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UNIVERSITY OF COLORADO DENVER

Information Systems Program

Module 2
Introduction to Databases and DBMSs

Lesson 1: Database Characteristics

Lesson Objectives

- Define basic terminology and database characteristics
- Provide an example of a databases

Motivation

- Databases crucial for daily operations and decision making in organizations
- Database management technology
  - Major part of software industry
  - Revolutionary evolvement over 40 years
  - Foundation for management of long term memory of organizations
- Vibrant field with employment opportunities

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

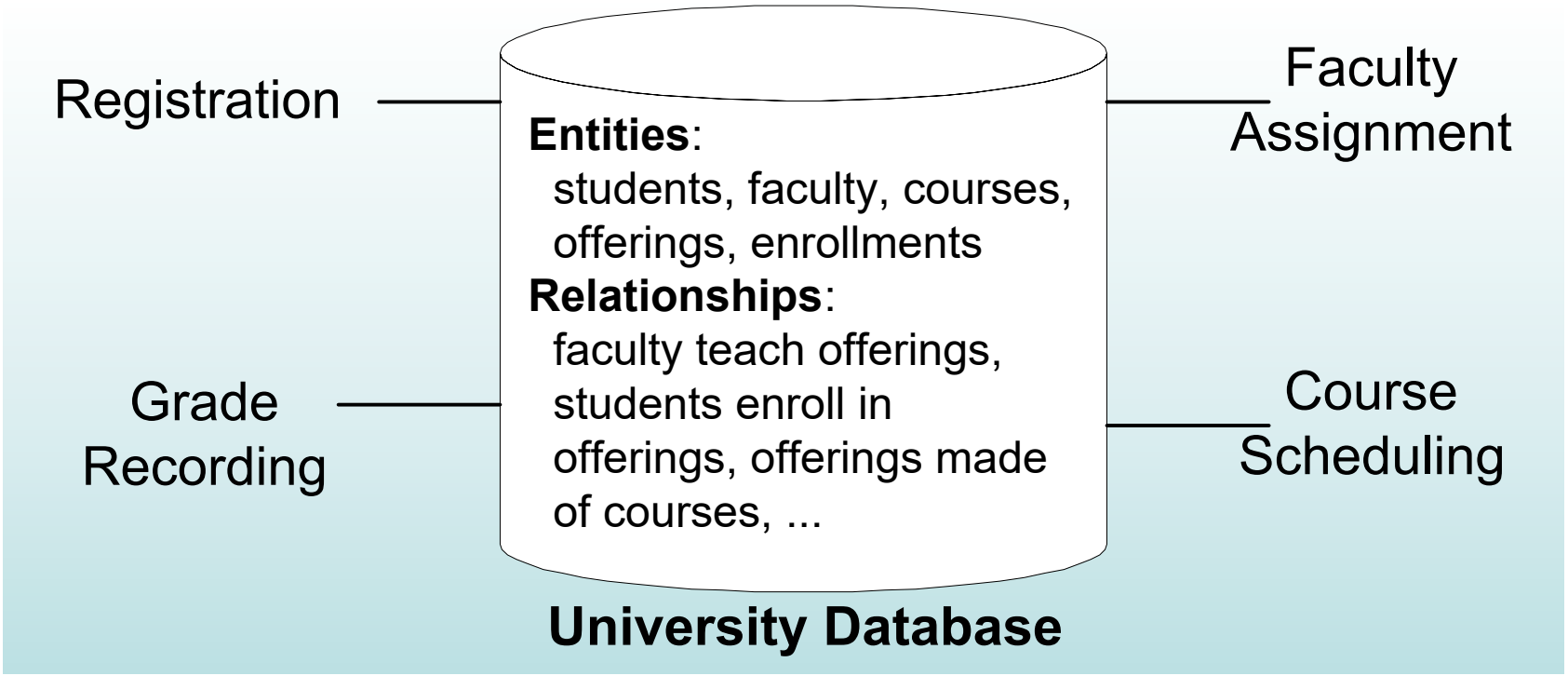
Database Characteristics

Persistent

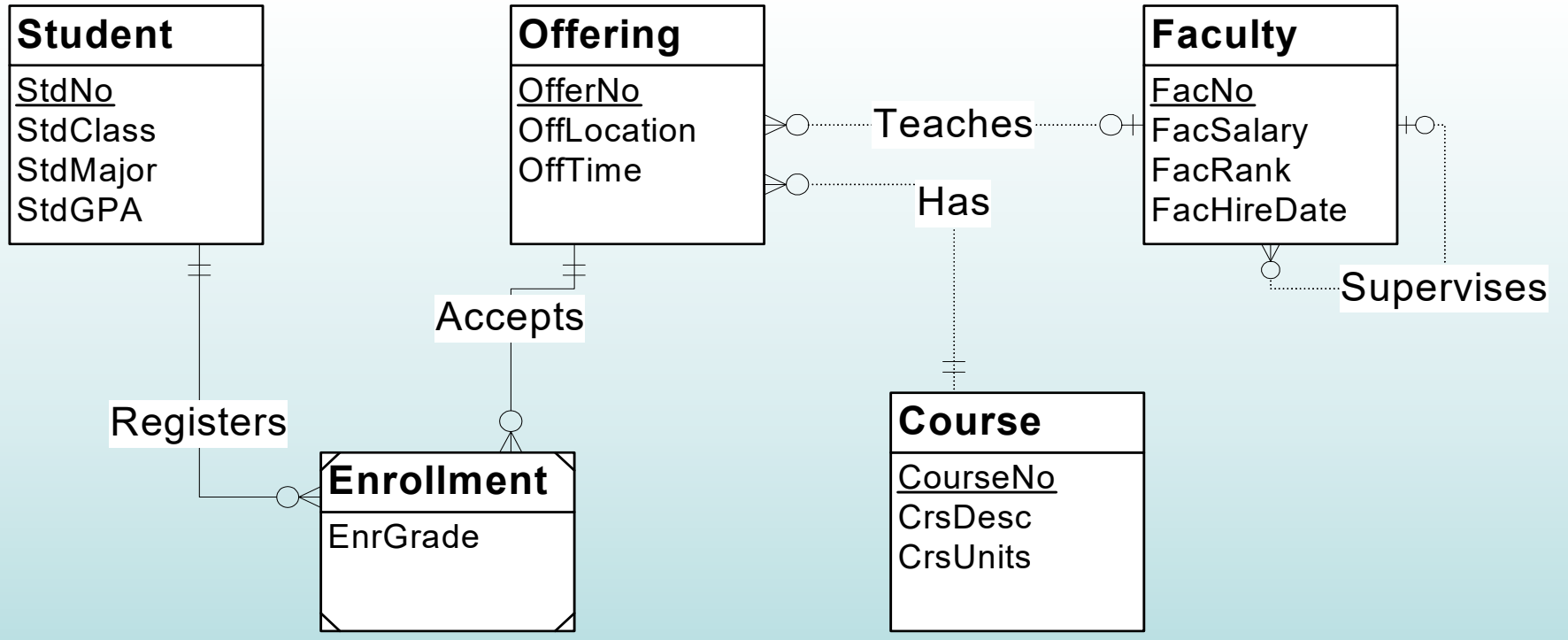
Inter-related

Shared

University Database



University Database (ERD)



Summary

- Databases and database technology vital to modern organizations
- Database technology supports daily operations and decision making
- Emphasize structured data
- Essential characteristics of shared, inter-related, and persistent

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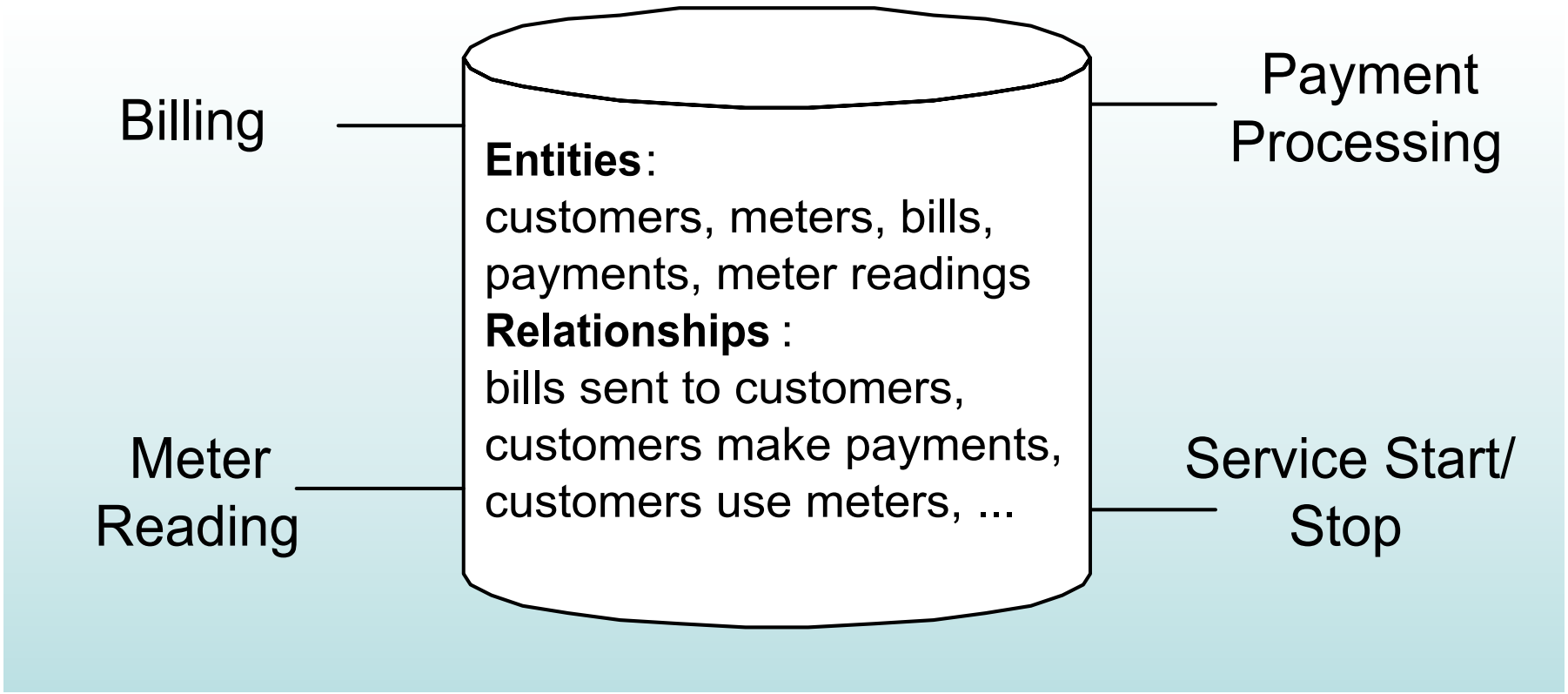
Lesson 2: Organizational Roles

