Relational Algebra (Part III)

R & G, Chapter 4

Announcement

- **Reminder: Assignment 1 due on Monday, Oct 3.**

Summary of Relational Algebra Operations

- **Basic operations**

  1. _Selection_ (σ)

  2. _Projection_ (π)

  3. _Cross-product_ ($\times$)
  4. _Set-difference_ ($-$)
  5. _Union_ ($\cup$)
- **Compound operations**
  1. Intersection ($\cap$)
  2. Join ($\bowtie$)
  3. Division (/)

Examples

Reserves

Sid	Bid	day
22	101	10/10/96
58	103	11/12/96

Sailors

Sid	Sname	Rating	Age
22	Dustin	7	45.0
31	Lubber	8	55.5
58	Rusty	10	35.5

Boats

Bid	Bname	Color
101	Interlake	Blue
102	Interlate	Red
103	Clipper	Green
104	Marine	red

Selection and Projection

- **Find "reserve" record for boat of ID 103**

$$\sigma_{bid=103}(\text{Re}serves)$$

- **Find the name of the boat of red color**

$$\pi_{bname}(\sigma_{color='red'}(Boats))$$

- **Find the name of the boat of either red or green color**

$$\pi_{bname}(\sigma_{color='red'\vee color='green'}(Boats))$$

Join (I)

- **Find names of sailors who've reserved boat #103**
- **Solution 1:**

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

- **Solution 2:**

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

Join (II)

- **Find names of sailors who've reserved a red boat**
  - Information about boat color only available in Boats; so need an extra join:

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

  - A more efficient solution:

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

$\bowtie$ *A query optimizer can find this given the first solution!*

Join (III)

- **Find the colors of boats reserved by the sailor named Lubber**
  - Information about boat color and reservation only available in Boats and Resevers; so need two joins:

$$\pi_{color}((\sigma_{sname='lubber'}(sailors)) \bowtie Reserves \bowtie Boats)$$

Join (IV)

- **Find the name of sailors who have reserved at least one boat**

$$\pi_{sname}(\text{Re}serves \bowtie Sailors)$$

Join + Set Operations (I)

- **Find the name of sailors who've reserved a red or a green boat**
  - Can identify all red or green boats, then find sailors who've reserved one of these boats:

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

$$\pi_{sname}(Tempboats \bowtie \text{Re}serves \bowtie Sailors)$$

Join + Set operations (II)

- **Find the name of sailors who've reserved a red _and_ a green boat**
  - Is the following solution correct?

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

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

Wrong! There is no boat of both colors.

Join + Set operations (II)

- **Find the name of sailors who've reserved a red <u>and</u> a green boat**
  - Must identify sailors who've reserved red boats, sailors who've reserved green boats, then find the intersection (note that *sid* is a key for Sailors):

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

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

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