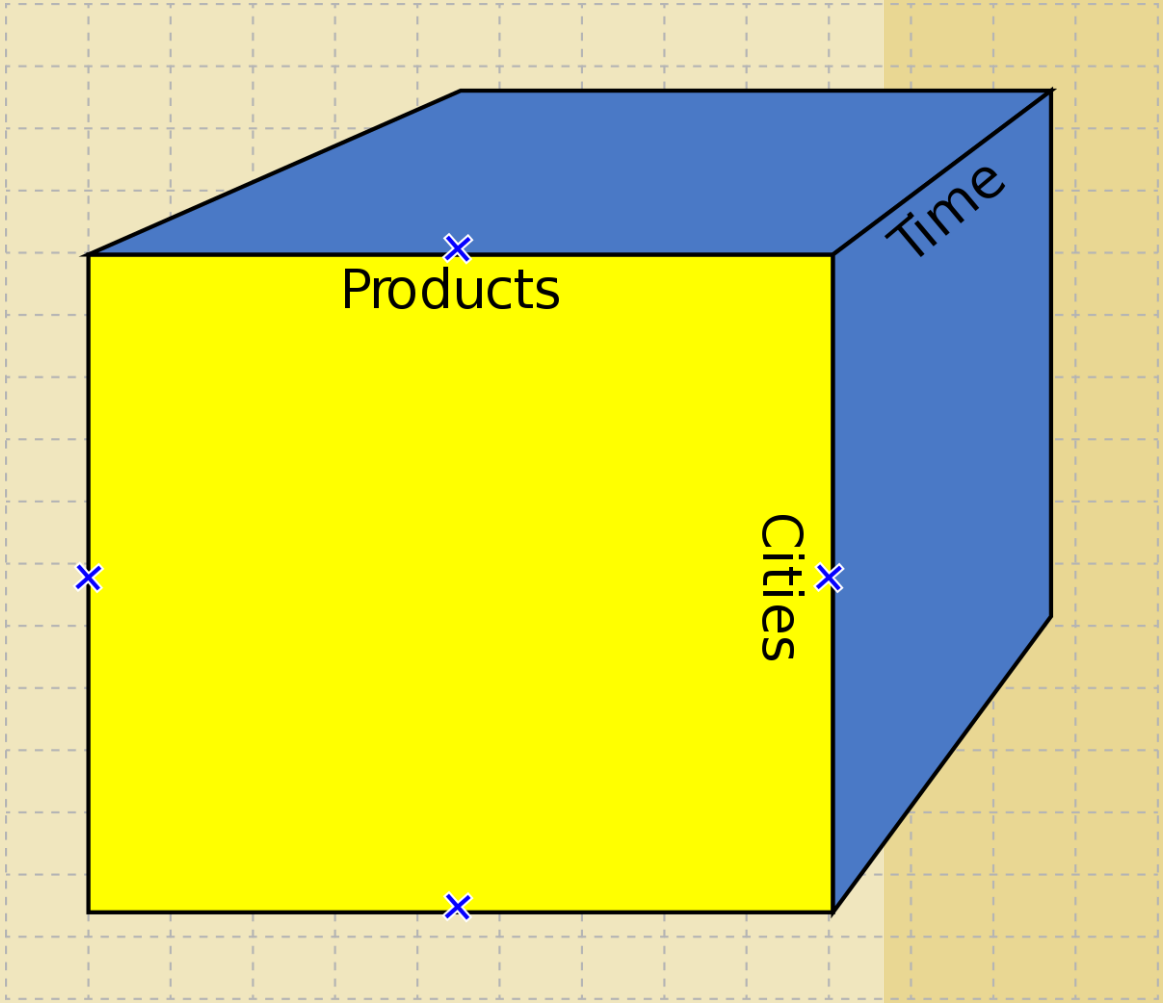
Next

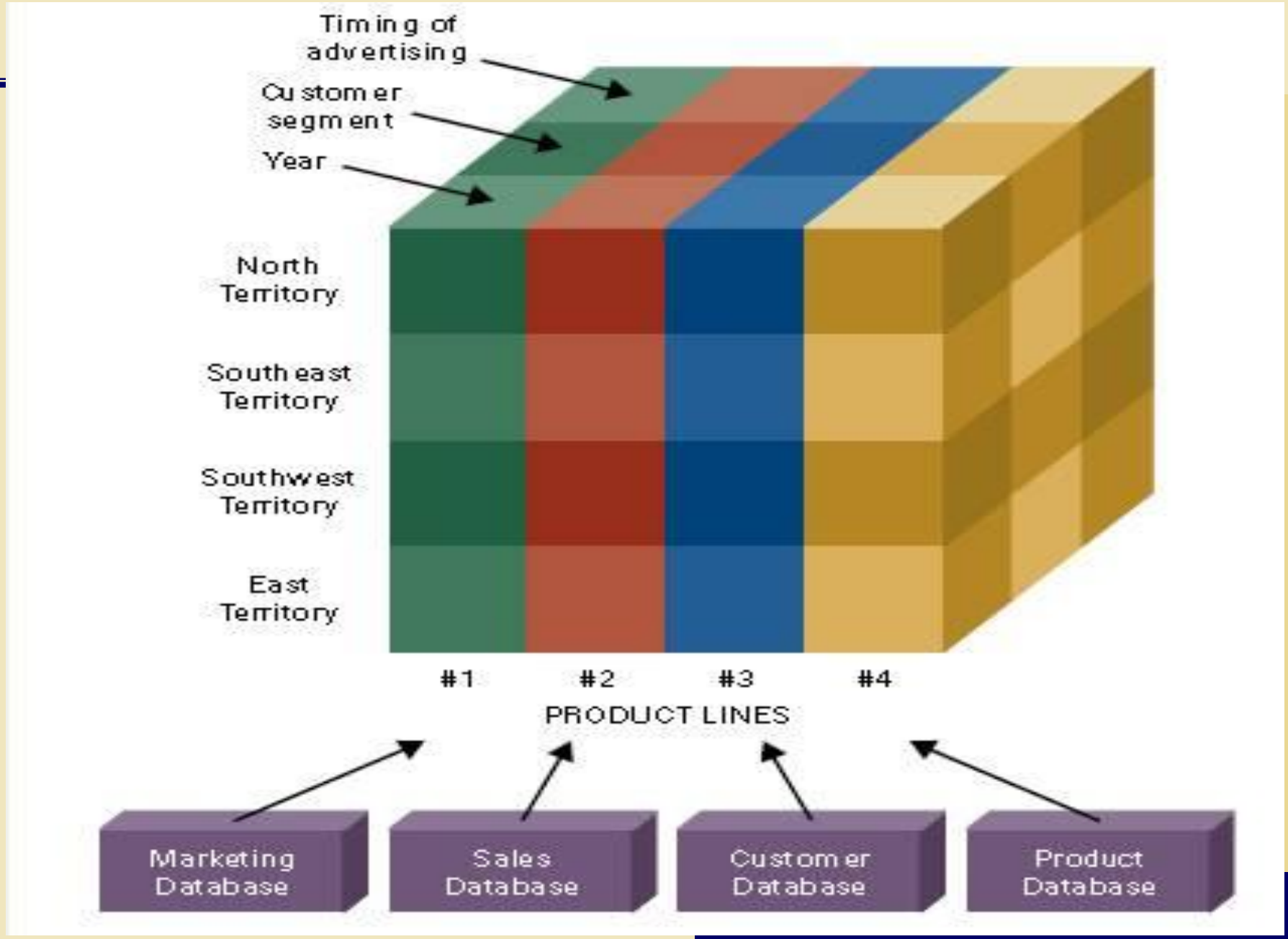
What is a multidimensional database?



Next

Hypercube:

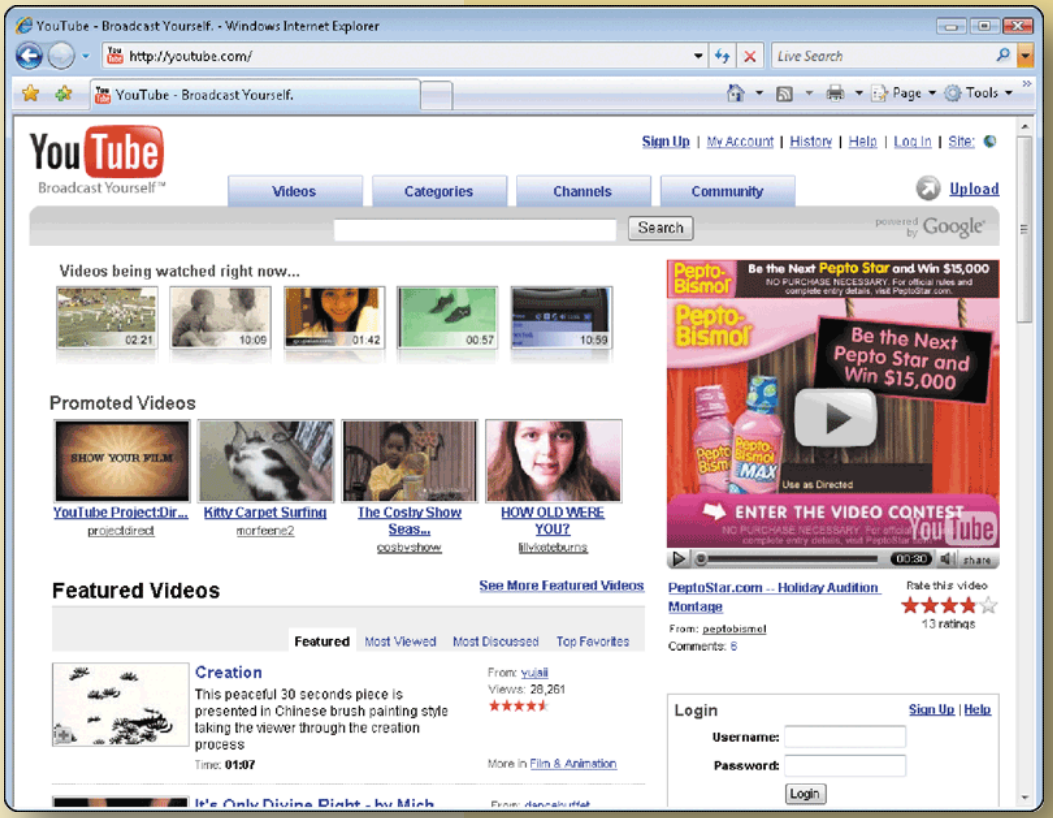



Timing of advertising
Customer segment
Year
North Territory
Southeast Territory
Southwest Territory
East Territory
#1
#2
#3
#4
PRODUCT LINES
Marketing Database
Sales Database
Customer Database
Product Database

Web Databases

What is a Web database?

