

Databases

OBJECTIVES

After reading this chapter, the reader should be able to:

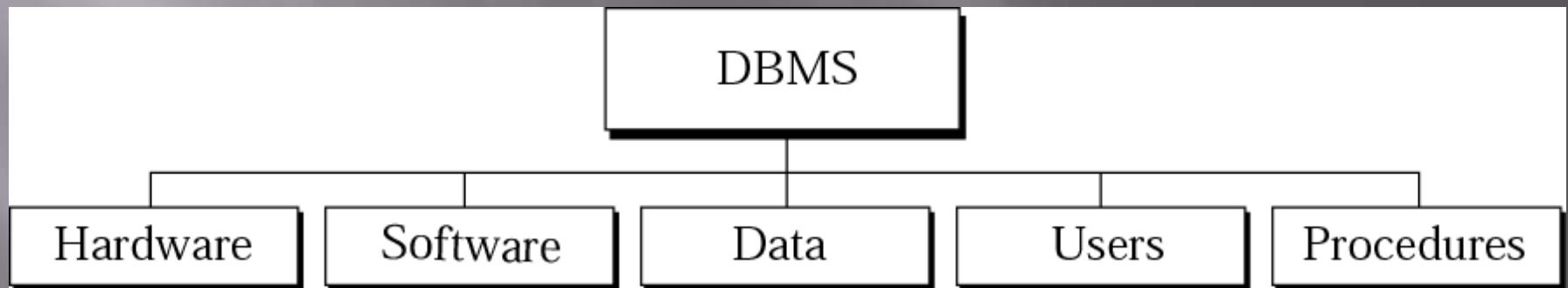
- Understand a DBMS and define its components.
- Understand the architecture of a DBMS and its levels.
- Distinguish between different database models.
- Understand the concept of relational database operations on a relation.
- Use Structured Query Language (SQL) to define simple relations.

***DATABASE
MANAGEMENT
SYSTEM***

DBMS

- ▣ A database management system (DBMS) defines, creates, and maintains a database.

DBMS components



DBMS components

- ▣ **Hardware**

- The physical computer system that allows physical access to data

- ▣ **Software**

- The actual program that allows users to access, maintain, and update physical data

- ▣ **Data:** stored physically on the storage devices

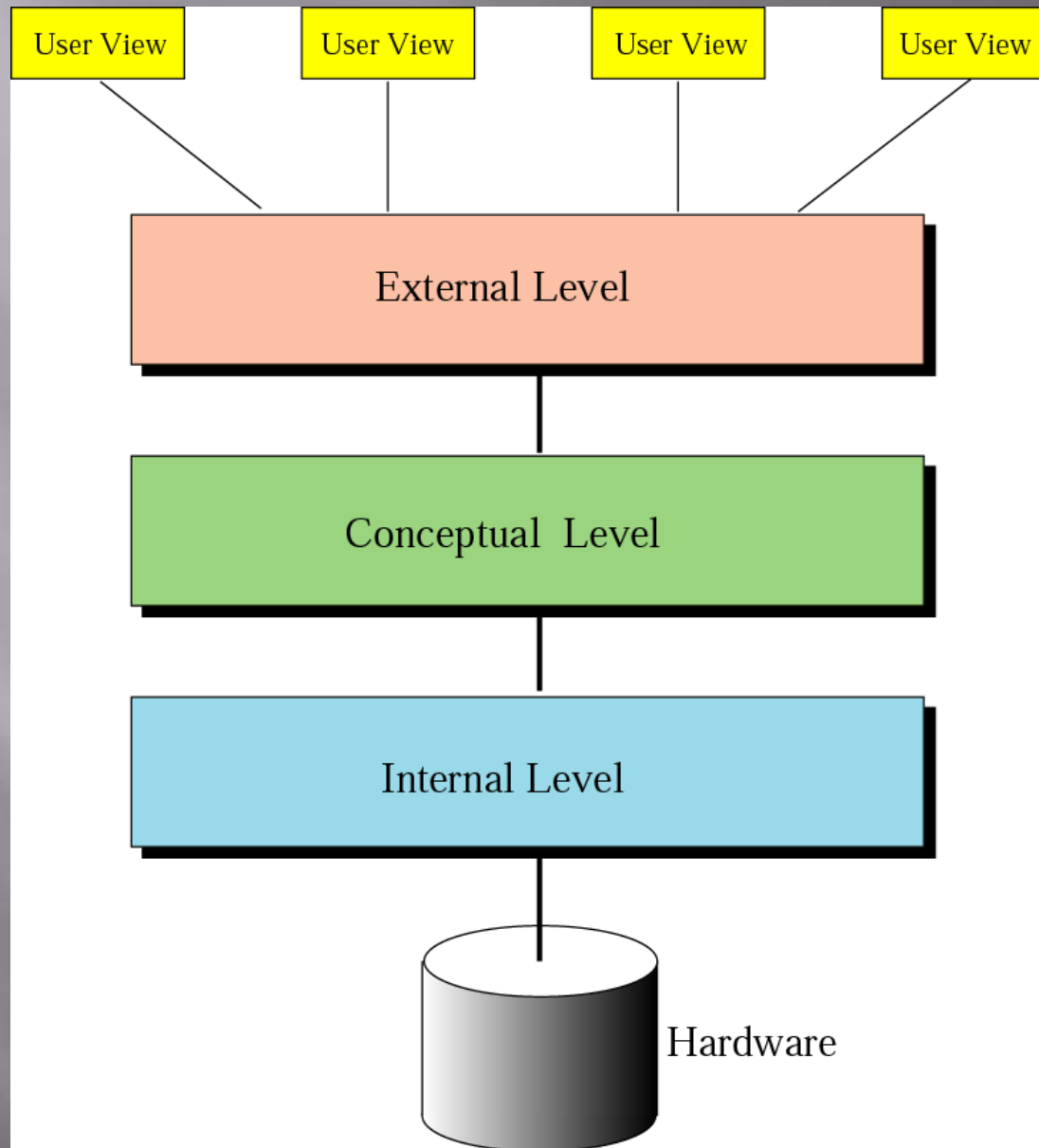
- ▣ **User:** include **end users** and **application programs**

