Name:

Vaquero ID:

Q1 (4 pt): Given the following tables:

- *Sailor(sid, name, rating, age)*
- *Boat(bid, Name, color)*
- *Buy(sid, bid)*

Answer the SQL statement for the following questions:

1. Find the names of the sailor whose rating is less than 7 and age greater than 34
2. Find the names of the sailor whose rating is greater than 4 and reserves all boats.

```
SELECT name FROM Sailor
WHERE rating<7 AND age> 34
```

```
SELECT S.name FROM Sailor S
WHERE rating > 4 AND
NOT EXISTS (
SELECT B.bid FROM Boat B
EXCEPT
SELECT B2.bid FROM Buy B2
WHERE B2.sid = S.sid
)
```

Q2 (6 pt): Given the same tables as Q1:

- *Sailor(sid, company, rating, age)*
- *Boat(bid, name, color)*
- *Buy(sid, bid)*

Answer the SQL statement for the following questions:

1. Return the average rating of the sailors.
2. For each company, find the lowest sailor rating. You should return a table contains (company, min_rating)
3. For each yellow boat which is reserved by sailors from different companies, find the total number of reservations. You should return a table contains (bid, count)

```
SELECT AVG(rating) FROM Sailor
```

```
SELECT company, MIN(rating) AS min_rating
FROM Sailor
GROUP BY company
```

3. For each yellow boat which is reserved by sailors from different companies, find the total number of reservations. You should return a table contains (bid, count)

```
SELECT bid, COUNT(*) FROM
Buy B3 WHERE
bid IN
(
SELECT bid FROM Boat B WHERE color='yellow'
AND
(SELECT COUNT(DISTINCT company) FROM
 Buy B2 NATURAL JOIN Sailor S WHERE
B2.bid=B.bid)>1
)
GROUP BY bid
```

easier solution:

3. For each yellow boat which is reserved by sailors from different companies, find the total number of reservations. You should return a table contains (bid, count)

```
SELECT bid, COUNT(*) FROM
Buy B NATURAL JOIN Boat B2 NATURAL JOIN Sailor S
WHERE B2.color='yellow'
GROUP BY bid
HAVING COUNT(DISTINCT S.company)>1
```

Q3(6 pt): Given a relation $R(A, B, C)$ and a functional dependency set $F = \{A \rightarrow C, C \rightarrow A\}$. Fill up the following table according to F^+. The first row in the table is filled up as a reference example. ($\surd$ indicates the functional dependency $row \rightarrow column$ is in F^+.)

	A	B	C	AB	AC	BC	ABC
A	√		√		√		
B							
C							
AB							
AC							
BC							
ABC							

Because neither A or C point to B, B+ = B.

Q3(6 pt): Given a relation $R(A, B, C)$ and a functional dependency set $F = \{A \rightarrow C, C \rightarrow A\}$. Fill up the following table according to F^+. The first row in the table is filled up as a reference example. ($\surd$ indicates the functional dependency $row \rightarrow column$ is in F^+.)

	A	B	C	AB	AC	BC	ABC
A	√		√		√		
B							
C							
AB							
AC							
BC							
ABC							

B+ = B
C+
AB+
AC+
BC+
ABC+ = ABC

A. ->. C
C. ->. A

Result = C
Result = AC

Q3(6 pt): Given a relation $R(A, B, C)$ and a functional dependency set $F = \{A \rightarrow C, C \rightarrow A\}$. Fill up the following table according to F^+. The first row in the table is filled up as a reference example. ($\surd$ indicates the functional dependency $row \rightarrow column$ is in F^+.)

	A	B	C	AB	AC	BC	ABC
A	√		√		√		
B							
C							
AB							
AC							
BC							
ABC							

B+ = B
C+ = AC
AB+
AC+
BC+
ABC+ = ABC

A. ->. C
C. ->. A
Result = AB
Result = ABC

Since there is an A in AB+, AB+ = ABC.

Q3(6 pt): Given a relation $R(A, B, C)$ and a functional dependency set $F = \{A \to C, C \to A\}$. Fill up the following table according to F^+. The first row in the table is filled up as a reference example. ($\surd$ indicates the functional dependency $row \to column$ is in F^+.)

