Databases, DBMS and SQL

IICT Lecture 08

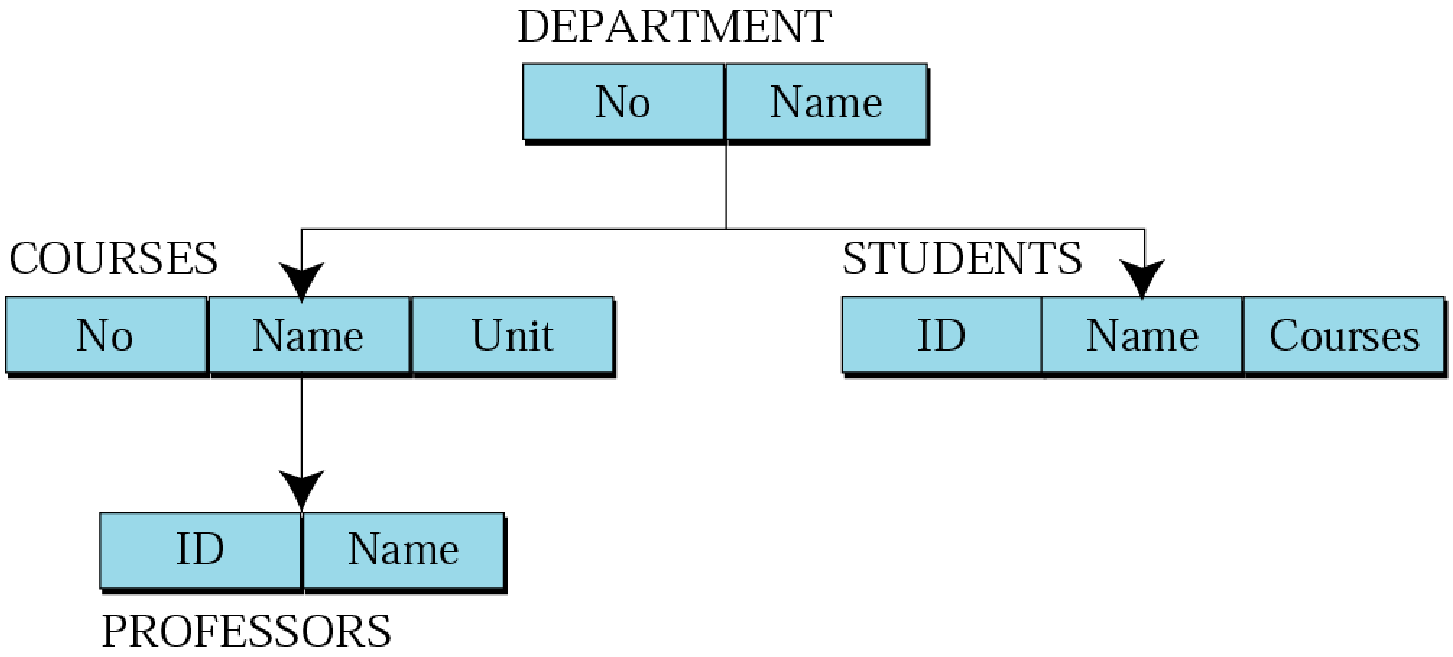
What is a Database?

- An organized collection of Data
- A comprehensive collection of related data organized for convenient access, generally in a computer

Database Model

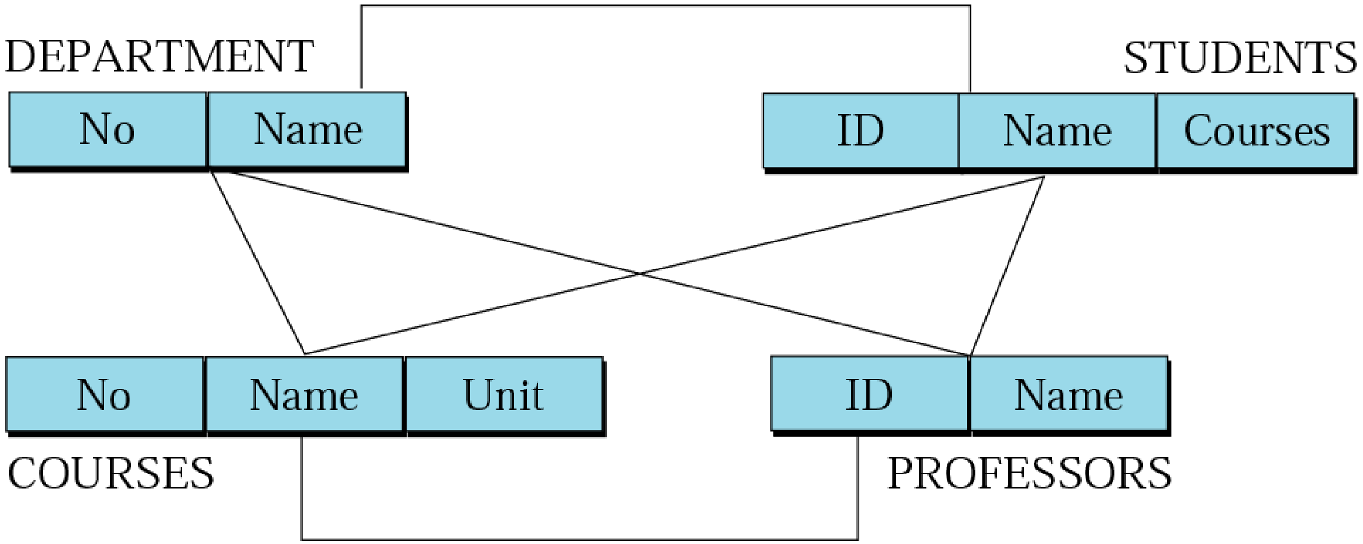
- Database model defines the logical design of data.
- Database model describes the relation between different parts of data.
- There are three database models:
    1. Hierarchical Model
    2. Network Model
    3. Relational Model

Hierarchical model



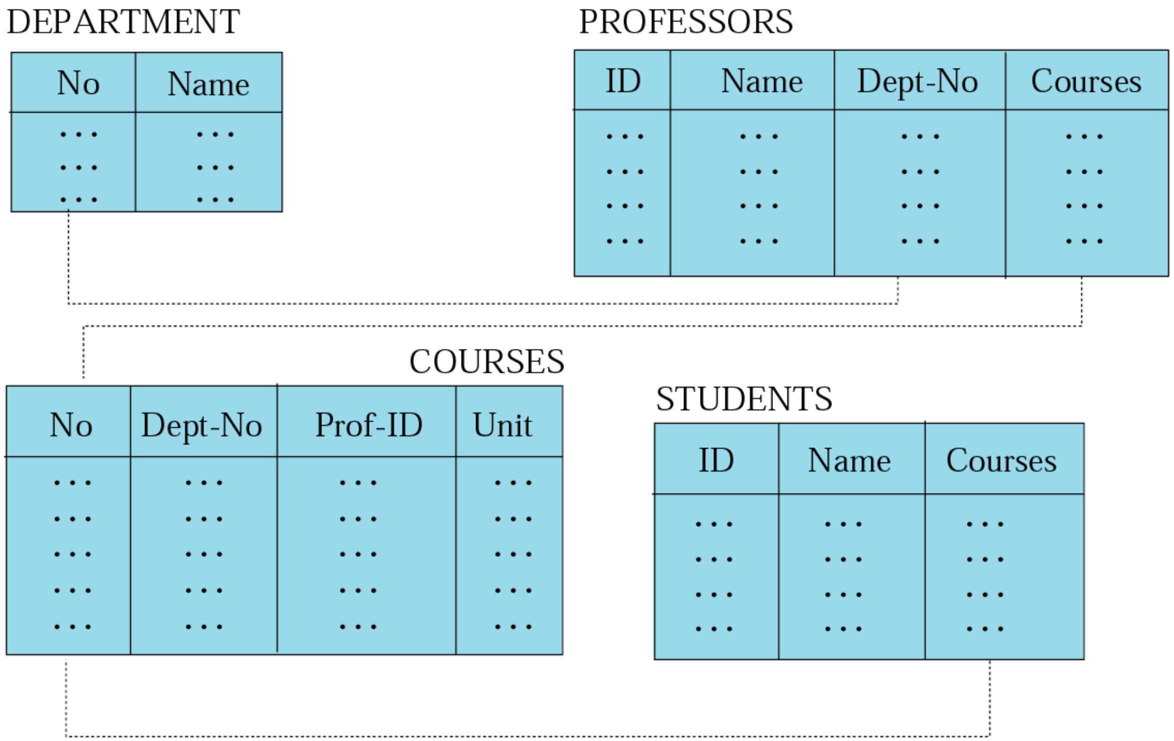
- Data are organized in an upside down tree
- Each entity has one parent and many children
- Old and not used now

