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Q1- $r(A,B)$, $s(B,C)$, $t(B,D)$

(a) let $r = (a,b)$

$s = (x, y)$

$t = (b,d)$

r outer left join s gives

$m = (a,b,NULL)$

m outer left join t gives

$(a, b, NULL, d)$

(b) No, for the first expression it is not possible for C to be NULL and D to be Not NULL

Consider $s = (P,q)$ $t = (P,d)$

for $c_{j,n}$ subexpression 's outer left joint to be NULL and d to be Not NULL

q needs to be initially NULL

$S \bowtie t = (P, q, d)$

$q \neq NULL$ [given]

so, it is not possible

Q2 (a) SELECT employee.employee-name,

Q2- (a) SELECT employee.employee-name, city
FROM employee employ, works wor
WHERE wor.company-name =
'First Bank Corporation' AND
wor.employee-name = employ.employee
nam

(b) SELECT *
From employee
WHERE employee-name IN
(SELECT employee-name
FROM Works
WHERE company-name = 'First Bank
Corporation'
AND salary > 10000

(c) SELECT comp.company-name
FROM company comp
WHERE (SELECT cit.city
From company cit
WHERE cit.company-name
= comp.company-name)
CONTAINS (SELECT x.city
FROM company x
WHERE x.company-name = 'Small Bank
Corporation')

(d)
```
SELECT company-name
FROM Works
Group by company-name
Having Count (distinct employee-name) >=all
    (Select count (distinct employee-name)
     FROM works
     GROUP BY company-name)
```

(e)
```
SELECT Company-name
FROM works
GROUP By company-name
Having avg (salary) > (SELECT avg(salary)
                       FROM Works
                       WHERE company-name
                       = 'First Bank Corporation')
```

(f)
```
SELECT employee-name
FROM employee
WHERE employee-name NOT IN
    (SELECT employee-name
     FROM works
     where Company name = 'First Bank
                          Corporation')
```

(9)

```
SELECT employee-name
FROM   works
WHERE  salary > ALL
       (SELECT salary
        FROM   works
        where company-name
        = 'small bank corporation')
```

Q3- (a) R(A, B, C, D)

A	B	C	D
a	1	X	123
d	2	Y	125
b	3	Z	12
c	4	X	13
a	5	P	14

B contains all distinct elements

So, $B \rightarrow \alpha$ is a functional dependency

$B \rightarrow A$, $B \rightarrow C$, $B \rightarrow D$

$B \rightarrow ACD$, $B \rightarrow ABCD$, etc are all functional dependencies.

$\alpha B \rightarrow Y$ is also a functional dependency for each unique value of B, αB is also unique

So, $AB \rightarrow CD$, $CB \rightarrow AD$, etc are functional dependencies

Similarly D also have all values unique

So, $\alpha D \rightarrow \beta$, $D \rightarrow \alpha$, etc are all functional dependencies.

(b) FD: $W \rightarrow X$ $\quad R(W, X, Y, Z)$

$Y \rightarrow X$

$YZ \rightarrow WXY$

$WY \rightarrow Z$

$W \rightarrow Y$

$Z \rightarrow XY$

$W^+ = WXYZ$ → Super key

$X^+ = X$

$Y^+ = YX$

$Z^+ = ZXYW$ → super key

Possible Candidate keys are minimal super keys

Candidate keys can be W or Z

Finding Canonical Cover

I- Decomposition

$\{W \to X, Y \to X, YZ \to W, YZ \to X$
$YZ \to Y, WY \to Z, W \to Y, Z \to X, Z \to Y\}$ ✓

II- (a) $(W \to X)$, $W^+ = WYZX$

(b) $(Y \to X)$, $Y^+ = Y$

(c) $(YZ \to X)$, $YZ^+ =$

(d) $(YZ \to W)$, $YZ^+ = YZ$

(c) $(YZ \to W)$, $YZ^+ = YZX$

(d) $(YZ \to X)$, $YZ^+ = YZWX$ ✓

(e) $(WY \to Z)$, $WY^+ = WYX$

(f) $(W \to Y)$, $W^+ = W$

(g) $(Z \to X)$, $Z^+ = ZYXW$ ✓

(h) $(Z \to Y)$, $Z^+ = Z$

FD Can be reduced to:

$Y \to X, YZ \to W, WY \to Z, W \to Y, Z \to Y$

III Canonical Cover

reducing the 2 attributes based LHS

$\{Y \to X, W \to Y, Z \to Y\}$
$\{Z \to X, Y \to Z\}$

[eg $Z^+ = ZYX$
$YZ \to X$ can be replaced by $Y \to X$
similarly $WY \to Z \Rightarrow Y \to$

Q4- $R = (A, B, C, D, E, F, G, H, I, J)$

$F = \{$
$A \rightarrow C$
$C \rightarrow B\ E$
$B \rightarrow D\ F$
$F \rightarrow G\ H$
$D \rightarrow I\ J$

