Structured Query Language (SQL)

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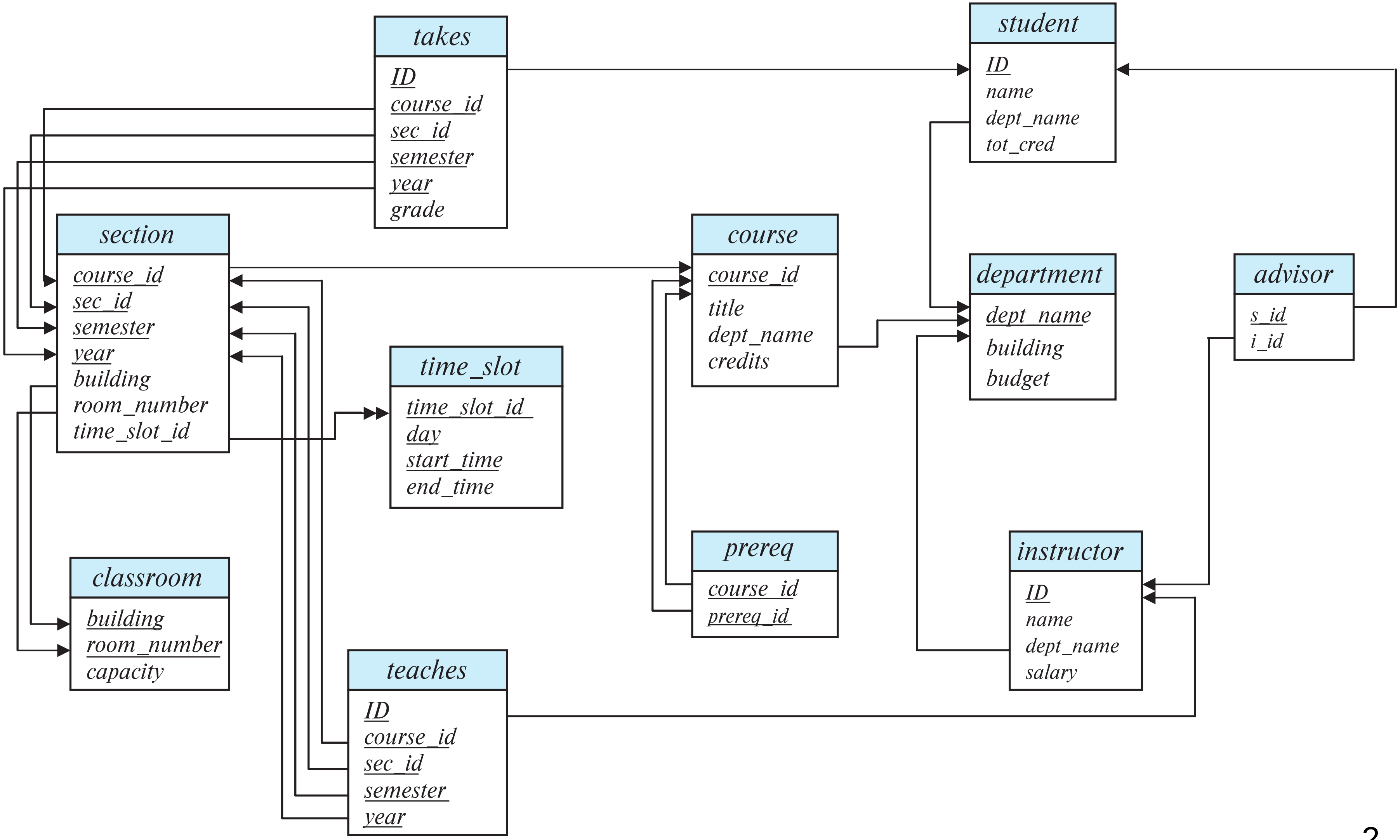
Recap: Schema for University Database



Recap: Relational Algebra

- A query language of a set of operations that take one or two relations as input and produce a new relation as their result.
- Operators
  - select: σ
  - project: $\prod$
  - union: $\cup$
  - set difference: –
  - Cartesian product: x
    - Natural Join $\bowtie$
    - Theta join $\bowtie_{\theta}$
  - rename: ρ
- Assignment
- Expression tree