- ▣ **Procedure**

- A set of procedures (rules) that should be clearly defined and followed by the users of the database



ARCHITECTURE



Database architecture

Database architecture

ANSI/SPARC

- ▣ Internal level
 - The internal level determines where data are actually stored on the storage device
- ▣ Conceptual level
 - The conceptual level defines the logical view of the data
- ▣ External level
 - The external level interacts directly with the user



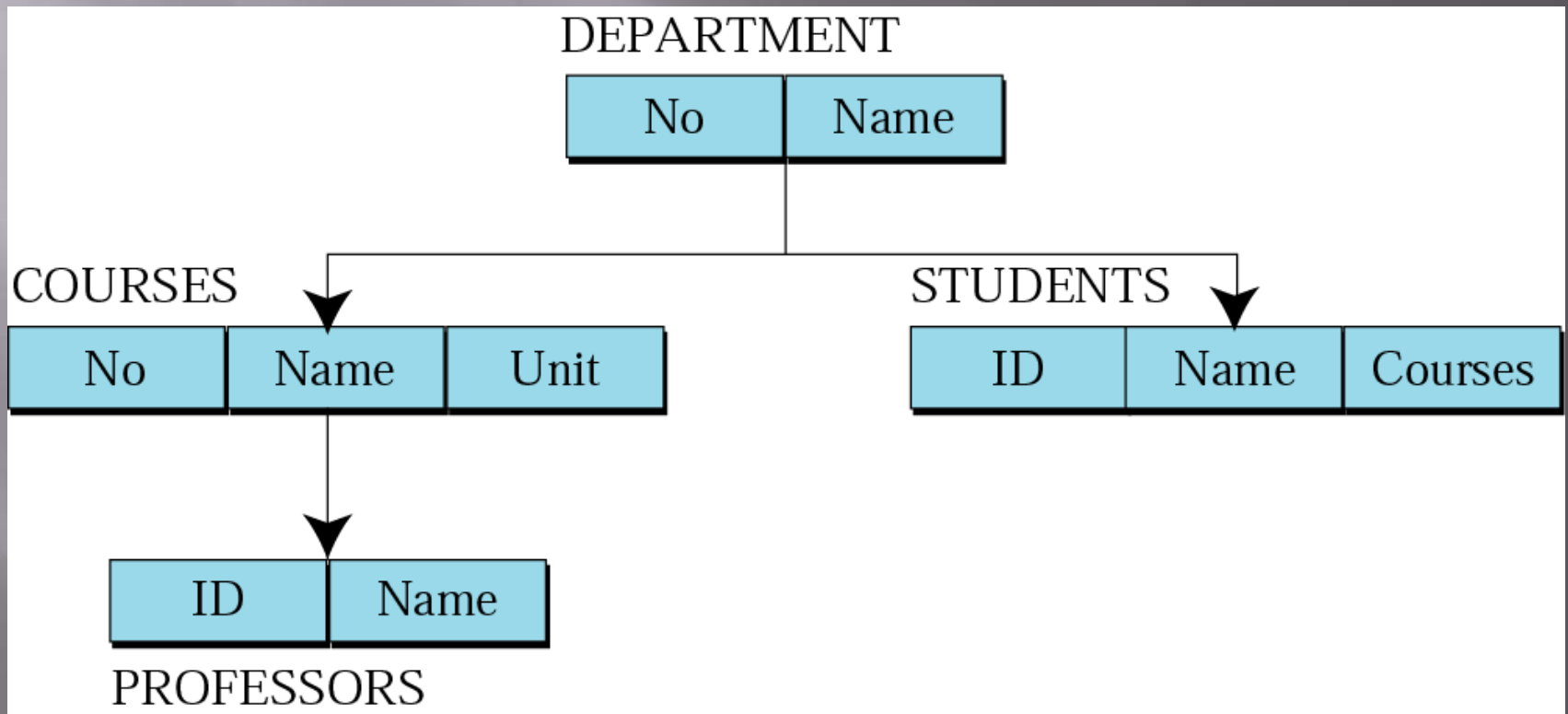
DATABASE MODELS

Database models

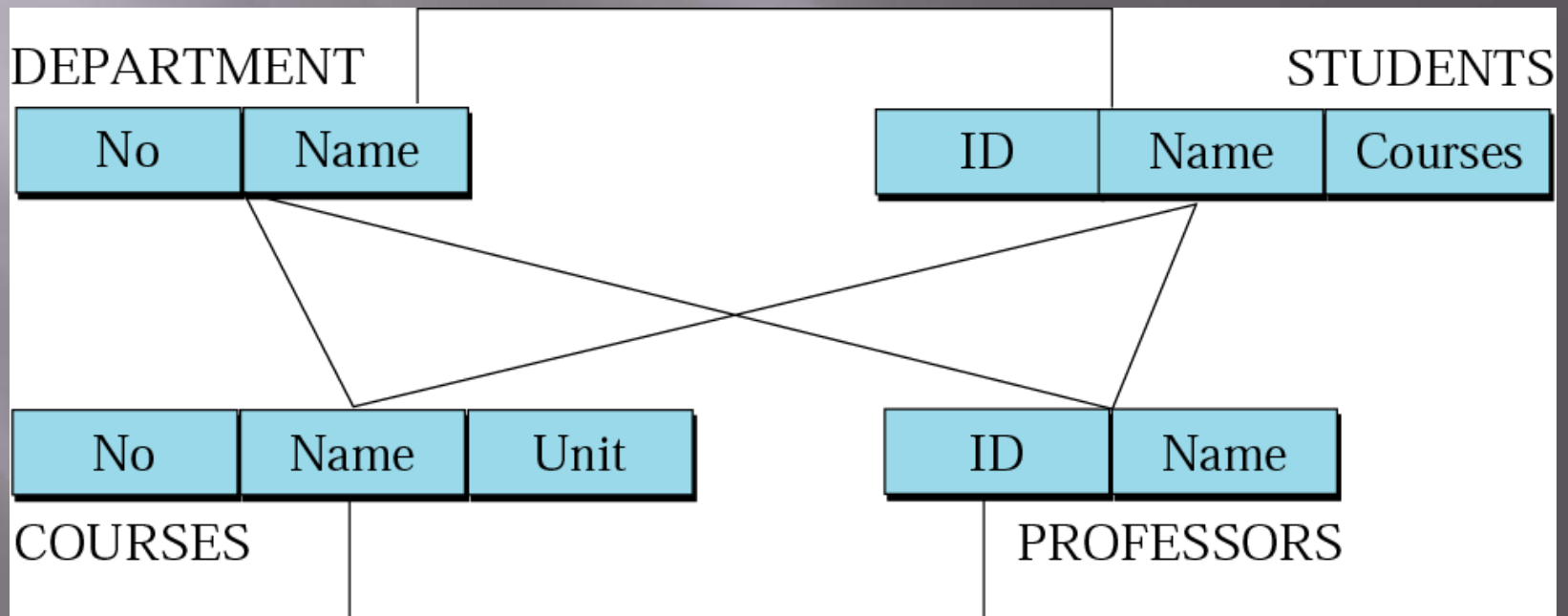
- ▣ Hierarchical model: obsolete
- ▣ Network model: obsolete
- ▣ Relational model
 - In a relational model, data are organized in two-dimensional tables called **relations**.

