University of Toronto
CSC343, Fall 2015

Assignment 1 – Solutions

Note that there are multiple correct answers to all of these questions.

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

   Answer:

   $CountriesThatCompeted(CID) := \Pi_{CID}(Results \bowtie Athlete)$

   $CountriesThatDidNotCompete(CID) := \Pi_{CID}Countries - CountriesThatCompeted$

   $Answer := \Pi_{lname}(Athlete \bowtie CountriesThatDidNotCompete)$

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:

   $AthletesThatWonAMedal(AID) := \Pi_{AID}\sigma_{medal=`gold' \vee medal=`silver' \vee medal=`bronze'}(Result)$

   $CountriesThatWonAMedal(CID) := \Pi_{CID}(AthletesThatWonAMedal \bowtie Athletes)$

   $CountriesThatDidNotWinAMedal(CID) := \Pi_{CID}Countries - CountriesThatWonAMedal$

   $Answer := \Pi_{lname}(Athletes \bowtie CountriesThatDidNotWinAMedal)$

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

   Answer:

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

   $AtLeastTwo(SID) := \Pi_{R1.SID}(\sigma_{R1.EID \neq R1.EID \wedge R1.SID=R2.SID}(\rho_{AtLeastOne}R1 \times \rho_{AtLeastOne}R2)$

   $StadiumIDs(SID) := \Pi_{SID}AtLeastOne - AtLeastTwo$

   $Answer := \Pi_{sname}(StadiumIDs \bowtie Stadium)$

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

   Answer:

   $CanadianAthletes(AID, sport) := \Pi_{AID,sport}(\sigma_{cname=`Canada'}(Athlete \bowtie Country))$

   $Answer := \Pi_{sport}(CanadianAthletes \bowtie Result)$

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:

   $Swimmers(AID, fname, lname, gold) := \Pi_{AID,fname,lname,gold}\sigma_{sport=`swimming'}Athletes$

   $NotMax(AID, fname, lname, gold) := \Pi_{S1.AID,S1.fname,S1.lname,S1.gold}$
   $\sigma_{S1.AID \neq S2.AID \wedge S1.gold<S2.gold}(\rho_{Swimmers}S1 \times \rho_{Swimmers}S2)$

   $Answer := \Pi_{fname,lname}(Swimmers - NotMax)$

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

   Answer:

   $MedalWinners(AID, medal) := \Pi_{AID,medal}$
   $\sigma_{medal=`gold' \vee medal=`silver' \vee medal=`bronze'}Result$

$WinnerCountries(CID, AID, medal) := \Pi_{CID,AID,medal}(MedalWinners \bowtie Athlete)$

$GoldCountries(CID, cname) := \Pi_{CID,cname}\sigma_{medal=`gold'}(WinnerCountries \bowtie Country)$

$SilverCountries(CID, cname) := \Pi_{CID,cname}\sigma_{medal=`silver'}(WinnerCountries \bowtie Country)$

$BronzeCountries(CID, cname) := \Pi_{CID,cname}\sigma_{medal=`bronze'}(WinnerCountries \bowtie Country)$

$Answer := \Pi_{cname}(GoldCountries \cap SilverCountries \cap BronzeCountries)$

Alternative Solution:
$Gold := \Pi_{CID}\sigma_{gold>0}Athlete$

$Silver := \Pi_{CID}\sigma_{silver>0}Athlete$

$Bronze := \Pi_{CID}\sigma_{bronze>0}Athlete$

$GoldCountries(CID, cname) := \Pi_{CID,cname}(Gold \bowtie Country)$

$SilverCountries(CID, cname) := \Pi_{CID,cname}(Silver \bowtie Country)$

$BronzeCountries(CID, cname) := \Pi_{CID,cname}(Bronze \bowtie Country)$

$Answer := \Pi_{cname}(GoldCountries \cap SilverCountries \cap BronzeCountries)$

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.

Answer:

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

$EarliestDate(TID, timeIssued, EID) := \Pi_{TID,timeIssued,EID}Tickets - NotEarliestDate$

$NotEarliestTime(TID, EID) :=$
$\Pi_{T3.TID,T3.EID}$
$\sigma_{T3.timeIssued>T4.timeIssued}(\rho_{EarliestDate}T3 \times \rho_{EarliestDate}T4)$

$EarliestTime(EID) := \Pi_{EID}EarliestDate - \Pi_{EID}NotEarliestTime$

$GoldAthlete(AID) := \Pi_{AID}\sigma_{medal=`gold'}(EarliestTime \bowtie Result)$

$GoldCountry(CID) := \Pi_{CID}(GoldAthlete \bowtie Athletes)$

$Answer := \Pi_{cname}(GoldCountry \bowtie Country)$

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:

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

$NotMax(AID, fname, lname, gold) := \Pi_{M1.AID,M1.fname,M1.lname,M1.gold}$
$\sigma_{M1.gold<M2.gold}(\rho_{MexicoAthlete}M1 \times \rho_{MexicoAthlete}M2)$

$NotSecondMax(AID, fname, lname, gold) := \Pi_{M3.AID,M3.fname,M3.lname,M3.gold}$
$\sigma_{M3.gold<M4.gold}(\rho_{NotMax}M3 \times \rho_{NotMax}M4)$

$Answer := \Pi_{fname,lname}(NotMax - NotSecondMax)$

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

Answer:

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

$Answer := \Pi_{sport,date}$
$\sigma_{B1.TID \neq B2.TID \wedge B1.EID=B2.EID}(\rho_{BoughtSameDate}B1 \times \rho_{BoughtSameDate}B2)$

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

    Answer:

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

    $Max(CID, AID, fname, lname, gold) := \Pi_{CID,AID,fname,lname,gold}Athlete - NotMax$

    $Answer := \Pi_{cname,fname,lname,gold}(Country \bowtie Max)$

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:

    $GoldsWon(EID, AID) := \Pi_{EID,AID}\sigma_{medal='gold'}Result$

    $CompletedEventsWithTicketsSold(EID, AID) := \Pi_{EID,AID}(GoldsWon \bowtie Tickets)$

    $AthletesWGoldAndNoTickets(AID) := \Pi_{AID}(GoldsWon - CompletedEventsWithTicketsSold)$

    $Answer := \Pi_{fname,lname}(AthletesWGoldAndNoTickets \bowtie Athlete)$

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:

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

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

   Answer:

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

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:

   $AthletesThatCompeted(EID, sport) := \Pi_{EID,sport}(Result \bowtie Athlete)$

   $\sigma_{A.EID=E.EID \wedge A.sport \neq E.sport}(\rho_{AthletesThatCompeted} A \times \rho_{Event} E) = \emptyset$