History: Structured Query Language (SQL)

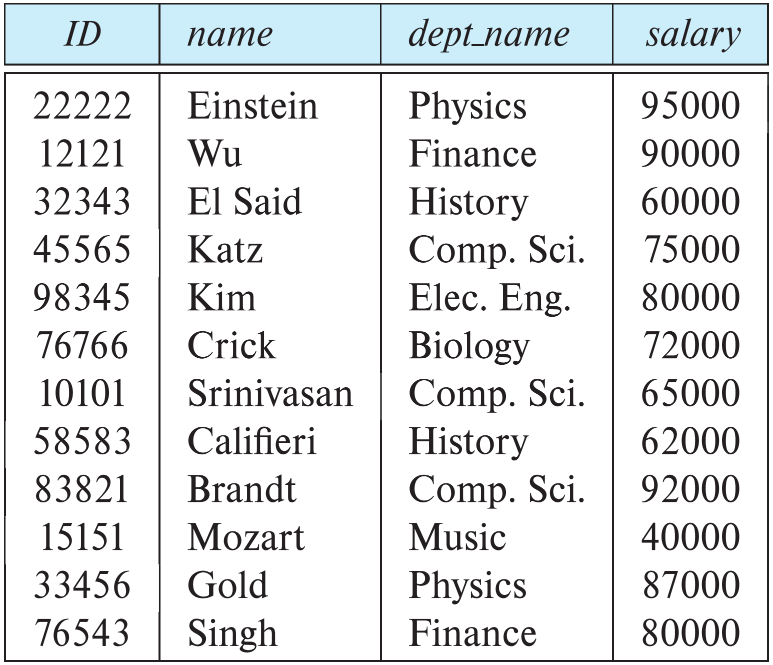
- ANSI and ISO standard SQL:
  - SQL-86
  - SQL-89
  - SQL-92
  - SQL:1999 (language name became Y2K compliant!)
  - SQL:2003

Data Definition Language (DDL)

- Define database schema

Example:

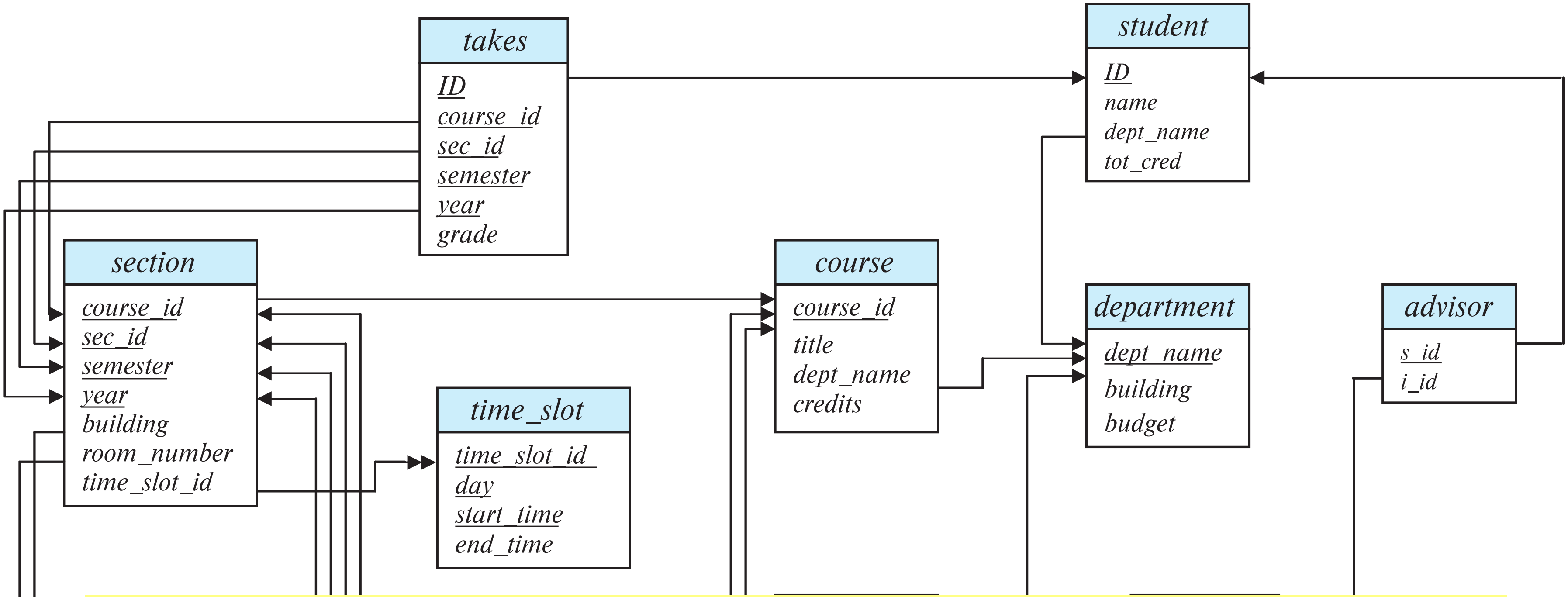
```
create table instructor (
        ID          char(5),
        name        varchar(20),
        dept_name   varchar(20),
        salary      numeric(8,2))
```



