

RDBMS and SQL

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

σ dept_name = Physics (*Instructor*)

$\wedge$
salary > 90000

"Information need"



"Completeness"

- Everything we need to say can be expressed

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

Relational algebra — select and project

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

$\sigma_{\text{dept_name} = \text{Physics} \wedge \text{salary} > 90000}(\text{Instructor})$

Flexible syntax

$$\sigma_{\theta_1 \wedge \theta_2}(r) = \sigma_{\theta_2 \wedge \theta_1}(r)$$
$$\sigma_{\theta_2}(\sigma_{\theta_1}(r)) = \sigma_{\theta_1}(\sigma_{\theta_2}(r))$$

ID	name	dept_name	salary
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	<u>95000</u>
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.	<u>92000</u>
98345	Kim	Elec. Eng.	80000

max = 0

False if $i = \text{len}(l)$

if $i < \text{len}(l)$ and $l[i] > \text{max}$:

Σ

if $i < \text{len}(l)$:

if $l[i] > \text{max}$:

Σ

Relational algebra — select and project

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

$\pi_{\text{name}}(\text{Instructor})$

$\sigma = \rho$ for project

$\pi_{ID, \text{name}}(\text{Instructor})$
 $\pi_{\text{name}, ID}(\text{Instructor})$ } Same

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
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

Relational algebra — select and project

- 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

$\pi_{\text{name}}(\sigma_{\text{dept_name} = \text{Physics}} (\text{Instructor}))$
 $\wedge$
 $\text{salary} > 90000$

$\sigma_{\dots} (\pi_{\text{name}}(\text{Instr.}))$

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
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

Relational algebra — select and project

- 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

$\pi_{\text{name}}(\sigma_{\text{dept_name} = \text{Physics}} (\text{Instructor}))$
 $\wedge$
 $\text{salary} > 90000$

$\pi_{\text{name}}(\pi_{\text{ID}, \text{name}} (\text{Instr.}))$
 $\Rightarrow \pi_{\text{name}} (\text{Instr})$

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
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

Relational algebra — join

- List details of ~~courses offered by instructors~~

Instructors offering courses

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

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

Procedural

vs

Declarative

Specify "how"



Imphertly "what
you want"

Specify "what"



Ignore "how"

Relational algebra – join

■ 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	Fall	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	22222	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
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...

TC left 4 columns (✓ Instructor.ID = teaches.ID)

⋈
⋈
×

⋈ + ⋈
⇒ ⋈_θ

Relational algebra — join

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

<i>Instructor.ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>	<i>teaches.ID</i>	<i>course_id</i>	<i>sec_id</i>	<i>semester</i>	<i>year</i>
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

Relational algebra — join

- Instructor $\bowtie$ 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

$\sigma_{\theta}(r_1 \times r_2)$

$r_1 \bowtie_{\theta} r_2$

"Natural" join = $\sigma_{\theta}(r_1 \times r_2)$

All columns with same name in r_1 & r_2
have same value

$r_1 \bowtie r_2$
↑
no θ

$\Rightarrow$ Natural join

Output has only one copy
of common column

Relational algebra — set operations

■ Union and intersection

$r_1 \cup r_2$ — r_1, r_2 have
 $r_2 \cap r_2$ — same columns

$\sigma_{\text{year}=2017}(\text{Teaches})$
 $\cup \sigma_{\text{year}=2018}(\text{Teaches})$
 $\Leftrightarrow \text{Teaches}$

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

Relational algebra — set operations

■ Union and intersection

Courses Taught in 2017 & 2018

$\pi_{\text{course_id}}(\sigma_{\text{year}=2017}(\text{Teaches}))$
 $\cap$
 $\pi_{\text{course_id}}(\sigma_{\text{year}=2018}(\text{Teaches}))$

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

Relational algebra — set operations

■ Union and intersection

vs $\wedge$, $\vee$

$$\sigma_{\theta_1 \vee \theta_2}(r) = \sigma_{\theta_1}(r) \cup \sigma_{\theta_2}(r)$$

Sets, duplicates
are removed!