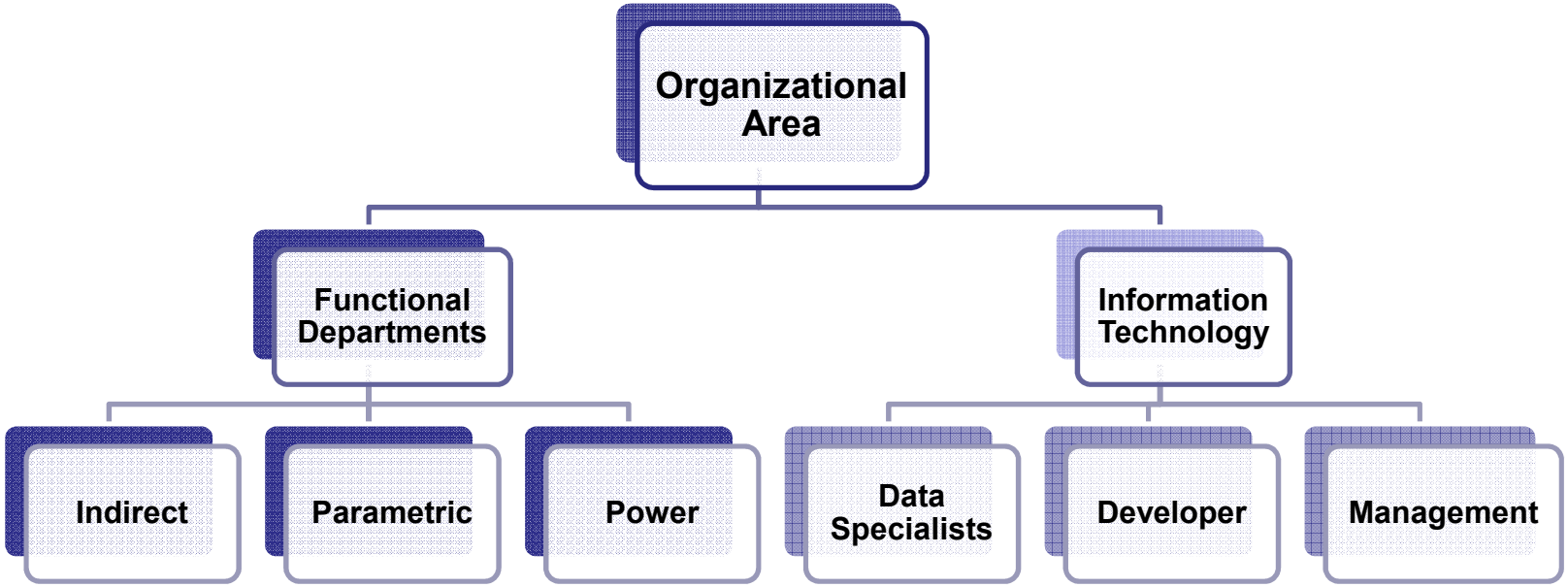
Lesson Objectives

- Discuss organizational roles in functional areas and information technology departments
- Think about your career interest especially your potential roles in information technology departments

Water Utility Database



Organizational Roles



Database Specialists

- Database administrator (DBA)
  - More technical
  - DBMS specific skills
- Data administrator
  - Less technical
  - Planning role

Summary

- Databases and database technology vital to modern organizations
- Database technology supports daily operations and decision making
- Active working with database technology as developer, data specialist, or power user
- Many opportunities to work with databases

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Lesson 3: DBMS Overview and Database Definition Feature

Lesson Objectives

- Define DBMS
- Explain DBMS product variations
- Discuss the essential difference between a DBMS and desktop software