Network model



- Entities are organized in a graph
- Entities can be accessed through several paths
- Old and not used

Relational model



DEPARTMENT

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

PROFESSORS

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

COURSES

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

STUDENTS

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

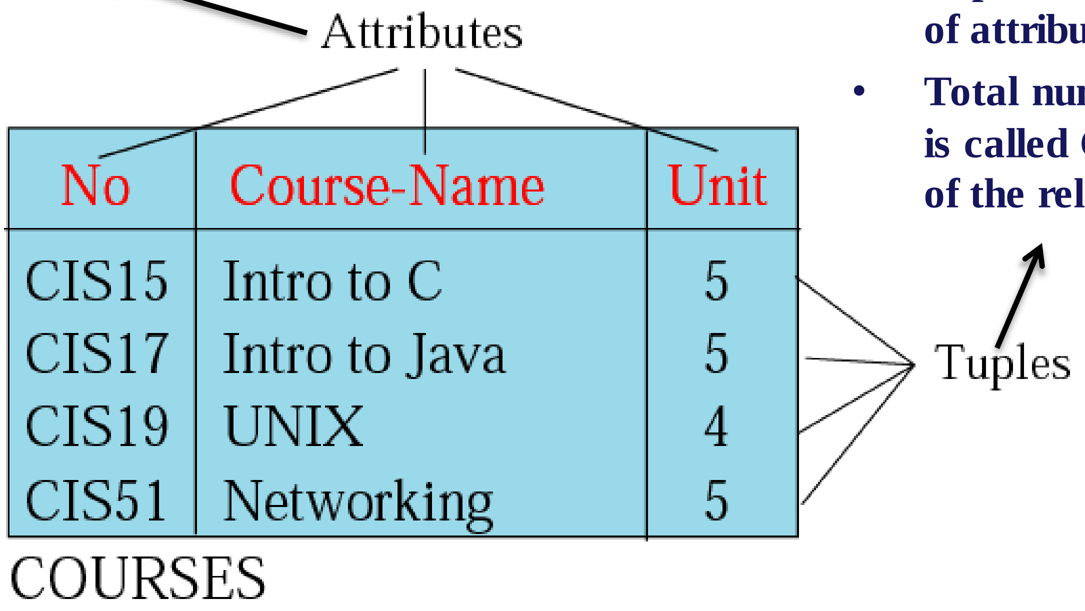
- **Data are organized in two dimensional tables (relations)**
- **Tables re related to each other**
- **Relational Database Management System (RDBMS) are more common model used today**

Relation (Name, Attributes, Tuples)

- Attributes are the column heading
- Each column must have a unique heading
- Number of columns is called the degree of the relation

- Each relation must have a unique name

- Tuple is a collection of attribute value
- Total number of rows is called Cardinality of the relation



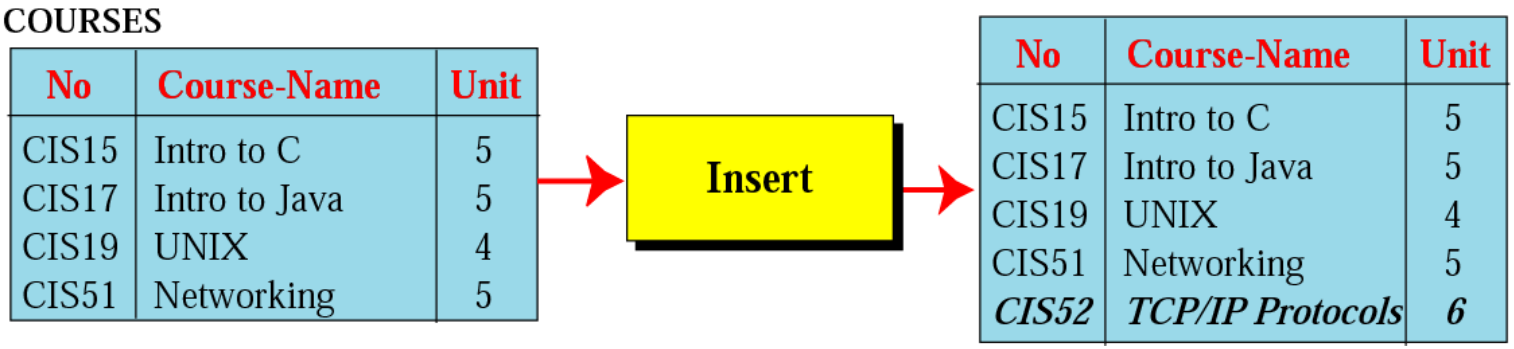
No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5

COURSES

- Relation appears in 2 dimensional table
- That doesn’t mean data stored as table; the physical storage of data is independent of the logical organization of data

OPERATIONS ON RELATIONS

Insert operation



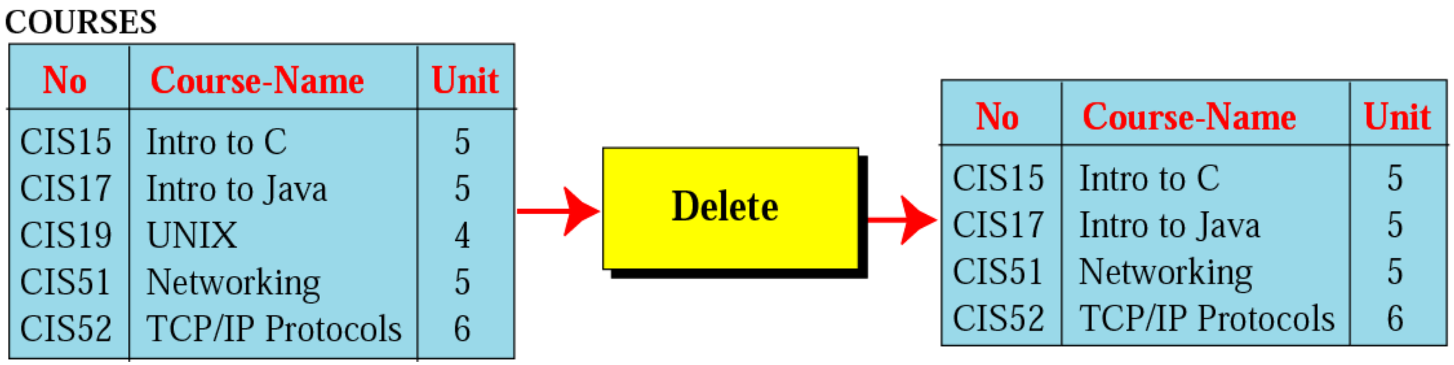
COURSES

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

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***

- **Unary operation**
- **Insert Operation: Inserts new tuple into the relation**

