Database Management System (DBMS)

L-1:

Overview

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Lecture Content

- Overview of Database and DBMS
- Data Model
- Data Manipulation Language (DML)
- Data Organization Approaches
- Course Outline Discussion
- Class Rep Selection

Database

"A Database is a collection of related data."

- Elmasri & Navathe

"An organized collection of logically related data."

- Hoffer, Prescott & McFadden

"A shared collection of logically related data, and a description of this data, designed to meet the information needs of an organization"

- Connolly & Begg

Definition of Database

"A Database is a collection of logically related data."

Essential Database Characteristics are:

- Represents an aspect of real world (UoD, miniworld)
- Well structured
- Reflects current state of the UoD
- Has users and applications
- Stored in a permanent (persistent) computer memory

All these characteristics have to be met.

Sample Database

Student

LName	*FName*	*StudId*	*Major*
Smith	Susan	131313	Comp
Bond	James	007007	Math
Smith	Susan	555555	Comp

Course

CName	*CourId*	*Hours*	*Dept*
DB Sys	C302	2+1	Comp
SofEng	C301	2+0	Comp
DisMat	M214	4+1	Math

Grade

StudId	*CourId*	*Grade*
007007	C302	A+
007007	C301	A
007007	M214	A+
131313	C301	B-
555555	C301	C
131313	C302	D
555555	C302	E

Data

"Raw facts"

"Meaningful facts, texts, graphics, images, sound, video segments.."

- Hoffer, Prescott & McFadden

"Data is a value of property of an individual UoD (Universe of Discourse).object or a relationship (between two UoD objects) at a particular period of time."

- Elmasri & Navathe

For Example,

UoD object(s)	James	James & CompSci
Property	Age	Number of Points
Time	Feb 2005	Feb 2005
Value	21	240

DBMS

"A software system that enables users to define, create, maintain and control access to the database is a Database Management System (DBMS)"