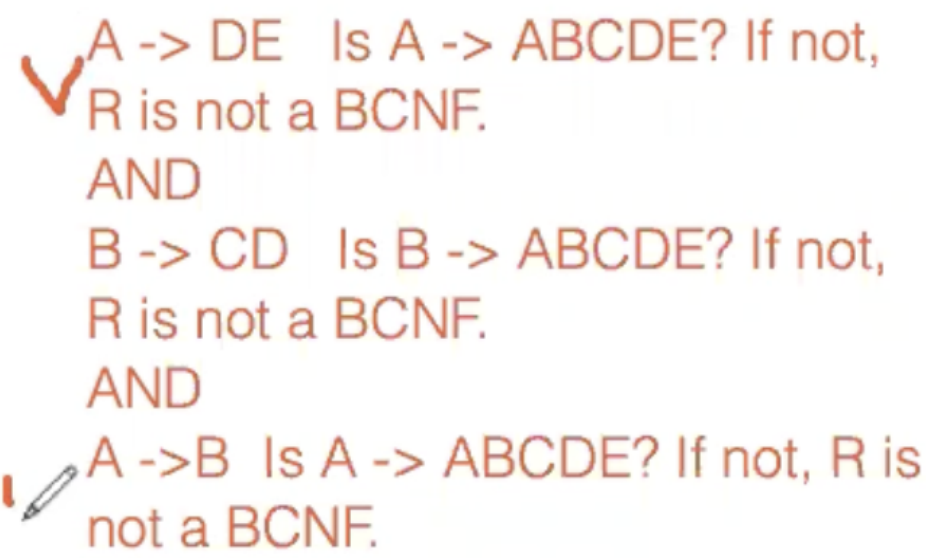
	A	B	C	AB	AC	BC	ABC
A	√		√		√		
B		√					
C	√		√		√		
AB	√	√	√	√	√	√	√
AC	√		√		√		
BC	√	√	√	√	√	√	√
ABC	√	√	√	√	√	√	√

A. ->. C
C. ->. A

B+ = B
C+ = AC
AB+ = ABC
AC+ = AC
BC+ = ABC
ABC+ = ABC

Q4(4pt): Given a relation: $R(A, B, C, D, E)$ and a functional dependency set $F = \{A \to DE, B \to CD, A \to B\}$, answer the following questions:

1. Is R a BCNF?
2. Answer the BCNF Decomposition of R



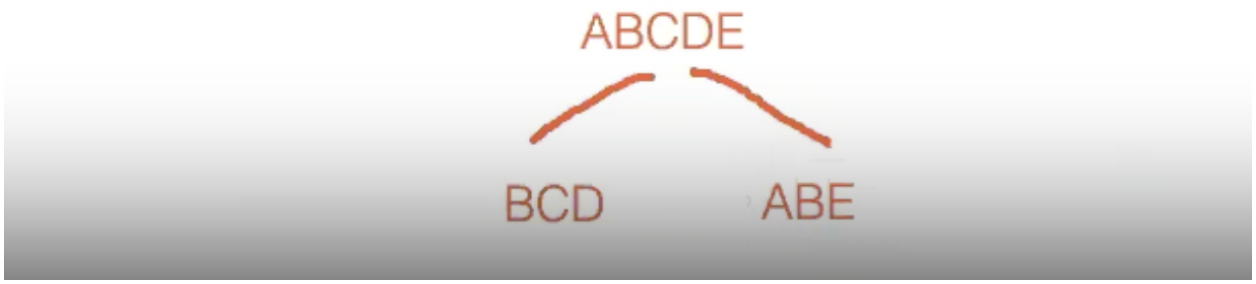
Both these conditions are satisfied because A -> B and B -> everything else so basically A -> everything which satisfies both.

However you cannot infer with B -> CD, so R is not a BCNF.

Q4(4pt): Given a relation: $R(A, B, C, D, E)$ and a functional dependency set $F = \{A \to DE, B \to CD, A \to B\}$, answer the following questions:

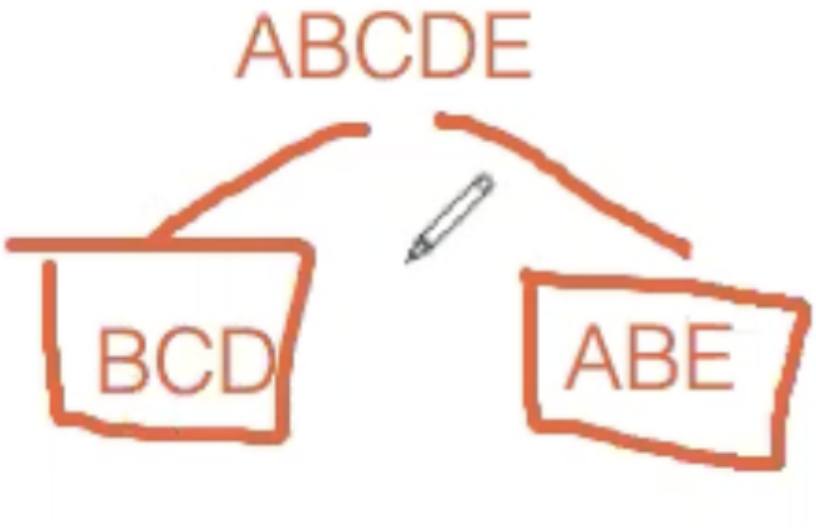
1. Is R a BCNF?
2. Answer the BCNF Decomposition of R

A -> DE Is A -> ABCDE? If not, R is not a BCNF.
AND
B -> CD Is B -> ABCDE? If not, R is not a BCNF.
AND
A ->B Is A -> ABCDE? If not, R is not a BCNF.

