

PART 1

1. AIDcompleted(AID) := $\pi_{AID} Result$ #find athletes' AID that completed event
 $CIDcompleted(CID) := \pi_{CID} AIDcompleted \bowtie Athlete$ #find their country
 $CIDnotcompleted(CID) := \pi_{CID} Country - CIDcompleted$ #find country that has
#not completed any event yet
 $Answer(lname) := \pi_{lname} (CIDnotcompleted \bowtie Athlete)$
2. medalAID(AID) := $\pi_{AID} (\sigma_{medal \neq "nomedal"} Result)$ #find athletes with medal
 $medalCID(CID) := \pi_{CID} medalAID \bowtie Athlete$ #find country with medal
 $nomedalCID(CID) := \pi_{CID} Country - medalCID$
 $Answer(lname) := \pi_{lname} (nomedalCID \bowtie Athlete)$
3. #Exactly_one = Allheld - Two_or_more
 $AllSID(SID) = \pi_{SID} Event$ #Finds all sid that held event
 $E1 := Event$
 $E2 := Event$
 $TwoOrMore(SID) := \pi_{SID} (\sigma_{E1.EID \neq E2.EID} (E1 \bowtie_{E1.SID=E2.SID} E2))$
 $OneEvent(SID) := AllSID - TwoOrMore$
 $Answer := \pi_{sname}(OneEvent \bowtie Stadium)$
4. #First find canadian athletes that completed some event, then find their sport
 $completedAID(AID) := \pi_{AID} Result$ #find who completed any event
 $CanadaCID(CID) := \pi_{CID} (\sigma_{cname='Canada'} Country)$ #Find Canada's CID
 $completedAthlete(CID, sport) := \pi_{CID, sport} (completedAID \bowtie Athlete)$
#Find Athletes' CID, sport.
 $CanadianAthlete := CanadaCID \bowtie completedAthlete$
 $CanadianSport := \pi_{sport} CanadianAthlete$
5. #Find swimming athlete first
 $SwimGuy := \sigma_{sport='swimming'} Athlete$
 $S1 := SwimGuy$
 $S2 := SwimGuy$
 $Fewer(fname, lname) := \pi_{S1.fname, S1.lname} (\sigma_{S1.gold < S2.gold} (S1 \times S2))$ #Find guys with less gold medal
 $Answer(fname, lname) := (\pi_{fname, lname} S1) - Fewer$
6. GoldCountry := $\pi_{CID} (\sigma_{gold > 0} Athlete)$
 $SilverCountry := \pi_{CID} (\sigma_{Silver > 0} Athlete)$
 $BronzeCountry := \pi_{CID} (\sigma_{Bronze > 0} Athlete)$
 $AllCID(CID) := GoldCountry \bowtie SilverCountry \bowtie BronzeCountry$
 $Answer := \pi_{cname}(AllCID \bowtie Country)$
7. FirstDayTicket := Ticket - ($\pi_{T1.TID, T1.dateIssued, T1.timeIssued, EID} (\sigma_{T1.dateIssued > T2.dateIssued} (\rho_{T1} Ticket) \times (\rho_{T2} Ticket)))$
 $FirstTicket := FirstDayTicket - (\pi_{T1.TID, T1.dateIssued, T1.timeIssued, EID} (\sigma_{T1.timeIssued > T2.timeIssued} (\rho_{T1} FirstDayTicket) \times (\rho_{T2} FirstDayTicket)))$
 $GoldAID := \pi_{AID} (\sigma_{medal='gold'} (FirstTicket \bowtie Result))$

