Assignment 2 – Developing queries in relational algebra

Introduction – Olympics and hockey
For this assignment, you will be writing queries on a database about Olympic hockey, using the schema provided below. Most of you are familiar with the Olympics, and many of you know something about hockey. Here are a few key facts about them for our database. Each Olympics has a unique identifier and has a city, country and year in which it takes place. Hockey is a team sport much like soccer. (I realize that those may be fighting words to some of you!) A game occurs in three periods, each lasting twenty minutes. Players from one team attempt to score goals on the other team, and the team with the most goals at the end wins. For each goal, one player is identified as the one who scored the goal, and one as the player who got the “assist.” We will assume that there is always a winner (no ties). In every game, we will refer to one team as the “home” team and the other as the “visiting” (or “away”) team. (This terminology comes from league play, when hockey games are normally played at the home arena of one of the teams.) Each country can enter only one team at a given Olympics.

Schema
The schema below represents data about Olympic hockey. Each relation has a primary key containing one or more attributes that are all underlined. Some relations have multiple keys. To avoid confusion, these additional keys are mentioned in the text. Many relations also contain several foreign keys to other relations; foreign key attributes will have the same name as the primary key attributes they refer to, unless stated otherwise. Our database contains the following relations:

Olympics(oID, city, country, year)
oID is the official winter Olympics number written as an integer (so XV is 15), city is the host city, country is the host country, and year is the year in which the Olympics are held. Example: Olympics(21, “Vancouver”, “Can”, 2010). Note that Olympics[year] is also a key for this relation meaning that there can be at most one Olympics in a given year.

Team(tID, country, oID, coach)
tID is the team ID, country is the country they play for, oID is the number of the Olympics in which the team played, and coach is the name of the team’s head coach. Note that Team[country,oID] is also a key for this relation meaning that a country can send at most one team to a given olympics.

Player(pID, name, position)
pID is the player’s ID number, name is his or her name, and position is the position they play, which is one of “c”, “rw”, “lw”, “rd”, “ld”, and “g” (for centre, right wing, left wing, right defense, left defense, and goalie).

PlaysOn(pID, tID)
pID is a player ID and tID is the team ID of a team that he or she plays on.

Game(gID, date, oID, hT, aT, hS, aS)
gID is the game’s ID number, date is the date on which it was played, oID is the number of the Olympics
which it was part of, hT is the team ID of the home team, aT is the team ID of the away team, hS is the score of the home team in the game, and aS is the score of the away team in the game.

Goal(glID, period, time, score, assist, goalie)

glID is the game ID of the game in which the goal was scored, period is the period of play in which the goal was scored (either 1, 2 or 3), time is the time (minutes and seconds) remaining in that period when the goal was scored, score is the player ID of the player who scored the goal, assist is the player ID of the player who got the assist, and goal is the player ID of the goalie on whom the goal was scored.

Results(oID, tID, place)
oID is the number of an Olympics, tID is the team and place is the team's final standing in the competition. A place of “1” means the team won the gold medal, “2” means silver, and “3” means bronze. Lower places are recorded but do not receive medals.

Queries

Given the above schema, provide RA queries that answer each of the following questions. All of the queries are to be interpreted relative to the content of the database only. For example, the phrase “every player” means “every player in the database.” Someone who plays in the NHL but has never been on an Olympic team would not appear in the database (and would be irrelevant to the query anyway).

1. Find all countries with a team in the 1928 Olympics.

   \[
   \text{Olympics } \sigma \text{ year}=1928 \ \join \text{ Team on oid } \pi \text{ country } \delta
   \]

2. Find all countries with a team in the 1928, 1932 or 1936 Olympics.

   \[
   \text{Olympics } \sigma \text{ year in } (1928,1932,1936) \ \join \text{ Team on oid } \pi \text{ country } \delta
   \]

3. Find all countries that competed in 1932 but did not compete in 1936.

   \[
   \text{Olympics } \sigma \text{ year}=1932 \ \join \text{ Team on oid } \pi \text{ country } \delta \ \rho T32
   \]
   \[
   \text{Olympics } \sigma \text{ year}=1936 \ \join \text{ Team on oid } \pi \text{ country } \delta \ \rho T36
   \]
   \[
   T32 - T36
   \]
   \[
   --or--
   \]
   \[
   \text{Olympics } \ \join \text{ Team on oid } \Gamma \text{ tid, sum(year=1932) as y32, sum(year=1936) as y36 } \sigma \text{ y32 } > 0 \text{ and y36}=0
   \]

4. Find the names of all coaches who have ever coached a gold medal-winning team.

   \[
   \text{Result } \sigma \text{ place}=1 \ \join \text{ Team on tid } \pi \text{ coach } \delta
   \]