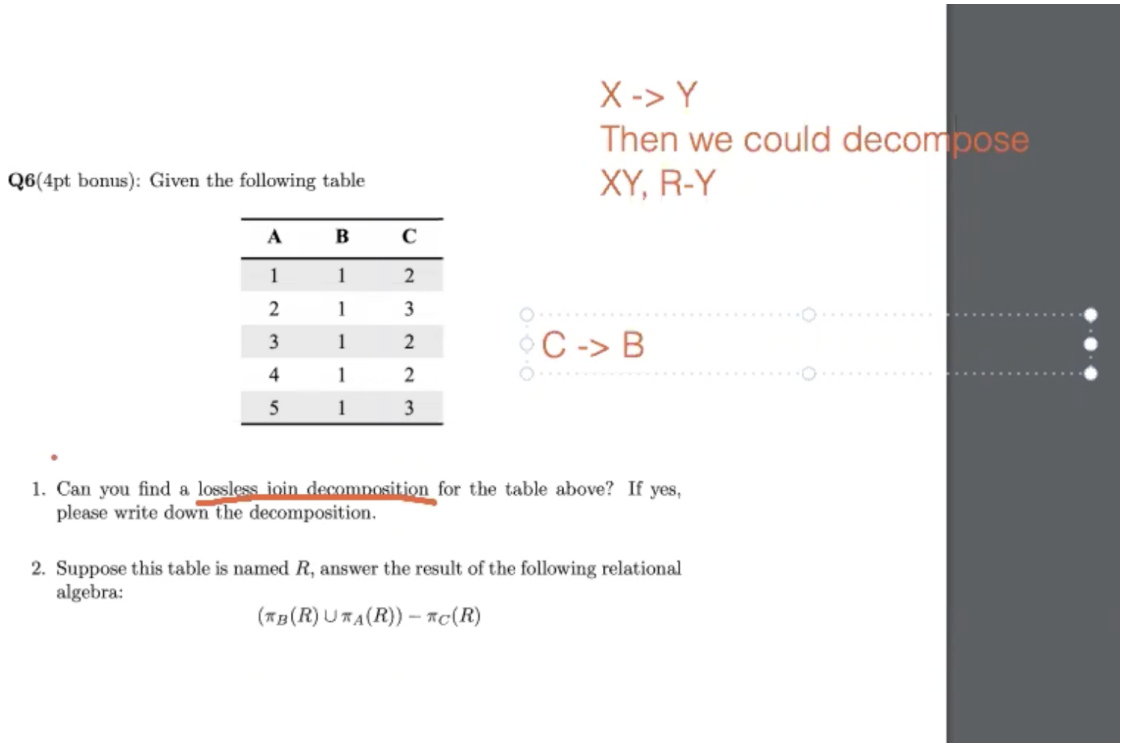


B -> CD is not automatically satisfied, so we make a tree. On the left of the tree, BCD. On the

right, everything besides CD, so ABE.



BCD and ABE are BCNF.



C -> B is satisfied since every value is the same.

X -> Y
Then we could decompose
XY, R-Y

Q6(4pt bonus): Given the following table

A	B	C
1	1	2
2	1	3
3	1	2
4	1	2
5	1	3

B -> A x

1. Can you find a lossless join decomposition for the table above? If yes, please write down the decomposition.

2. Suppose this table is named R, answer the result of the following relational algebra:

$$(\pi_B(R) \cup \pi_A(R)) - \pi_C(R)$$

B -> A is not satisfied because values change.