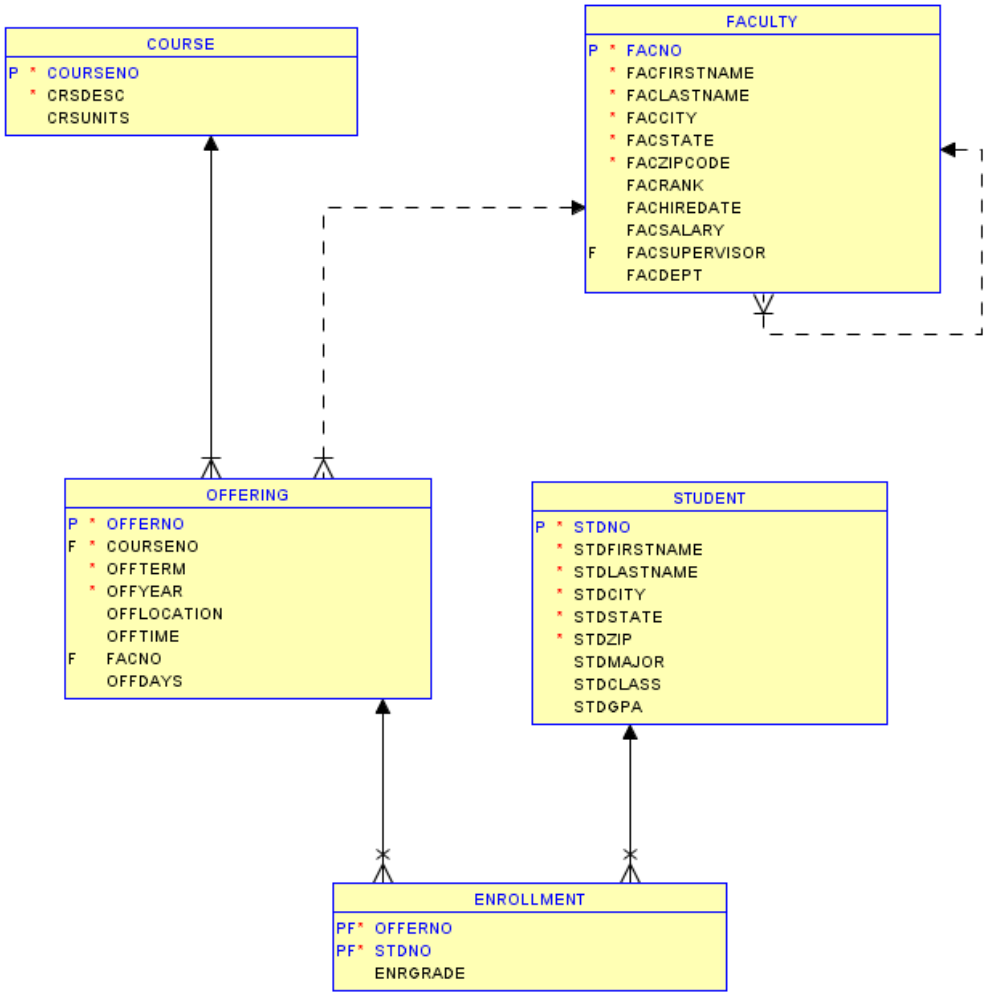
Database Management System (DBMS)

- Collection of components that support data acquisition, dissemination, storage, maintenance, retrieval, and formatting
- Product variations
  - Enterprise DBMSs
  - Desktop DBMSs
  - Embedded DBMSs
- Major part of information technology infrastructure

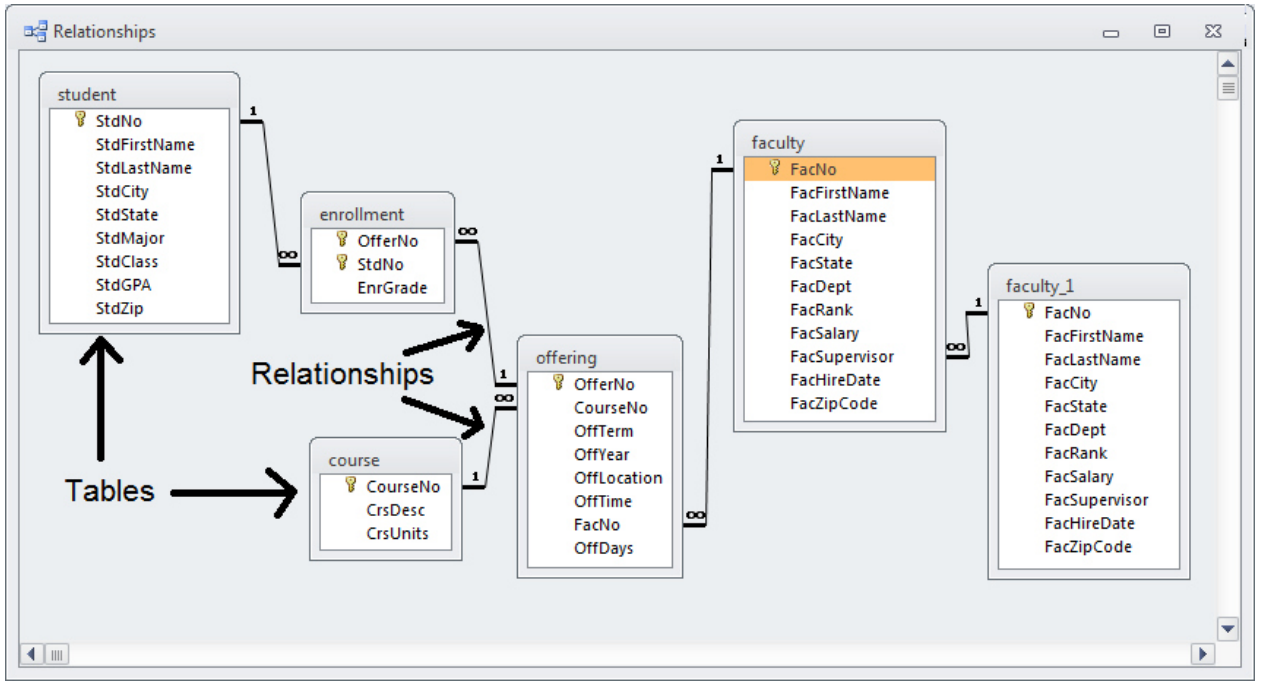
Database Definition Feature

- Define database before populating and using a database
- Tables and relationships
- SQL CREATE TABLE statement
- Graphical tools

Oracle Relational Diagram



Microsoft Access Database Diagram



Summary

- Database technology supports daily operations and decision making
- Define database before using it
- Nonprocedural access is a crucial feature

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Lesson 4: Non-Procedural Access