Delete operation



COURSES

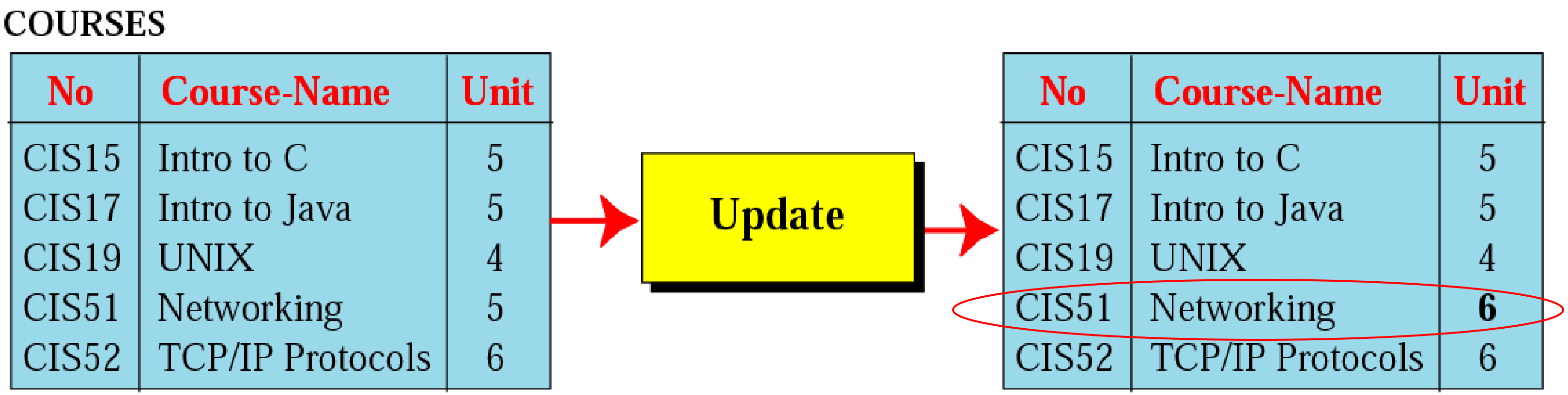
No	Course-Name	Unit
CIS15	Intro to C	5
CIS17	Intro to Java	5
CIS19	UNIX	4
CIS51	Networking	5
CIS52	TCP/IP Protocols	6

Delete

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

- **Unary operation**
- **Delete Operation: Deletes tuple from the relation**

Update operation



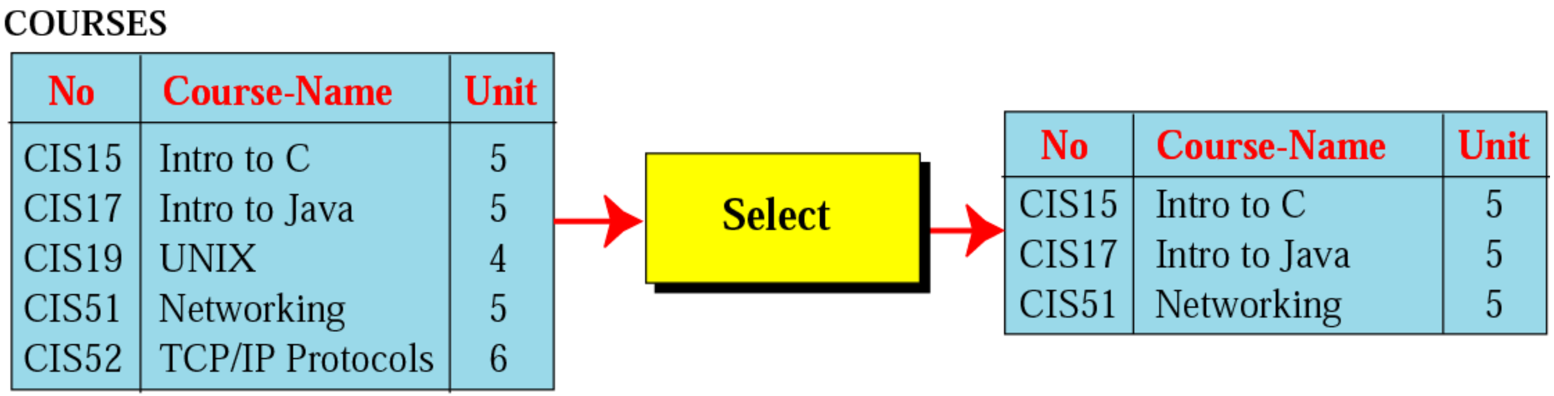
COURSES

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

- **Unary operation**
- **Update Operation: Changes the values of some attributes of a tuple**

Select operation



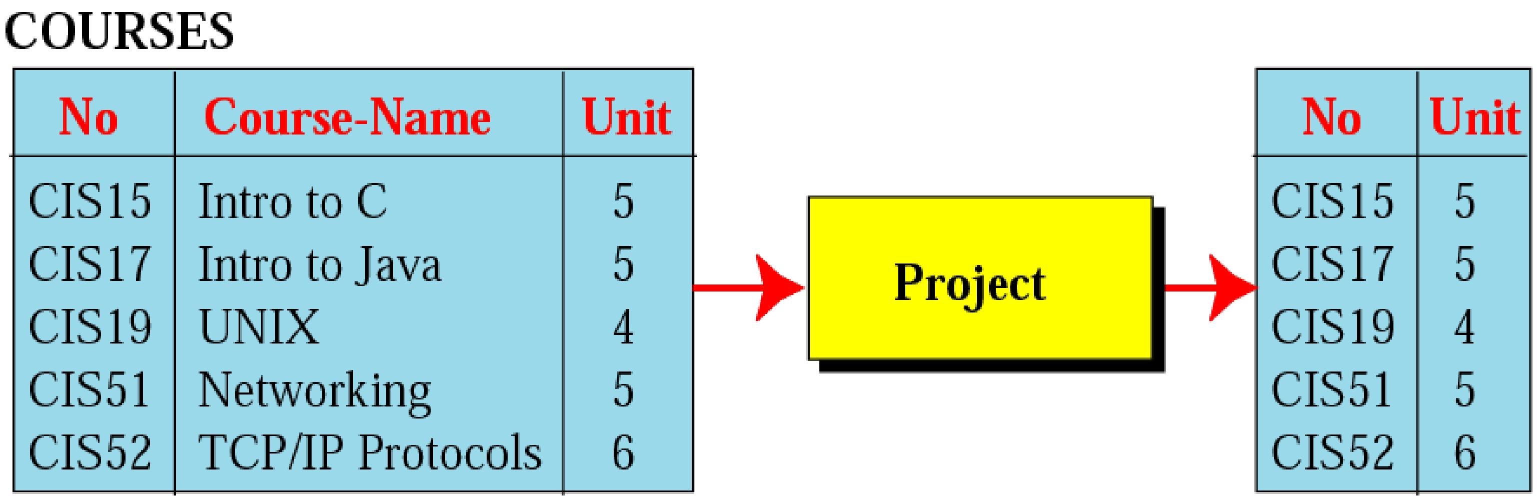
COURSES

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

- Unary operation
- Select Operation: Uses some criteria to select some tuples from the original relation