- Database you access through the Web by filling in a form on a Web page
- Usually resides on a database server, a computer that stores and provides access to a database



Next

Database Administration

What are guidelines for developing a database?

1. **Determine the purpose of the database**

2. **Design the tables**
   - Design tables on paper first
   - Each table should contain data about one subject

3. **Design the records and fields for each table**
   - Be sure every record has a unique primary key
   - Use separate fields for logically distinct items
   - Do not create fields for information that can be derived from entries in other fields
   - Allow enough space for each field
   - Set default values for frequently entered data

4. **Determine the relationships among the tables or files**

Next

Database Administration

What is the role of the database analyst and administrator?

Database analyst (DA)

- Focuses on meaning and usage of data
- Decides proper placement of fields, defines relationships, and identifies users' access privileges

Database administrator (DBA)

- Creates and maintains data dictionary, manages database security, monitors database performance, and checks backup and recovery procedures

Next

Summary of Database Management

- How data and information are valuable assets to an organization
- Methods for maintaining high-quality data
- Assessing the quality of valuable information
- Advantages of organizing data in a database
- Various types of databases
- Role of the database analysts and administrators

Chapter 10 Complete

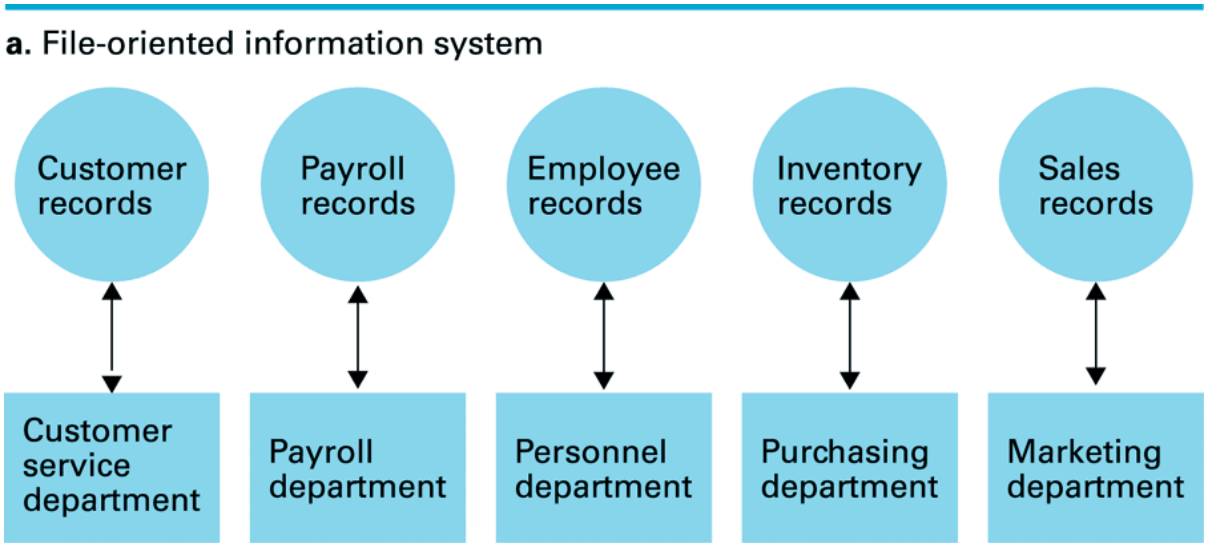
CHAPTER 9

Database Structures

- (Large) integrated collections of data that can be accessed quickly

9.1: Historical Perspective

- Originally: departments of large organizations stored all data separately in *flat files*

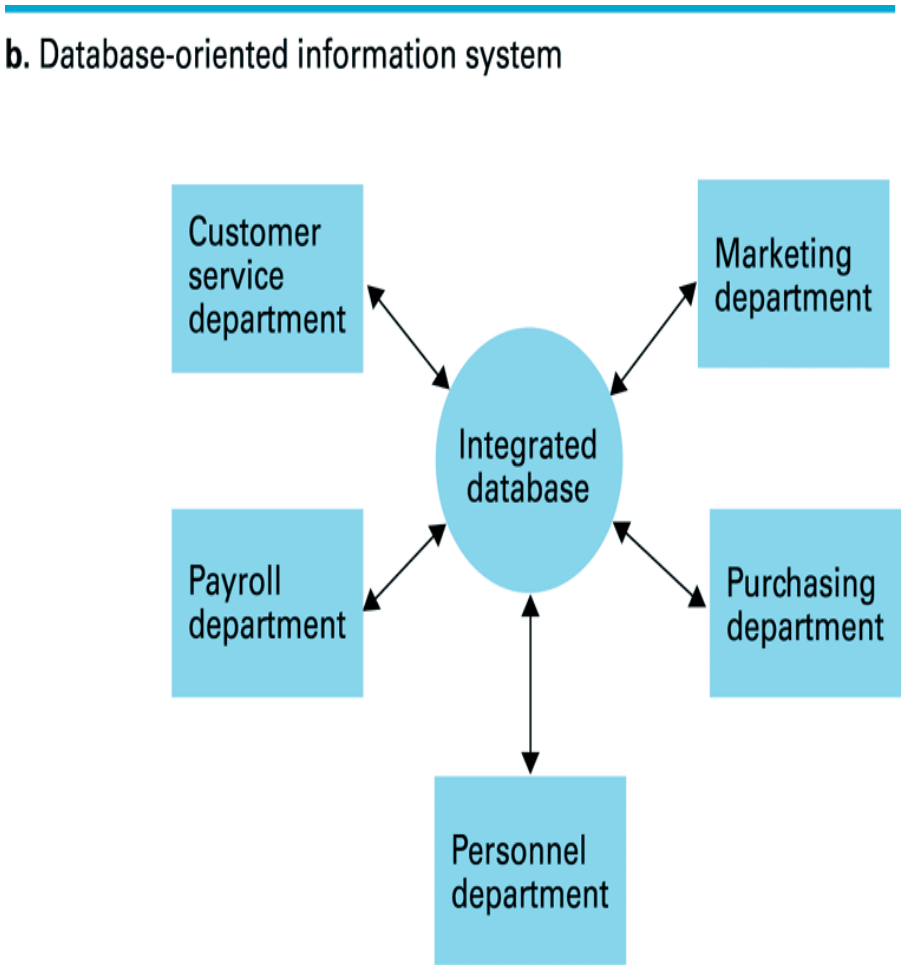


- Problems: redundancy & inconsistencies

9.1: Integrated Database System

- Better approach: integrate all data in a single system, to be accessed by all departments.
- Schema and Subschema

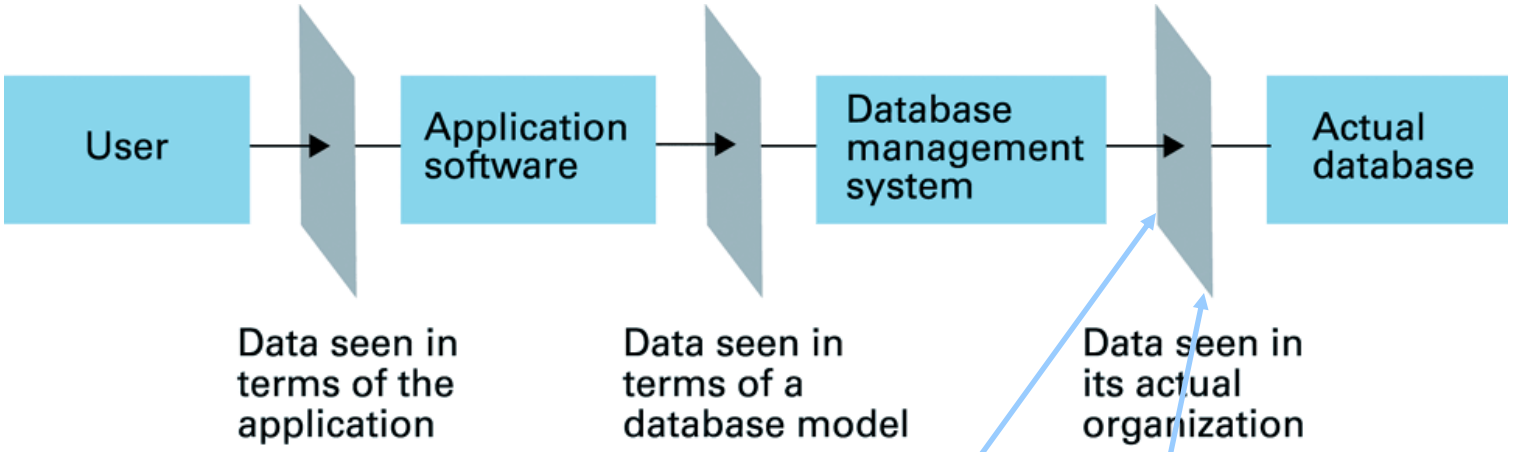
Example:
University student and faculty records



