RDBMS and SQL

Madhavan Mukund

https://www.cmi.ac.in/~madhavan

Lecture 2, 22 August 2024

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All information is stored as tables (relations)

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

3

- All information is stored as tables (relations)
- Mechanism for working with tables

ID	name	dept_name	salary	
10101	Srinivasan	Comp. Sci.	65000	
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Instructor

3

- All information is stored as tables (relations)
- Mechanism for working with tables
 - Describing table structure (schema)

 $T \subseteq S_1 \times S_2 \times S_3$ reRXRXR

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10101	Srinivasan	Comp. Sci.	65000
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Instructor

- All information is stored as tables (relations)
- Mechanism for working with tables
 - Describing table structure (schema)
 - Additions, deletions, modifications

ID	name dept_name		salary
10101	Srinivasan	Comp. Sci.	65000
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- All information is stored as tables (relations)
- Mechanism for working with tables
 - Describing table structure (schema)
 - Additions, deletions, modifications
 - Extracting useful information (querying)

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Instructor

- All information is stored as tables (relations)
- Mechanism for working with tables
 - Describing table structure (schema)
 - Additions, deletions, modifications
 - Extracting useful information (querying)
- Initially, focus on abstract query language

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



List instructors from Physics Full Y	ID	name	dept_name	salary
department with salary above 90,000	10101	Srinivasan	Comp. Sci.	65000
Select mus that meet	12121	Wu	Finance	90000
	15151	Mozart	Music	40000
Some condition	22222	Einstein	Physics	95000
	32343	El Said	History	60000
	33456	Gold	Physics	87000
o relation	45565	Katz	Comp. Sci.	75000
	58583	Califieri	History	62000
Undition	76543	Singh	Finance	80000
	76766	Crick	Biology	72000
T V (Instructor)	83821	Brandt	Comp. Sci.	92000
dept name = Physics and	98345	Kim	Elec. Eng.	80000
salary > 9000 (h)		< 🗆	> < @ > < E > < E	া ≣ ৩৭৫



- List instructors from Physics department with salary above 90,000
- List names of instructors

TL list of col names (r) TL name (Instructor)

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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	1	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

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- List names of instructors
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department with salary above 90,000	10101	Srinivasan	Comp. Sci.	65000
List names of instructors	12121	Wu	Finance	90000
	15151	Mozart	Music	40000
 List names of instructors from Physics 	22222	Einstein	Physics	95000
department with salary above 90,000	32343	El Said	History	60000
	33456	Gold	Physics	87000
	45565	Katz	Comp. Sci.	75000
	58583	Califieri	History	62000
TU deal-wand Punger (INSTR)	76543	Singh	Finance	80000
name hour - houses	76766	Crick	Biology	72000
A A	83821	Brandt	Comp. Sci.	92000
salary > 900	98345	Kim	Elec. Eng.	80000
J				

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98345	Kim	Elec. Eng.	80000

- List instructors from Physics department with salary above 90,000
- List names of instructors
 List names of instructors from Physics department with salary above 90,000
 Salary

$$\nabla_{\Theta_2} \left(\nabla_{\Theta_1} (r) \right)$$

ID	name	dept_name	salary
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000 ?
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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

List	details of cou	urses offered b	by instruc	tors	/	teacher	T			
ID	name	dept_name	salary		ID	course_id	sec_id	semester	year	
10101 12121 15151 22222 32343 33456 45565 58583 76542	Srinivasan Wu Mozart Einstein El Said Gold Katz Califieri Singh	Comp. Sci. Finance Music Physics History Physics Comp. Sci. History Einence	65000 90000 40000 95000 60000 87000 75000 62000		1010 10101 12121 15151 22222 32343 45565 45565 76766 76766 83821	CS-101 CS-315 CS-347 FIN-201 MU-199 PHY-101 HIS-351 CS-101 CS-319 BIO-101 BIO-301 CS-190	1 1 1 1 1 1 1 1 1 1 1 1 1 1	Fall Spring Fall Spring Fall Spring Spring Spring Summer Summer Spring	2017 2018 2017 2018 2018 2018 2018 2018 2018 2018 2017 2018 2017	Cours tab
76543 76766 83821	Crick Brandt	Biology Comp. Sci.	72000 92000		83821 83821 98345	CS-190 CS-319 EE-181	2 2 1	Spring Spring Spring	2017 2018 2017	
98345	Kim	Elec. Eng.	80000							

