Assignment 1 (30 marks)

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1 Relational Algebra (3+3+3+3+9+9 = 30 marks)

Use the following schema:

Sailors(*sid:* `integer`, *sname:* `string`, *rating:* `integer`, *age:* `real`)
Boats(*bid:* `integer`, *bname:* `string`, *color:* `string`)
Reserves(*sid:* `integer`, *bid:* `integer`, *day:* `date`)

The key fields are underlined, and the domain of each field is listed after the field name. Thus, **sid** is the key for *Sailors*, **bid** is the key for *Boats*, and all three fields together form the key for table *Reserves*.

For the following relational algebra expressions, clearly mention what "query" (in plain English) they are attempting to perform. Also, provide clear step-wise explanations of how you arrived at the answer that outlines what the output(s) of the relational algebra expressions are. There are no credits given for partial answers.

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

2. $\rho(Tempboats, (\sigma_{color='red' \vee color='green'}Boats))$
   $\pi_{sname}(Tempboats \bowtie Reserves \bowtie Sailors)$

3. $\rho(Temp1, \pi_{sid}((\sigma_{color='red'}Boats) \bowtie Reserves))$
   $\rho(Temp2, \pi_{sid}((\sigma_{color='green'}Boats) \bowtie Reserves))$
   $\pi_{sname}((Temp1 \cap Temp2) \bowtie Sailors)$

4. $\rho(Reservations, \pi_{sid,sname,bid}(Sailors \bowtie Reserves))$
   $\rho(ReservationPairs(1 \rightarrow sid1, 2 \rightarrow sname1, 3 \rightarrow bid1, 4 \rightarrow sid2, 5 \rightarrow sname2, 6 \rightarrow bid2), Reservations \times Reservations)$
   $\pi_{sname1}\sigma_{(sid1=sid2)\wedge(bid1\neq bid2)}ReservationPairs$
   Hint: On step 2, the tuples output from step 1, are being renamed "attribute/field wise".

5. $\pi_{sid}(\sigma_{age>20}Sailors) - \pi_{sid}((\sigma_{color='red'}Boats) \bowtie Reserves \bowtie Sailors)$