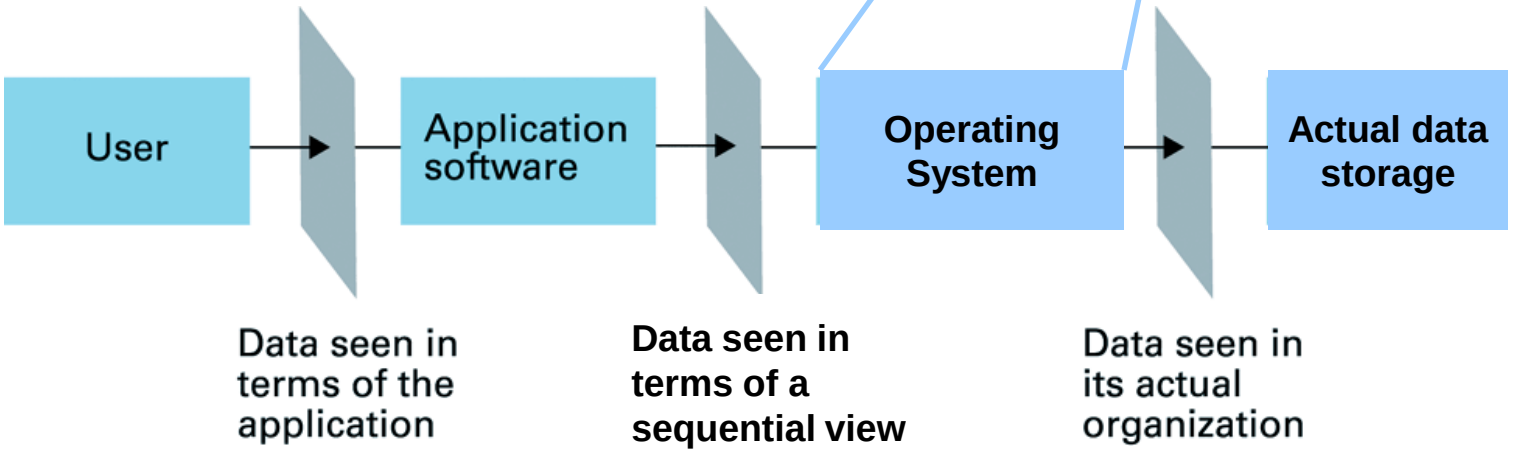
9.1: Disadvantages of Data Integration

- Control of access to sensitive data?
- Misinterpretation of integrated data?
- What about the **right** to hold/collect/interpret data?

9.2: Conceptual Database Layers



- Compare:



9.3: The Relational Model

- Relational Model
  - shows data as being stored in rectangular tables, called *relations*, e.g.:

Empl Id	Name	Address	SSN
25X15	Joe E. Baker	33 Nowhere St.	111223333
34Y70	Cheryl H. Clark	563 Downtown Ave.	999009999
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555
•	•	•	•
•	•	•	•
•	•	•	•

  - row in a relation is called '*tuple*'
  - column in a relation is called '*attribute*'

9.3: Issues of Relational Design

- So, *relations* make up a relational database…
- … but this is not so straightforward:

Empl Id	Name	Address	SSN	Job Id	JobTitle	Skill Code	Dept	Start Date	Term Date
25X15	Joe E. Baker	33 Nowhere St.	111223333	F5	Floor manager	FM3	Sales	9-1-2001	9-30-2002
25X15	Joe E. Baker	33 Nowhere St.	111223333	D7	Dept. head	K2	Sales	10-1-2002	*
34Y70	Cheryl H. Clark	563 Downtown Ave.	999009999	F5	Floor manager	FM3	Sales	10-1-2001	*
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555	S25X	Secretary	T5	Personnel	3-1-1999	4-30-2001
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555	S25Z	Secretary	T6	Accounting	5-1-2001	*
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•

- Problem: more than one concept combined in single relation

9.3: Redesign by extraction of 3 concepts

EMPLOYEE relation

Empl Id	Name	Address	SSN
25X15	Joe E. Baker	33 Nowhere St.	111223333
34Y70	Cheryl H. Clark	563 Downtown Ave.	999009999
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555
•	•	•	•
•	•	•	•
•	•	•	•

JOB relation

Job Id	JobTitle	Skill Code	Dept
S25X	Secretary	T5	Personnel
S26Z	Secretary	T6	Accounting
F5	Floor manager	FM3	Sales
•	•	•	•
•	•	•	•
•	•	•	•

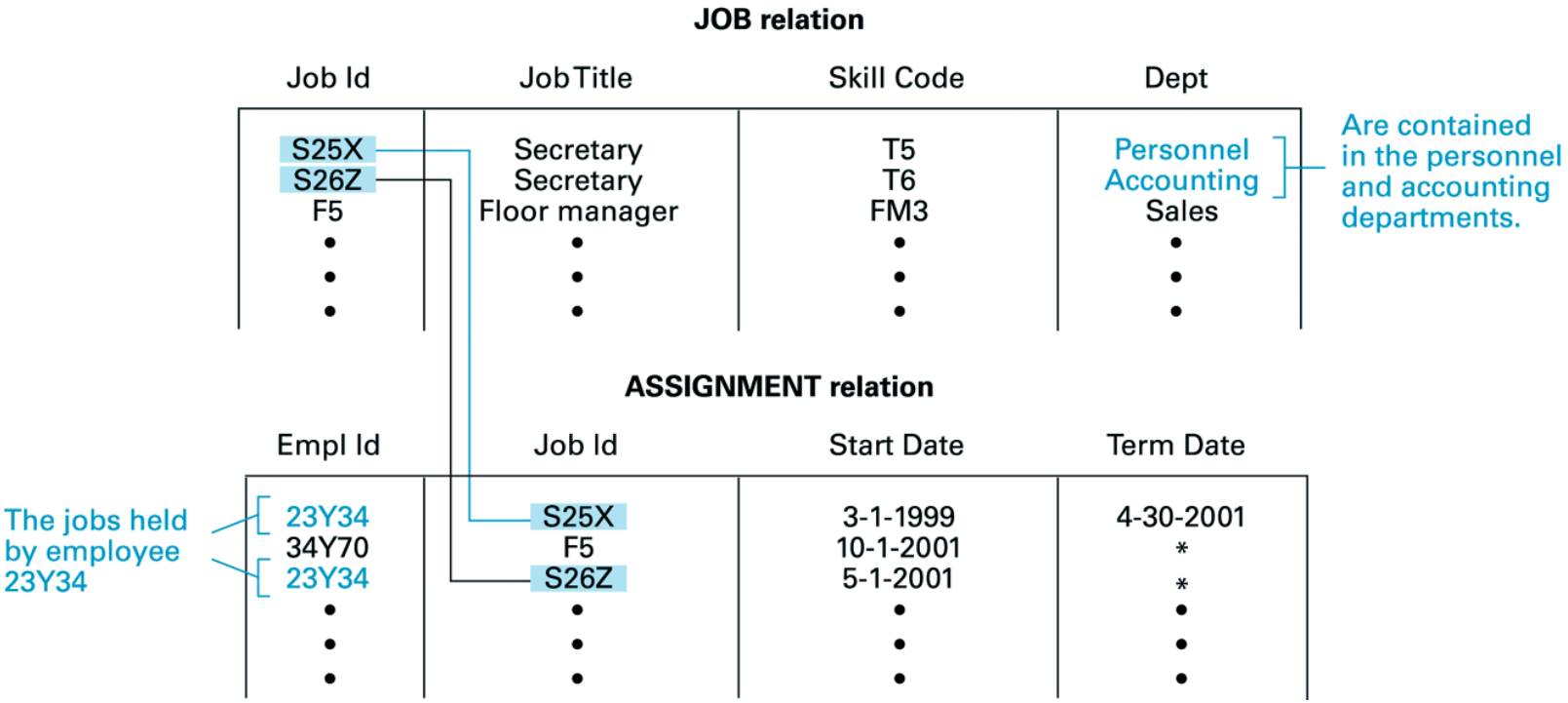
ASSIGNMENT relation

Empl Id	Job Id	Start Date	Term Date
23Y34	S25X	3-1-1999	4-30-2001
34Y70	F5	10-1-2001	*
25X15	S26Z	5-1-2001	*
•	•	•	•
•	•	•	•
•	•	•	•

Any information obtained by combining information from multiple relations

9.3: Example:

- Finding all departments in which employee 23Y34 has worked:

