EECS 3421 M

ASSIGNMENT - 1

Team members:

1) Ali Tashfiq Wazed
   EECS login - tashfiq
   Student ID - 214677405

2) Shifat Akter
   EECS login - shifata
   Student ID - 215162183

   Grace days used - **01**

Part 1 [20% - 4 marks each]: Additional Integrity Constraints

1. **No team can play itself.**

   $\sigma_{country1 = country2}(Competes) = \varnothing$

2. **All tickets for a match have to be purchased before the time of the match.**

   $\sigma_{Match.date > Ticket.dateIssued \land Match.time => Ticket.timeIssued}(Match \bowtie Ticket) = \varnothing$

3. **The number of tickets purchased for a match should not exceed the capacity of the stadium where the match takes place.**

   "Cannot be expressed"

4. **A coach can only coach one team**

   $\rho_{c1}(Team) \bowtie_{(c1.coach = c2.coach \land c1.country \neq c2.country)} \rho_{c2}(Team)$

5. **A player's position should be one of 'G', 'D', 'M' or 'S' representing a goalkeeper, defender, midfielder or striker, respectively.**

   $\sigma_{position != 'G' \lor position != 'D' \lor position != 'M' \lor position != 'S'}(Player) = \varnothing$

Part 2 [80% - 8 marks each]: Queries

1. Report the country of the team that has played in every stadium. If there are ties report all of them.

In A we theta join all countries from Competes with Team

A := Team $\bowtie_{country=country1 \lor country=country2}$ (Competes)

In B, we join Match and Stadium
B := Match $\bowtie$ Stadium

In C, we find all possible combinations
C := A $\bowtie$ B

In D, we project Country and SID of C

D := $\pi_{country,SID}$(C)

In E, we find SID of all stadium

E := π_{SID} (Stadium)

F can also we written as D/E, but since it's not part of relational algebra, its expressed according
To the formula
 F := $\pi_{country}$ (D) - $\pi_{country}$ (($\pi_{country}$ (D) x E) - D)

2. Report the MID of the match for which the highest number of tickets was purchased. If there are ties report all of them.

Cannot be expressed

3. Report the PID(s) of the player(s) of the team(s) that didn't play in any match.

In 'A' we are getting the countries from the Competes relation, the country2 attribute and renaming them
 to country.
A:= $\pi_{country}$ ($\rho_{country1 \rightarrow country}$ (Completes))

In 'B' we are getting the countries from the Competes relation, the country1 attribute and renaming them
to country.
B:= $\pi_{country}$ ($\rho_{country2 \rightarrow country}$ (Completes))

In 'C' we are finding the union of 'A' and 'B', that is finding countries who played in matches.
C := (A U B)

In 'D' we are finding the list of all countries in the competition.
D := $\pi_{country}$(Team)

In 'E' we are finding countries that did not play any matches
E := D - C

In 'F' we are finding PID's of players of 'E'
F := π_{pid} (E ⋈ Player)

4. Report the SID(s) of the stadium(s) where exactly one match took place.

In A, we rename everything in Match
A := $\rho_{mid \rightarrow MID,\ d \rightarrow date,\ t \rightarrow time,\ sid \rightarrow SID}$ (Match)

In B, we use theta join of A and Match with condition of equal SID values
B := A ⋈$_{sid=SID}$ (Match)

In C, we find the MIDs that does not match from B
C := π_{sid} ($\sigma_{mid \neq MID}$ (B))

In D, we find all SIDs from Match and Stadium
D := π_{SID} (Match ⋈ Stadium)

In E, we find SIDs that are left
E := D - C

5. Report the coaches of the teams with the highest difference in the number of goals when competed with each other at a match. If there are ties, report all of them.

In A, we rename everything in Competes
A := $\rho_{mid \rightarrow MID,\ coun1 \rightarrow country1,\ coun2 \rightarrow country2,\ g1 \rightarrow goals1,\ g2 \rightarrow goals2}$ (Competes)

In B, we find all possible combination of A and Compete
B := (A x Competes)

In C we find max goal difference from B
C := $\sigma_{(goals1 - goals2 < g1 - g2)\ \vee\ (goals2 - goals1 < g2 - g1)}$ (B)

In D, we project from C

$D := \pi_{MID,country1,country2,goals1,goals2} (C)$

In E, we find the difference between Competes and D

E := Competes - D

In F and G we rename entities in Team

$F := \rho_{team1 \rightarrow country,coach1 \rightarrow coach} (Team)$

$G := \rho_{team2 \rightarrow country,coach2 \rightarrow coach} (Team)$

In H we equi-join entities of E, F and G

$H := (F) \bowtie_{country1=team1} (E) \bowtie_{country2=team2} (G)$

In I, we project names of the coaches

$I := \pi_{coach1,coach2} (H)$

6. Report the fname and lname of the players whose position is 'D' and have scored the largest number of goals among all players (in any team) who play at the same position.

In 'A' we are renaming all attributes in Player schema

$A := \rho_{PID \rightarrow pid, fname \rightarrow first, lname \rightarrow last, position \rightarrow pos, goals \rightarrow g, country \rightarrow coun} (Player)$

In 'B' we are doing the cross product of A with Player

B := Player x A

In 'C' we are selecting g > goals from B

$C := \pi_{goals} (\sigma_{(position =' D') \wedge (g > goals)} (B))$

In 'D' we are removing total goals from C

$D := \pi_{goals} (Player) - C$

In the last step 'E' we're finding the fname and lname of players with pos = 'D'

$E := \pi_{fname,lname} (\sigma_{position = 'D'} (Player \bowtie D))$

7. Find the winner country of the match for which the very first ticket out of all the tickets in the database was purchased. If there was a tie in the match, report nothing.