$\text{Answer}(\text{cname}) := \pi_{\text{cname}} (\text{Country} \bowtie (\pi_{\text{CID}} (\text{GoldAID} \bowtie \text{Athlete})))$
 8. $\text{MexCID} := \pi_{\text{CID}} \sigma_{\text{cname}='Mexico'} \text{Country}$
 $\text{Mexican} := \sigma_{\text{CID}=\text{MexCID}} \text{Athlete}$
 $\text{WithoutNo1} := (\pi_{M1.\text{AID}, M1.\text{fname}, M1.\text{lanme}, M1.\text{sport}, M1.\text{CID}, M1.\text{gold}, M1.\text{silver}, M1.\text{bronze}} (\sigma_{M1.\text{gold} < M2.\text{gold}} (\rho_{M1} \text{Mexican}) \times (\rho_{M2} \text{Mexican})))$
 $\text{Second} := \text{WithoutNo1} -$
 $(\pi_{W1.\text{AID}, W1.\text{fname}, W1.\text{lanme}, W1.\text{sport}, W1.\text{CID}, W1.\text{gold}, W1.\text{silver}, W1.\text{bronze}} (\sigma_{W1.\text{gold} < W2.\text{gold}} (\rho_{W1} \text{WithoutNo1}) \times (\rho_{W2} \text{WithoutNo1})))$
 9. $\text{E0}(\text{sport}, \text{TID}, \text{EID}) := \pi_{\text{sport}, \text{TID}, \text{Event.EID}} (\text{Event} \bowtie_{\substack{\text{Event.EID} = \text{Ticket.EID} \\ \text{Event.date} = \text{Ticket.dateissued}}} \text{Ticket})$
 #Find sport and TID of Events which ticket was purchased on the date
 $\text{Answer} := \pi_{\text{sport}} (\sigma_{\text{E1.TID} \neq \text{E2.TID}} ((\rho_{E1} \text{ E0}) \bowtie_{\text{E1.EID} = \text{E2.EID}} (\rho_{E2} \text{ E0})))$
 10. $\text{AllAthlete} := \pi_{\text{AID}, \text{fname}, \text{lanme}, \text{sport}, \text{Athlete.CID}, \text{gold}, \text{silver}, \text{bronze}, \text{cname}} (\text{Athlete} \bowtie \text{Country})$
 $\text{MostGoldAthlete} := \text{AllAthlete} -$
 $(\pi_{A1.\text{AID}, A1.\text{fname}, A1.\text{lanme}, A1.\text{sport}, A1.\text{CID}, A1.\text{gold}, A1.\text{silver}, A1.\text{bronze}, A1.\text{cname}} (\sigma_{A1.\text{gold} < A2.\text{gold}} (\rho_{A1} \text{AllAthlete}) \times (\rho_{A2} \text{AllAthlete})))$
 $\text{Answer} := \pi_{\text{fname}, \text{lname}, \text{cname}, \text{gold}} \text{ MostGoldAthlete}$
 11. Cannot Be Expressed
 12. $\text{NoSoldEID} := (\pi_{\text{EID}} \text{Event}) - (\pi_{\text{EID}} \text{Ticket})$
 $\text{GoldAID} := \pi_{\text{AID}} (\sigma_{\text{medal}='gold'} (\text{NoSoldEID} \bowtie \text{Result}))$
 $\text{Answer} := \pi_{\text{fname}, \text{lname}} (\text{GoldAID} \bowtie \text{Athlete})$

PART 2

- $(\rho_{R1} \text{Result} \bowtie_{\substack{R1.\text{AID} = R2.\text{AID} \\ R1.\text{EID} = R2.\text{EID} \\ R1.\text{medal} \neq R2.\text{medal}}} \rho_{R2} \text{Result}) = \emptyset$
- $\text{TicketSold} := \text{Ticket} \bowtie \text{Event}$
 $\sigma_{\substack{\text{dateIssue} > \text{date} \\ \vee (\text{dateIssue} = \text{date} \wedge \text{timeIssued} > \text{time})}} \text{TicketSold} = \emptyset$
- Cannot be expressed
- $\text{Needed} := ((\rho_{\text{event}} (\text{Event} \bowtie \text{Result})) \bowtie_{\text{Event.AID} = \text{Athlete.AID}} \text{Athlete})$
 $\sigma_{\text{Event.sport} \neq \text{Athlete.sport}} \text{ Needed} = \emptyset$