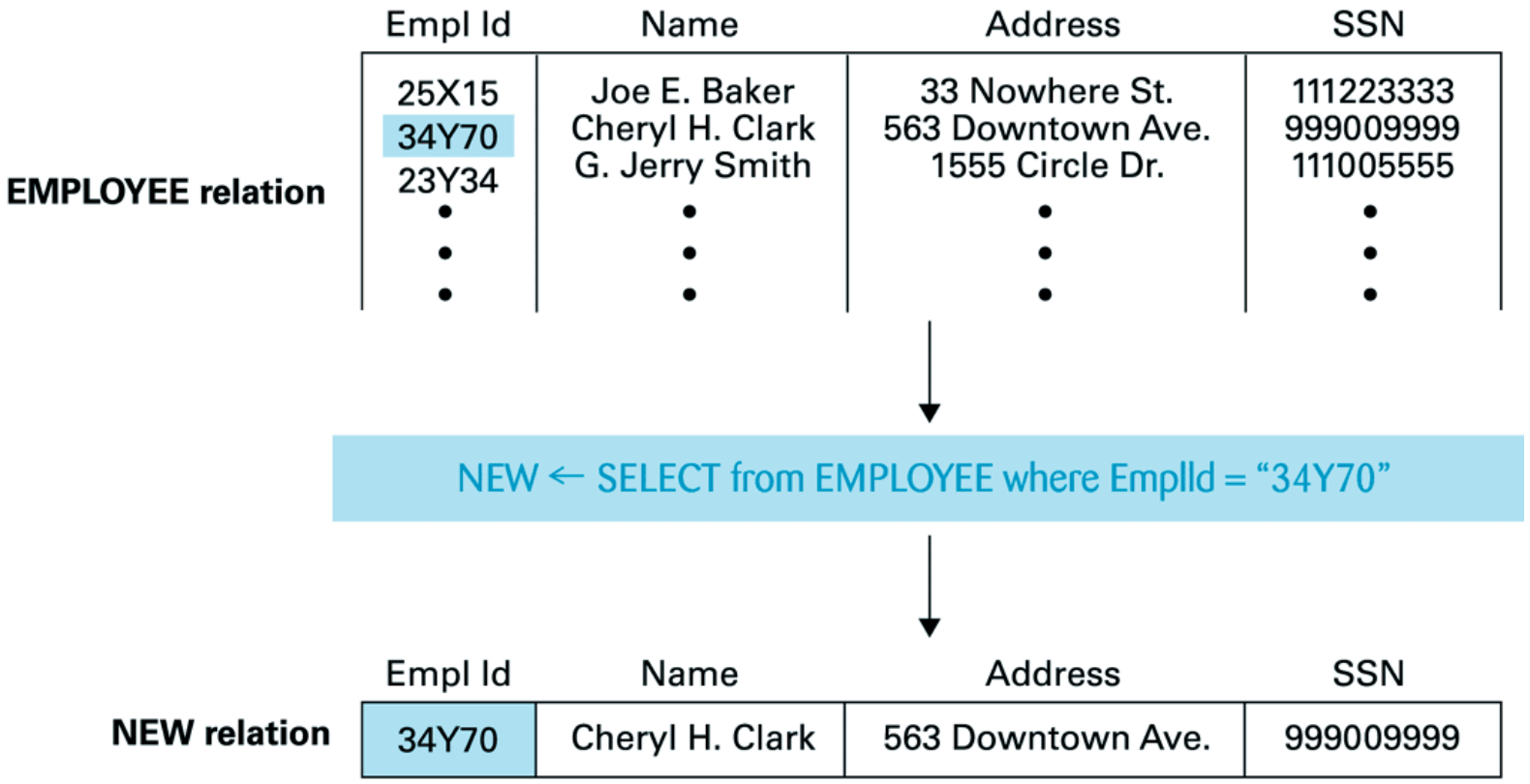


9.3: Relational Operations

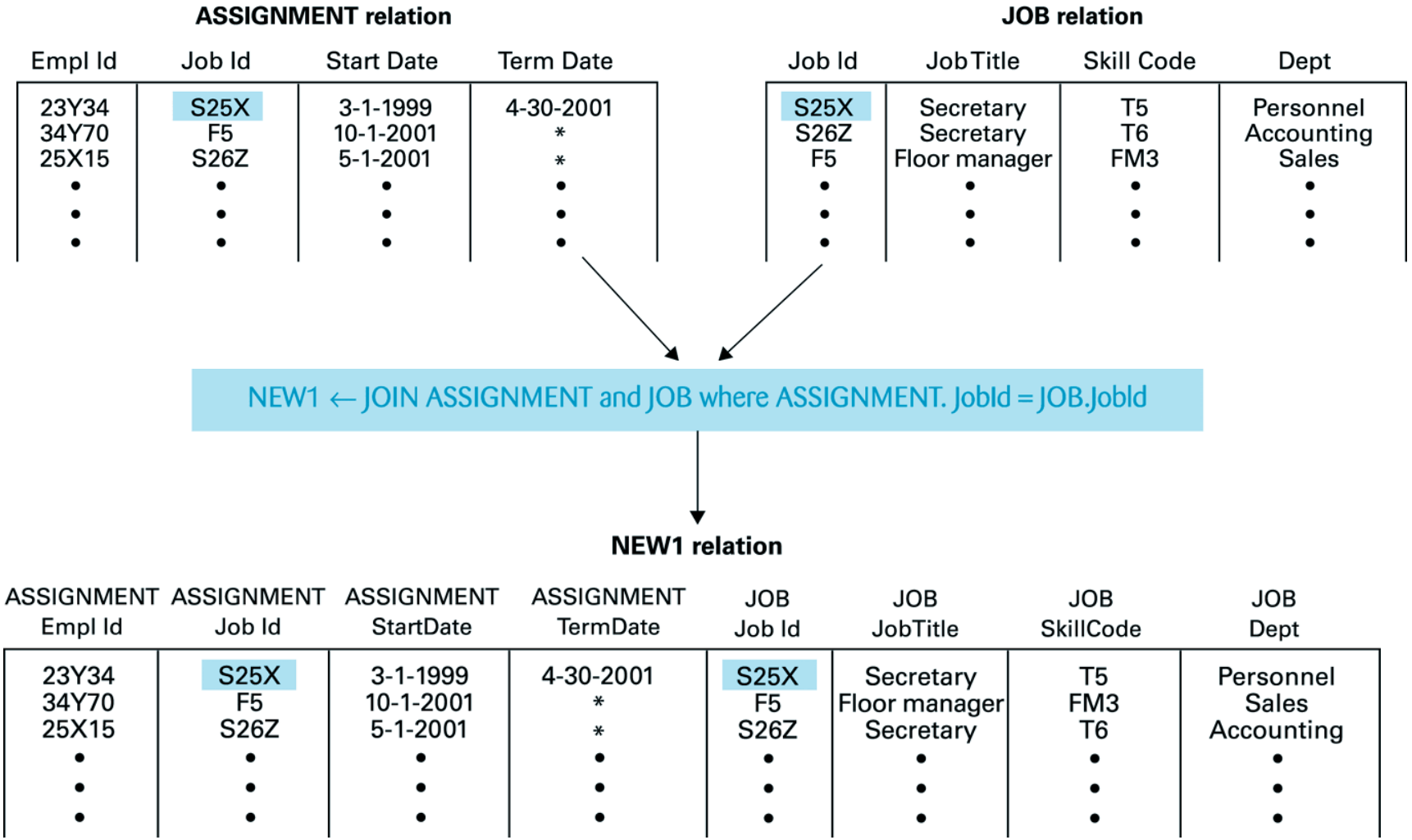
- Extracting information from a relational database by way of *relational operations*
  - Most important ones:
    - (1) extract tuples (rows) : SELECT
    - (2) extract attributes (columns) : PROJECT
    - (3) combine relations : JOIN

- Such operations on relations produce other relations
  - so: they can be used in combination, to create complex database requests (or '*queries*')

9.3: The SELECT operation



9.3: The JOIN operation



Chapter 9 - Database Structures: Conclusions

- Database Structures:
  - (large) integrated collections of data that can be accessed quickly
- Database Management System
  - provides high-level view of actual data storage (database model)
- Relational Model most often used
  - relational operations: SELECT, PROJECT, JOIN, …
  - high-level language for database access: SQL

Background: Relational Database

- Ted Codd Mathematician paper
- “A relational Model of data for large shared data banks”
- Chamberlin inspired by Codd’s Symposium and convinced IBM to create R system group and to fund a research project to build a prototype of relational DB which leads to DB2 and SQL creations
- IBM focused on IMS in 1968

Background (Continued...)

- Based on Codd's Work two professors from university of Berkeley started a project "Ingres"
- Researched Competition flared between the two groups and number of the research papers are being published. IBM did not realizing the potential of the project, published these papers publicly.

Background (Continued...)

- Larry Ellison formed a company “System Development Labs” which recruited Employees from System R and Ingres. He started developing a system based on the research papers by the funding from CIA and NAVY.
- First Structured Query Language was launched in 1979.
- IBM came up with its version in 1983, with SQL/IDS 1980
- Ellison Changed the Company name to Oracle
- In 2003, $ 7 Billion Relational DB

Chapter contents

- Good Decision requires good information and good information is derived from raw facts called data.
- *Good Decision means which delivers accurate, relevant and timely information*.
- What is DB?, What does it do? And Comparison between other Data Management Methods, Different Types of DB and Importance of DB Design.

File System

- Database is evolved from the File Systems.
- Understand the characteristics of the file system.
- Data management limitations by File system.
- Eliminations of the short comings of the file system by DBMS.

Basic Definitions

- Data: raw facts
  - Not processed yet to reveal their meaning
  - Constitute building blocks of information
  - For Examples:
    - Online Surveys
    - Online Data Entry Forms
    - Excel Sheets
    - Reports Forms
- Record keeping with the raw facts
  - Example: Students
    - » Pass 90%
    - » Fail 10 %
    - » Quick Answers

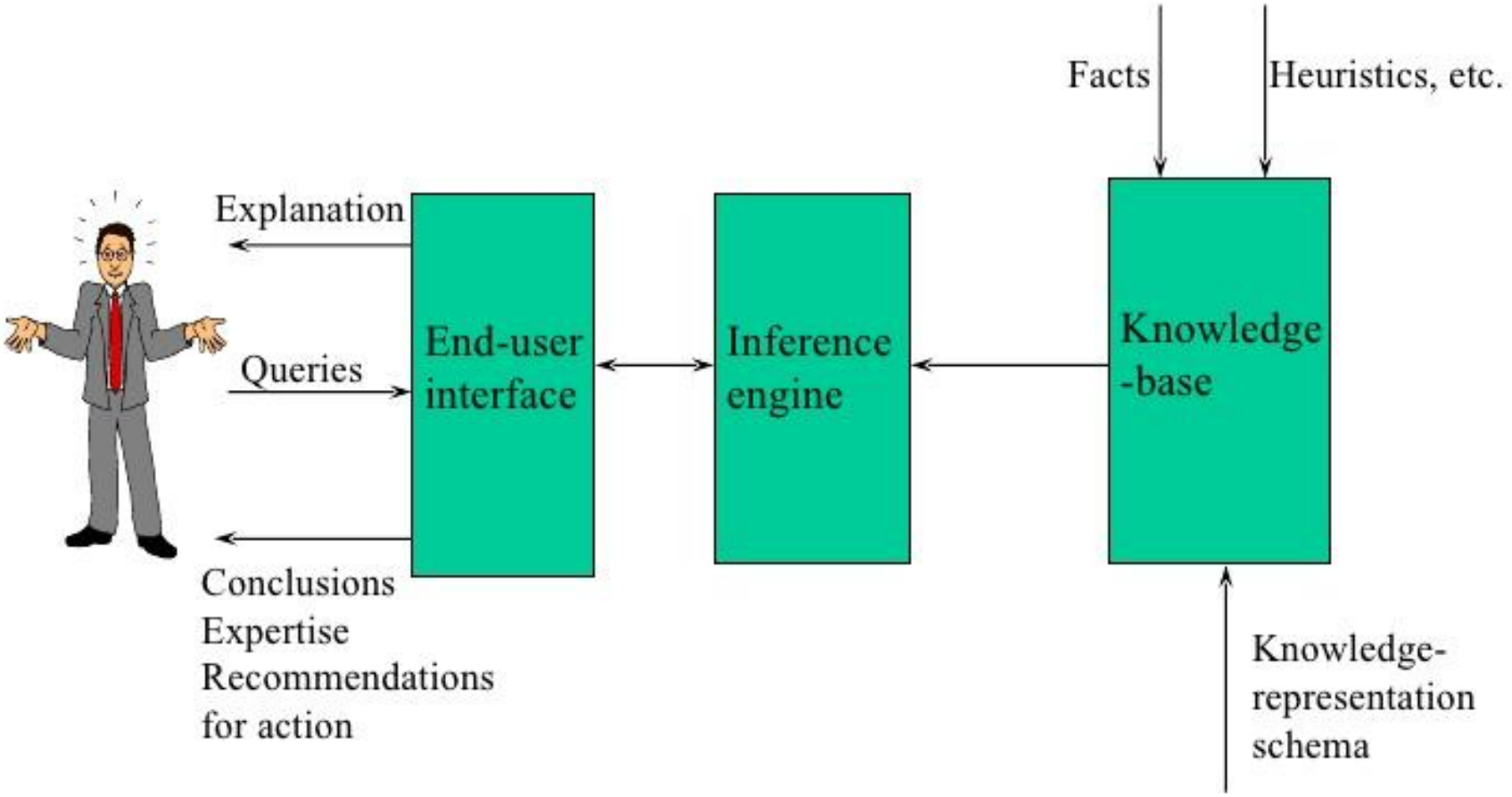
Basic Definitions (Continued…)

