Sailer-Boat-Reserve Queries
Shuo Yang

Schema:

Sailor(*sid*: integer, *sname*: string, *rating*: integer, *age*: real)
Boat(*bid*: integer, *bname*: string, *color*: string)
Reserve(*sid*: integer, *bid*: integer, *day*: date)

Tables:

Sailor:

sid	sname	rating	age
22	Dustin	7	45.0
29	Brutus	1	33.0
31	Lubber	8	55.5
32	Andy	8	25.5
58	Rusty	10	35.0
64	Horatio	7	35.0
71	Zorba	10	16.0
74	Horatio	9	35.0
85	Art	3	25.5
95	Bob	3	63.5

Boat:

bid	bname	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserve:

sid	bid	day
22	101	10/10/98
22	102	10/10/98
22	103	10/8/98
22	104	10/7/98
31	102	11/10/98
31	103	11/6/98
31	104	11/12/98
64	101	9/5/98
64	102	9/5/98
64	103	9/5/98

- Q1: Find the names of sailors who have reserved boat 103.

  RA1(naive way):
  RA1'(Expressing RA1 with cross product):
  RA2(push selection, avoid join on large tables):
  RA3(push projection):

$$\pi_{sname}(\sigma_{bid=103}(Reserve \bowtie Sailor))$$
$$\pi_{sname}(\sigma_{bid=103}(\sigma_{Reserve.sid=Sailor.sid}(Reserve \times Sailor)))$$
$$\pi_{sname}((\sigma_{bid=103}Reserve) \bowtie Sailor)$$
$$\pi_{sname}((\pi_{sid}(\sigma_{bid=103}Reserve)) \bowtie Sailor)$$

- Q2: Find the names of sailors who have reserved a red boat.

  RA1:
  RA2(push projection, will generate intermediate relation instances with fewer tuples):

$$\pi_{sname}((\sigma_{color='red'}Boat) \bowtie Reserve \bowtie Sailor)$$
$$\pi_{sname}(\pi_{sid}(\pi_{bid}(\sigma_{color='red'}Boat) \bowtie Reserve) \bowtie Sailor)$$

- Q3: Find the colors of boats reserved by Lubber.

  RA:

$$\pi_{color}(\sigma_{sname='Lubber'}Sailor \bowtie Reserve \bowtie Boat)$$

- Q4: Find the names of sailors who have reserved at least one boat.

  RA:

$$\pi_{sname}(Sailor \bowtie Reserve)$$

- Q5: Find the names of sailors who have reserved a red or a green boat.

  RA:

$$\pi_{sname}((\sigma_{color='red' \vee color='green'}Boat) \bowtie Reserve \bowtie Sailor)$$

- Q6: Find the names of sailors who have reserved a red and a green boat.

  RA1:

$$\rho(TmpRel1, (\sigma_{color='red'}Boat) \bowtie Reserve \bowtie Sailor)$$
$$\rho(TmpRel2, (\sigma_{color='green'}Boat) \bowtie Reserve \bowtie Sailor)$$
$$\pi_{sname}(TmpRel1 \cap TmpRel2)$$

  RA1'(incorrect!!!):

$$\rho(TmpRel1, \pi_{sname}(\sigma_{color='red'}Boat) \bowtie Reserve \bowtie Sailor)$$
$$\rho(TmpRel2, \pi_{sname}(\sigma_{color='green'}Boat) \bowtie Reserve \bowtie Sailor)$$
$$\pi_{sname}(TmpRel1 \cap TmpRel2)$$

  Note: since *sname* is not a key for the Sailor table, RA1' is incorrect. Consider the case when two persons with the same name, one reserved only a red boat and another one reserved only a green boat, this query will return this name.

  RA2 (more efficient):

$$\rho(TmpRel1, \pi_{sid}((\sigma_{color='red'}Boat) \bowtie Reserve))$$
$$\rho(TmpRel1, \pi_{sid}((\sigma_{color='green'}Boat) \bowtie Reserve))$$
$$\pi_{sname}((TmpRel1 \cap TmpRel2) \bowtie Sailor)$$

- Q7: Find the names of sailors who have reserved at least two boats.

  RA:

$$\rho(TmpReserve, \pi_{sid,sname,bid}(Sailor \bowtie Reserve))$$
$$\rho(TmpReservePair(1 \to sid1, 2 \to sname1, 3 \to bid1, 4 \to sid2, 5 \to sname2, 6 \to bid2),$$
$$TmpReserve \times TmpReserve)$$
$$\pi_{sname}(\sigma_{sid1=sid2 \wedge bid1 \neq bid2}TmpReservePair)$$

- Q8: Find the sids of sailors with age over 20 who have not reserved a red boat.
  RA:

$$\pi_{sid}(\sigma age > 20 Sailor) - \pi_{sid}((\sigma_{color='red'} Boat) \bowtie Reserve \bowtie Sailor)$$

- Q9: Find the names of sailors who have reserved all boats.
  RA:

$$\rho(TmpSid, (\pi_{sid,bid} Reserve)/(\pi_{bid} Boat))$$
$$\pi_{sname}(TmpSid \bowtie Sailor)$$

$$(\pi_{sid,bid} Reserve)/(\pi_{bid} Boat) = \pi_{sid} Reserve - \pi_{sid}((\pi_{sid} Reserve) \times (\pi_{bid} Boat) - \pi_{sid,bid} Reserve)$$

- Q10: Find the names of sailors who have reserved all boats called Interlake.
  RA:

$$\rho(TmpBoat, \pi_{bid}(\sigma_{bname='interlake'} Boat))$$
$$\rho(TmpSid, (\pi_{sid,bid} Reserve)/TmpBoat)$$
$$\pi_{sname}(TmpSid \bowtie Sailor)$$

$$(\pi_{sid,bid} Reserve)/TmpBoat = \pi_{sid} Reserve - \pi_{sid}((\pi_{sid} Reserve) \times TmpBoat - \pi_{sid,bid} Reserve)$$