$A^+ = A\ C\ B\ E\ D\ F\ G\ H\ I\ J$ ✓

$C^+ = C\ B\ E\ D\ F\ G\ H$

$B^+ = B\ D\ F\ G\ H\ I\ J$

$F^+ = G\ H$

$D^+ = I\ J$

$E^+ = E$

$G^+ = G$

$H^+ = H$

$I^+ = I$

$J^+ = J$

A is the key of the relation R

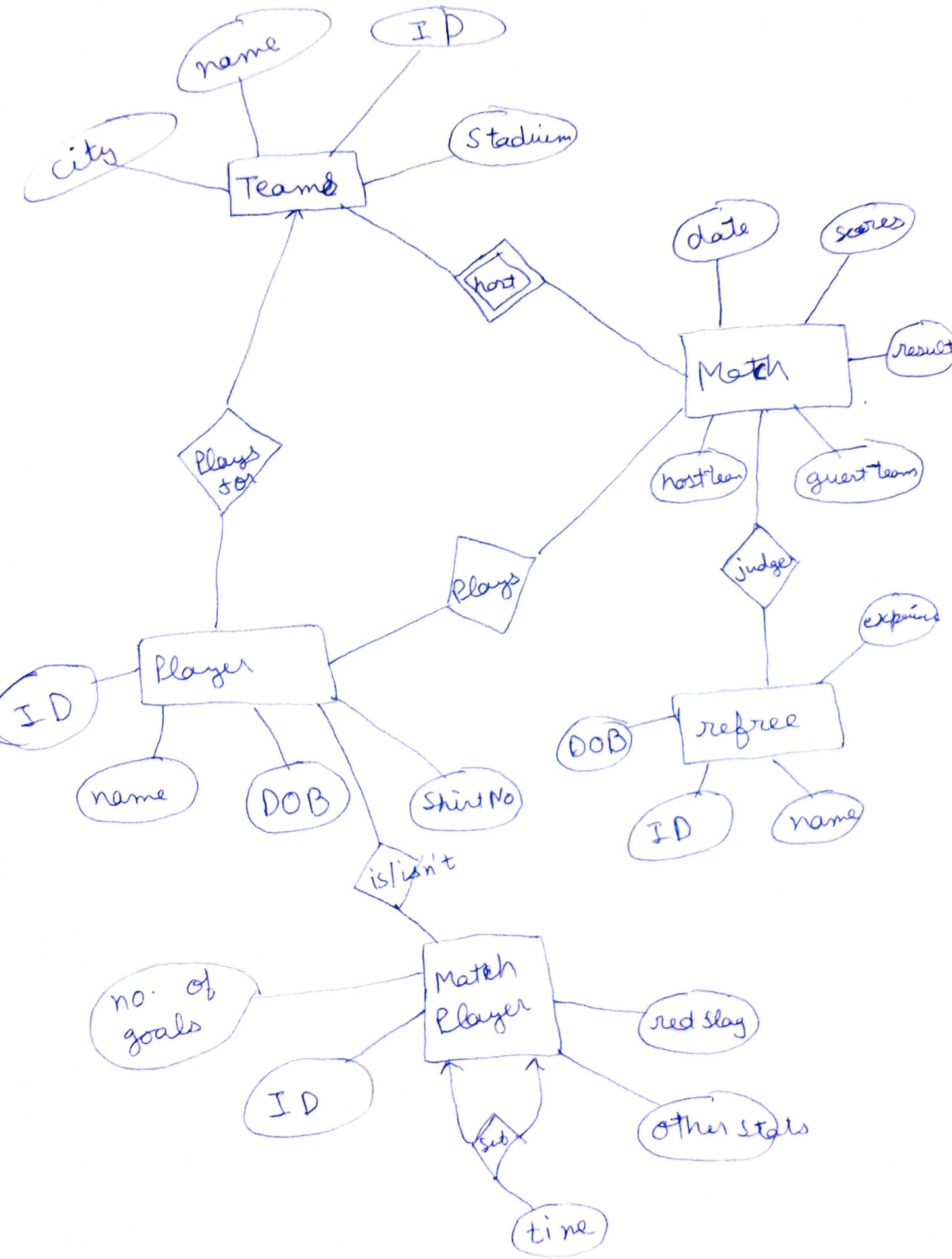
$D_1 = (R1, R2, R3)$

$R_1 = (A, B, C, D, E)$

$R_2 = (B, F, G, H)$

$R_3 = (D, I, J)$

Q5


name
ID
city
Stadium
Teams
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Match
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hostTeam
guestTeam
judge
Plays
expire
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DOB
refree
name
DOB
ShirtNo
ID
name
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Match Player
no. of goals
red slag
ID
Other stats
Sub
time