- Information: is produced by processing data and reveals meaning of data
  - Good, timely, relevant information key to decision making
  - Good decision making key to organizational survival
  - Example: Informed decisions to meet student grading record
  - Raw data: Storage, Processing and presentation
- Complex formatting: is required when working with complex data types such as sounds, videos ‘or’ images.
- For Example: Yes/No or Y/N

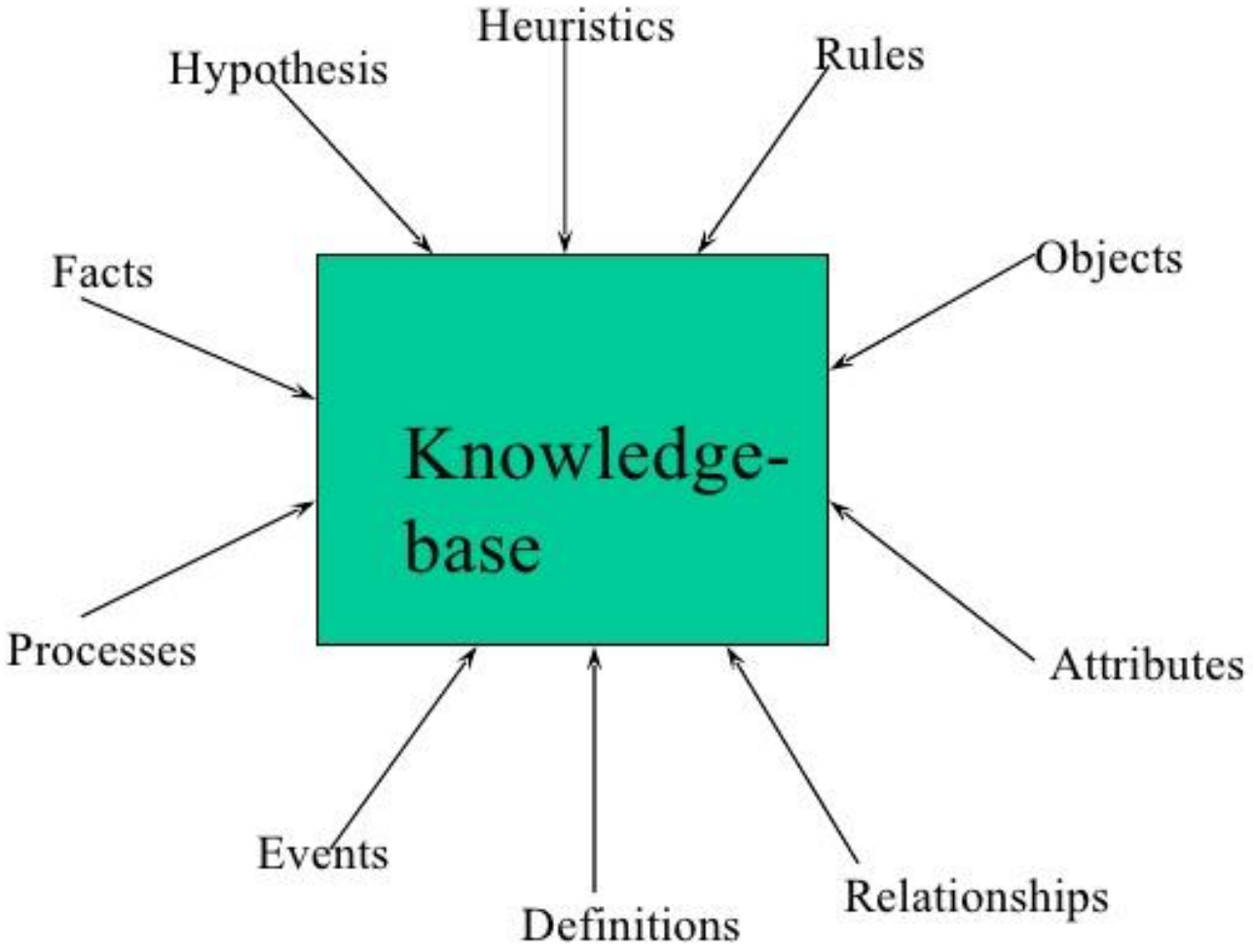
Basic Definitions (Continued...)

- Knowledge: the body of the information and facts about a specific subjects
- Knowledge implies familiarity awareness and understanding of information.
- New Knowledge can be derived from Old Knowledge.

3. KBS Architecture



(1) Knowledge-base



Basic Definitions (Continued...)

- Data Management is a discipline that focuses on the proper generation, storage and retrieval of data.
- Efficient Data Management requires computer DB.

Basic Definitions (Continued...)

- Database: shared, integrated computer structure housing:
  - End user data
  - Metadata
- Metadata provides a description of the data characteristics and set of relationships that link the data within the Database.
  - Structural metadata is data about the containers of data.
  - Descriptive metadata uses individual instances of application data or the data content.

An Example

- Converting data to information

Class Roster

Course: MGT 500 Business Policy Semester: Spring 200X

Section: 2

Name	ID	Major	GPA
Baker, Kenneth D.	324917628	MGT	2.9
Doyle, Joan E.	476193248	MKT	3.4
Finkle, Clive R.	548429344	PRM	2.8
Lewis, John C.	551742186	MGT	3.7
McFerran, Debra R.	409723145	IS	2.9
Sisneros, Michael	392416582	ACCT	3.3

An Example (Cont'd)

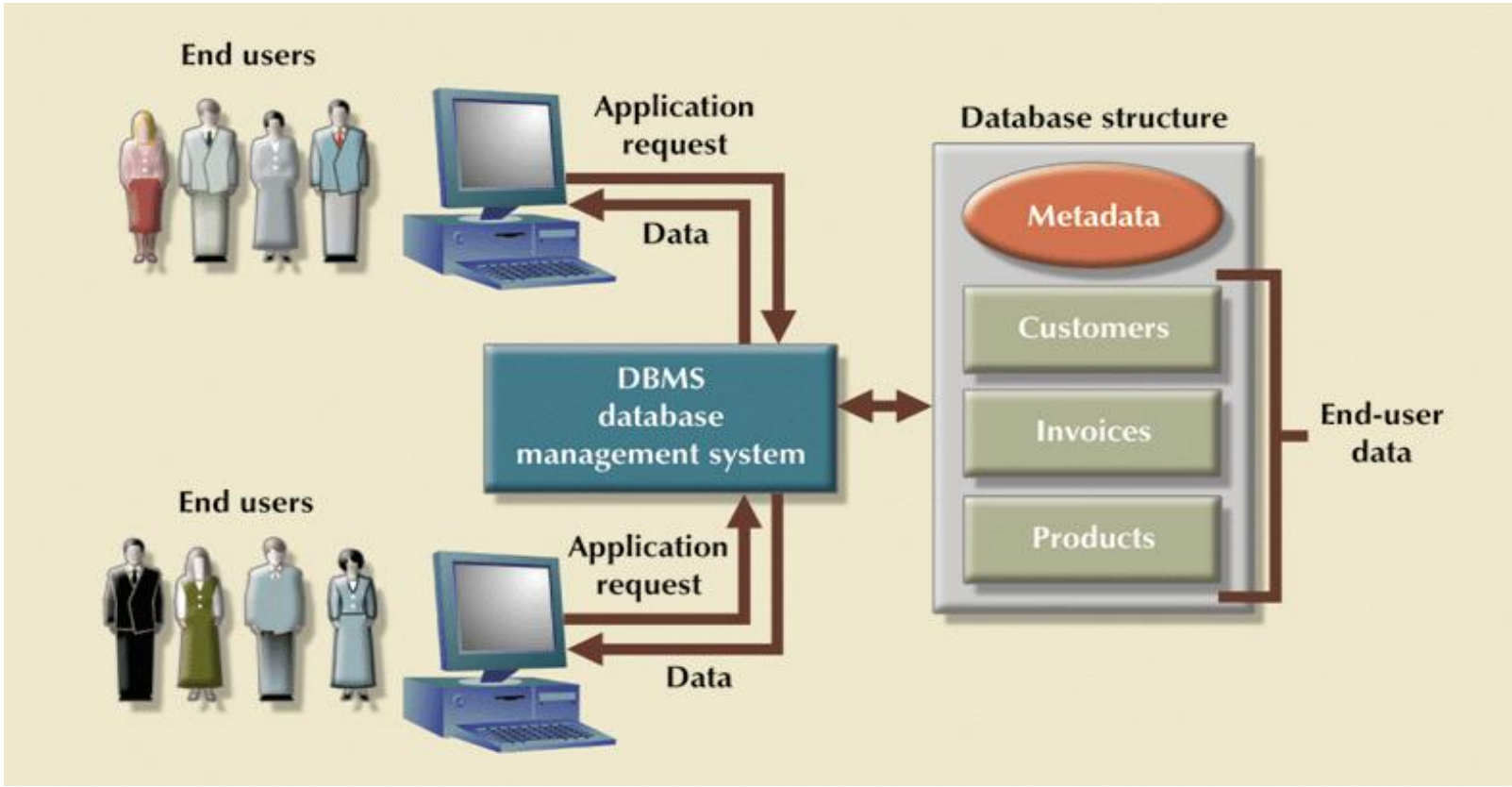
- Metadata

Data Item		*Value*			
Name	**Type**	**Length**	**Min**	**Max**	**Description**
Course	Alphanumeric	30			Course ID and name
Section	Integer	1	1	9	Section number
Semester	Alphanumeric	10			Semester and year
Name	Alphanumeric	30			Student name
ID	Integer	9			Student ID (SSN)
Major	Alphanumeric	4			Student major
GPA	Decimal	3	0.0	4.0	Student grade point average