5. Find all teams that have ever won a gold medal playing in an Olympics in their home country. Report the country and year for each.

   \[
   \text{Report country and year for each.}
   \]
6. Find the names of all players who have never won any medal.

\[ \text{Result} \join \text{PlaysOn on tid} \join \text{Player on pid} \ni \text{Gamma } \text{pid,name,}\min(\text{place}) \text{ as best} \ni \sigma \text{best} > 3 \ni \pi \text{name} \\delta \]

7. Find the year and city of the first Olympics.

\[ \text{Olympics} \ni \text{Gamma } \min(\text{year}) \text{ as first_year} \ni \rho \text{First} \ni \text{Olympics year=First} \ni \pi \text{year,city} \]

8. Find all games that were won with at least a 5-goal difference between the score of the two teams. Report the host city of the Olympics in which the game occurred, the countries of the two teams, and the final score (for both the home and away teams).

\[ \text{Team} \join \text{Game on tid=at} \ni \text{rho country as ac} \ni \text{pi at,ac} \ni \rho \text{ATeam} \ni \text{Team} \join \text{Game on tid=ht} \ni \text{rho country as hc} \ni \text{pi ht hc} \ni \rho \text{HTeam} \ni \text{Olympics} \ni \text{pi oid,year} \ni \text{join Game on oid} \ni \sigma |\text{as-hs}| \geq 5 \ni \text{join HTeam on at=tid} \ni \text{join ATeam on ht=tid} \ni \text{pi city hc ac hs as} \]

9. Find the names of all players who have scored with less than 1 minute left in the 3rd period.

\[ \text{Goal} \ni \sigma \text{period}=3 \text{ and time} < 1 \ni \text{join Player on pid=score} \ni \pi \text{name} \\delta \]

10. Find the names of all players who were part of Olympics 15, and who scored no goals at all in that Olympics.

\[ \text{Olympics} \ni \sigma \text{oid}=15 \ni \text{join Game on oid} \ni \text{join Goal on gid} \ni \text{join Player on pid=score} \ni \pi \text{pid,name} \ni \rho \text{Scored} \ni \text{Olympics} \ni \sigma \text{oid}=15 \ni \text{join Team on oid} \ni \text{join PlaysOn on tid} \ni \text{join Player on pid} \ni \pi \text{pid,name} \ni \left \text{Scored} \ni \left \text{or-} \ni \text{Olympics} \ni \sigma \text{oid}=15 \ni \text{join Team on oid} \ni \text{join PlaysOn on tid} \ni \text{join Player on pid} \ni \\text{left join Goal on pid=score} \ni \\text{Gamma pid,name,} \text{count(score)} \ni \sigma \text{n}\ni \sigma \text{n}=0 \]

11. Find the name of every country that has won at least one of every type of medal (gold, silver, and bronze).
12. Find the name of every country that has won at least one medal in every Olympics.

\[ \text{Result } \Gamma \text{ tid, sum(place=1) as } g, \text{ sum(place=2) as } s, \text{ sum(place=3) as } b \]
\[ \sigma g>0 \text{ and } s>0 \text{ and } b>0 \text{ \join Team on } \text{ tid } \pi \text{ country } \delta \]

13. Find the name of all coaches who coached at only one Olympics.

\[ \text{Team } \Gamma \text{ coach, count(*) as } n \sigma n=1 \pi \text{ coach} \]

14. Find the names of all players who played in at least two Olympics held in different countries.

\[ \text{Olympics } \rho \text{ country as host_country } \join \text{ Team on oid } \]
\[ \text{ \join PlaysOn on tid } \Gamma \text{ pid, count(host_country) n } \sigma n \geq 2 \join \text{ Player on pid } \pi \text{ name} \]

15. Find the country and coach of the team whose opponents scored the highest number of goals against it, in any game of any Olympics. Report also the number of goals against this team.

\[ \text{Goal } \join \text{ Player on pid=goalie } \join \text{ PlaysOn on pid } \join \text{ Team on tid } \Gamma \text{ tid, count(*) as } ngoals \pi \text{ country, coach, ngoals } \]
\[ \tau -ngoods \limit 1 \]

Note: the following is tempting, but wrong (why?):

\[ \text{Olympics } \left \join \text{ Result on oid } \left \join \text{ Team on tid } \Gamma \text{ country, count(*) as nolymp, sum(place<=3) as nmedals } \sigma nolymp=nmedals \pi \text{ country} \]

\[ \text{Team } \Gamma \text{ coach, count(*) as n } \sigma n=1 \pi \text{ coach} \]