

## Relational Algebra Practice Queries

CS430/630  
Lecture 3

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

## Relational Algebra

### Basic operations:

- ▶ **Selection**  $\sigma$  Selects a subset of rows from relation
- ▶ **Projection**  $\pi$  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**  $\rho$  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**  $\sigma$  **Projection**  $\pi$
2. **Cross-product**  $\times$  **Join**  $\bowtie$
3. **Set-difference**  $-$  **Intersection**  $\cap$
4. **Union**  $\cup$

## Example Schema

Sailors

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

Boats

<u>bid</u>	name	color
101	interlake	red
103	clipper	green

Reserves

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

## Sample Query 1

Sailors				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>

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

$$\pi_{sname}((\sigma_{bid=103} Reserves) \bowtie Sailors)$$

$$\pi_{sname}(\sigma_{bid=103}(Reserves \bowtie Sailors))$$

## Example Schema

Sailors

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

Boats

<u>bid</u>	name	color
101	interlake	red
103	clipper	green

Reserves

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

### Sample Query 2

Sailors				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>

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

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

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

### Example Schema

Sailors				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color
22	dustin	7	45.0	101	interlake	red
31	lubber	8	55.5	103	clipper	green
58	rusty	10	35.0			

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>
22	101	10/10/96
58	103	11/12/96

### Sample Query 3

Sailors				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>

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

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

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

### Example Schema

Sailors				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color
22	dustin	7	45.0	101	interlake	red
31	lubber	8	55.5	103	clipper	green
58	rusty	10	35.0			

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>
22	101	10/10/96
58	103	11/12/96

### Sample Query 4

Sailors				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>

- 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				Boats		
<u>sid</u>	sname	rating	age	<u>bid</u>	name	color
22	dustin	7	45.0	101	interlake	red
31	lubber	8	55.5	103	clipper	green
58	rusty	10	35.0			

  

Reserves		
<u>sid</u>	<u>bid</u>	<u>day</u>
22	101	10/10/96
58	103	11/12/96

### Sample Query 5

Sailors				Boats		
sid	sname	rating	age	bid	name	color

  

Reserves		
sid	bid	day

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

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

$$\rho(\text{Tempothers}, \pi_{sid}((\sigma_{color \neq red} \text{Boats}) \bowtie \text{Reserves}))$$

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

►

### 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

$$\rho(S1, \text{Sailors})$$

$$\rho(S2, \text{Sailors})$$

$$\rho(\text{TempJoin}(1 \rightarrow f1, 2 \rightarrow f2, 3 \rightarrow f3, 4 \rightarrow f4),$$

$$S1 \bowtie S1.age < S2.age \text{ } S2)$$

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

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

Final results

$$\text{Sailors} - \text{LeftHalf}$$

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