- Connolly & Begg

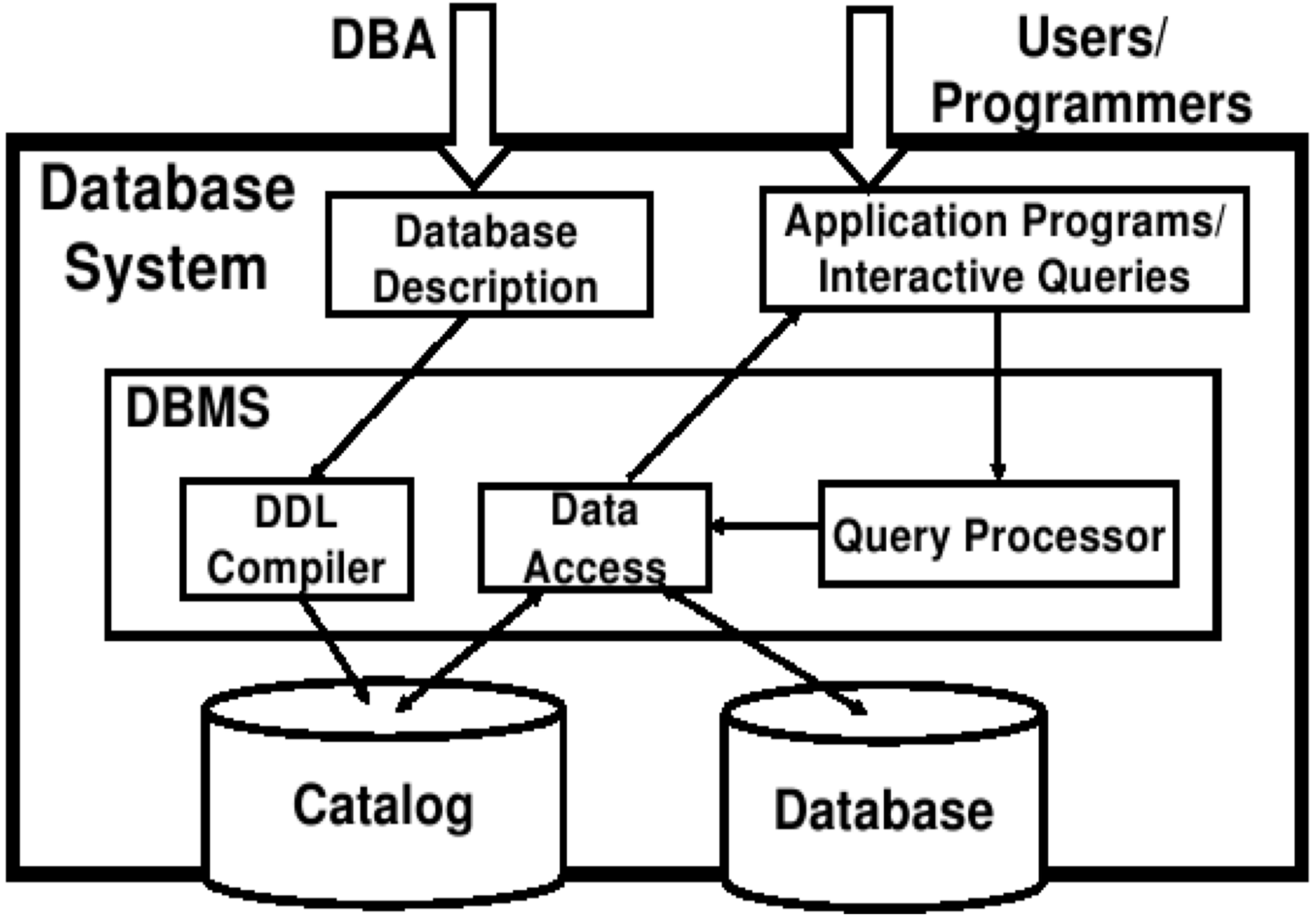
Definition of DBMS

A collection of programs that enable:

- **Defining** (describing the structure),
- **Constructing** (populating the data),
- **Manipulating** (querying, updating),
- **Preserving Consistency**,
- **Protection** from misuse,
- **Recovery** from failure, and
- **Concurrency**

of a database.

A simplified database system layout



Query Example

```
SELECT   CName, Grade, LName AS SURNAME,
 FROM    Student s, Grades g, Course p
 WHERE   FName = 'James' AND
         s.StudId = g.StudId AND
         p.CourId = g.CourId
```

Update Example

```
INSERT INTO Student (FName, LName, StudId)
 VALUES  ('Ann', 'Bole', 111111),
         ('Sharon', 'King' 121212);
```

Data Definition Example

Defining a table in SQL:

```
CREATE TABLE Course (
    CourId   CHR(4)    CONSTRAINT cspk PRIMARY
  KEY,
    CName    CHR(15)   NOT NULL,
    Points   INT       NOT NULL,
    Dept     CHR(25)
  );
```

Data Models

- **A data model is a mathematical abstraction** -

  - to make approximate representation of a real system

  - to make a model of a database of this real system

- **A data model provides components** to represent -

  - The structure, and

  - Dynamics

  of a real system and to map them to a database structure,

  constraints and operations

Classifications of Data Models

- **High level conceptual data models**

  - Enhanced Entity Relationship (EER- highly abstract, no DBMS)

- **Higher level implementation data models**

  - Object-Oriented (some DBMS, mainly nevigational)

- **Representation implementation data models**

  - Network (legacy, navigational)