X -> Y
Then we could decompose
XY, R-Y

Q6(4pt bonus): Given the following table

A	B	C
1	1	2
2	1	3
3	1	2
4	1	2
5	1	3

A -> C

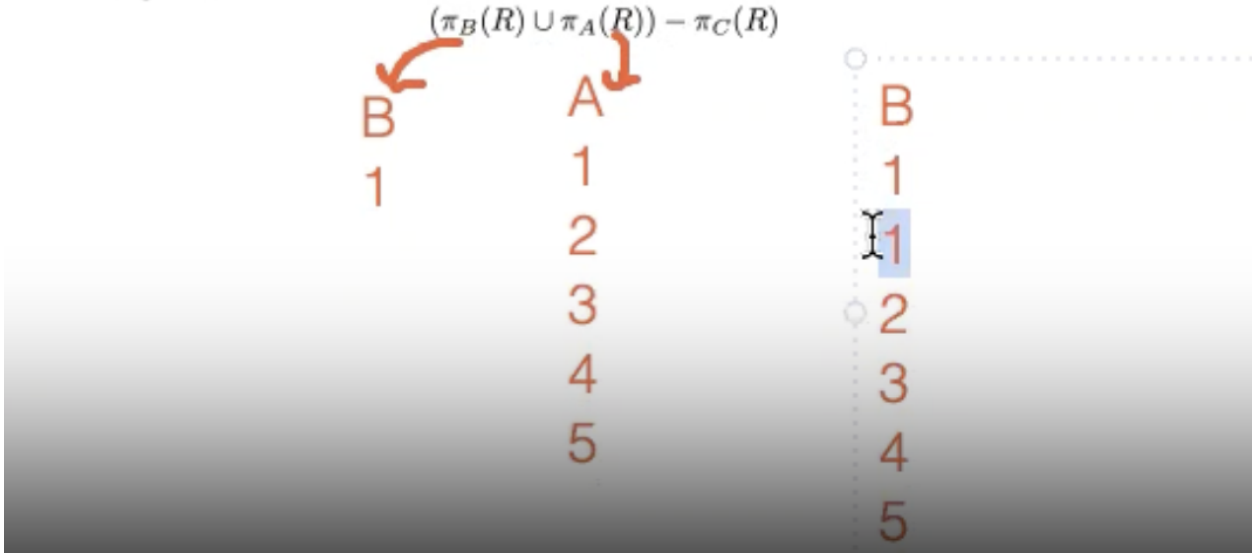
AC, AB

1. Can you find a lossless join decomposition for the table above? If yes, please write down the decomposition.

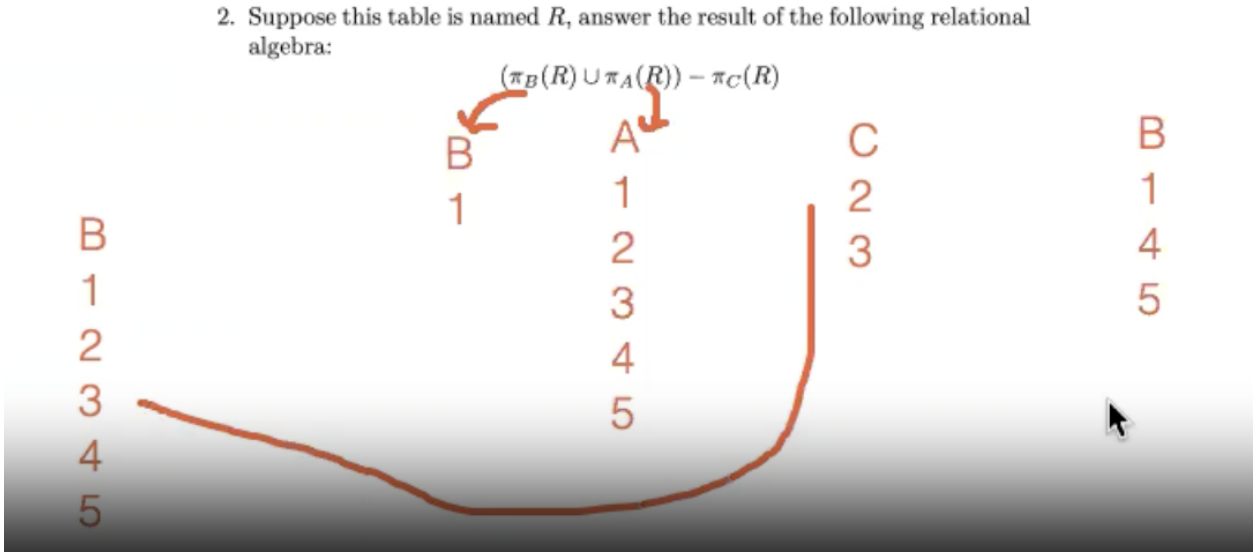
AC, AB are the decomposition we need to have.
A is X, C is Y. So XY is AC.

R is ABC, Y is C. So R - Y is ABC - C = AB.

2. Suppose this table is named R, answer the result of the following relational algebra:



We cannot have a duplicate 1, so the second 1 on the right column gets deleted. (This is only the union step).



Set deletion.