CSC343: Introduction to Databases

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Part 1: Queries

Question 1.

Find all the users who have never liked or viewed a post or story of a user that they do not follow. Report their user id AND "about" information. Put the information into a relation with attributes "username" AND "description".

1) All the user ID's of the users that have liked a post by a user that they do not follow:

$$\mathit{Liked}(\mathit{uid}) := \pi_{\text{liker}}(\sigma_{\text{liker} \neq \text{follower AND Likes.pid = Post.pid AND Post.uid = followed}} \\ (\mathit{Likes} \times \mathit{Post} \times \mathit{Follows}))$$

2) All the user ID's of the users that have viewed a story by a user that they follow:

$$\mathit{Viewed}(\mathit{uid}) := \pi_{\text{viewid}}(\sigma_{\text{viewerid} \neq \text{follower AND Saw.sid = Story.sid AND Story.uid = followed}} \\ (\mathit{Saw} \times \mathit{Story} \times \mathit{Follows}))$$

3) All the user ID's of the users that have liked a post by a user that they follow or viewed a story by a user that they follow:

$$\mathit{LikedOrViewed}(\mathit{uid}) := \mathit{Liked} \cup \mathit{Viewed}$$

4) All the users who have never liked or viewed a post or story of a user that they do not follow:

$$\mathit{NeverLikedOrViewed}(\mathit{uid}) := (\pi_{\text{uid}}(\mathit{User})) - (\mathit{LikedOrViewed})$$

$$\mathit{Answer}(\mathit{username}, \mathit{description}) := \pi_{\text{uid, about}}(\mathit{User} \bowtie \mathit{NeverLikedOrViewed})$$

Question 2.

Find every hashtag that has been mentioned in at least two post captions on any day of 2018. You may assume that there is at least one post on each day of a year.

1) All hashtags that have been mentioned at least twice:

$$\mathit{Twice}(\mathit{pid}, \mathit{tag}) := \pi_{\text{H1.pid, H1.tag}}(\sigma_{\text{H1.pid != H2.pid AND H1.tag = H2.tag}}(\rho_{H1}(\mathit{Hashtag})) \times \rho_{H2}(\mathit{Hashtag}))$$

2) All posts made in 2018:

$$\mathit{Posts}2018(\mathit{pid}) := \pi_{\text{pid}}(\sigma_{\text{when.year = 2018}}(\mathit{Post}))$$

3) All hashtags that have been mentioned in at least two posts on any day of 2018:

$$\mathit{Answer}(\mathit{tag}) := \pi_{\text{tag}}(\mathit{Twice} \bowtie \mathit{Posts}2018)$$

Question 3.

Let's say that a pair of users are "reciprocal followers" if they follow each other. For each pair of reciprocal followers, and all of their "uncommon followers": users who follow one of them but not the other. Report one row for each of the pair's uncommon follower. In it, include the identifiers of the reciprocal followers, and the identifier, name and email of the uncommon follower.

Find all pairs of reciprocal followers:

(a) Separate into two parts, one way:

$$PairsOneWay(uid1, uid2) := \pi_{\text{T1.uid, T2.uid}}(\sigma_{\text{T1.uid = follower AND T2.uid = followed}}$$
$$(\rho_{T1}(User) \times \rho_{T2}(User) \times Follows))$$

(b) Following the other way:

$$Pairs(recip1, recip2) := \pi_{\text{uid1, uid2}}(\sigma_{\text{uid2 = follower AND uid1 = followed}}$$
$$(PairsOneWay \times Follows))$$

Find the uncommon pairs:

1) Find users that are following at least one of the reciprocal pair users:

$$AtLeastOne(recip1, recip2, uid) := \pi_{\text{recip1, recip2, uid}}$$
$$(\sigma_{\text{(uid = follower AND recip1 = followed) OR (uid = follower AND recip2 = followed)}}(Pairs \times Users \times Follows))$$

2) (a) Find users that are following both in the pairs: separate by one way and then the other

$$FollowPart(recip1, recip2, uid) := \pi_{\text{recip1, recip2, uid}}$$
$$(\sigma_{\text{uid = follower AND recip1 = followed}}(AtLeastOne \times Follows))$$