For every now in Instructor table For every now in Teaches table



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■ Instructor × Teaches

Instructor.ID	name	dept_name	salary	teaches.ID	course_id	sec_id	semester	year
10101	Srinivasan	Comp. Sci.	65000	10101	CS-101	1	Fa11	2017
10101	Srinivasan	Comp. Sci.	65000	10101	CS-315	1	Spring	2018
10101	Srinivasan	Comp. Sci.	65000	10101	CS-347	1	Fall	2017
10101	Srinivasan	Comp. Sci.	65000	12121	FIN-201	1	Spring	2018
10101	Srinivasan	Comp. Sci.	65000	15151	MU-199	1	Spring	2018
10101	Srinivasan	Comp. Sci.	65000	22202	PHY-101	1	Fall	2017
12121	Wu	Finance	90000	10101	CS-101	1	Fall	2017
12121	Wu	Finance	90000	10101	CS-315	1	Spring	2018
12121	Wu	Finance	90000	10101	CS-347	1	Fall	2017
12121	Wu	Finance	90000	12121	FIN-201	1	Spring	2018
12121	Wu	Finance	90000	15151	MU-199	1	Spring	2018
12121	Wu	Finance	90000	22222	PHY-101	1	Fall	2017

Madhavan Mukund

• $\sigma_{\text{Instructor.ID} = \text{teaches.ID}}(\text{Instructor} \times \text{Teaches})$

0	Instructor.ID	name	dept_name	salary	teaches.ID	course_id	sec_id	semester	year
	10101	Srinivasan	Comp. Sci.	65000	10101	CS-101	1	Fall	2017
	10101	Srinivasan	Comp. Sci.	65000	10101	CS-315	1	Spring	2018
	10101	Srinivasan	Comp. Sci.	65000	10101	CS-347	1	Fall	2017
	12121	Wu	Finance	90000	12121	FIN-201	1	Spring	2018
	15151	Mozart	Music	40000	15151	MU-199	1	Spring	2018
	22222	Einstein	Physics	95000	22222	PHY-101	1	Fall	2017
	32343	El Said	History	60000	32343	HIS-351	1	Spring	2018
	45565	Katz	Comp. Sci.	75000	45565	CS-101	1	Spring	2018
	45565	Katz	Comp. Sci.	75000	45565	CS-319	1	Spring	2018
	76766	Crick	Biology	72000	76766	BIO-101	1	Summer	2017
	76766	Crick	Biology	72000	76766	BIO-301	1	Summer	2018
	83821	Brandt	Comp. Sci.	92000	83821	CS-190	1	Spring	2017
	83821	Brandt	Comp. Sci.	92000	83821	CS-190	2	Spring	2017
	83821	Brandt	Comp. Sci.	92000	83821	CS-319	2	Spring	2018
	98345	Kim	Elec. Eng.	80000	98345	EE-181	1	Spring	2017

■ Instructor ⋈ Instructor.ID = teaches.ID Teaches — cartesian project with select