Project operation



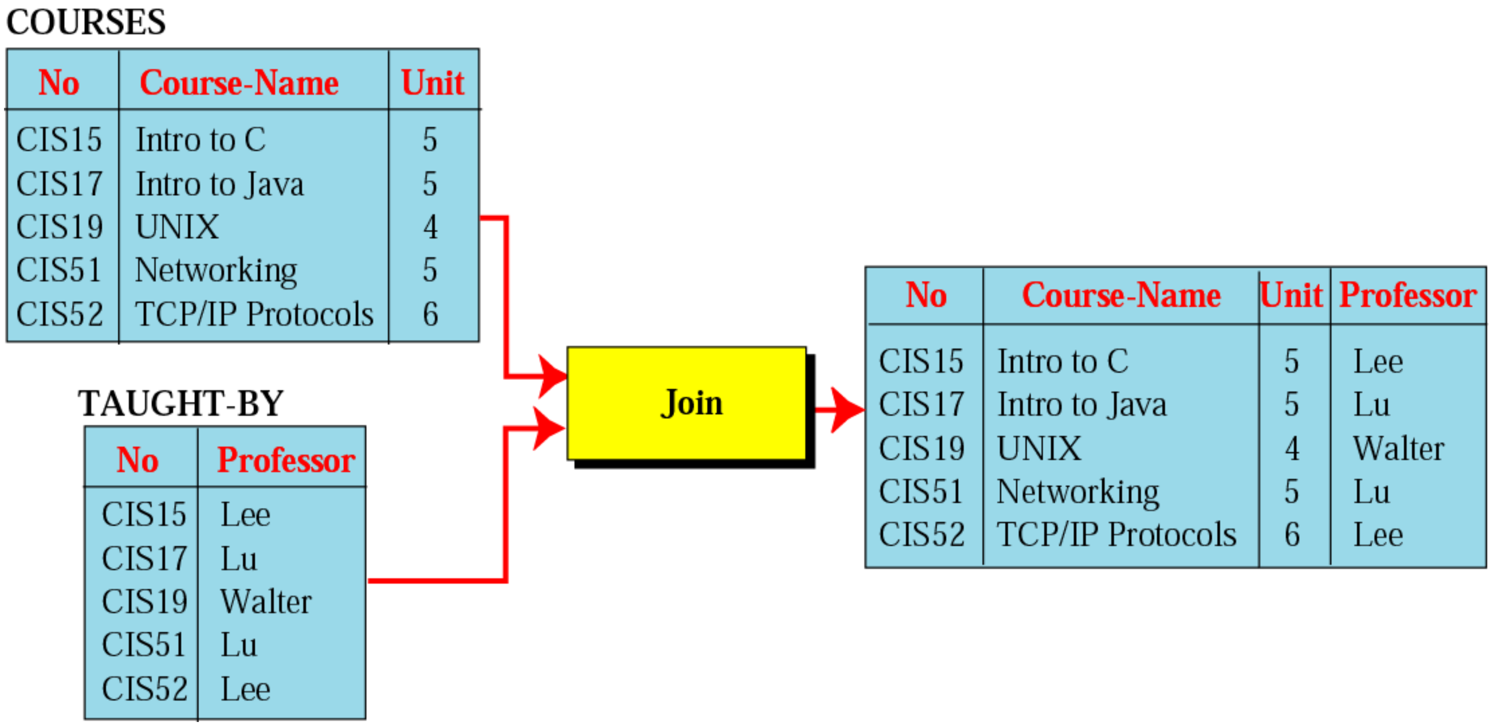
COURSES

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	Unit
CIS15	5
CIS17	5
CIS19	4
CIS51	5
CIS52	6

- **Unary operation**
- **Project Operation: Creates relation in which each tuple has fewer attributes**

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

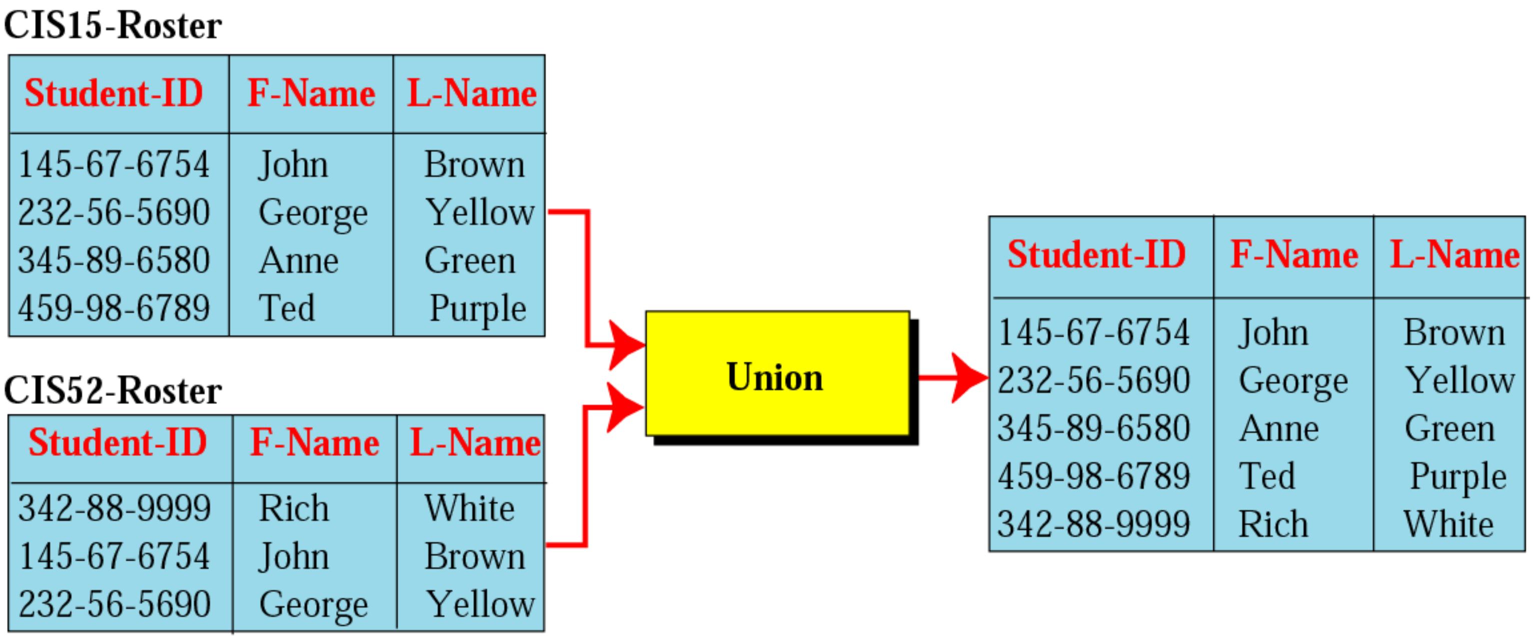
TAUGHT-BY

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

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

- **Binary operation**
- **Join Operation: Takes two relation and combine them based on common attribute**

