University of Toronto
CSC343, Fall 2015

Assignment 1: Tiantian Fang 1000919955 g5fangti

Unary operators on relations:

- $\Pi_{x,y,z}(R)$
- $\sigma_{condition}(R)$
- $\rho_{New}(R)$
- $\rho_{New(a,b,c)}(R)$

Binary operators on relations:

- $R \times S$
- $R \bowtie S$
- $R \bowtie_{condition} S$
- $R \cup S$
- $R \cap S$
- $R - S$

Logical operators:

- $\vee$
- $\wedge$
- $\neg$

Assignment:

- $New(a, b, c) := R$

Below is the text of the assignment questions; we suggest you include it in your solution. We have also included a nonsense example of how a query might look in LaTeX. We used `\var` in a couple of places to show what that looks like. If you leave it out, most of the time the algebra looks okay, but names such as "Offer" look horrific without it.

The characters "\\" create a line break and "[5pt]" puts in five points of extra vertical space. The algebra is easier to read with extra vertical space. We chose "—" to indicate comments, and added less vertical space between comments and the algebra they pertain to than between steps in the algebra. This helps the comments visually stick to the algebra.

Part 1: Queries [84% - 7 marks each]

1. Find the last names of the athlete(s) of the country(ies) that did not compete in any event yet.

   Answer:

   $NoCompeteCountry(CID) := \Pi_{CID}Country - \Pi_{CID}(Result \bowtie Athlete)$

$AthleteinNCC(lanme) := \Pi_{lname}(Athlete \bowtie NoCompeteCountry)$

2. Find the last names of the athlete(s) of the country(ies) that did not win any medals yet (either because they did not compete, or because their athletes did not rank in the top 3 in any event so far).

   Answer:

   $NoMedalCountry(CID) := \Pi_{CID}Country - (\Pi_{CID}\sigma_{medal\neq"nomedal"}(Result \bowtie Athlete))$

   $AthleteinNMC(lanme) := \Pi_{lname}(Athlete \bowtie NoMedalCountry)$

3. Find the stadium names of all the stadiums where exactly one event took place.

   Answer:

   $AtLeastOne(SID, sname, EID) := \Pi_{SID,sname,EID}(Stadium \bowtie Event \bowtie Result)$

   $AtLeastTwo(SID, sname) := \Pi_{S1.SID,S1.sname}\sigma_{S1.SID=S2.SID \wedge S1.EID \neq S2.EID}(\rho_{S1}AtLeastOne \times \rho_{S2}AtLeastOne)$

   $ExactOneS(sname) := \Pi_{sname}((\Pi_{SID,sname}AtLeastOne) - AtLeastTwo)$

4. Find all the sporting disciplines that Canadian athletes have competed in so far.

   Answer:

   $Canadasport(sport) := \Pi_{sport}\sigma_{cname="Canada"}(Result \bowtie Event \bowtie Athlete \bowtie Country)$

5. Find the first and last name of the athletes whose sporting discipline is "swimming" and who have won the highest number of gold medals among all athletes who compete in the same sport.

   Answer:

   $SwimAthlete(AID, fname, lname, gold) := \Pi_{AID,fname,lname,gold}\sigma_{sport="swimming"}Athlete$

   $NotFirst(AID, fname, lname, gold) := \Pi_{A1.AID,A1.fname,A1.lname,A1.gold}\sigma_{A1.gold<A2.gold}(\rho_{A1}SwimAthlete \times \rho_{A2}SwimAthlete)$

   $FirstSwimAthlete(fname, lanme) := \Pi_{fname,lanme}(SwimAthlete - NotFirst)$

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

   Answer:

   $Countrywon(CID) := (\Pi_{CID}\sigma_{gold\neq 0}Athlete) \cap (\Pi_{CID}\sigma_{silver\neq 0}Athlete) \cap (\Pi_{CID}\sigma_{bronze\neq 0}Athlete)$

   $Countryname(cname) := \Pi_{cname}(Countrywon \bowtie Country)$

7. Find the gold medalist country of the event for which the very first ticket out of all the tickets in the database was purchased. A gold medalist country is a country that has won at least one gold medal.