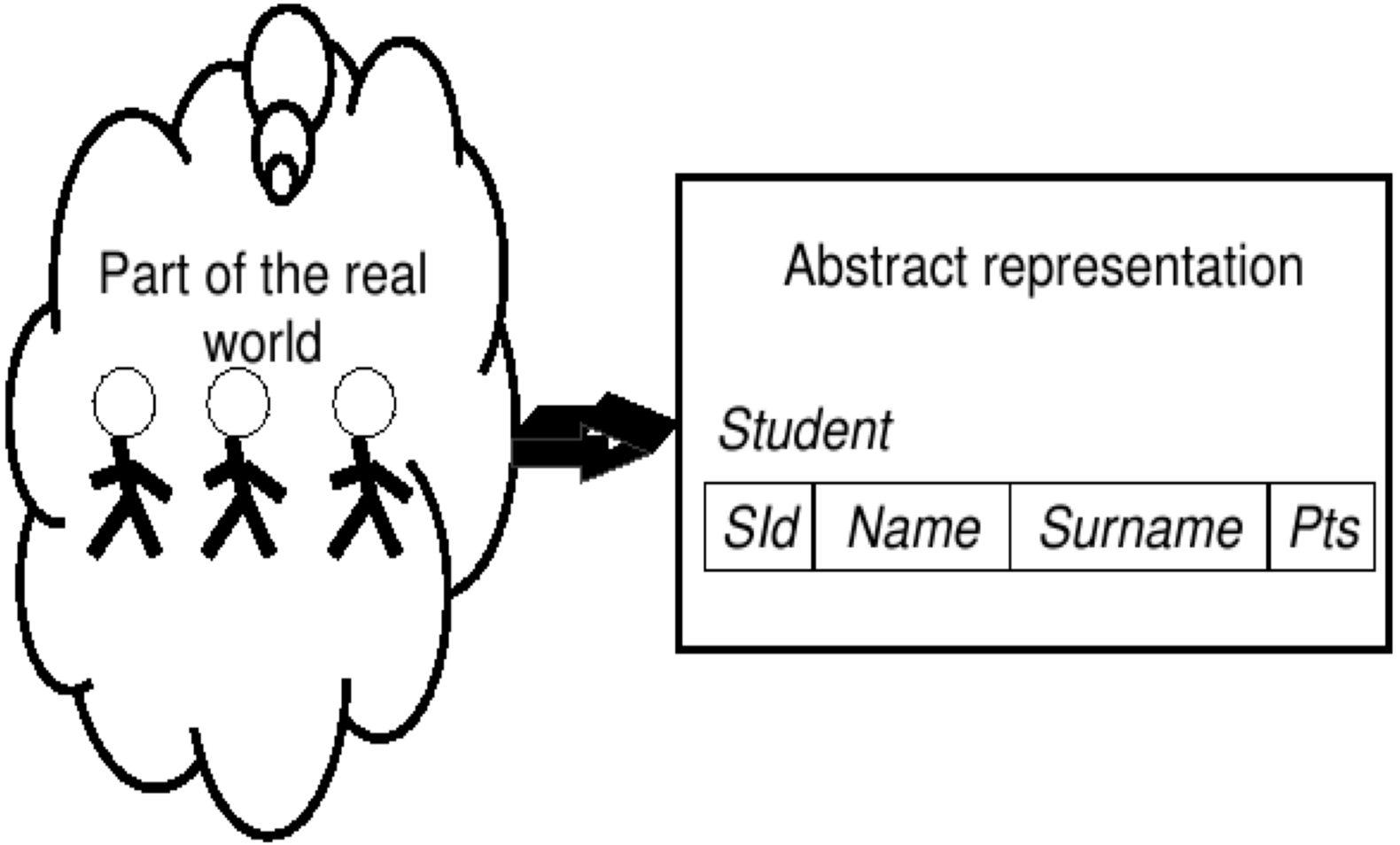
  - Hierarchical (legacy, navigational)

  - Relational (Contemporary, declarative)

- **Low level physical storage data models**

  - ISAM, VSAM (file systems)

Data Model Abstraction



Data Model Structural Component

- **Structural Components builds the structure of an object / entity**

  For example,

  (Bond, James, 007007, Comp)

- **And integrity constraints are statement about values & relationships that must hold between data**

  For example,

  - Each student must have unique *Stuid*
  - *Noofpts* is integer, three digit long
  - For any course, a student can get at most one *grade*.

Data Model Dynamic Component

- **Dynamic Components gives the dynamic aspects of an object / entity**

  For example,

  - Database retrieval / update
  - User defined operations

- **These operations are supported by programming languages**

  For example,

  - A **DML** (Data Manipulation Language) for retrieval / updates
  - A **general purpose language** (eg, Java, C++, VB) for user defined operations

Data Manipulation Language (DML)

A Data Manipulation Language (DML) is a language to

- insert
- retrieve
- delete and
- modify

data.

A DML can be -

- Navigational or
- Declarative

Navigational DML

A Navigational DML :

- Procedural (has loops, branching conditions)
- Selects one record at a time
- Programmer explicitly uses databases physical information to navigate through database
- Programmer has to define WHAT and HOW

Navigational DML

```
Find record with StudId = 007007 in Grades
If successful then
    Do while there are Courses connected to the student
        Find next Course Id in Grades
        Find corresponding Grade
        Find Course name in Course
    End do
Else
    Display error message
End if
```