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

Relational algebra — set operations

■ Union and intersection

$$\sigma_{\theta_1 \wedge \theta_2}(r) \stackrel{?}{=} \sigma_{\theta_1}(r) \cap \sigma_{\theta_2}(r)$$

$$\sigma_{2017 \wedge 2018}(r) = \sigma_{2017}(r) \cap \sigma_{2018}(r)$$

Trivially ϕ — Be careful if θ_1, θ_2 “overlap”

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

Relational algebra — set operations

- Union and intersection
- Complementation?

Means what?

$$r \subseteq S_1 \times S_2 \quad \text{sqnrt} \subseteq \mathbb{N}_0 \times \mathbb{R}$$

complement of r ?

set difference

$$(S_1 \times S_2) \setminus r$$

← Infinite

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

Relational algebra — set operations

- Union and intersection
- Complementation?
- Set difference

$r_1 \setminus r_2$ "Relative complement"

Courses not taught in 2017

Courses in Teaches, not taught in 2017

$\pi_{ID}(\text{Teaches}) \setminus \pi_{ID}(\sigma_{\text{year}=2017}(\text{Teaches}))$

ID	course_id	sec_id	semester	year
10101	<u>CS-101</u>	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	<u>CS-101</u>	1	Spring	2018
45565	CS-319	1	Spring	2018
76766	BIO-101	1	Summer	2017
76766	BIO-301	1	Summer	2018
83821	<u>CS-190</u>	1	Spring	2017
83821	<u>CS-190</u>	2	Spring	2017
83821	CS-319	2	Spring	2018
83845	EE-181	1	Spring	2017

Sets – ordering

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
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

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
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, unsorted

Sets – duplicates

π dept-name (Instructor)

CS
Fin
Mus
Phy
His
Phy

X

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

A challenge

- List instructors who teach more than one course ^{course_id}

```
for r1 in Teaches
  for r2 in Teaches
    if r1.ID = r2.ID
      and
      r1.course_id ≠ r2.course_id
      → a record r1
```

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
98765	EE-181	1	Spring	2017

Teaches

A challenge

- List instructors who teach more than one course

Teachers $\bowtie$ ^{which}
 $ID = ID \wedge$
 $course_id \neq course_id$
^{which}

Check $r \bowtie r = r$

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

Teaches

Relational algebra — assignment, renaming

let

Left $\leftarrow$ Teaches

Right $\leftarrow$ Teaches

in

Left $\bowtie$

Right

Left.ID = Right.ID

$\wedge$

Left.course_ID $\neq$ Right.course_ID

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

Teaches

Relational algebra — assignment renaming

Rename operation $\rightarrow$ ρ

$S_{\text{Left}}(\text{Teaches}) \bowtie S_{\text{Right}}(\text{Teaches})$

left.id =
Right.id

$\uparrow$
Left.course.id
 $\neq$ Right.course.id

Renaming
either one
is sufficient

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

Teaches

Relational algebra — assignment, renaming

In general — can also rename cols

$\rho_{\text{left}}(\underline{LID, LC, LS, LSem, LY})$ (Teaches)
if omitted,
no change

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

Teaches

Relational Algebra

σ, π

$\bowtie \Rightarrow \bowtie$

$\cup, \cap, \setminus$

ρ

Relational algebra — Examples

`Instructor(ID,name,dept_name,salary)`

- Find all faculty members from Physics who earn more than **at least one** faculty member from Comp.Sci.

Think about this

Relational algebra — Examples

`Instructor(ID,name,dept_name,salary)`

- Find all faculty members from Physics who earn more than **every** faculty member from Comp.Sci.

Relational algebra — Examples

`Instructor(ID,name,dept_name,salary)`

- Find the faculty member(s) with the minimum salary.

Relational algebra — Examples

`family(ID,name,gender)`

`relation(ID1,ID2,relationship)`

- Compute the relation

`sister(ID1,ID2)` — `ID1` is a sister of
`ID2`

Relational algebra — Examples

`family(ID,name,gender)`

`relation(ID1,ID2,relationship)`

- Compute `grandparent(ID1,ID2)` —
`ID1` is grandparent of `ID2`

Relational algebra — Examples

`family(ID,name,gender)`

`relation(ID1,ID2,relationship)`

- Compute

`greatgrandparent(ID1,ID2) — ID1`

is greatgrandparent of `ID2`

Relational algebra — Examples

`family(ID,name,gender)`

`relation(ID1,ID2,relationship)`

- Can you compute `ancestor(ID1,ID2)` in general?