Relational Algebra
Practice Queries

CS430/630
Lecture 3

Slides based on “Database Management Systems” 3rd ed, Ramakrishnan and Gehrke

Relational Algebra

- Basic operations:
  - Selection σ Selects a subset of rows from relation
  - Projection π Deletes unwanted columns from relation
  - Cross-product $\times$ Allows us to combine several relations
  - Join $\bowtie$ Combines several relations using conditions
  - Division $\div$ A bit more complex, will cover later on
  - Set-difference $-$ Union $\cup$ Intersection $\cap$
  - Renaming ρ Helper operator, does not derive new result, just renames relations and fields

$$\rho(R(F), E)$$

    - F contains *oldname* $\rightarrow$ *newname* pairs

Operator Precedence

- In decreasing order of priority:
  1. Selection σ Projection π
  2. Cross-product $\times$ Join $\bowtie$
  3. Set-difference $-$ Intersection $\cap$
  4. Union $\cup$

Example Schema

Sailors

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

Boats

bid	name	color
101	interlake	red
103	clipper	green

Reserves

sid	bid	day
22	101	10/10/96
58	103	11/12/96

Sample Query 1

Sailors

sid	sname	rating	age

Boats

bid	name	color

Reserves

sid	bid	day

- Find names of sailors who've reserved boat #103

$$\pi_{sname}((\sigma_{bid=103}\text{Re}serves)\bowtie Sailors)$$

$$\pi_{sname}(\sigma_{bid=103}(\text{Re}serves\bowtie Sailors))$$

Example Schema

Sailors

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

Boats

bid	name	color
101	interlake	red
103	clipper	green

Reserves

sid	bid	day
22	101	10/10/96
58	103	11/12/96

Sample Query 2

Sailors

sid	sname	rating	age

Boats

bid	name	color

Reserves

sid	bid	day

- Find names of sailors who've reserved a red boat

$$\pi_{sname}(\pi_{sid}((\pi_{bid}(\sigma_{color='red'}Boats))\bowtie \mathrm{Res})\bowtie Sailors)$$

$$\pi_{sname}((\sigma_{color='red'}Boats)\bowtie \mathrm{Reserves}\bowtie Sailors)$$

Example Schema

Sailors

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

Boats

bid	name	color
101	interlake	red
103	clipper	green

Reserves

sid	bid	day
22	101	10/10/96
58	103	11/12/96

Sample Query 3

Sailors

sid	sname	rating	age

Boats

bid	name	color

Reserves

sid	bid	day

- Find names of sailors who've reserved a red or a green boat

$$\rho\ (Tempboats, (\sigma_{color='red' \vee color='green'}\ Boats))$$

$$\pi_{sname}(Tempboats \bowtie Reserves \bowtie Sailors)$$

Example Schema

Sailors

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

Boats

bid	name	color
101	interlake	red
103	clipper	green

Reserves

sid	bid	day
22	101	10/10/96
58	103	11/12/96

Sample Query 4

Sailors

sid	sname	rating	age

Boats

bid	name	color

Reserves

sid	bid	day

- Find names of sailors who've reserved a red and a green boat

$$\rho\ (Tempred, \pi_{sid}((\sigma_{color='red'} Boats) \bowtie Reserves))$$

$$\rho\ (Tempgreen, \pi_{sid}((\sigma_{color='green'} Boats) \bowtie Reserves))$$

$$\pi_{sname}((Tempred \cap Tempgreen) \bowtie Sailors)$$

Example Schema

Sailors

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

Boats

bid	name	color
101	interlake	red
103	clipper	green

Reserves

sid	bid	day
22	101	10/10/96
58	103	11/12/96

Sample Query 5

Sailors

sid	sname	rating	age

Boats

bid	name	color

Reserves

sid	bid	day

- Find names of sailors who've reserved only red boats

$$\rho\ (Tempred, \pi_{sid}((\sigma_{color='red'} Boats) \bowtie \text{Re}serves))$$

$$\rho\,(Tempothers, \pi_{sid}((\sigma_{color<>'red'} Boats) \bowtie \text{Re}serves))$$

$$\pi_{sname}((Tempred - Tempothers) \bowtie Sailors)$$

An Example of Self-Joins

Sailors

sid	sname	rating	age
22	dustin	7	45.0
31	lubber	8	55.5
58	rusty	10	35.0

- Find sailors with maximum age

An Example of Self-Joins

sid	sname	rating	age	sid	sname	rating	age
22	dustin	7	45.0	22	dustin	7	45.0
22	dustin	7	45.0	31	lubber	8	55.5
22	dustin	7	45.0	58	rusty	10	35.0
31	lubber	8	55.5	22	dustin	7	45.0
31	lubber	8	55.5	31	lubber	8	55.5
31	lubber	8	55.5	58	rusty	10	35.0
58	rusty	10	35.0	22	dustin	7	45.0
58	rusty	10	35.0	31	lubber	8	55.5
58	rusty	10	35.0	58	rusty	10	35.0

- Join condition: "left" age smaller than "right" age

An Example of Self-Joins

$$\rho(S1, Sailors) \qquad \rho(S2, Sailors)$$

$$\rho(TempJoin(1 \to f1, 2 \to f2, 3 \to f3, 4 \to f4), S1 \bowtie_{S1.age < S2.age} S2)$$

$$\rho(LeftHalf, \pi_{f1, f2, f3, f4} TempJoin)$$

- Finally, subtract the resulting left hand side from the initial relation, and you get sailors with maximum ages
  - Final result is

$$Sailors - LeftHalf$$