Introduction

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Database Applications Examples

- Enterprise
- Manufacturing
- Banking and finance
  - Customer information, accounts, loans, and banking transactions.
  - Credit card transactions
- Universities
  - registration, grades
- Airlines
- Telecommunication
- Web-based services
- Navigation systems

Purpose of Database Systems

- Massive
- Persistent
- Safe
- Multi-user
- Convenience
- Efficiency
- Reliable

University Database Running Example

- In this text we will be using a university database to illustrate all the concepts
- Data consists of information about:
  - Students
  - Instructors
  - Classes
- Application program examples:
  - Add new students, instructors, and courses
  - Register students for courses, and generate class rosters
  - Assign grades to students, compute grade point averages (GPA) and generate transcripts

Data Models

- A collection of tools for describing
  - Data
  - Data relationships
  - Data semantics
  - Data constraints
- Relational model
- Entity-Relationship data model (mainly for database design)
- Graph model (many to many relationships)
- Document (one to many relationships) XML JSON
- Key value (one to one relationships)

Relational Model

- Database = a set of relations (names) = a set of tables
- A relation has a set of attributes (names, types/domains)
- A relation has an indefinite set of tuples
- Example of tabular data in the relational model
- Schema & instances

Columns / attributes

Rows / tuples

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

dept_name	*building*	*budget*
Comp. Sci.	Taylor	100000
Biology	Watson	90000
Elec. Eng.	Taylor	85000
Music	Packard	80000
Finance	Painter	120000
History	Painter	50000
Physics	Watson	70000

(b) The *department* table

Relational Model: Attributes

- Domain
- Atomic types / structured types
- NULL: a special value, indicating that the particular value is unknown.
- The NULL value causes complications of many operations
- Example:

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

Relational Model: Keys

- Attribute of a relation where every attribute value of the relation is **unique**
- **A set of attributes** that are unique: {*ID*} and {ID,name} are both keys
- Candidate key (minimal)
- **Primary key**
- Why key is important
  - Identify specific tuples
  - Query/index efficiency
  - Reference (**Foreign keys**)

dept_name	*building*	*budget*
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Finance	Painter	120000
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(b) The *department* table

ID	*name*	*dept_name*	*salary*
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98345	Kim	Elec. Eng.	80000
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15151	Mozart	Music	40000
33456	Gold	Physics	87000
76543	Singh	Finance	80000

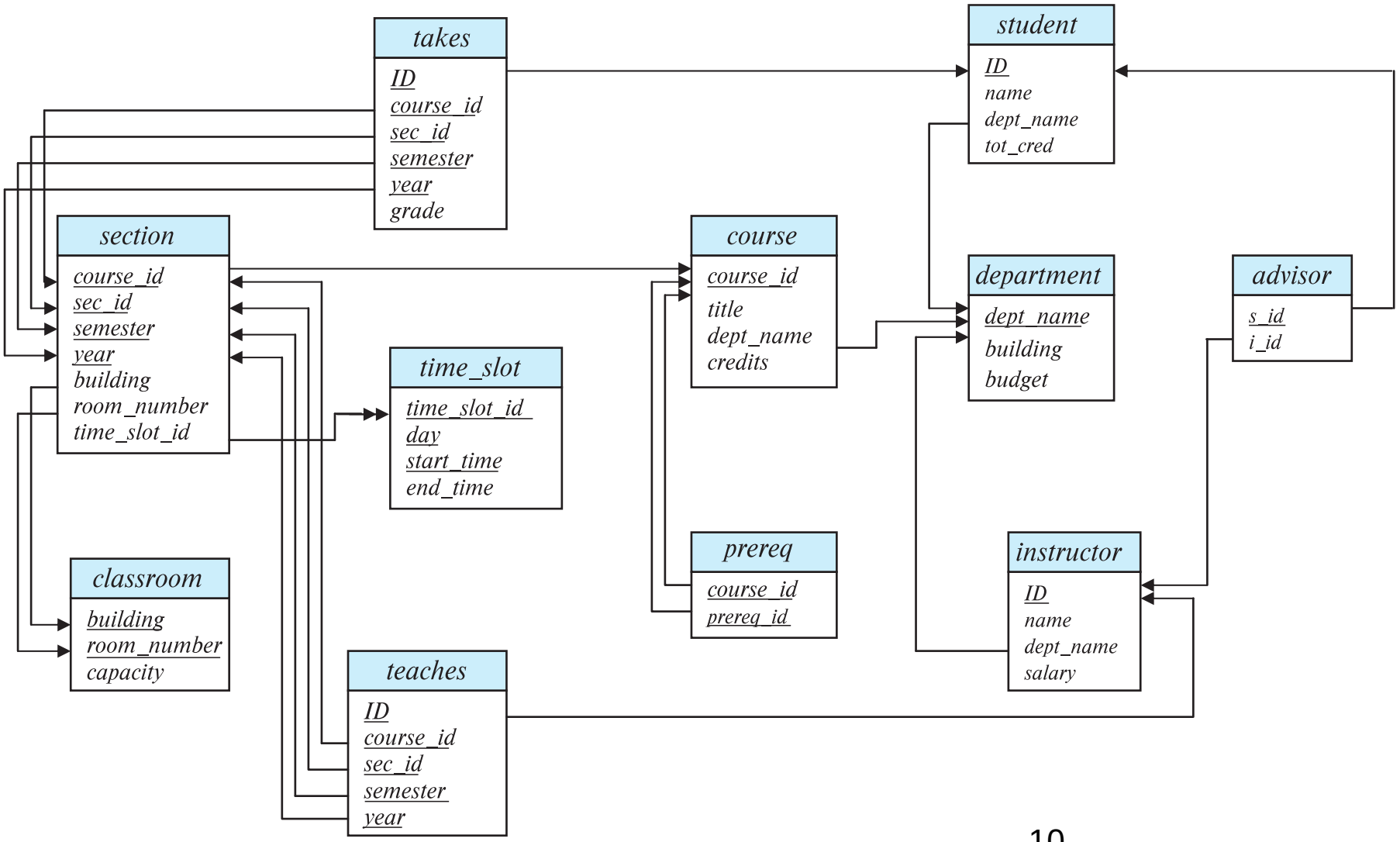
(a) The *instructor* table

Relations are Unordered

- Order of tuples is irrelevant (tuples may be stored in an arbitrary order)
- Example: *instructor* relation with unordered tuples

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

Schema Diagram for University Database



Wrap up

- Database application examples
- Purpose of database systems
- Data models
- Relational model
  - NULL values
  - Keys
  - Schema Diagram

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Any questions?