What is a Database Management System (DBMS)

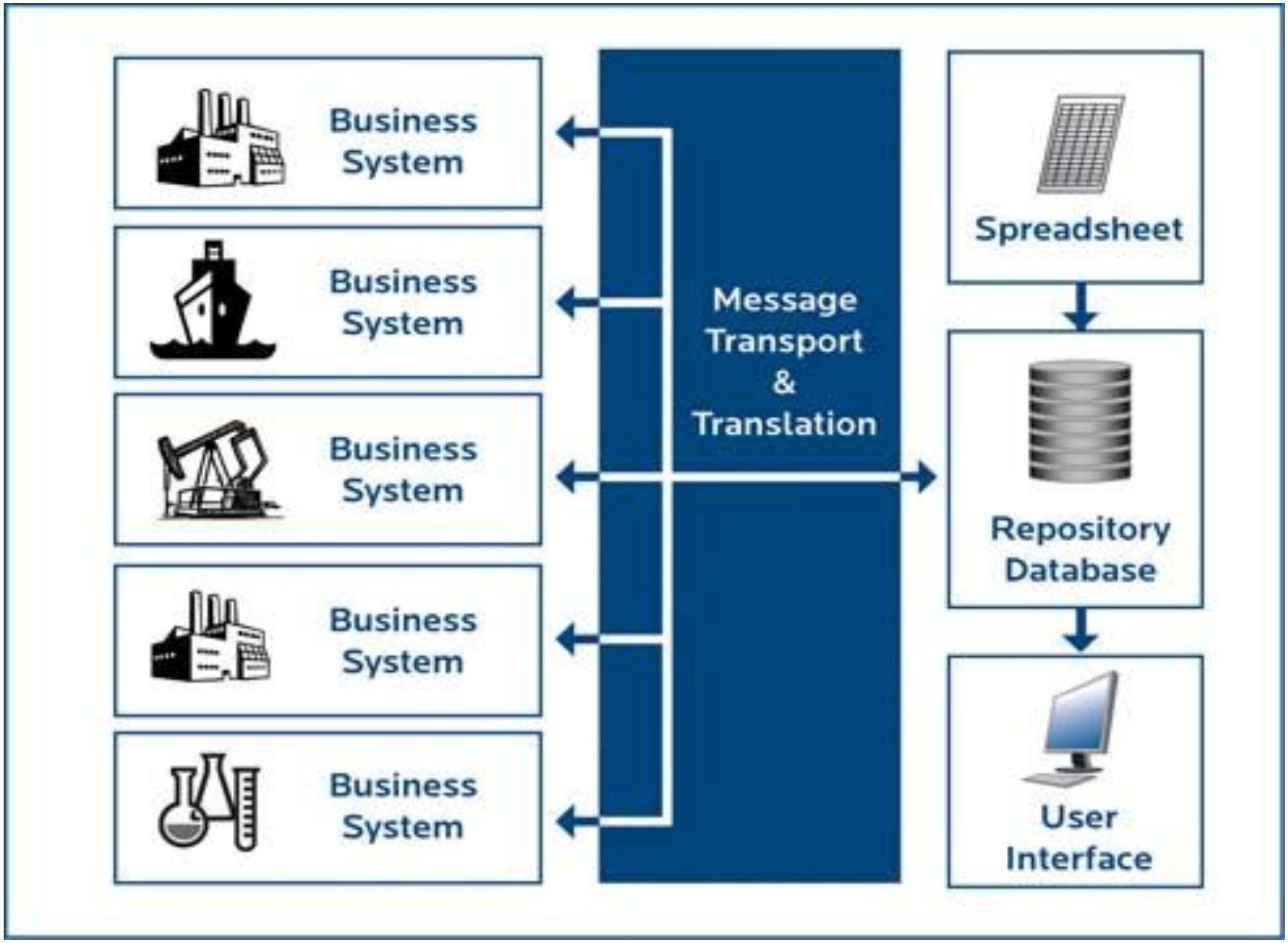
- A collection of programs that manages the database structure and controls access to the data stored in the database
  - Possible to share data among multiple applications or users
    - Example: bank and its ATM machines
  - Makes data management more efficient and effective
    - End users have better access to more and better-managed data
- DBMS hides much of the database's internal complexity from application program and End user

DBMS Manages Interaction



Advantages of the DBMS

- Improved data sharing
  - Shared among users and applications
- Better Data Integration
  - Different User's views into single data Repository
    - Repository: can be a place where multiple DBs or files are located for distribution over the network.
- Minimized Data inconsistency
  - Different versions of the same data.
    - Example: Product ID and Product Number in different departments


Business System
Business System
Business System
Business System
Business System
Message Transport & Translation
Spreadsheet
Repository Database
User Interface

Advantages of the DBMS

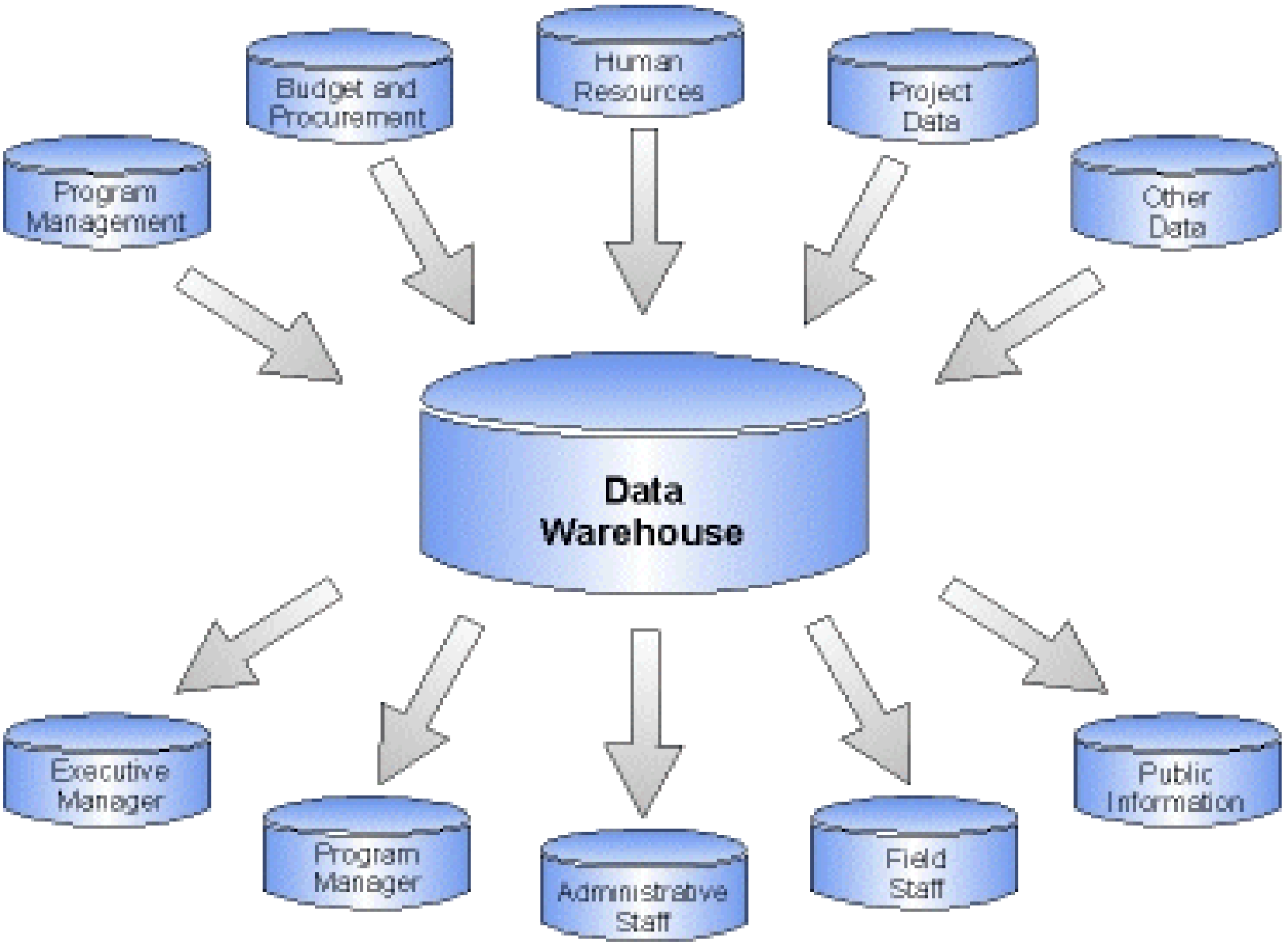
- Improved Data access
  - Quick answers to the ad hoc queries
  - Query is a complete question: a specific request for data manipulation (read or update data)
  - DBMS sends back an Answer (Query result set) to the application
- Improved Decision Making
  - Better managed data and improved data access ->to better quality information ->better decisions
- Increased End User Productivity