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

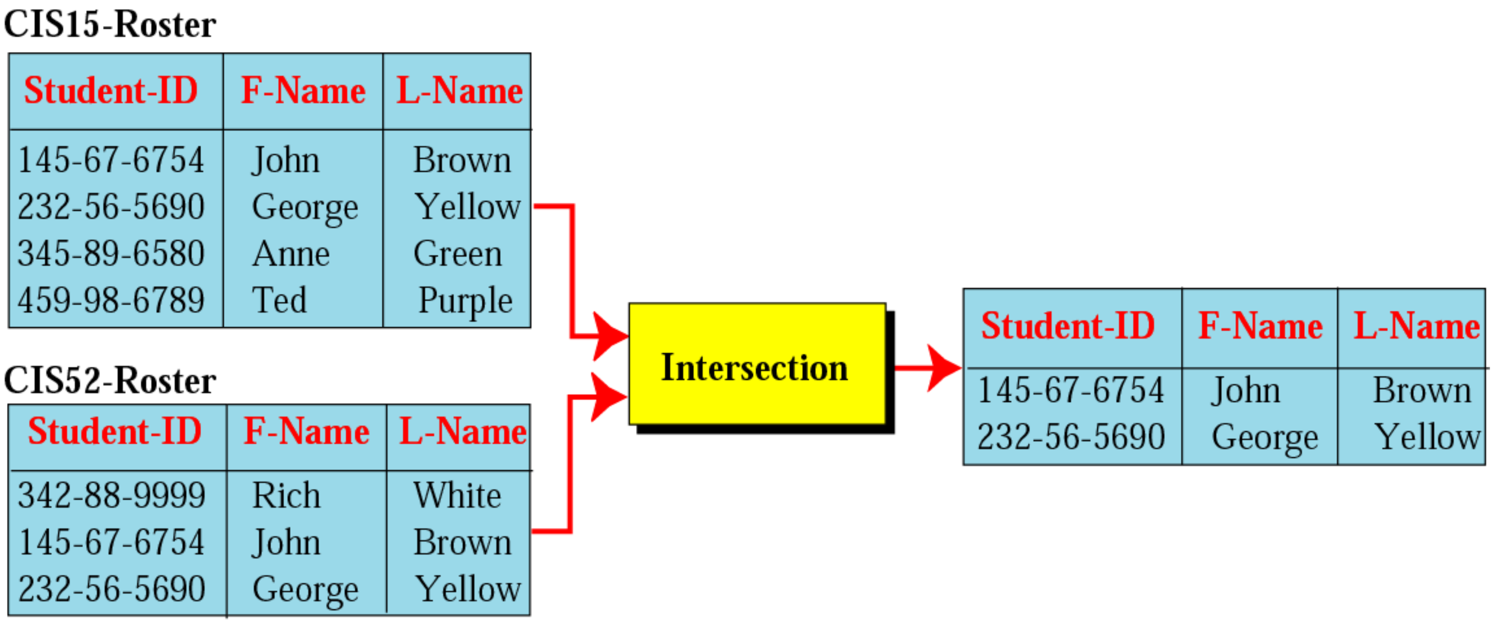
Student-ID	F-Name	L-Name
342-88-9999	Rich	White
145-67-6754	John	Brown
232-56-5690	George	Yellow

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

- Binary operation
- Union Operation: Creates new relation in which each tuple is either in the first relation, the second relation or in both

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

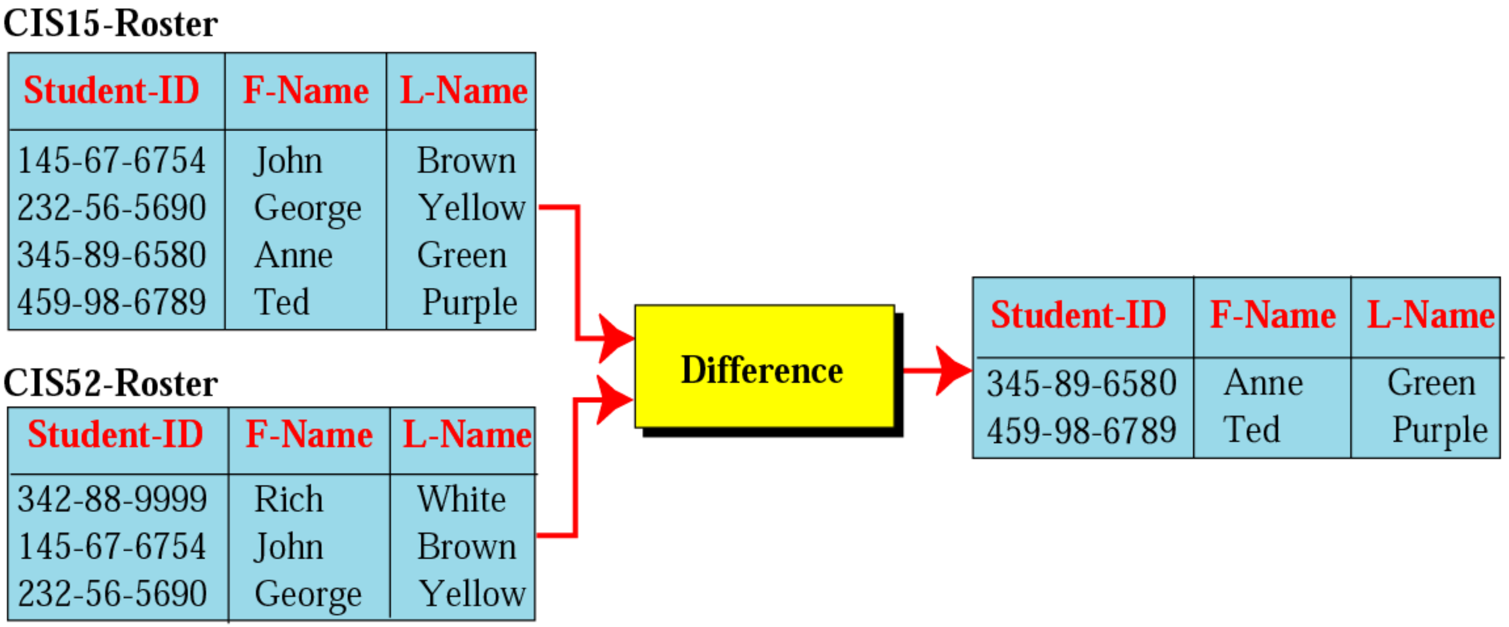
CIS52-Roster

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

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

- Binary operation
- Intersection Operation: Creates new relation in which each tuple is in both relations.

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

- **Binary Operation**
- **Difference Operation: Creates new relation where the new tuples are in the first relation but not in the second.**

Database Management System

- A database management system (DBMS) is system software for creating and managing Database.
- The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data.
- DBMS allow all the operations on database discussed in previous slides
  - Inserte, Delete, retrieve, Union, Join etc…

STRUCTURED QUERY LANGUAGE

SQL

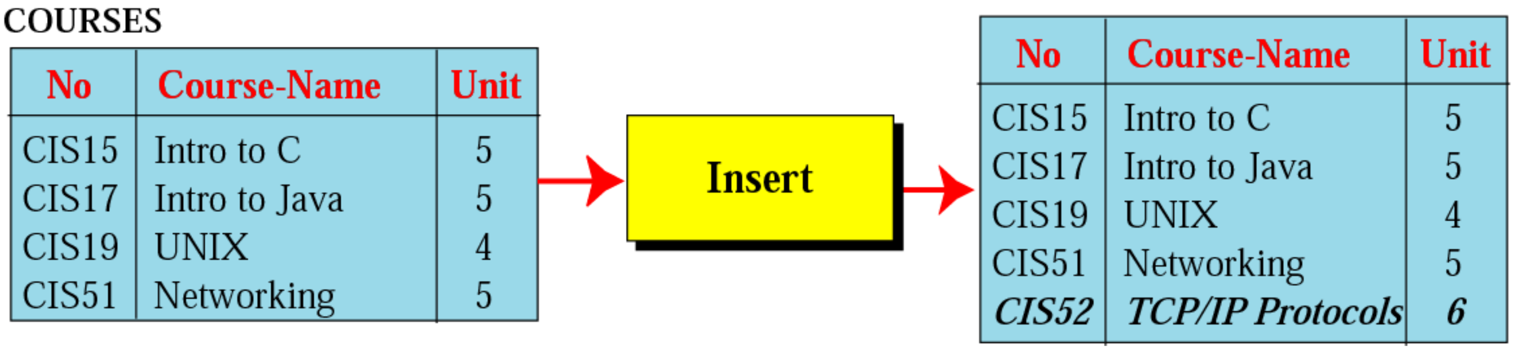
- SQL is the standard language used for relational databases.
- It is declarative language where users declare what they want without having to write a step by stem procedure.
- It was first implemented by Oracle Corporation