Figure 14-3

Hierarchical model



Network model: graph



Relational model

DEPARTMENT

No	Name
...	...
...	...
...	...

PROFESSORS

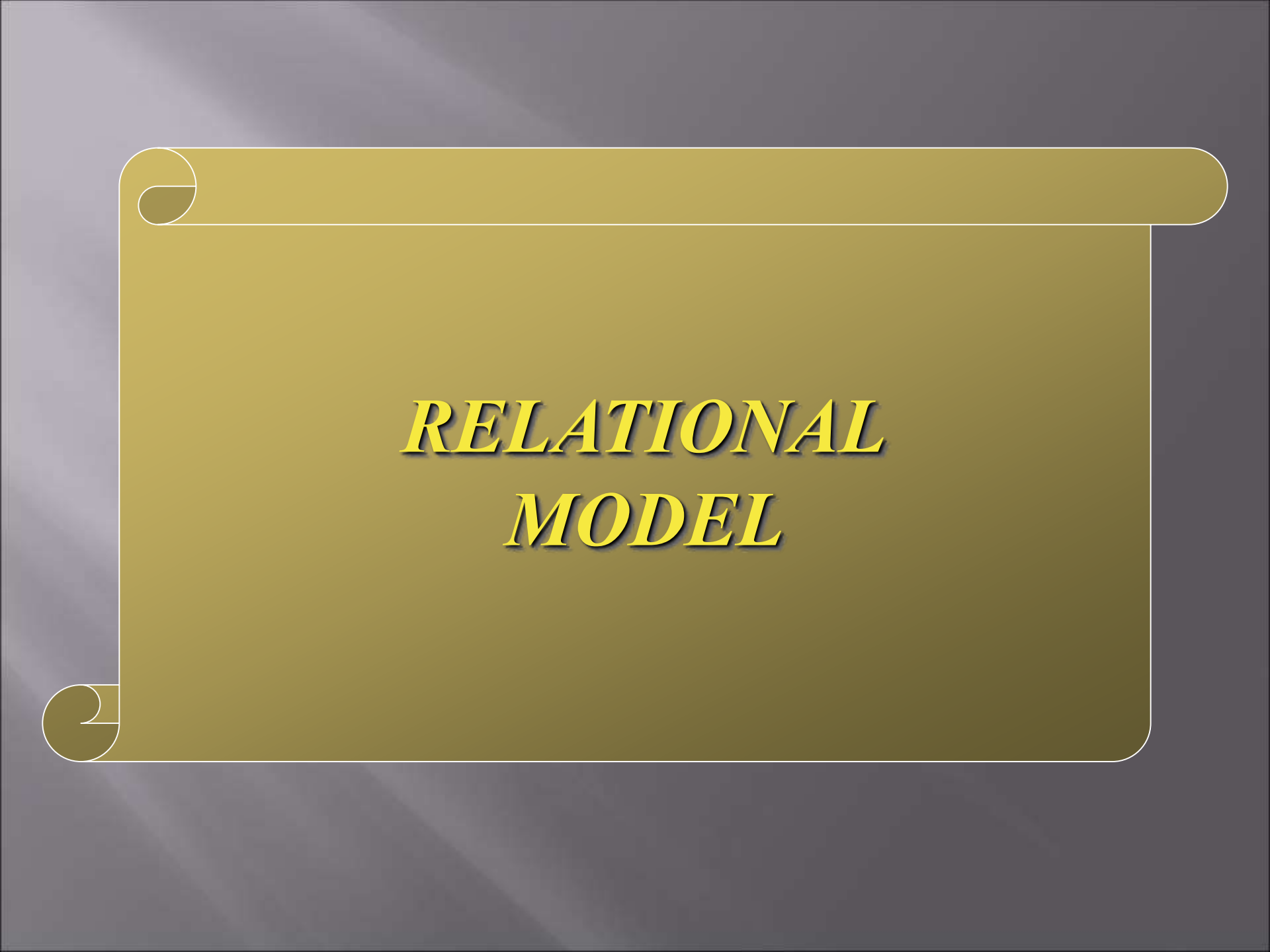
ID	Name	Dept-No	Courses
...	...	...	...
...	...	...	...
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...	...	...	...