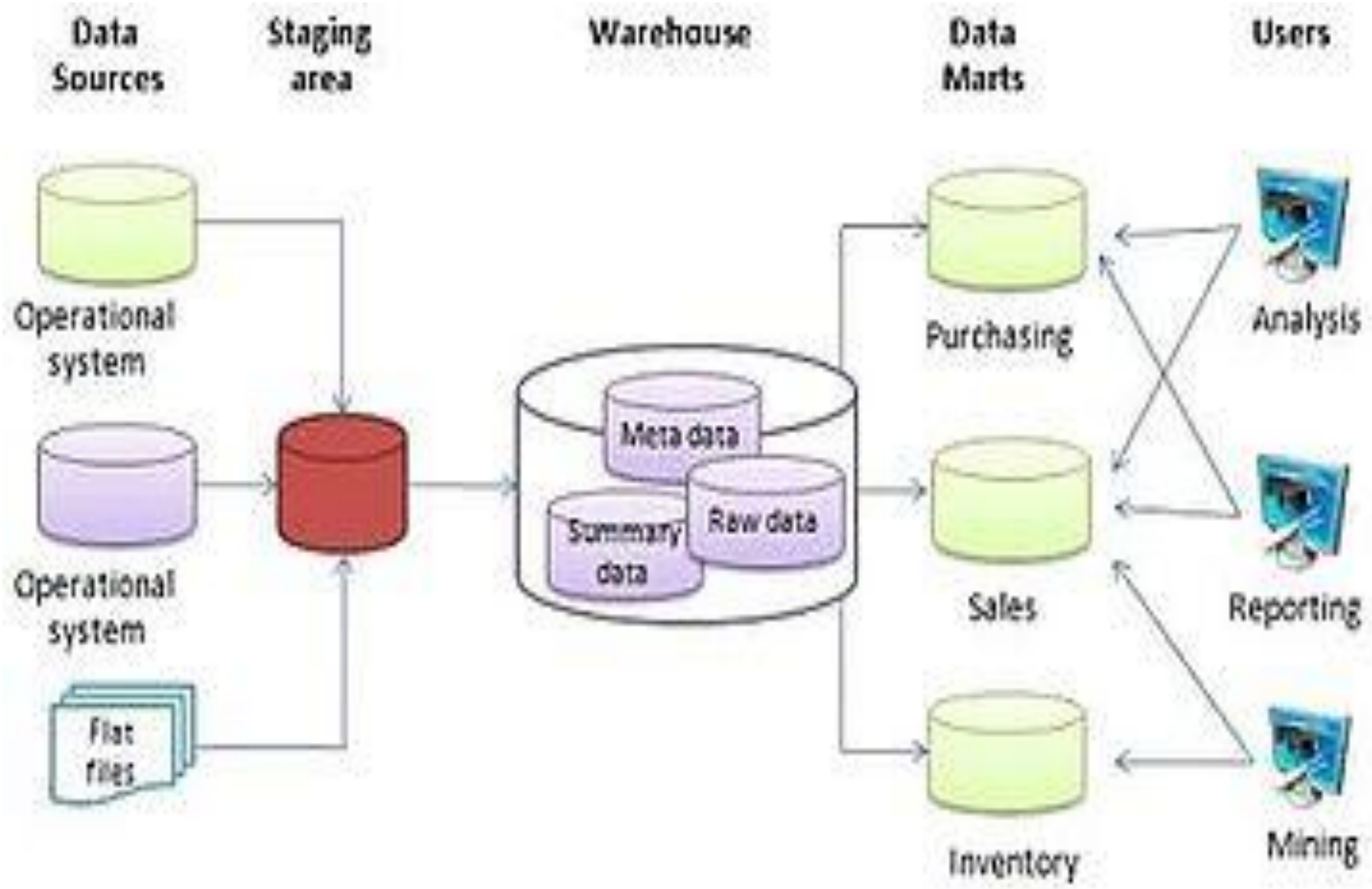
Types of the databases

- Single User Database: Runs on a personal Computer
- Multiuser Database: less than 50 workgroup DB, more than 50 Enterprise DB
- Location wise:
  - Single site: Centralized DB
  - Several sites: Distributed DB
- Function wise: Operational/transactional/production
  - Time Sensitive information gathered
  - Support a company ‘s day to day operations

Types of the databases:
Data ware house

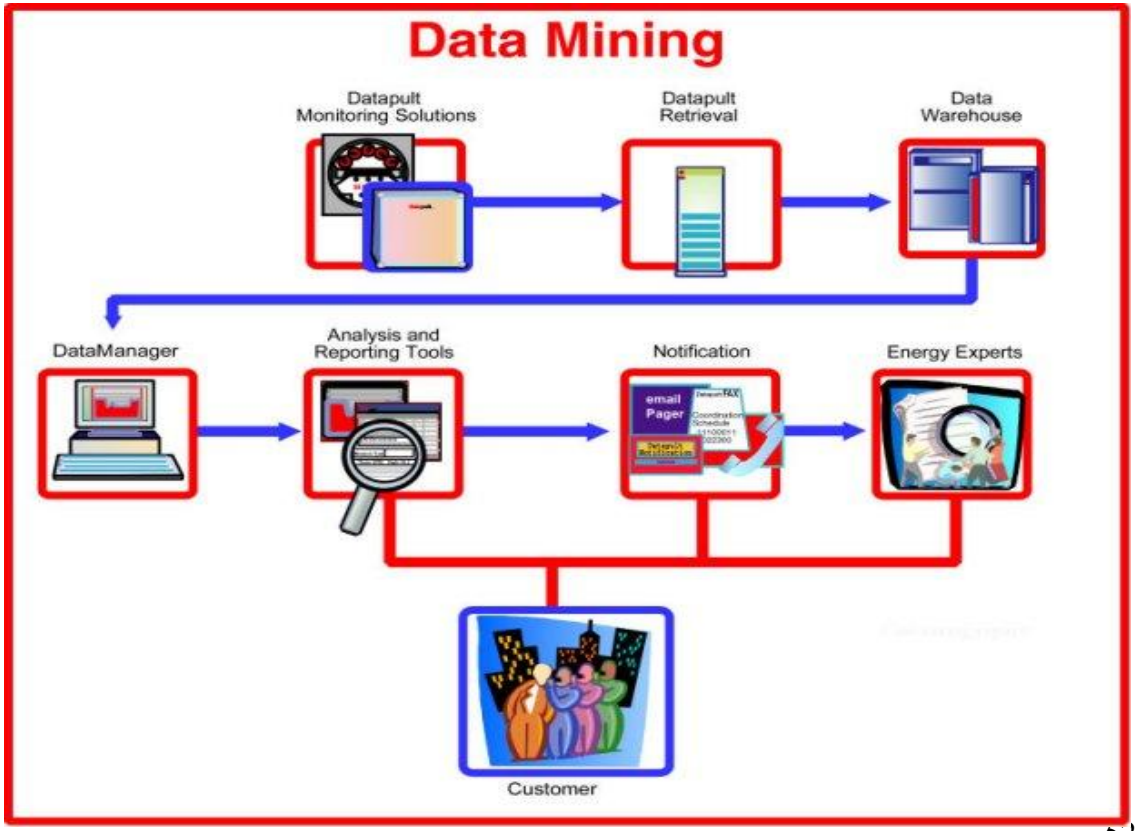
- A collection of data designed to support management decision making generally refers to combination of many different DBs across entire enterprise.
  - Generate information to make tactical or strategic decisions
    - Extensive data messaging
    - Historical data from operational DB
    - Examples:
      - Formulate pricing decisions
      - Sale forecast
      - Market Position


Budget and Procurement
Human Resources
Project Data
Program Management
Other Data
Data Warehouse
Executive Manager
Program Manager
Administrative Staff
Field Staff
Public Information