Declarative DML

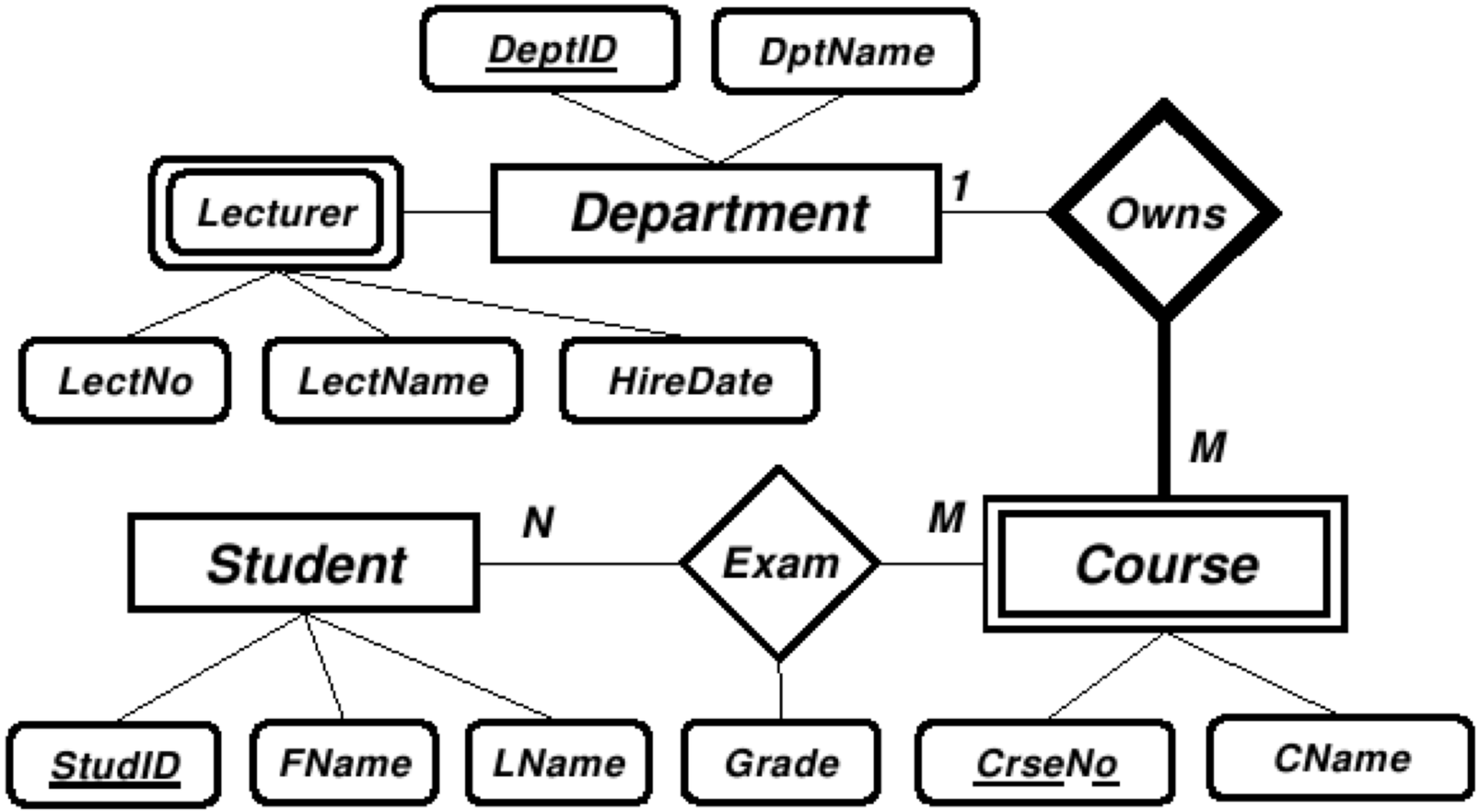
A Declarative DML :

- Non Procedural
- Set oriented (selects all data that match the given condition)
- Programmers completely independent of a database physical organization
- Programmer has to define just WHAT

Declarative DML

```
SELECT CourId, CName, Grade
FROM Course, Grades
WHERE StudId = 007007 AND Grades.CourId =
Course.CourId;
```