COURSES

No	Dept-No	Prof-ID	Unit
...	...	...	...
...	...	...	...
...	...	...	...
...	...	...	...
...	...	...	...

STUDENTS

ID	Name	Courses
...	...	...
...	...	...
...	...	...
...	...	...



RELATIONAL MODEL

RDBMS

- ▣ RDBMS: the relational database management system (RDBMS)
- ▣ Relation: a relation is a 2D table has the following features:

- Name
- Attributes
- Tuples

The diagram illustrates a relation table with three columns: 'No', 'Course-Name', and 'Unit'. The table contains four rows of data. Annotations include: a bracket labeled 'Attributes' above the header row; a red arrow pointing to the 'No' header; a green arrow pointing to the first data row; and a bracket labeled 'Tuples' to the right of the data rows. The table is labeled 'COURSES' at the bottom.

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5

COURSES

*OPERATIONS
ON
RELATIONS*

Operations on relations

- ▣ Insert : unary operation
- ▣ Delete : unary operation
- ▣ Update : unary operation
- ▣ Select : unary operation
- ▣ Project : unary operation
- ▣ Join : binary operation
- ▣ Union : binary operation
- ▣ Intersection : binary operation
- ▣ Difference : binary operation

Insert operation

COURSES

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5

Insert

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
<i>CIS52</i>	<i>TCP/IP Protocols</i>	<i>6</i>

Delete operation

COURSES

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
CIS52	TCP/IP Protocols	6

Delete

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS51	Networking	5
CIS52	TCP/IP Protocols	6

Update operation

COURSES

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
CIS52	TCP/IP Protocols	6



No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	6
CIS52	TCP/IP Protocols	6

Select operation

COURSES

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
CIS52	TCP/IP Protocols	6



No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS51	Networking	5

Project operation

- ▣ The project operation creates a relation in which each tuple has **fewer** attributes.

COURSES

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
CIS52	TCP/IP Protocols	6



No	Unit
CIS15	5
CIS17	5
CIS19	4
CIS51	5
CIS52	6

Join operation

COURSES

No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
CIS52	TCP/IP Protocols	6

TAUGHT-BY

No	Professor
CIS15	Lee
CIS17	Lu
CIS19	Walter
CIS51	Lu
CIS52	Lee

Join

No	Course-Name	Unit	Professor
CIS15	Intro to C	5	Lee
CIS17	Intro to Java	5	Lu
CIS19	UNIX	4	Walter
CIS51	Networking	5	Lu
CIS52	TCP/IP Protocols	6	Lee

Union operation

CIS15-Roster

Student-ID	F-Name	L-Name
145-67-6754	John	Brown
232-56-5690	George	Yellow
345-89-6580	Anne	Green
459-98-6789	Ted	Purple

CIS52-Roster

Student-ID	F-Name	L-Name
342-88-9999	Rich	White
145-67-6754	John	Brown
232-56-5690	George	Yellow

Union

Student-ID	F-Name	L-Name
145-67-6754	John	Brown
232-56-5690	George	Yellow
345-89-6580	Anne	Green
459-98-6789	Ted	Purple
342-88-9999	Rich	White

Intersection operation

CIS15-Roster

Student-ID	F-Name	L-Name
145-67-6754	John	Brown
232-56-5690	George	Yellow
345-89-6580	Anne	Green
459-98-6789	Ted	Purple

CIS52-Roster

Student-ID	F-Name	L-Name
342-88-9999	Rich	White
145-67-6754	John	Brown
232-56-5690	George	Yellow

Intersection

Student-ID	F-Name	L-Name
145-67-6754	John	Brown
232-56-5690	George	Yellow

Difference operation

CIS15-Roster

Student-ID	F-Name	L-Name
145-67-6754	John	Brown
232-56-5690	George	Yellow
345-89-6580	Anne	Green
459-98-6789	Ted	Purple

CIS52-Roster

Student-ID	F-Name	L-Name
342-88-9999	Rich	White
145-67-6754	John	Brown
232-56-5690	George	Yellow

Difference

Student-ID	F-Name	L-Name
345-89-6580	Anne	Green
459-98-6789	Ted	Purple