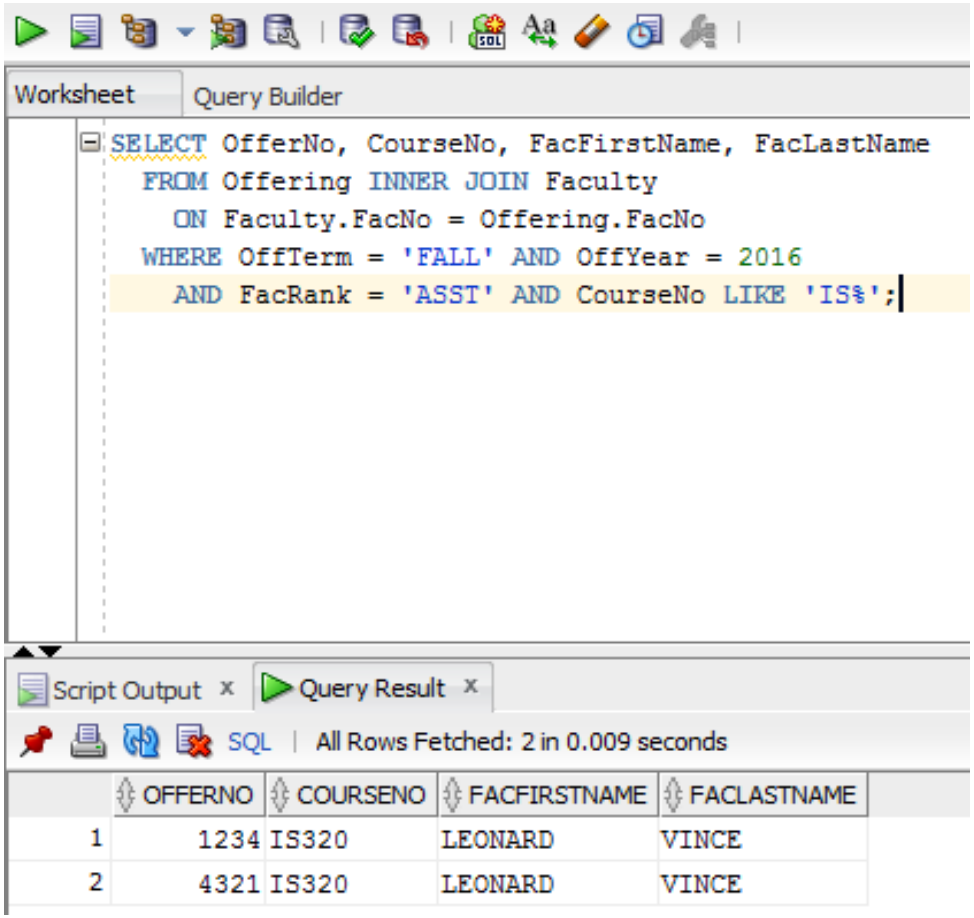
Lesson Objectives

- Discuss the importance of non-procedural access
- Explain the link between the five types of application development tools and nonprocedural access

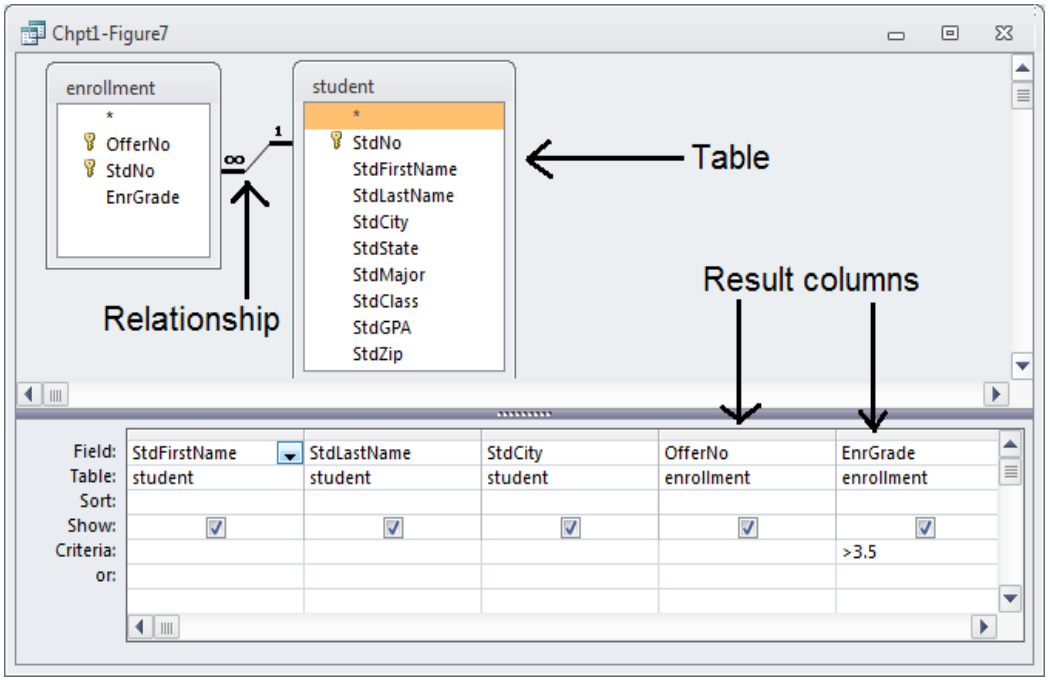
Nonprocedural Database Access

- Query: request for data to answer a question
- Indicate what parts of database to retrieve not the procedural details
- Improve productivity and improve accessibility
- SQL SELECT statement and graphical tools