1. Insert

- SQL Insert Operation format

```
insert into   RELATION-NAME
values        (…, …, …)
```

Insert (Example)



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
CIS52	*TCP/IP Protocols*	*6*

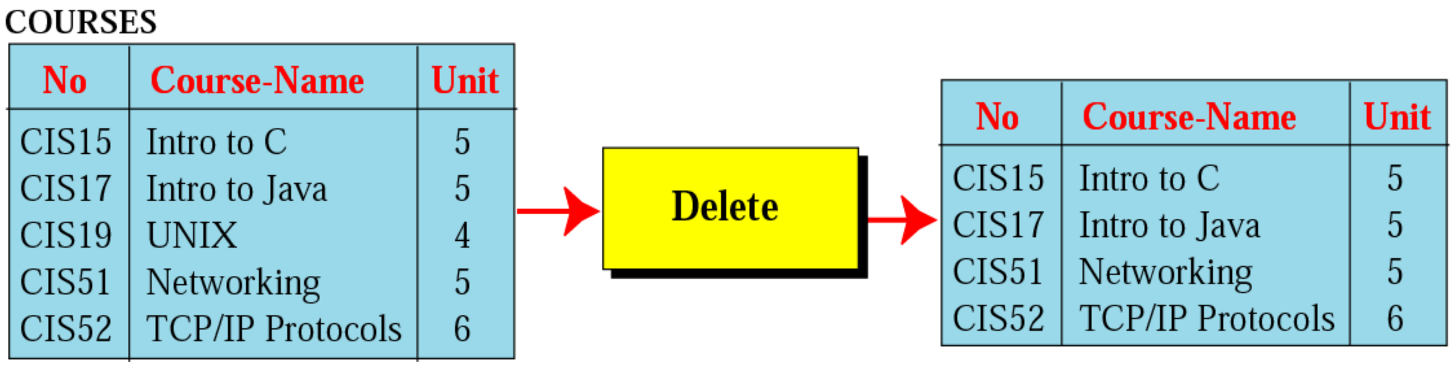
insert into COURSES
values (“CIS52”, “TCP/IP Protocols”, 6)

2. Delete

- SQL Delete Operation format

```
delete from   RELATION-NAME
where         criteria
```

Delete (Example)



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
CIS52	TCP/IP Protocols	6

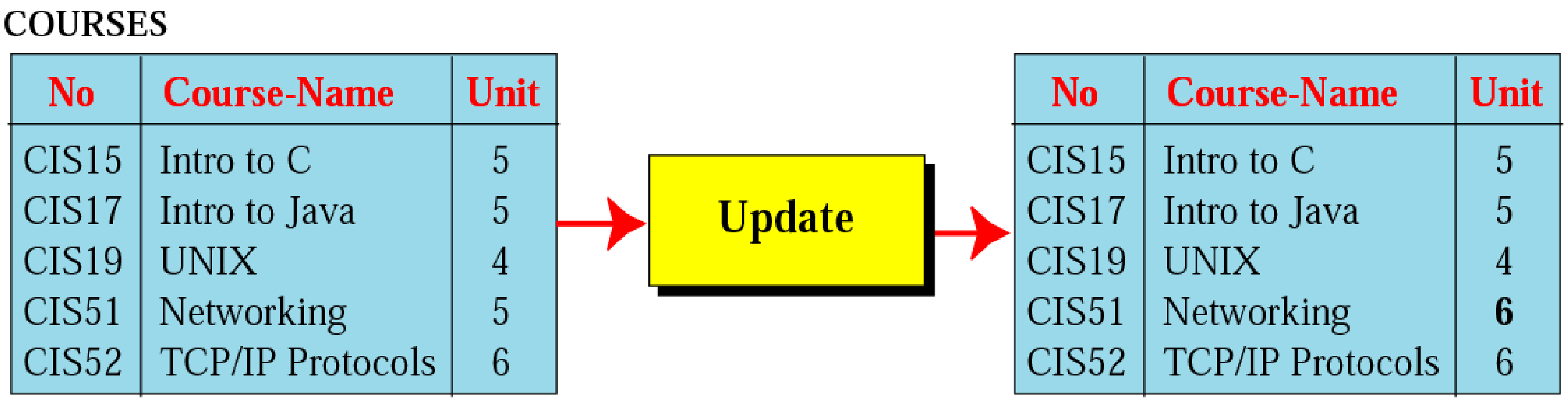
Delete from COURSES
where No = “CIS19”

3. Update

- SQL Update Operation format

```
update   RELATION-NAME
set      attribute1  = value1   attribute 2 = value2 …
where    criteria
```

Update (Example)



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

Update

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

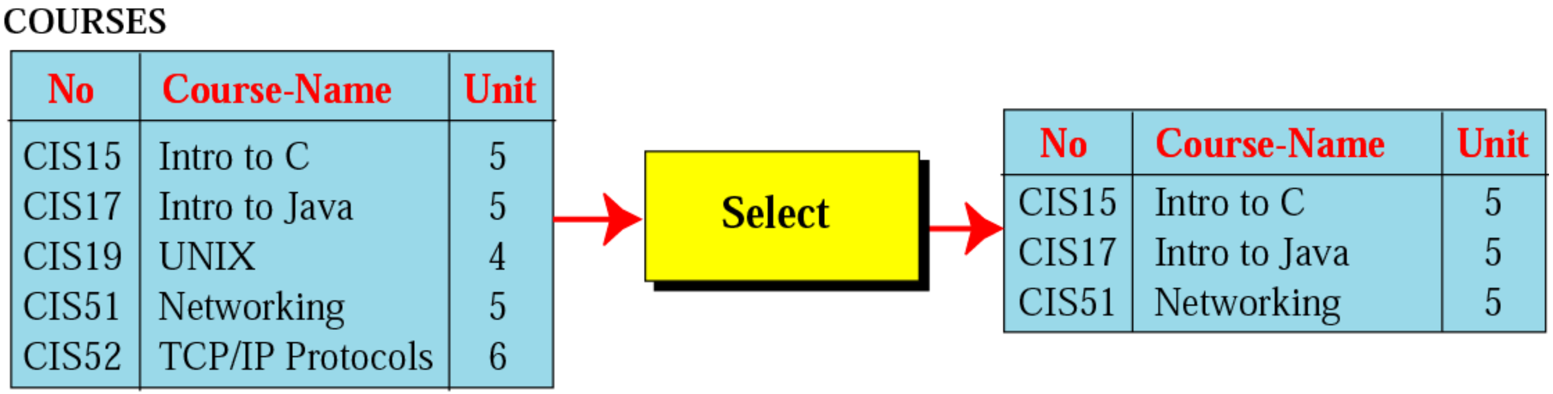
```
update   COURSES
set      unit = 6
where    No = “CIS51”
```

