* "Assignment - 1" *

1) The given relational algebra expression is :-

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

→ The expression $\pi_{bid}\sigma_{color='red'}Boats$ (which is a part of above expression) is a query to find the distinct boat id's of red colored boats.

→ The expression $\pi_{sid}((\pi_{bid}\sigma_{color='red'}Boats) \bowtie Reserves)$ is a query to find the distinct sailor id's of the sailors who have a red colored boat.

→ Finally, the given ~~query~~ expression in the question is attempting to find the distinct names of all the sailors who have a red colored boat.

2) The first given relational algebra expression is :-

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

→ The expression $\sigma_{color='red' \vee color='green'}Boats$ essentially selects all the Tuples from the "Boats" table whose attribute color is either red (or) green. Now, using the rename operation (P) we are naming this table (containing refined tuples) as Tempboats. The attributes of this table are bid, bname and color.

→ The second relational algebra expression given in the question is :-

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

→ We can observe that the Tempboats and Sailors tables are not having any attributes in common. Tempboats and Reserves tables have bid as the common attribute whereas Sailors and Reserves tables have sid as the common attribute. Hence, the tables are naturally joined on these attributes.

Hence, the final query that the second relational algebra expression is attempting to perform is to find the distinct names of all the sailors who have a red (or) green colored boat.

3) The first relational algebra expression that is given in the question is :-

→ $\rho(Temp1, \Pi_{sid}((\sigma_{color='red'} Boats) \bowtie Reserves))$

→ The expression $\Pi_{sid}((\sigma_{color='red'} Boats) \bowtie Reserves)$ is attempting to find unique sailor id's of sailors who have red colored boats. Now, using the rename (ρ) operation, we are naming this table as Temp1 (this table only has sid as the attribute).

→ The second relational algebra expression that is given in the question is :-

→ $\rho(Temp2, \Pi_{sid}((\sigma_{color='green'} Boats) \bowtie Reserves))$

→ The expression $\Pi_{sid}((\sigma_{color='green'} Boats) \bowtie Reserves)$ is attempting to find unique sailor id's of sailors who have green colored boats. Now, using the rename (ρ) operation, we name this table as Temp2. (this table also has sid as the only attribute)

→ The final relational algebra expression given to us in the question is :-

→ $\Pi_{sname}((Temp1 \cap Temp2) \bowtie Sailors)$

→ $Temp1 \cap Temp2$ is a table containing the sailor id's of sailors who have both red and green colored boats.

→ finally, the given expression is attempting to find the distinct names of all the sailors who have both red and green colored boats.

4) The first relational algebra expression that is given in the question is:

→ ρ(Reservations, $\Pi_{sid, sname, bid}$ (Sailors $\bowtie$ Reserves))

→ The expression $\Pi_{sid, sname, bid}$ (Sailors $\bowtie$ Reserves) is essentially selecting only the sailor id, sailor name, boat id attributes (out of the 6 attributes that are initially obtained after naturally joining the Sailors and Reserves tables) Now, using the rename (ρ) operation we are naming this table of 3 attributes as Reservations.

→ The second relational algebra expression that is given in the question is:

→ ρ(ReservationPairs (1 → sid1, 2 → sname1, 3 → bid1, 4 → sid2, 5 → sname2, 6 → bid2), Reservations x Reservations)

→ In the above expression, Reservations x Reservations essentially denotes that we are taking the cartesian product of Reservations table with itself giving us 6 attributes in the resulting table.

→ Now using the rename operation, we are renaming the first 3 attributes of above table as sid1, sname1 & bid1 and the last 3 attributes as sid2, sname2 & bid2 respectively. Also, this table as a whole is named as the ReservationPairs table.

→ The third relational algebra expression that is given in the question is:

→ Π_{sname1} $\sigma_{(sid1 = sid2) \wedge (bid1 \neq bid2)}$ ReservationPpairs

→ The above expression is attempting to select the distinct names of all the sailors who have boats with two different boat id's which is equivalent to saying that they have 2 different boats. (as bid is a key field in the Boats table)

5) The relational algebra expression that is given in the question is :-

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

→ Let us first consider the expression $\Pi_{sid}(\sigma_{age>20}\ Sailors)$. Using this expression we are first selecting all the tuples from the Sailors table who have the attribute 'age' greater than 20. Then using the projection operator we are selecting only the sid (Sailor id) attribute of such tuples. Hence, using this expression we are essentially attempting to find the distinct sailor id's of all the sailors who are aged over 20.

→ Now, let us consider the second part of the given expression which is $\Pi_{sid}((\sigma_{color='red'}\ Boats) \bowtie Reserves \bowtie Sailors)$.

→ First, using the expression $\sigma_{color='red'}\ Boats$ we are selecting all the tuples from the Boats table who have their color attribute as red.

→ Now the expression $(\sigma_{color='red'}\ Boats) \bowtie Reserves \bowtie Sailors$ naturally joins the three tables using the common attributes. The tables Reserves and $\sigma_{color='red'}\ Boats$ have bid as the common attribute whereas Sailors and Reserves tables have sid as the common attribute. Sailors and $\sigma_{color='red'}\ Boats$ tables do not have any attributes in common.

→ Finally, after naturally joining the tables we use the projection operator to select only the sailor id attribute from the resulting table. Hence, we are attempting to find the distinct sailor id's of all the sailors who have red colored boats using the second part of expression given in the question.

→ Hence, the ~~query~~ expression given in the question is attempting to find the distinct sailor id's of all the sailors who are aged over 20 but do not have a red colored boat.