SELECT Statement Execution

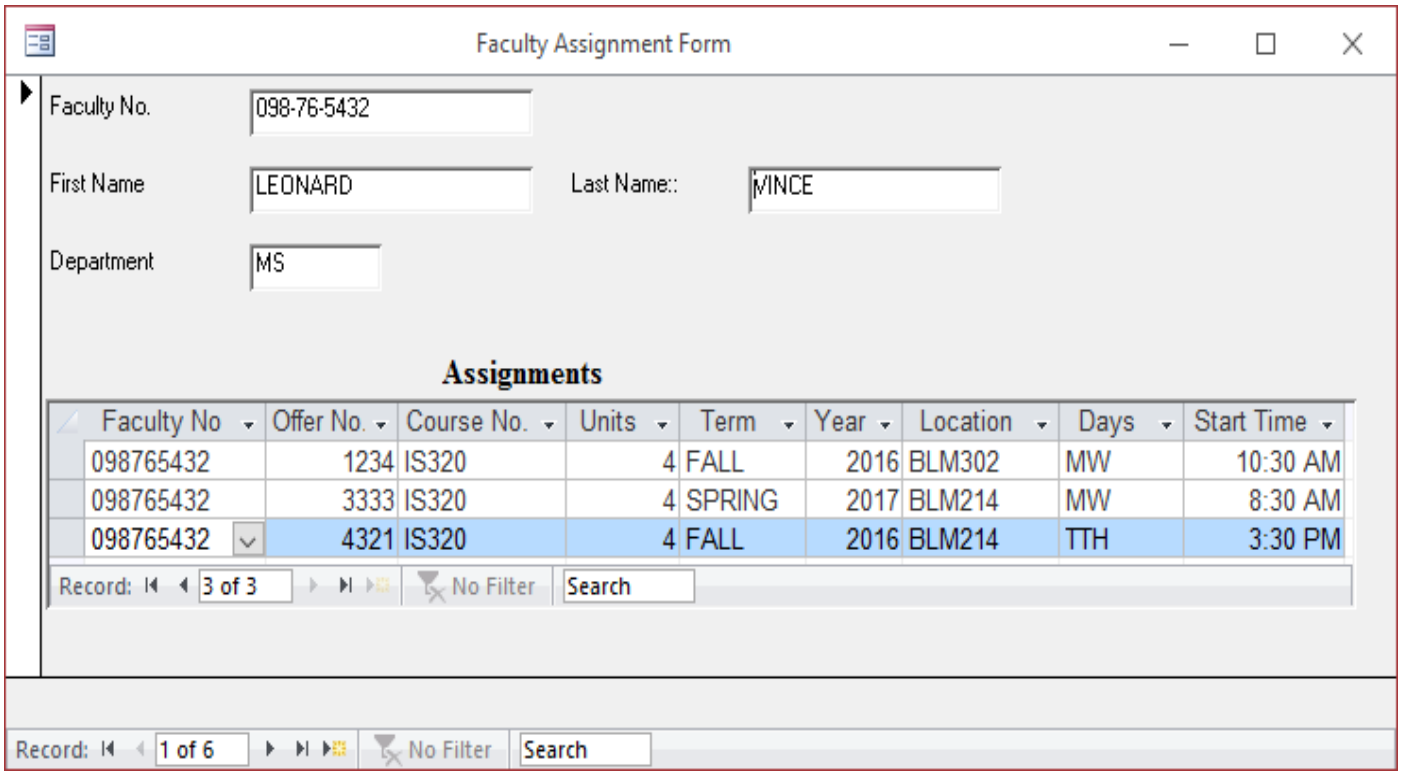


Graphical Tool for Nonprocedural Access



StdFirstName	StdLastName	StdCity	OfferNo	EnrGrade
MARIAH	DODGE	SEATTLE	1234	3.8
BOB	NORBERT	BOTHELL	5679	3.7
ROBERTO	MORALES	SEATTLE	5679	3.8
MARIAH	DODGE	SEATTLE	6666	3.6
LUKE	BRAZZI	SEATTLE	7777	3.7
WILLIAM	PILGRIM	BOTHELL	9876	4

Sample Data Entry Form



Sample Report

Faculty Work Load Report for the 2016-2017 Academic Year

Department	Name	Term	Offer Number	Units	Limit	Enrollment	Percent Full	Low Enrollment
FIN								
	JULIA MILLS							
		WINTER	5678	4	20	1	5.00%	☑
		Summary for 'term' = WINTER (1 detail record)						
		Sum		4		1		
		Avg					5.00%	
	Summary for JULIA MILLS							
	Sum			4		1		
	Avg						5.00%	
Summary for 'department' = FIN (1 detail record)								
Sum				4		1		
Avg							5.00%	

Procedural Language Interface

- Combine procedural language with nonprocedural access
- Why
  - Batch processing
  - Customization (especially for ecommerce) and automation
  - Performance improvement

Summary

- Database technology vital to modern organizations
- Crucial DBMS feature: nonprocedural access
- Query language, visual tool, form tool, report tool, and embedding
- Fundamental skill: query formulation

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Lesson 5: Transaction Processing Overview

Lesson Objectives

- Provide an example of a transaction that you use
- Briefly explain key characteristics of database transactions
- Explain the word “transparency” for transaction processing services

Transaction Definition

- Supports daily operations of an organization
- Collection of database operations
- Reliably and efficiently processed as one unit of work
- No lost data
  - Interference among multiple users
  - Failures