4. Select

- SQL Select Operation format

```
select                 *
from     RELATION-NAME
where    criteria
```

Select (Example)



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

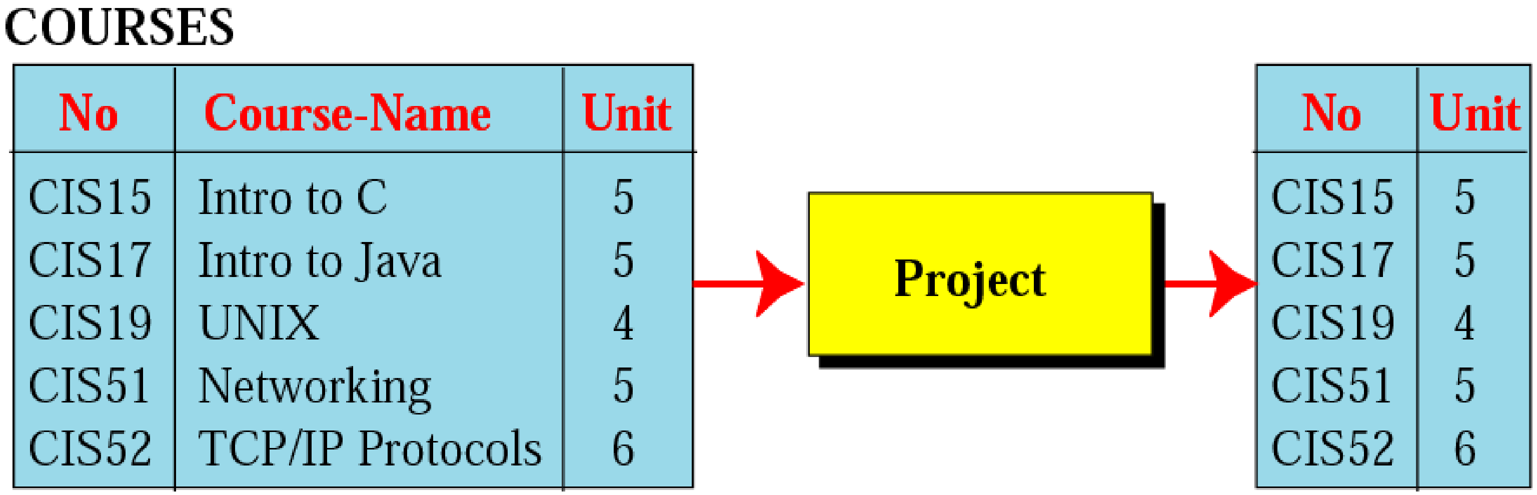
```
select    *
from      COURSES
where     Unit = 5
```

5. Project

- SQL Project Operation format

```
select      attribute-list
from      RELATION-NAME
```

Project (Example)



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

Project

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

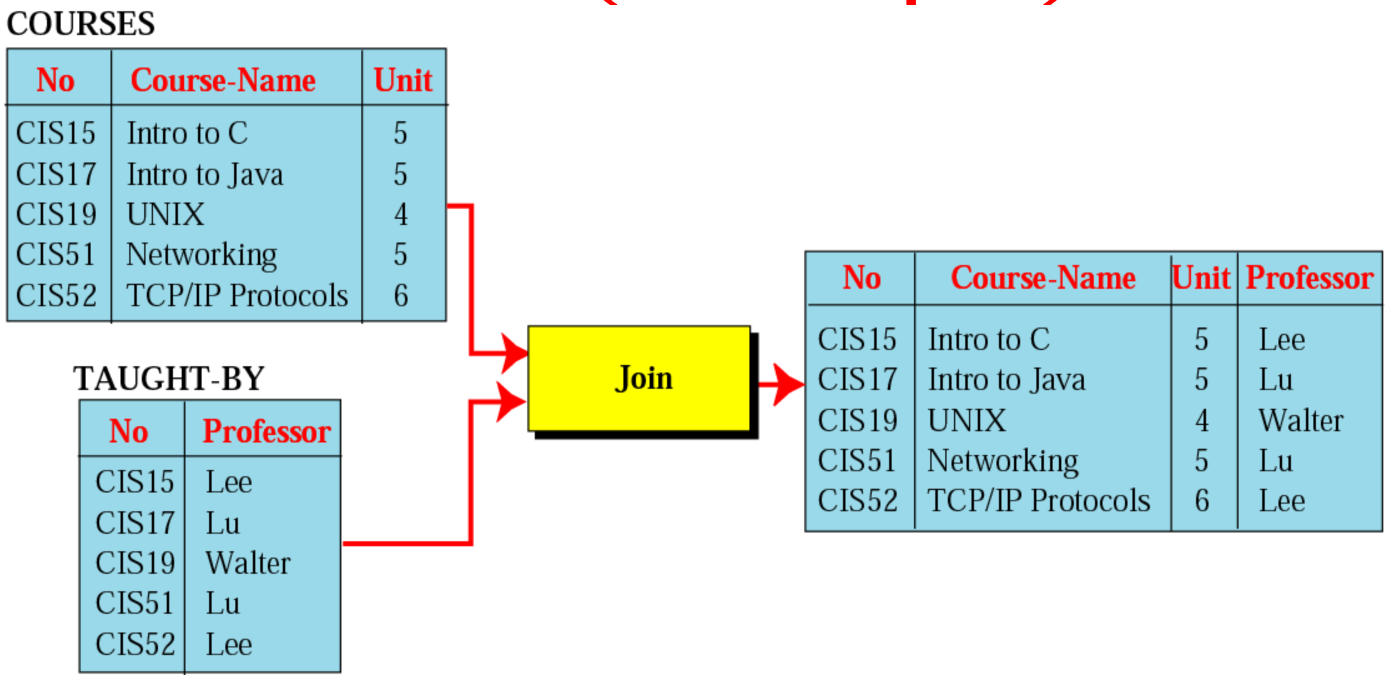
```
select    No, Unit
from      COURSES
```

6. Join

- SQL Join Operation format

```
select    attribute-list
from      RELATION NO1, RELATION NO2
where     criteria
```

Join (Example)



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

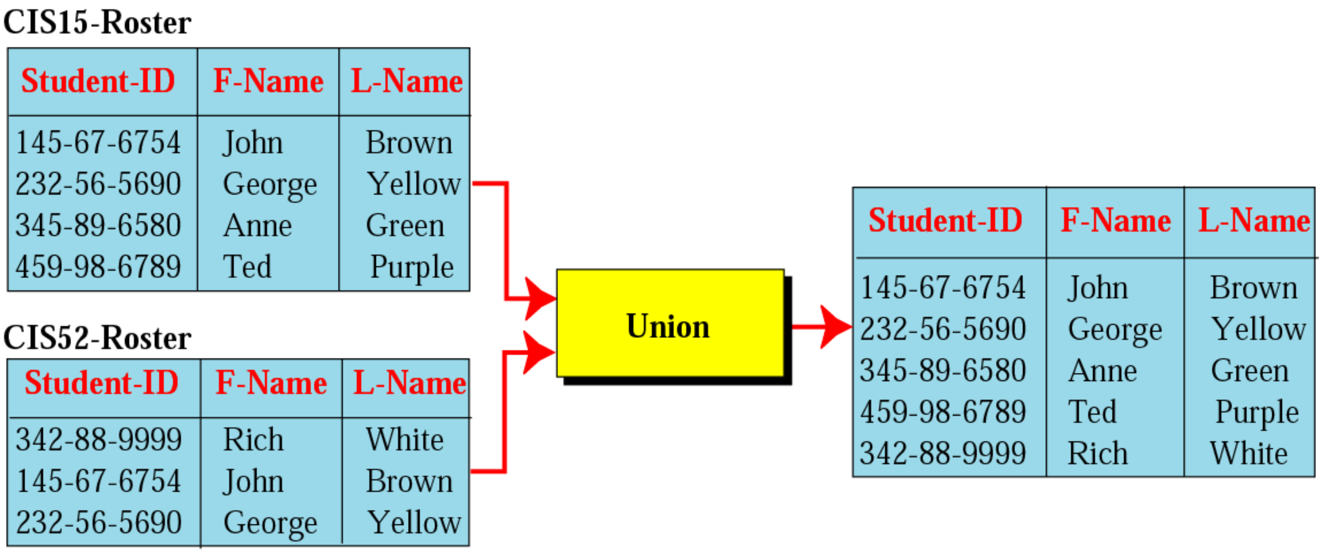
```
select    No, Course-Name,  Unit,  Professor
from      COURSES, TAUGHT-BY
where     COURSES.No = TAUGHT-BY.No;
```