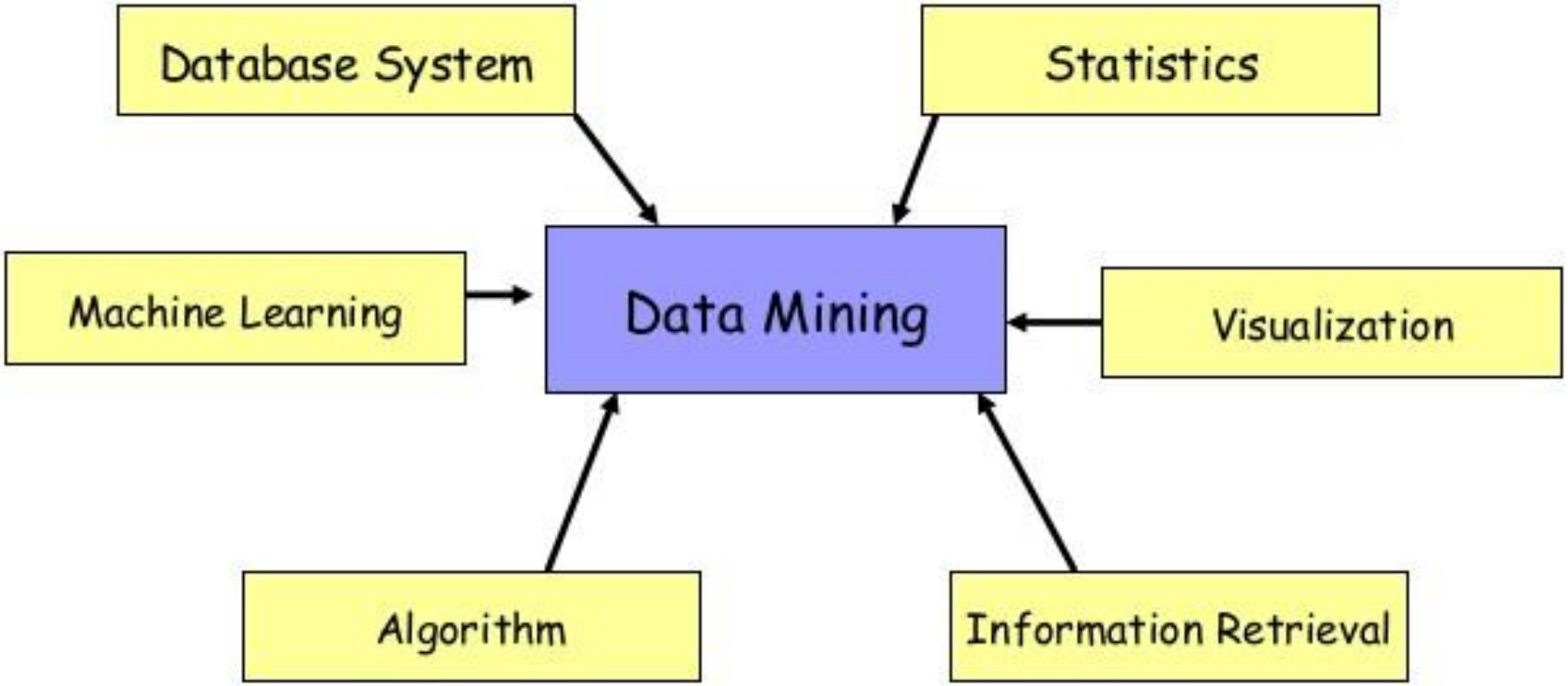

Data Sources
Staging area
Warehouse
Data Marts
Users
Operational system
Operational system
Flat files
Meta data
Summary data
Raw data
Purchasing
Sales
Inventory
Analysis
Reporting
Mining

Data Mining Concept

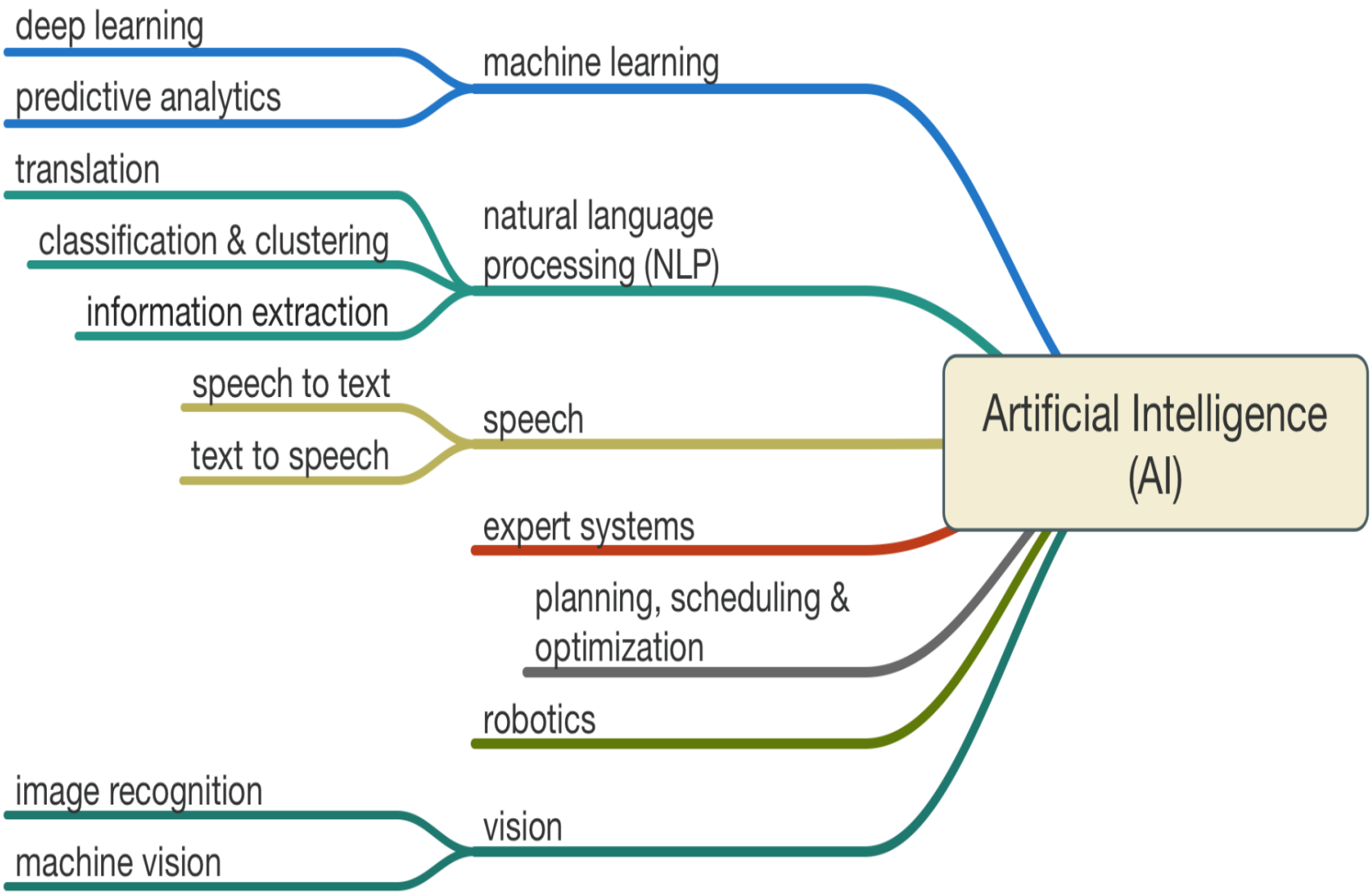
- A class of database applications that look for the hidden patterns in a group of data that can be used to predict future behavior.



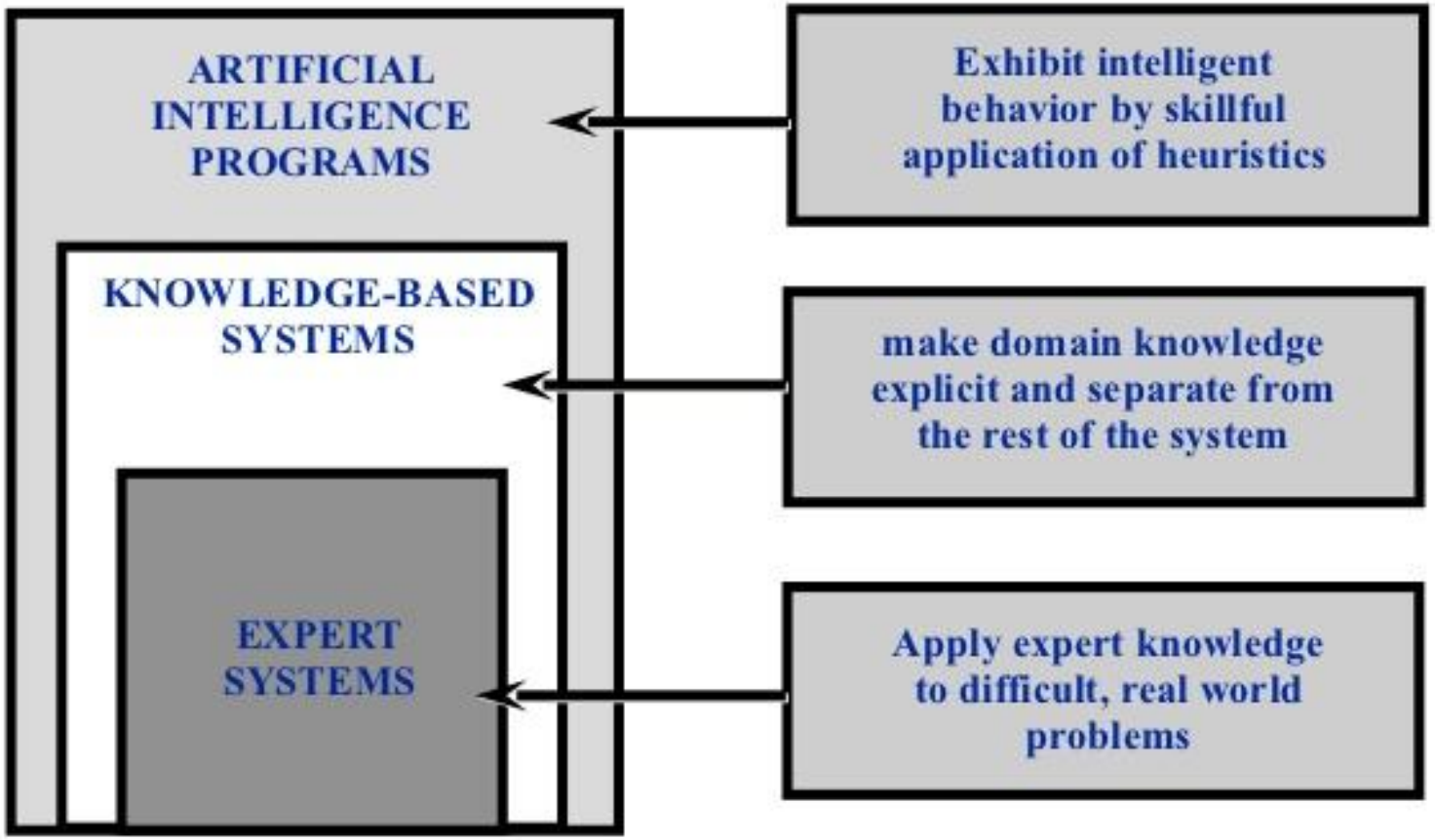
Disciplines Of Data Mining



Advance Subjects:



What is expert system?



Presentations Schedule & Guidelines

- **Following Presentations will be conducted in coming classes:**
  - **Title, Introduction, literature Survey**
  - **Proposed Model, Results and Discussion, Journal Selection**
  - **Conclusion and Future Work, Abstract,, Final formatted paper**
- **Every group must present 30 Slides(at least), 15 slides for each student in every Class**

Students Marking and Grading Criteria:

Students will be marked on ACCKO System:

- ❑Appearance
- ❑Communication
- ❑Coordination among group fellows
- ❑Knowledge
- ❑Overall performance

- Slide for Reference