Airline Transaction Example

START TRANSACTION
Display greeting
Get reservation preferences from user
SELECT departure and return flight records
If reservation is acceptable then
UPDATE seats remaining of departure flight record
UPDATE seats remaining of return flight record
INSERT reservation record
Print ticket if requested
End If
On Error: **ROLLBACK**
COMMIT

ATM Transaction Example

START TRANSACTION
- Display greeting
- Get account number, pin, type, and amount
- SELECT account number, type, and balance
- If balance is sufficient then
  - UPDATE account by posting debit
  - UPDATE account by posting debit
  - INSERT history record
  - Display message and dispense cash
  - Print receipt if requested
- End If
- On Error: **ROLLBACK**

COMMIT

Transaction Processing

- Reliable and efficient processing of transactions
  - Control simultaneous users
  - Recover from failures
- Internal features for enterprise DBMSs
  - Concurrency control manager
  - Recovery manager
  - Transparent services for application developers

Summary

- Supports daily operations
- Evolution over 50 years
- Key technology behind growth of electronic commerce

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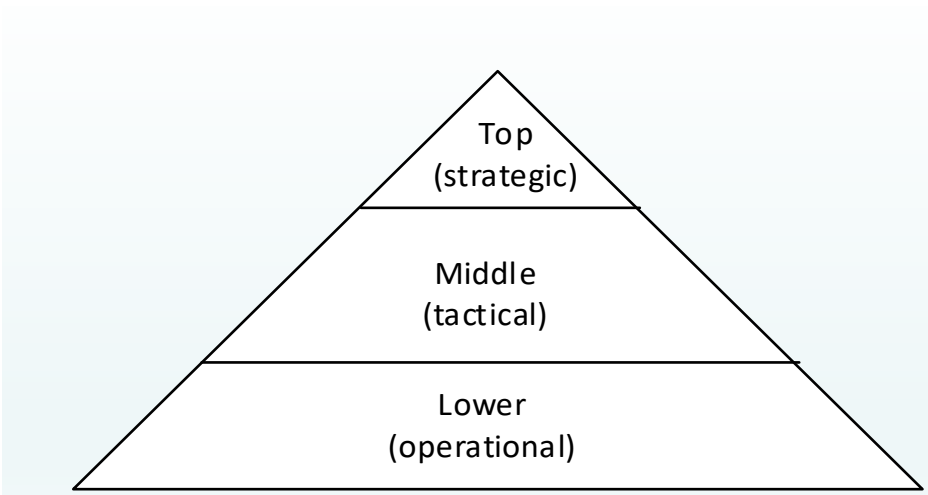
Lesson 6: Overview of Data Warehouse Processing

Lesson Objectives

- List three levels of decision making and at least one decision on each level
- Define data warehouse
- Explain at least one characteristic different for transaction processing versus business intelligence processing

Decision Making Hierarchy

Decision making hierarchy

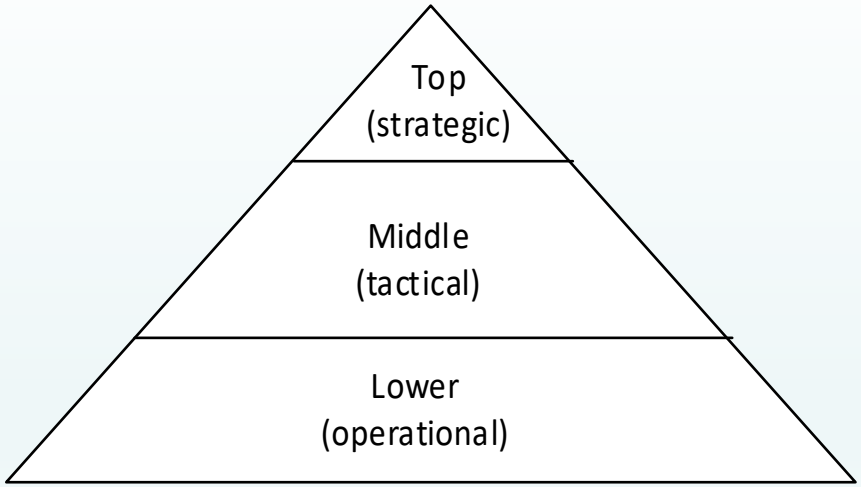


Typical decisions

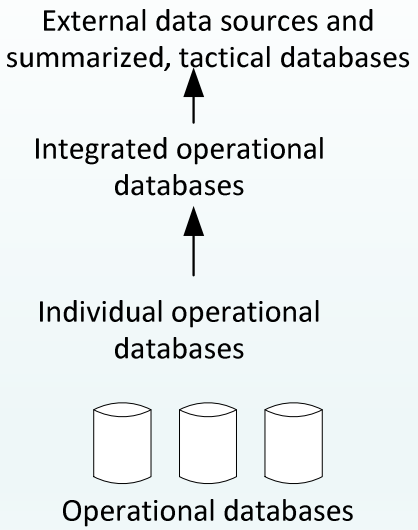
Identify new markets, choose store locations, Choose suppliers, forecast sales Resolve order delays, schedule employees

Database Support

Decision making hierarchy



Database support



Data Warehouse Characteristics

- Essential part of infrastructure for business intelligence
- Logically centralized repository for decision making
  - Populated from operational databases and external data sources
  - Integrated and transformed data
  - Optimized for reporting

Comparison of Environments

- Transaction processing
  - Primary data in operational databases
  - Large volumes of transactions with relatively small amounts of data per transaction
  - Some reporting requirements for operations
- Business intelligence processing
  - Secondary data from operational databases
  - Substantial processing for transformations and integration
  - Large volumes of data for reporting