ID	*name*	*dept_name*	*salary*
22222	Einstein	Physics	95000
12121	Wu	Finance	90000
32343	El Said	History	60000
45565	Katz	Comp. Sci.	75000
98345	Kim	Elec. Eng.	80000
76766	Crick	Biology	72000
10101	Srinivasan	Comp. Sci.	65000
58583	Califieri	History	62000
83821	Brandt	Comp. Sci.	92000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
76543	Singh	Finance	80000

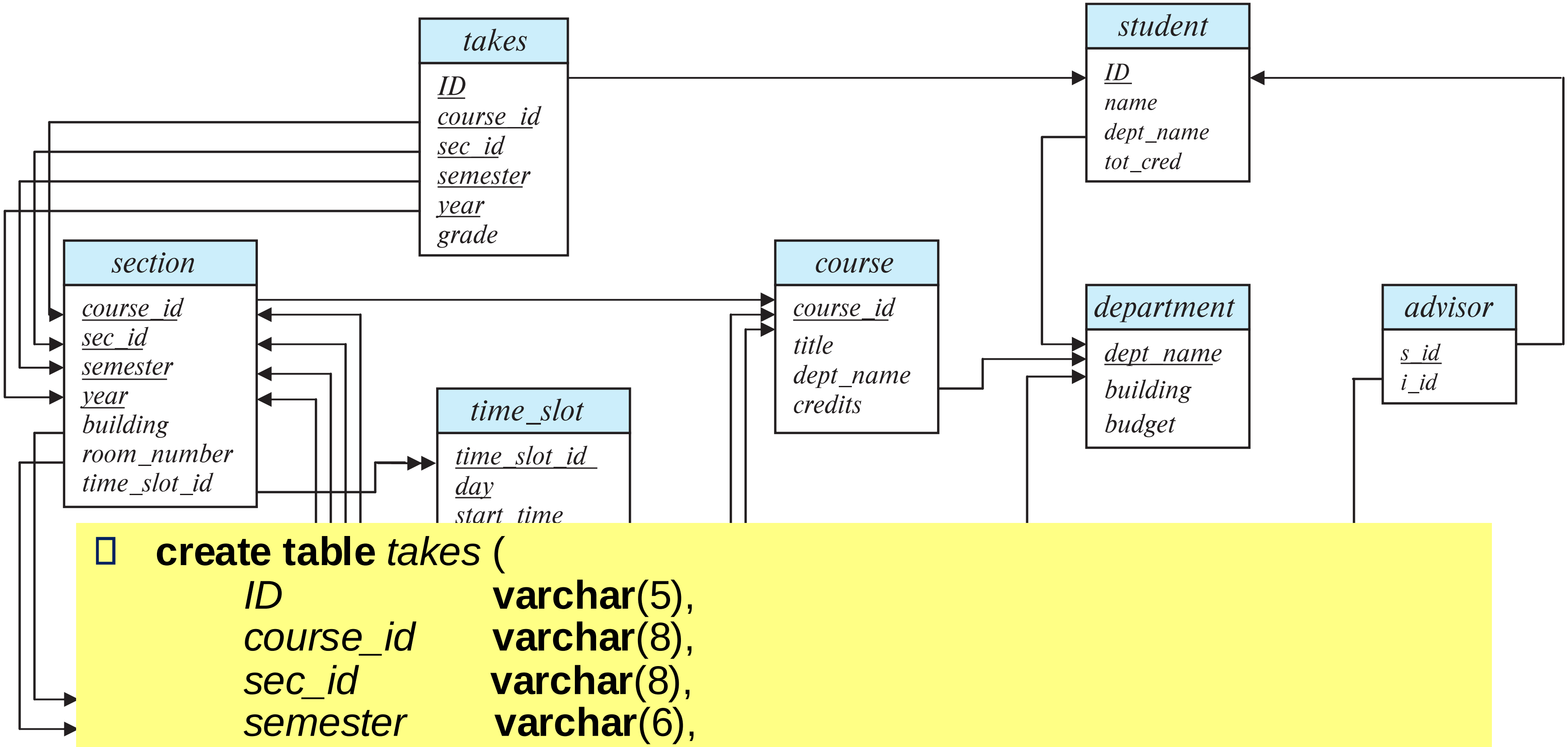
(a) The *instructor* table

University Database: Create table for student



```
create table student (
        ID                varchar(5),
        name              varchar(20) not null,
        dept_name         varchar(20),
        tot_cred          numeric(3,0),
        primary key (ID),
       foreign key (dept_name) references department);
