William Frank
2/7/20
Database Systems – Homework 3

1. Joins

   1. T1 $\bowtie_{T1.A = T2.A}$ T2

T1.A	T1.Q	T1.R	T2.A	T2.B	T2.C
20	a	5	20	b	6
20	a	5	20	b	5

   2. T1 $\bowtie_{T1.Q = T2.B}$ T2

T1.A	T1.Q	T1.R	T2.A	T2.B	T2.C
25	b	8	20	b	6
25	b	8	20	b	5

   3. T1 $\bowtie$ T2

A	T1.Q	T1.R	T2.B	T2.C
20	a	5	b	6
20	a	5	b	5

   4. T1 $\bowtie_{T1.A = T2.A \,\&\&\, T1.R = T2.C}$ T2

T1.A	T1.Q	T1.R	T2.A	T2.B	T2.C
20	a	5	20	b	5

2. Reformulate

   1. $\pi_{x, y, z}(\sigma_{T2.x = T3.x \,\&\&\, T2.y = T3.y}(T2 \times T3))$

   2. $\pi_x(T2) - (\pi_x(T2) - T1)$

   3. $\pi_z(\sigma_{T2.y = T3.y}(T2 \times T3))$

   4. $\pi_y(T2) - \pi_y(\pi_y(T2) \times T1 - T2)$

3. Chess Queries

   1. $\pi_{Name}(\sigma_{Elo >= 2850}(Players))$

   2. $\pi_{Name}(Players \bowtie_{Players.pID = Games.wpID} Games)$

   3. $\pi_{Name}(Players \bowtie_{Players.pID = Games.wpID \,\&\&\, Games.Result = 'W'} Games)$

   4. $\rho(PlayerGames, Players \bowtie_{Players.pID = Games.wpID \,||\, Players.pID = Games.bpID} Games)$
      $\pi_{Name}(PlayerGames \bowtie_{Year = 2018} Events)$

   5. $\rho(MID, \pi_{pID}(\sigma_{Name = 'Magnus\ Carlsen'}(Players)))$
      $\rho(MLosses, MID \bowtie_{(MID.pID = Games.wpID \,\&\&\, Games.Result = 'B') \,||\, (MID.pID = Games.bpID \,\&\&\, Games.Result = 'W')} Games)$
      $\pi_{Name, Year}(MLosses \bowtie Events)$

   6. $\rho(MID, \pi_{pID}(\sigma_{Name = 'Magnus\ Carlsen'}(Players)))$
      $\rho(MagnusWhiteGames, MID \bowtie_{MID.pID = Games.wpID} Games)$
      $\rho(MagnusBlackGames, MID \bowtie_{MID.pID = Games.bpID} Games)$
      $\rho(MagnusOpps1, MagnusWhiteGames \bowtie_{MagnusWhiteGames.bpID = Players.pID} Players)$
      $\rho(MagnusOpps2, MagnusBlackGames \bowtie_{MagnusBlackGames.wpID = Players.pID} Players)$
      $\pi_{Name}(MagnusOpps1 \cup MagnusOpps2)$

   7. $\rho(WhiteLoss, \pi_{wpID}(\sigma_{Result = B}(Games)))$
      $\rho(BlackLoss, \pi_{bpID}(\sigma_{Result = W}(Games)))$
      $\rho(WhiteNotLost, \pi_{Name}(WhiteLoss \bowtie_{WhiteLoss.wpID \,!=\, Players.pID} Players))$
      $\rho(BlackNotLost, \pi_{Name}(BlackLoss \bowtie_{BlackLoss.bpID \,!=\, Players.pID} Players))$
      $WhiteNotLost \cap BlackNotLost$

4. LMS Queries

   1.
      a) Relation:

Name
Hermoine
Harry

      b) Description:

The name of all students who have never gotten a 'C' in a class.

   2.
      a) Relation:

S2.Name
Hermoine

      b) Description:

The name of every student with the same DOB as Ron

   3.
      a) Relation:

Name

      b) Description:

The name of every course being taken by all students

4. Provide a relational algebra query that uses the divide operator to find the names of all students who are taking all of the 3xxx-level classes.

$$\pi_{\text{Name}} \left(\left(\pi_{\text{sID, cID}} \left(\text{Enrolled} \right) / \pi_{\text{cID}} \left(\sigma_{\text{cID} \geq 3000 \ \&\& \ \text{cID} < 4000} \left(\text{Courses} \right) \right) \right) \bowtie \text{Students} \right)$$