(b) Other way:

$$FollowBoth(recip1, recip2, uid) := \pi_{\text{recip1, recip2, uid}}$$
$$(\sigma_{\text{uid = follower AND recip2 = followed}}(FollowPart \times Follows))$$

3) Subtract the set that follows both from the set that follows at least one to get the set that's following exactly one

$$Uncommon(recip1, recip2, uid) := AtLeastOne - FollowBoth$$

4) Answer:

$$Answer(recip1, recip2, uid, name, email) := \pi_{\text{recip1, recip2, Uncommon.uid, name, email}}$$
$$(Uncommon \bowtie_{\text{Uncommon.uid = User.uid}} Users)$$

Question 4.

Find the user who has liked the least posts. Report the user's id, name and email, and the id of the posts they have liked. If there is a tie, report them all.

A solution **does not** exist.

Question 5.

Let's say a pair of users are "backscratchers" if they follow each other and like all of each others' posts. Report the user id of all users who follow some pair of backscratcher users.

1) Find users that follow each other (a) Separate into two parts, one way:

$$PairsOneWay(uid1, uid2) := \pi_{\text{T1.uid, T2.uid}}(\sigma_{\text{T1.uid = follower AND T2.uid = followed}}$$
$$(\rho_{T1}(User) \times \rho_{T2}(User) \times Follows))$$

(b) Following the other way:

$$FollowEachOther(recip1, recip2) := \pi_{\text{uid1, uid2}}(\sigma_{\text{uid2 = follower AND uid1 = followed}}$$
$$(PairsOneWay \times Follows))$$

2) Find all posts and likes

$$PostsAndLikes(liker, pid, uid) := \pi_{\text{liker, pid, uid}}(Likes \bowtie Post)$$

3) Find users that liked none of each others post's

$$LikedNone(liker, pid, uid) := \pi_{\text{P1.liker, P1.pid, P1.uid}}$$
$$(\sigma_{\text{P1.liker} \neq \text{P2.uid AND P1.uid} \neq \text{P2.liker}})(\rho_{P1}(PostsAndLikes) \times \rho_{P2}(PostsAndLikes))$$

4) Find users that liked not all each others post's

$$LikedNotAll(liker, pid, uid) := \pi_{\text{P1.liker, P1.pid, P1.uid}}$$
$$(\sigma_{\text{P1.liker} \neq \text{P2.liker AND P1.uid = P2.uid}})$$
$$(\rho_{P1}(PostsAndLikes) \times \rho_{P2}(PostsAndLikes))$$

5) Find users that liked all of each others posts by subtracting users that liked none of their posts and users that liked not all of their posts

$$LikedAllPostsOfEachOther(liker, pid, uid) := (PostsAndLikes - LikedNotAll - LikedNone)$$

6) Find all users who have followed and liked each other

$$Backscratcher(uid) := \pi_{\text{L1.liker}}$$
$$(\sigma_{\text{L1.liker = F1.follower}})(\rho_{L1}(LikedAllPostsOfEachOther) \times \rho_{F1}(FollowEachOther))$$

7) Find all the 'backscratcher' pairs of users

$$BackscratcherPairs(firstuid, seconduid) := \pi_{\text{B1.uid, B2.uid}}$$
$$(\sigma_{\text{B1.uid} \neq \text{B2.uid}})(\rho_{B1}(Backscratcher) \times \rho_{B2}(Backscratcher))$$

8) Find all users who follow some pair of backscratcher users

$$Answer(uid) := \pi_{\text{F1.follower}}$$
$$(\sigma_{\text{F1.follower = F2.follower AND F1.followed = B.firstuid AND F2.followed = B.seconduid}})$$
$$((\rho_{F1}(Follows) \times \rho_{F2}(Follows)) \times \rho_{B}(BackscratcherPairs))$$

Question 6.

The “most recent activity” of a user is his or her latest story or post. The “most recently active user” is the user whose most recent activity occurred most recently.