7. Union

- SQL Union Operation format

```
select    *
from      RELATION NO1
union
select    *
from      RELATION NO2
```

Union (Example)



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

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

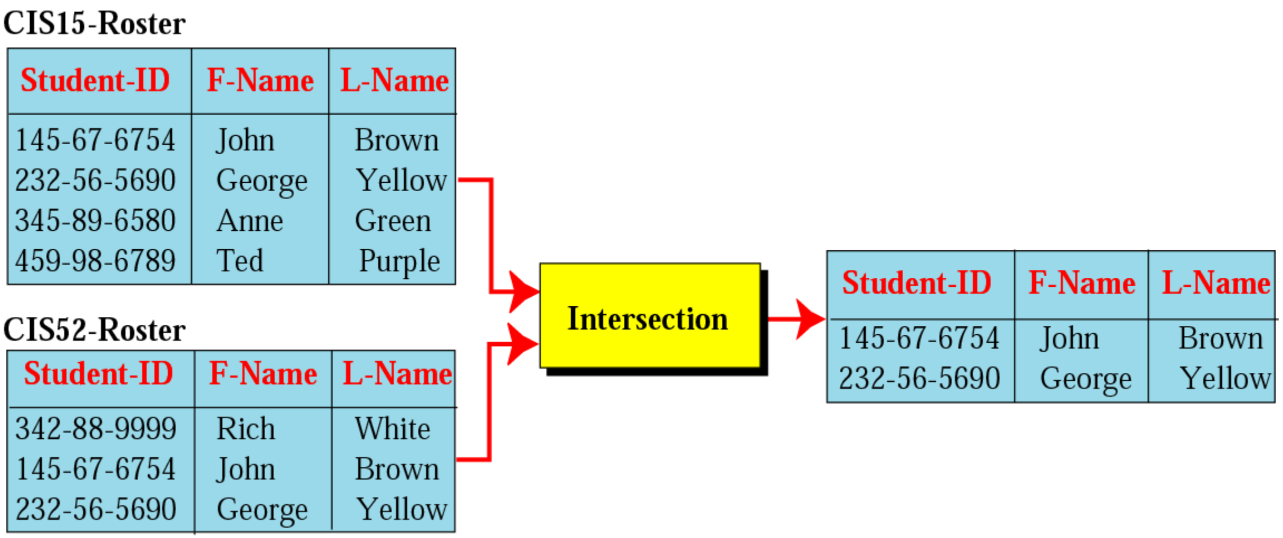
```
select    *
from      CIS15-Roster
union
select    *
from      CIS52-Roster;
```

8. Intersection

- SQL Intersection Operation format

```
select      *
from        RELATION NO1
intersection
select      *
from        RELATION NO2
```

Intersection (Example)



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

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

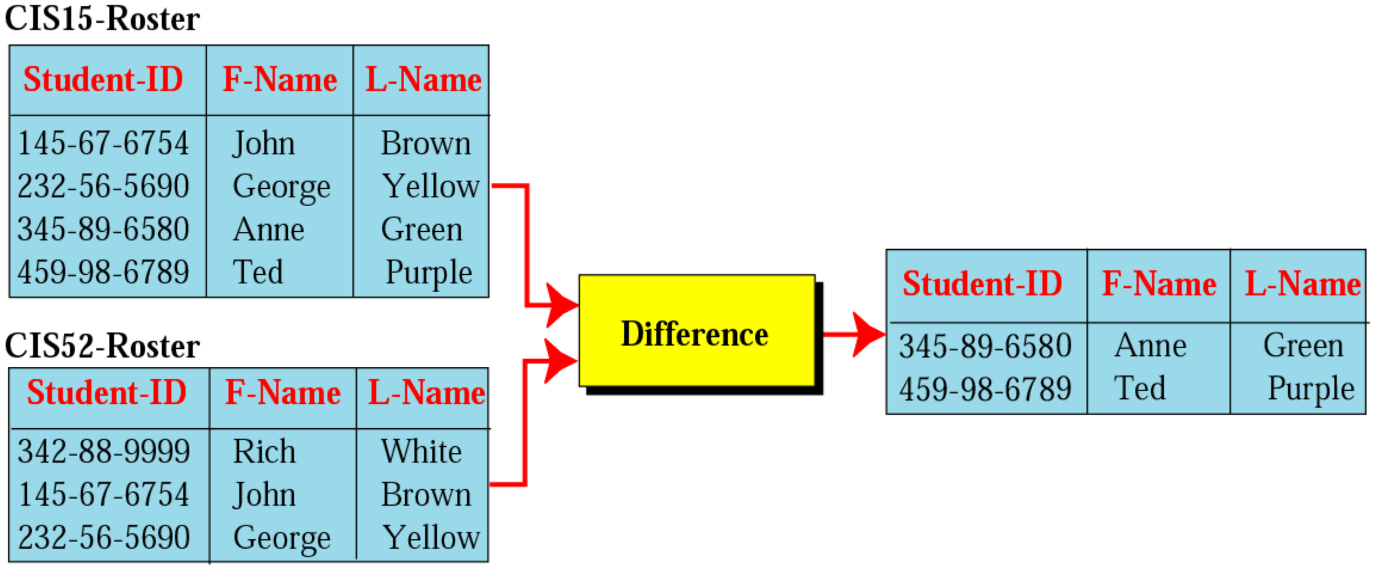
```
select       *
from         CIS15-Roster
intersection
select       *
from         CIS52-Roster;
```

9. Difference

- SQL Difference Operation format

```
select    *
from      RELATION NO1
minus
select    *
from      RELATION NO2
```

Difference(Example)



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

```
select    *
from      CIS15-Roster
minus
select    *
from      CIS52-Roster;
```

The levels of Data

Database	**One or more tables**
Table (relation)	**A collection of Records**
Record	**A group of related fields**
Field	**One or more character**
Character	**At least 8 bits**
Bit	**0 or 1**

5 characteristics of Good Database

Data Integrity	Ensuring data is valid
Data Independence	Data is separated from software
Avoiding data Redundancy	Repetition of input data is avoided
Data Security	Data is not accessible to unauthorized users
Data Maintenance	Set procedures for adding ,deleting … records for the purpose of optimization

Tutorial on MS Access 2013

- https://www.quackit.com/microsoft_access/microsoft_access_2013/tutorial/