Databases and Information Systems CS303

Relational Databases
04-08-2023

Relational Databases

- Most commonly used Database architecture
- Introduced by Codd in 1970s (won Turing award for doing it)
- Storing data in Tables
- Has strong mathematical background and helps in query analysis and optimization

Relations (Tables)

- Tables are also called Relations
  Example:
  instructor is a relation
  department is a relation
  (Hence called Relational Databases)

- Each column of a Relation is called attribute of that relation

- Tuple refers to a row in a relation

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
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

instructor

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

department

Relations (Tables)

- Every Table has a unique name
- Each Table has a specific number of columns (with column headers)
- Every row is called a tuple
  Example:
  (12121, Wu, Finance, 90000) is a tuple of size 4 in instructor table
  (Comp. Sci., Taylor, 10000) is a tuple of size 3 in department table

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
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

instructor

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

department

Properties of a relation (Table)

- Tuples cannot repeat

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
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

instructor

Properties of a relation (Table)

- Tuples are order independant

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

`instructor`

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10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
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76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

`instructor`

Schema

- Describes what are the relations (tables) in the database and what are the attributes in each relation.
- instructor(ID, name, dept_name,salary)
- Note the difference between instructor schema and instructor relation

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

instructor

Schema

- Same attribute can occur in multiple tables

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
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`instructor`

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

`department`

Keys

- Tuples should be uniquely identifiable:
  No two tuples can have the same values for all attributes
- Super Key : Set of one or more attributes taken collectively allow us to identify tuples uniquely
- Candidate Key : Minimal Super Key
  There can be more than one candidate key for a given relation
- Primary Key : Candidate key chosen by the database designer to uniquely identify the tuples.

course_id	*sec_id*	*semester*	*year*	*building*	*room_number*	*time_slot_id*
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
CS-319	2	Spring	2010	Taylor	3128	C
CS-347	1	Fall	2009	Taylor	3128	A
EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

section

Primary Key

- Should be chosen with care (Non-repeating set of attributes)
- Attributes of primary key should never or very rarely change
- Common practise to denote all the attributes of the primary key in the beginning of the table
- Attributes of the primary key are underlined

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10101	Srinivasan	Comp. Sci.	65000
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76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

instructor

Foreign Key

- Primary Key of one relation (R1) can occur in another table (R2) dept_name of department occurs as attribute of instructor table

- R2 is called referencing relation; R1 is called referenced relation

dept_name	*building*	*budget*
Biology	Watson	90000
Comp. Sci.	Taylor	100000
Elec. Eng.	Taylor	85000
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department

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76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

instructor

Foreign Key

- dept_name in some row of instructor table with value Mathematics does not make sense
- Referential Integrity Constraint : The values appearing in specified attributes of any tuple in the referencing relation also appear in specified attributes of at least one tuple in the referenced relation.

dept_name	*building*	*budget*
Biology	Watson	90000
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Physics	Watson	70000

department

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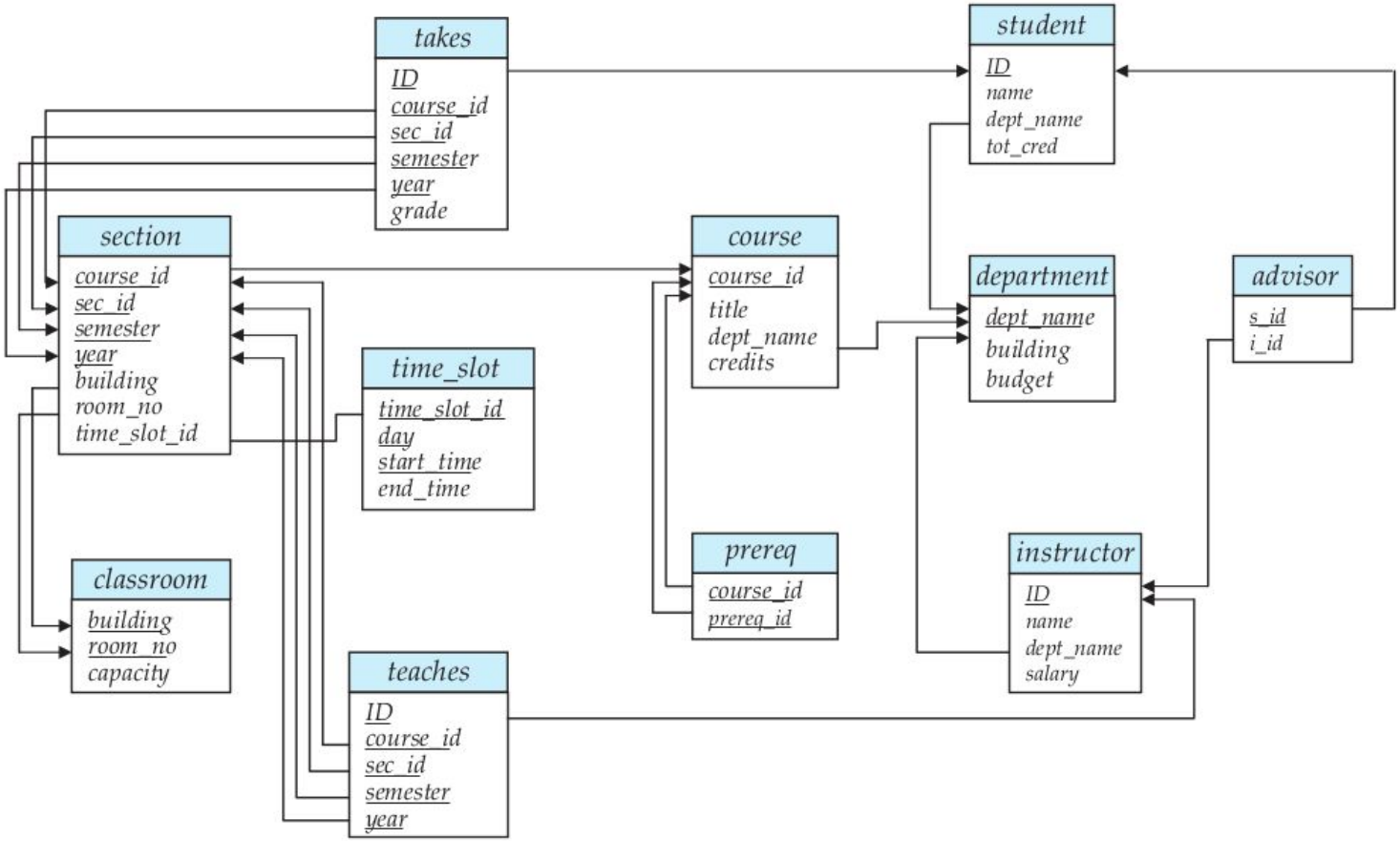
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

instructor

Database Schema Representation



Reference:

Database System Concepts by Silberschatz, Korth and Sudarshan
Chapter 2