Report the name of every user, and for the most recently active user they follow, report their name and email, and the date of their most-recent activity. If there is a tie for the most recently active user that a user follows, report a row for each of them.

1) A table of all user id’s and their activity:

$$\mathit{AllActivity}(\mathit{uid}, \mathit{when}) := \pi_{\text{uid, when}}(\mathit{Post}) \cup \pi_{\text{uid, when}}(\mathit{Story})$$

2) Not the most recent activity for all users:

$$\mathit{LeastRecentActivity}(\mathit{uid}, \mathit{when}) := \pi_{\text{A1.uid, A1.when}}$$
$$(\sigma_{\text{A1.uid = A2.uid AND A1.when < A2.when}}[\rho_{A1}(\mathit{AllActivity}) \times \rho_{A2}(\mathit{AllActivity})])$$

3) The most recent activity for all users:

$$\mathit{RecentActivity}(\mathit{uid}, \mathit{when}) := \mathit{AllActivity} - \mathit{LeastRecentActivity}$$

4) All followers of the most recently active users:

$$FollowersOfRecent(follower, followed, when) := \pi_{\text{follower, uid, when}}$$
$$(\sigma_{\text{uid = followed}}[\mathit{RecentActivity} \times Follows])$$

5) All the followed of not the most recently active users:

$$NotRecent(follower, followed, when) := \pi_{\text{F1.follower, F1.followed, F1.when}}$$
$$(\sigma_{\text{F1.follower = F2.follower AND F1.when < F2.when}}$$
$$[\rho_{F1}(FollowersOfRecent) \times \rho_{F2}(FollowersOfRecent)])$$

6) All followers of users of the most recent activity:

$$MostRecent(follower, followed, when) := FollowersOfRecent - NotRecent$$

$$\mathit{Answer}(name, followedName, followedEmail, when) := \pi_{\text{U1.name, U2.name, U2.email, when}}$$
$$(\sigma_{\text{U1.uid = follower AND U2.uid = followed}}[\rho_{U1}(User) \times \rho_{U2}(User) \times MostRecent])$$

Question 7.

Report the name and email of the user who has gained the minimum number of new followers in 2018. If there is a tie, report them all.

A solution **does not** exist.

Question 8.

For each user who has ever put any comments, report their id and the id of the first and of the last post they commented on.

1) Get all commenters - everyone who has ever commented

$$Commenters(pid, commenter, when) := \pi_{\text{pid, commenter, when}}(Comment)$$

2) Get all the comments that weren't first

$$NotFirst(pid, commenter, when) := \pi_{\text{T1.pid, T1.commenter, T1.when}}$$
$$(\sigma_{\text{T1.commenter = T2.commenter AND T1.when > T2.when}}(\rho_{T1}Commenters \times \rho_{T2}Commenters))$$

3) Get all the comments that are first

$$First(pid, commenter) := \pi_{\text{pid, commenter}}(Commenters - NotFirst)$$

2) Get all the comments that weren't last

$$NotLast(pid, commenter, when) := \pi_{\text{T1.pid, T1.commenter, T1.when}}$$
$$(\sigma_{\text{T1.commenter = T2.commenter AND T1.when < T2.when}}(\rho_{T1}Commenters \times \rho_{T2}Commenters))$$

3) Get all the comments that are last

$$Last(pid, commenter) := \pi_{\text{pid, commenter}}(Commenters - NotLast)$$

4) Getting first and last posts, and the uid

$$Answer(uid, firstid, lastid) := \pi_{\text{commenter, First.pid, Last.pid}}(First \bowtie Last))$$

Part 2: Additional Integrity Constraints

Question 1.

A view on a story must occur after the date-time of the story itself.

$$\sigma_{\text{Saw.sid = Story.sid AND Saw.when} \leqslant \text{Story.when}}(Saw \times Story) = \emptyset$$

Question 2.

Each user can have at most one current story.

$$\sigma_{\text{S1.uid = S2.uid AND S1.current = true AND S2.current = true AND S1.sid} \neq \text{S2.sid}}(\rho_{S1}(Story) \times \rho_{S2}(Story)) = \emptyset$$