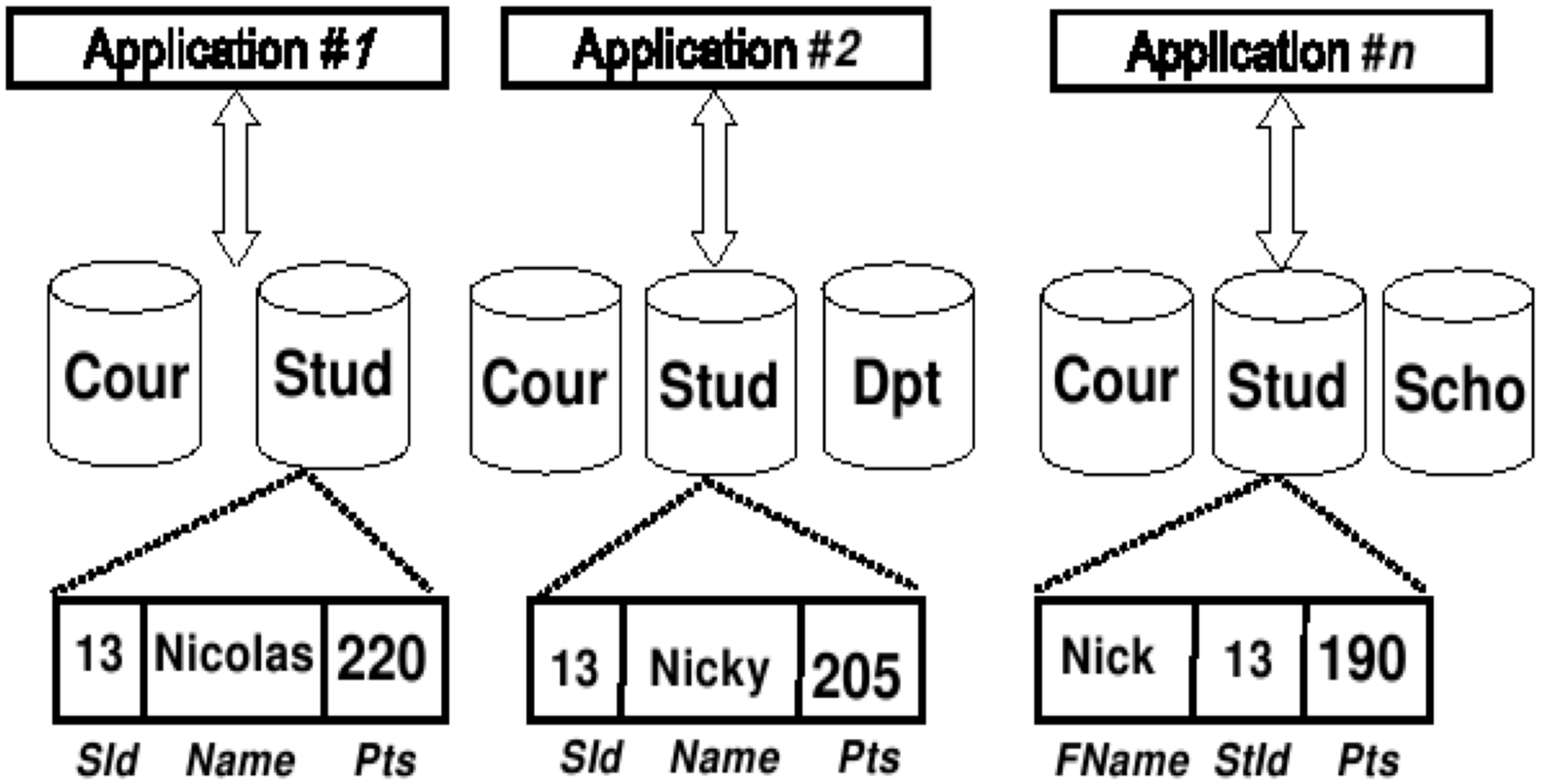
Database Design Example



Data Organization Approaches

- Traditional File Approach
- Database Approach

Traditional File Approaches

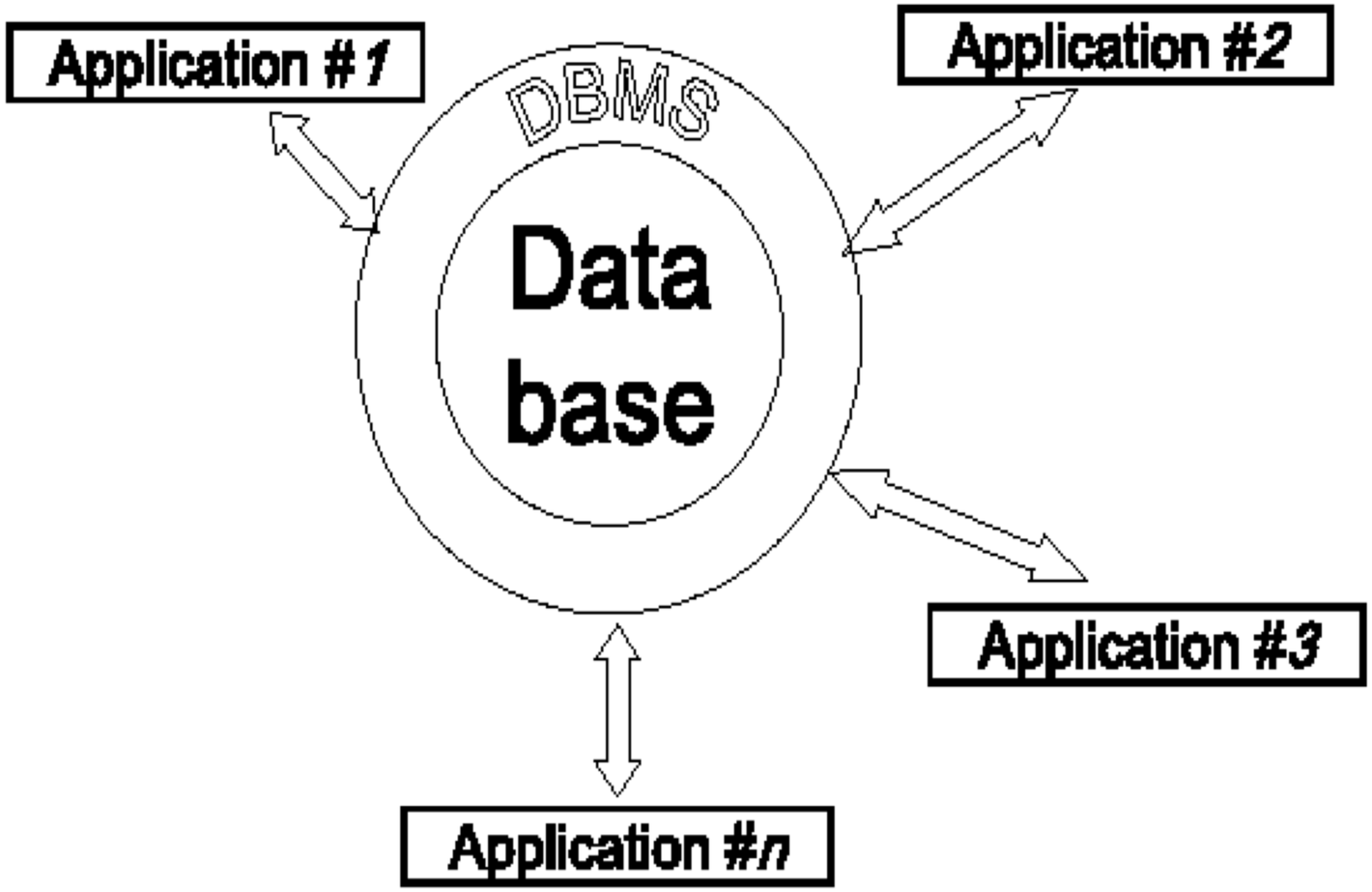


Disadvantages: Traditional File Approaches

Disadvantages:

- Data Redundancy
- Data Inconsistency
- No Centralized data sharing
- No Data Concurrency
- Program and Data Dependency etc.

Database Approaches



Advantages: Database Approaches

Advantages:

- Control of Data Redundancy
- Data Consistency
- Centralized data sharing
- Program and Data Independent
- Improved Data Integrity
- Increased Concurrency
- Economy
- Improved Maintenance, Security, Backup and Recovery etc.

Disadvantages: Database Approaches

Disadvantages:

- Complexity
- DBMS Cost
- Hardware Cost
- Implementation Cost
- Possible Technical Failure Risk
- Computer literate user needed to use a database etc.

Summary

- A Database is a collection of logically related data
- Database Management System (DBMS) is a software which manages database/s
- Data Models are abstraction of real world objects
- Data model provides structural and dynamic component to represent real world objects/entities precisely
- Two types of Data Manipulation Language (DML) are navigational declarative
- Database approach has eliminated all problems in file based Data organization approach