   Answer:

   $NotFirstDayTicket(TID, timeIssued, EID) := \Pi_{F1.TID,F1.timeIssued,F1.EID}\sigma_{F1.dateIssued>F2.dateIssued}$

   $(\rho_{F1}(Ticket) \times \rho_{F2}(Ticket))$

   $FirstDayTicket(TID, timeIssued, EID) := (\Pi_{TID,timeIssued,EID}Ticket) - NotFirstDayTicket$

   $NotFirstTicket(TID, EID) := \Pi_{T1.TID,T1.EID}\sigma_{T1.timeIssued>T2.timeIssued}(\rho_{T1}(FirstDayTicket) \times \rho_{T2}(FirstDayTicket))$

   $FirstTicket(TID, EID) := (\Pi_{TID,EID}FirstDayTicket) - NotFirstTicket$

   $WonFirstTicket(cname) := \Pi_{cname}\sigma_{medal="gold"}(FirstTicket \bowtie Result \bowtie Athlete \bowtie Country)$

8. Find the first and last name of the athlete representing "Mexico", who so far has the second highest number of gold medals (among athletes of the same country).

   Answer:

   $MexicoAthlete(AID, fname, lname, gold) := \Pi_{AID,fname,lname,gold}\sigma_{cname="Mexico"}(Athlete \bowtie Country)$

   $WorseThanF(AID, fname, lname, gold) := \sigma_{F1.gold<F2.gold}(\rho_{F1}(MexicoAthlete) \times \rho_{F2}(MexicoAthlete))$

   $WorseThanS(AID, fname, lname, gold) := \sigma_{S1.gold<S2.gold}(\rho_{S1}(WorseThanF) \times \rho_{S2}(WorseThanF))$

   $SecondMex(fname, lname) := \Pi_{fnmae,lname}(WorseThanF - WorseThanS)$

9. Find the sports disciplines for events for which at least two tickets were bought on the date of the event.

   Answer:

   $SameDateTicket(EID, sport, TID) := \Pi_{EID,sport,TID}\sigma_{date=dateIssued}(Event \bowtie Ticket)$

   $TwoSameDateTicket(sport) := \Pi_{sport}\sigma_{E1.EID=E2.EID \wedge E1.TID \neq E2.TID}(\rho_{E1}(SameDateTicket) \times \rho_{E2}(SameDateTicket))$

10. Find the athlete with the highest overall number of gold medals won so far, and report that athlete first and last name, country name, and number of gold medals won.

    Answer:

    $NotHighestAthlete(fname, lname, cname, gold) := \Pi_{fname,lname,cname,gold}\sigma_{H1.gold<H2.gold}(\rho_{H1}(Athlete) \times \rho_{H2}(Athlete))$

    $HighestGold(fname, lname, cname, gold) := \Pi_{fname,lname,cname,gold}(((\Pi_{fname,lname,cname,gold}Athlete) - NotHighestAthlete) \bowtie Country)$

11. Find the discipline (sport) of the event for which the highest number of tickets was purchased.

    Answer:

cannot be expressed

12. Find the first and last name for all athletes who have won a gold medal in an event for which no tickets were sold.

    Answer:

    $NoTicketEvent(EID) := \Pi_{EID} Result - \Pi_{EID}(Ticket \bowtie Result)$

    $WonNTE(fname, lname) := \Pi_{fname,lname}\sigma_{medal="gold"}(NoTicketEvent \bowtie Result \bowtie Athlete)$

Part 2: Additional Integrity Constraints [16% - 4 marks each]

Below are some additional integrity constraints on our schema. Express each of them using the notation from Section 2.5 of your textbook. If a constraint cannot be expressed using such notations, simply write "cannot be expressed".

1. An athlete cannot win more than one medal type in the same event.

   Answer:

   $\sigma_{R1.AID=R2.AID \wedge R1.EID=R2.EID \wedge R1.medal \neq R2.medal}(\rho_{R1}(Result) \times \rho_{R2}(Result)) = \emptyset$

2. All tickets for an event have to be purchased before the time of the event.

   Answer:

   $\sigma_{date<dateIssued \vee (date=dateIssued \wedge time \leq timeIssued)}(Event \bowtie Ticket) = \emptyset$

3. The number of tickets purchased for an event should not exceed the capacity of the stadium where the event takes place.

   Answer:

   cannot be expressed

4. An athlete could not have competed in an event for a sporting discipline that they are not qualified to participate in.

   Answer:

   $\sigma_{Athlete.sport \neq Event.sport \wedge Athlete.AID=Result.AID}((Event \bowtie Result) \times Athlete) = \emptyset$