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Assignment 5

1. P = Predecessor, W = Westerosi, Oh1 = OfHouse, Oh2 = OfHouse
    a. RA Translation:

$Q = \pi_{W.wid,\, W.wname}(\sigma_{W.wid=P.succid}(W \bowtie P)) \; - \; \pi_{W.wid,\, W.wname}(\sigma_{W.wid=P.succid \wedge Oh2.wid=P.predid}(W \bowtie P \bowtie Oh1 \bowtie_{Oh1.wages<=Oh2.wages} Oh2))$

$\pi_{q.wid,\, q.wname}(Q)$

    b. Optimization:
        i. Pushing condition onto P, Oh1, and Oh2 (excluding W)

$Wage = \pi_{P.succid}(P \bowtie Oh1 \bowtie_{P.predid = O.wid \wedge P.succid = Oh2.wid \wedge Oh1.wages<=Oh2.wages} Oh2))$

$Q = \pi_{W.wid,\, W.wname}(W \bowtie_{wid:succid} P) \; - \; \pi_{W.wid,\, W.wname}(W \bowtie_{W.wid=Wage.succid} Wage)$

$\pi_{q.wid,\, q.wname}(Q)$

        ii. Rewrite rule for – set operation (because Westerosi join happens in both clauses of except statement, we can pull it out and reduce a join)

$Q = \pi_{succid}(P) \; - \; \pi_{succid}(Wage)$

$\pi_{W.wid,\, W.wname}(\sigma_{W.wid=Q.succid}(W \bowtie Q))$

2. H = House, OH = OfHouse, WS = WesterosiSkill
    a. RA Translation:

$\pi_{H.hname,\, H.kingdom}(\sigma_{skill = 'Archery' \wedge Oh.wid=WS.wid \wedge OH.wages<60000}(H \bowtie OH \bowtie WS))$

    b. Optimization:
        i. Attribute elimination on House because we're projecting all of House's attributes

$(H \bowtie OH \bowtie_{skill = 'Archery' \wedge OH.wid=WS.wid \wedge OH.wages<60000} WS)$

        ii. Pushing down selection of archery onto WS relation

$A = \pi_{wid}(\sigma_{skill='Archery'}(WS))$

$H \bowtie (\sigma_{OH.wages<60000}(OH \bowtie A)$

        iii. Semi-join OH and A because you only need the wid from OH

$H \bowtie (\sigma_{OH.wages<60000}(OH \ltimes A)$

3. W = Westerosi, W1 = WesterosiSkill, H = OfHouse
    a. RA Translation:

$$WG = \pi_{wid}(\sigma_{wlocation='WinterFell'}(W))$$

$$\pi_{W.wid}(\sigma_{wages=50000 \wedge W1.skill<>'Swordsmanship}(WG \bowtie H \bowtie_{W.wid = W1.wid} W1))$$

    b. Optimization:
        i. Pushing condition of wages onto H

$$F = \pi_{wid}(\sigma_{wages=50000}(H))$$

$$\pi_{W.wid}(\sigma_{W1.skill<>'Swordsmanship}(WG \bowtie F \bowtie_{W.wid = W1.wid} W1))$$

        ii. Pushing condition of swordsmanship onto W1

$$F = \pi_{wid}(\sigma_{skill<>'Swordsmanship'}(W1))$$

$$\pi_{W.wid}(WG \bowtie F \bowtie W1)$$

        iii. Attribute elimination on WG because we are selecting all attributes from WG

$$WG \bowtie F \bowtie W1$$

4. W = Westerosi, WS = WesterosiSkill, O = OfHouse, H = HouseAllyRegion
    a. RA Translation:

$$\pi_{W.wid}(\sigma_{WS.skill='Archery'}(W \bowtie_{W.wid=WS.wid} WS)) \cap \pi_{O.wid}(\sigma_{H.region='IronIslands'} O \bowtie_{O.hname=H.hname} H)$$

    b. Optimization:
        i. Natural join W and WS

$$\pi_{W.wid}(\sigma_{WS.skill='Archery'} W \bowtie WS)) \cap \pi_{O.wid}(O \bowtie_{O.hname=H.hname \wedge H.region = 'IronIslands'} H)$$

        ii. Pushing archery condition onto WS

$$A = \pi_{wid}(\sigma_{skill='Archery'}(WS))$$

$$\pi_{W.wid}(W \bowtie A)) \cap \pi_{O.wid}(O \bowtie_{O.hname=H.hname \wedge H.region = 'IronIslands'} H)$$

        iii. Pushing IronIslands condition

$$I = \pi_{hname}(\sigma_{region='IronIslands'}(H))$$

$$\pi_{W.wid}(W \bowtie A)) \cap \pi_{O.wid}(O \bowtie H)$$

        iv. Semi-join H and A because you don't need their attributes

$$\pi_{W.wid}(W \ltimes A)) \cap \pi_{O.wid}(O \ltimes H)$$

5. W=Westerosi, WS=WesterosiSkill, O=OfHouse, H=HouseAllyRegion
    a. RA Translation:

$$\pi_{W.wid}(\sigma_{O.wages>50000 \wedge O.hname=H.hname \wedge H.region='KingsLanding'} W \bowtie WS \bowtie O \bowtie H)$$

    b. Optimization:
        i. Pushing HouseAllyRegion condition over join

$$K = \pi_{hname}(\sigma_{region='KingsLanding'}(H))$$

$\pi_{W.wid}(\sigma_{O.wages>50000} W \ltimes WS \ltimes O \ltimes K)$

ii. Pushing wages condition over join

$F = \pi_{wid, hname}(\sigma_{wages > 50000}(H))$

$\pi_{W.wid}(W \ltimes WS \ltimes F \ltimes K)$

iii. Semijoin W and WS because you only need W's attributes to be projected, but you can't use semijoins on everything else because it's not associative

$\pi_{W.wid}(W \ltimes (WS \ltimes F \ltimes K))$