Summary

- Data warehouse processing supports tactical and strategic decision making
- Business intelligence processing evolution since mid 1990s
- Different DBMS features for business intelligence support

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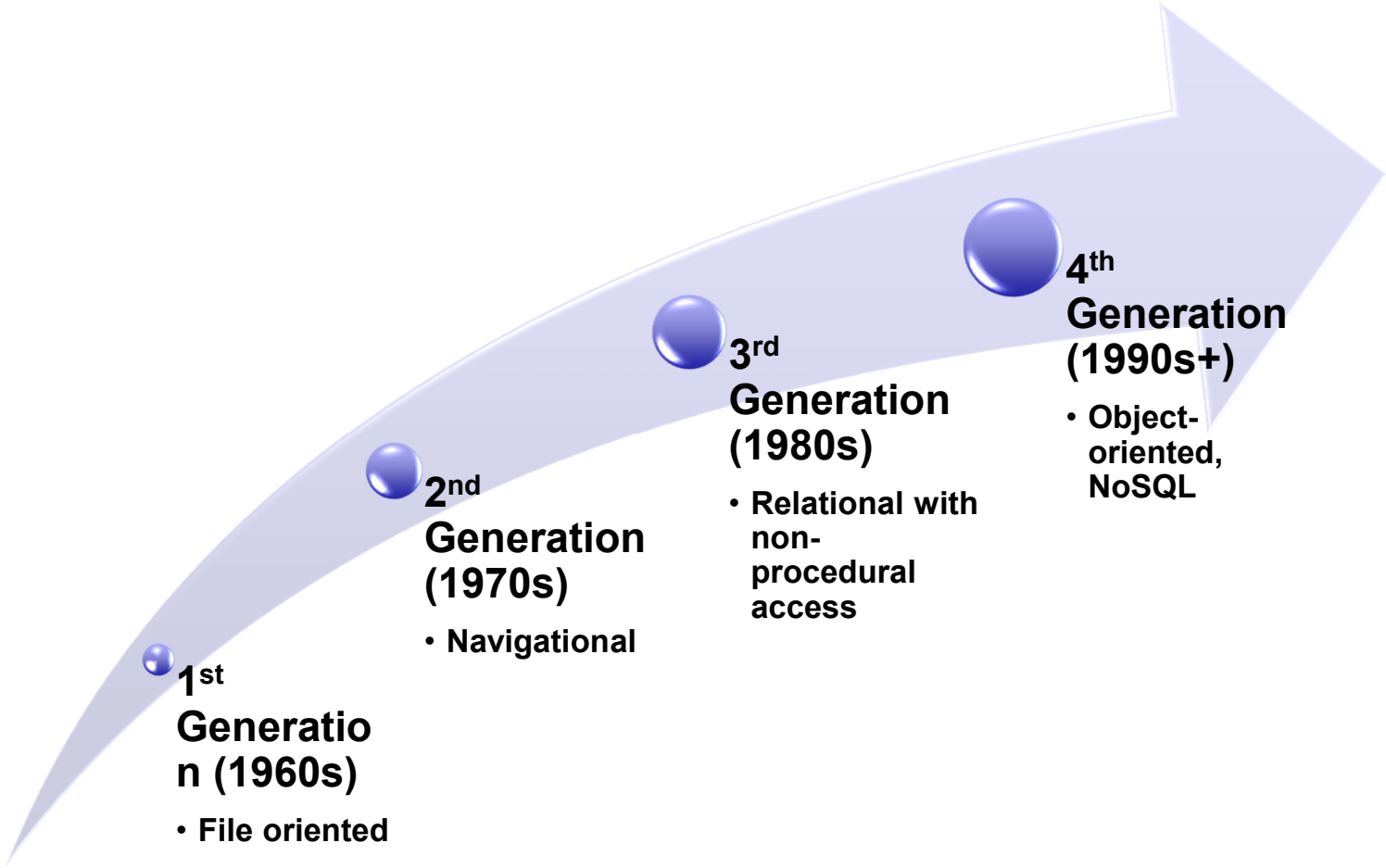
Lesson 7: DBMS Technology Evolution

Lesson Objectives

- Appreciate the advances in database technology and the contribution of database technology to modern society
- List the major periods of database technology evolution and one advancement in each period

DBMS Product Generations



Recent Database Technology Developments

- Business intelligence processing
  - Data integration
  - Storage/retrieval of summary data
- Cloud computing
  - No fixed costs of ownership
  - Data and software
- Optimization for big data demands
  - Demands from smart phones, automotive technology, RFID tags, digitized media
  - NoSQL: simplified models for high performance

DBMS Marketplace

- Enterprise DBMS
  - Oracle: dominates in Unix; strong in Windows
  - SQL Server: strong in Windows
  - DB2: strong in MVS and VM environments
  - Teradata: usage as a data warehouse platform
  - Amazon Web Services
  - SAP Sybase: possible challenge to Oracle
  - Significant open source DBMSs: MySQL, PostgreSQL, MongoDB, MariaDB, SQLite, Cassandra
  - Cloud-based and NoSQL: rapidly evolving
- Desktop DBMS
  - Access: dominates
  - LibreOffice Base, Open Office Base, FileMaker Pro

Summary

- Databases and database technology vital to modern organizations
- Remarkable product evolution
- Competitive industry with lots of continuing innovation