```

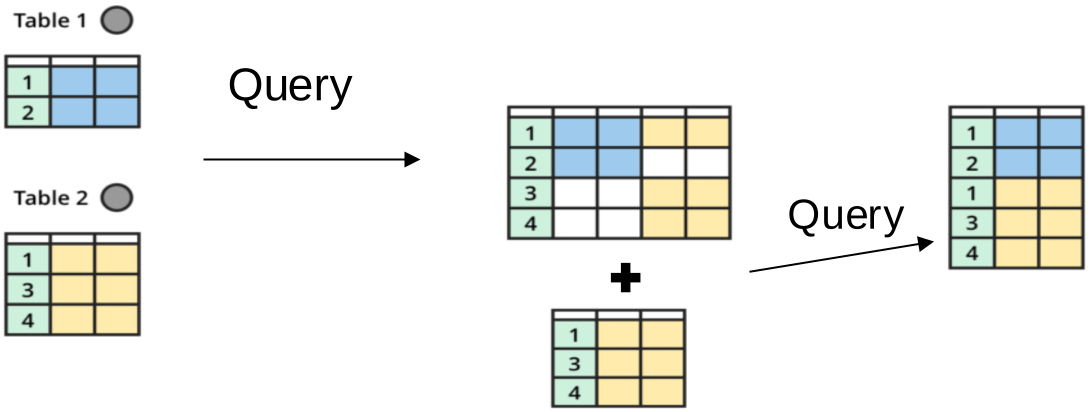
University Database: Create table for takes



```
create table takes (
        ID              varchar(5),
        course_id       varchar(8),
        sec_id          varchar(8),
        semester        varchar(6),
        year            numeric(4,0),
        grade           varchar(2),
        primary key (ID, course_id, sec_id, semester, year) ,
        foreign key (ID) references  student,
        foreign key (course_id, sec_id, semester, year) references section);
```

Data Manipulation Language (DML)

- Language for accessing and updating the data
- DML also known as **query language**
- **Declarative**
- Query returns a relation => compositional and close
- Compositional