Instructor.ID	name	dept_name	salary	teaches.ID	course_id	sec_id	semester	year
10101	Srinivasan	Comp. Sci.	65000	10101	CS-101	1	Fall	2017
10101	Srinivasan	Comp. Sci.	65000	10101	CS-315	1	Spring	2018
10101	Srinivasan	Comp. Sci.	65000	10101	CS-347	1	Fall	2017
12121	Wu	Finance	90000	12121	FIN-201	1	Spring	2018
15151	Mozart	Music	40000	15151	MU-199	1	Spring	2018
22222	Einstein	Physics	95000	22222	PHY-101	1	Fall	2017
32343	El Said	History	60000	32343	HIS-351	1	Spring	2018
45565	Katz	Comp. Sci.	75000	45565	CS-101	1	Spring	2018
45565	Katz	Comp. Sci.	75000	45565	CS-319	1	Spring	2018
76766	Crick	Biology	72000	76766	BIO-101	1	Summer	2017
76766	Crick	Biology	72000	76766	BIO-301	1	Summer	2018
83821	Brandt	Comp. Sci.	92000	83821	CS-190	1	Spring	2017
83821	Brandt	Comp. Sci.	92000	83821	CS-190	2	Spring	2017
83821	Brandt	Comp. Sci.	92000	83821	CS-319	2	Spring	2018
98345	Kim	Elec. Eng.	80000	98345	EE-181	1	Spring	2017

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Find all taxpayers from Chennai with annual income over Rs 1 cr



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Find all taxpayers from Chennai with annual income over Rs 1 cr



 $r_1 \bowtie r_2$ I says - match values for same clumn vames in rik ri "Natural" join $r_1 \otimes r_2$ (no θ)

Relational algebra — set operations

IPL2023	1PL2024		ID	course_id	sec_id	semester	year
	•		10101	CS-101	1	Fall	2017
		12	10101	CS-315	1	Spring	2018
	1(1,2)		10101	CS-347	1	Fall	2017
		1 ([3]	12121	FIN-201	1	Spring	2018
	()	\sim	15151	MU-199	1	Spring	2018
•			22222	PHY-101	1	Fall	2017
Dualicates	removed		32343	HIS-351	1	Spring	2018
Pupilova			45565	CS-101	1	Spring	2018
			45565	CS-319	1	Spring	2018
	10 500		76766	BIO-101	1	Summer	2017
	2 20,0	13	76766	BIO-301	1	Summer	2018
			83821	CS-190	1	Spring	2017
1		14	83821	CS-190	2	Spring	2017
			83821	CS-319	2	Spring	2018
	+		98345	EE-181	1	Spring	2017
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Relational algebra — set operations

		V	0R	U	ID	course_id	sec_id	semester	year
	r.	A	0-00	Δ	10101	CS-101	1	Fall	2017
1111	'2			•	10101	CS-315	1	Spring	2018
•					10101	CS-347	1	Fall	2017
					12121	FIN-201	1	Spring	2018
					15151	MU-199	1	Spring	2018
					22222	PHY-101	1	Fall	2017
J (2)					32343	HIS-351	1	Spring	2018
	$\nabla \Theta_{1}(\mathbf{r})$				45565	CS-101	1	Spring	2018
					45565	CS-319	1	Spring	2018
					76766	BIO-101	1	Summer	2017
					76766	BIO-301	1	Summer	2018
V	$= \sqrt{r}$	JV	n(r)		83821	CS-190	1	Spring	2017
$\Theta_{A} \vee \Theta_{2} \vee I$					83821	CS-190	2	Spring	2017
	-				83821	CS-319	2	Spring	2018
	- ()	•		1	98345	EE-181	1	Spring	2017
V01 102 (r)		()	VO2 (r	1					

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Relational algebra — set operations

Not? 7	Relative Complement
V 101 (r)	Compleme Ton(r)]
ln r, mus	?
that do not	
sahfy O1	

ID	course_id	sec_id	semester	year
10101	CS-101	1	Fall	2017
10101	CS-315	1	Spring	2018
10101	CS-347	1	Fall	2017
12121	FIN-201	1	Spring	2018
15151	MU-199	1	Spring	2018
22222	PHY-101	1	Fall	2017
32343	HIS-351	1	Spring	2018
45565	CS-101	1	Spring	2018
45565	CS-319	1	Spring	2018
76766	BIO-101	1	Summer	2017
76766	BIO-301	1	Summer	2018
83821	CS-190	1	Spring	2017
83821	CS-190	2	Spring	2017
83821	CS-319	2	Spring	2018
98345	EE-181	1	Spring	2017