In A, we rename relations in Ticket

$A = \rho_{tid \rightarrow TID, d \rightarrow dateIssued, t \rightarrow timeIssued, mid \rightarrow MID} (Ticket)$

In B, we find every possible combinations
B := A x Ticket

C := π_d ($\sigma_{d>\text{dateIssued} \land t>\text{timeIssued}}$ (B))

D is first ticket sold
D := π dateIssued (Ticket) - C

In E, we rename dateIssued to date
E := $\rho_{\text{date} \rightarrow \text{dateIssued}}$ (D)

In F, we find date and date issued to get all info to join with Competes
F := $\sigma_{\text{date}=\text{dateIssued}}$ (E x Ticket)

In G, we have the game for which first ticket was sold and all the info. Now to find the winning team
G := F ⋈ Competes

In H, we find winning country and rename to coun
H := π_{coun} ($\rho_{\text{coun} \rightarrow \text{country1}}$ ($\sigma_{\text{goals1} > \text{goals2}}$ (G)))

In I, we find losing country and rename to coun
I := π_{coun}($\rho_{\text{coun} \rightarrow \text{country2}}$ ($\sigma_{\text{goals2} > \text{goals1}}$ (G)))

In J, we get the team we're sure won
J := H ∪ I

In K, we are renaming and taking all country1 and country2 from Completes schema
K := $\pi_{\text{country1,country2}}$ ($\sigma_{(\text{goals1} > \text{goals2}) \lor (\text{goals2} > \text{goals1})}$ (Competes))

In L and M rename both country1 and country2 in Competes to country
L := π_{country} ($\rho_{\text{country} \rightarrow \text{country1}}$ (Competes))
M := π_{country} ($\rho_{\text{country} \rightarrow \text{country2}}$ (Competes))

In N, we have a single list of countries that competed
N := L ∩ M

In O, we select the common countries from N and J and project coun to find the expected result
O := π_{coun} ($\sigma_{\text{coun}=\text{country}}$ (N ⋈ J))

8. Report the fname and lname of the player of the country 'Spain' with the second largest number of goals among players of that country.

In A we are taking a selection of all the players from Spain

$A := \sigma_{country='Spain'} (Player)$

In B we are renaming all the players from Player schema

$B := \rho_{ID \to PID1, fname \to fname1, lname \to lname1, position \to position1, goals \to goals1, country \to country1P}(Player)$

In C we are taking a selection of all the players of Spain from 'B'

$C := \sigma_{country1='Spain'} (B)$

In D we are doing a Cartesian Product of 'A' and 'C' to combine both the tables

$D := A \times C$

In E we are doing a selection of tuples which satisfy the condition of goals1>goals from E

$E := \sigma_{goals1>goals} (D)$

In G we are projecting the attributes PID, fname,lname,position,goals,country from E

$G := \pi_{PID,fname,lname,position,goals,country} (E)$

In F we are subtracting A from G in order to get the player with the highest number of goals

$F := A - G$

In H we are subtracting A from F to get a table without the player with the highest number of goals

$H := A - F$

In I we are renaming all the attributes from H

$I := \rho_{PID \to PID2, fname \to fname2, lname \to lname2, position \to position2, goals \to goals2, country \to country2} (H)$

In J we are doing a cartesian product of I and H

$J := I \times H$

In K we are taking a selection of which satisfy the condition of goals2>goals from J

$K := \sigma_{goals2>goals} (J)$

In L we are doing a projection from K to get a table without the player with the second highest goals

$L := \pi_{PID,fname,lname,position,goals,country} (K)$

In M we subtract H from L to get a table with only one tuple which is the player with the second highest goals

$M := H - L$

Finally, in N we do a projection in M to get the fname and lname from M, which we know is the name of the player with the second highest goals

N := $\pi_{fname,lname}$ (M)

9. Report the MID(s) of the matches for which at least two tickets were bought on the date of the match.

In A, we're joining Match and Ticket relations to find matches with common SIDs
A := Match ⋈ Ticket

In B we select date=dateIssued to find tickets bought on day of match

B := $\sigma_{date=dateIssued}$ (A)

In C, we project MIDs of B

C := π_{MID} (B)

The query for at least 2 tickets bought cannot be expressed since we cannot track no of tickets

10. Consider all teams that have won at least one match. For each of these teams, report its country, the position of its player with the largest number of goals and the number of goals he/she has scored.

In 'A' we find the winning teams from Competes

A := $\pi_{country1,country2}$ ($\sigma_{(goals1 > goals2) \lor (goals2 > goals1)}$ (Competes))

In 'B' we rename country1 to country in 'A'
B := π country ($\rho_{country1 \to country}$ (A))

In 'C' we rename country2 to country in 'A'
C := π country ($\rho_{country2 \to country}$ (A))

In 'D' we found the countries that have won at least one match
D := B ∩ C

In 'E' we join common countries from D with Player and project country, position and goals
E := $\pi_{country,position, goals}$ (D ⋈ Player)