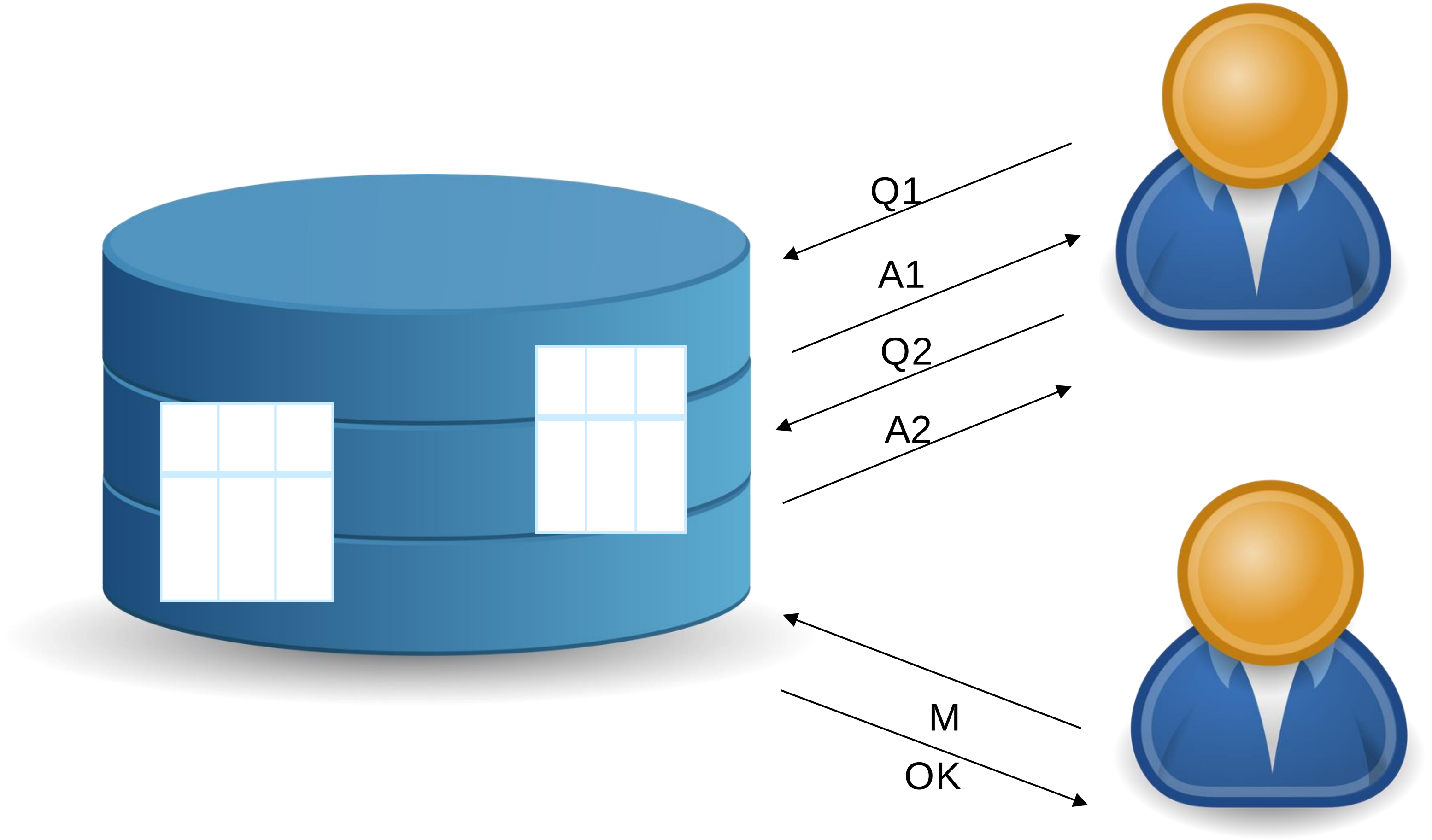
Basic Query Structure

- A typical SQL query has the form:

  select A_1, A_2, ..., A_n
  from r_1, r_2, ..., r_m
  where P

  - A_i represents an attribute
  - r_i represents a relation
  - P is a predicate.
- The result of an SQL query is a relation.
- Update
  - **insert into** *instructor* **values** ('10211', 'Smith', 'Biology', 66000);
  - **delete from** *student*
  - **drop table** *student*
  - alter
    - **alter table** *student* **add** *age numeric(0,150)*
    - **alter table** *student* **drop** *age*

Basic steps in creating and using relational DB



Wrap up

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Basic Query Structure
- Basic steps in creating and using relational DB

Demonstrations

- Basic Query Structure of SQL Queries
- Additional Basic Operations
- Set Operations
- Null Values
- Aggregate Functions
- Nested Subqueries
- Modification of the Database

Demonstrations

- Join Expressions
- Views
- Transactions
- Integrity Constraints
- SQL Data Types and Schemas
- Index Definition in SQL
- Authorization

FIN

Any questions?