Assignment 4: The Relational Algebra

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The requested queries

1. $\sigma_{\text{startdate} < \text{enddate}}(\text{event})$

2. $\pi_{\text{U.uid,E.eid}}(\rho_{\text{U}}(\text{user}) \bowtie_{\text{U.postcode = E.postcode}} \rho_{\text{E}}(\text{event}))$

3. $X := \rho_{\text{E}}(\text{event}) \bowtie_{\text{E.eid = EnoRv.eid}} \rho_{\text{EnoRv}}(\pi_{\text{eid}}(\text{event}) \setminus \pi_{\text{event}}(\text{review}))$
   $\pi_{\text{E.eid,E.title,E.description,E.startdate,E.enddate,E.organizer,E.postcode}}(X)$

4. Select events with at least 3 keywords:
   $X := \rho_{\text{K}_1}(\text{keyword}) \times \rho_{\text{K}_2}(\text{keyword}) \times \rho_{\text{K}_3}(\text{keyword})$
   $Y := \sigma_{K_1.\text{word} \neq K_2.\ \text{word} \wedge K_1.\text{word} \neq K_3.\ \text{word} \wedge K_2.\text{word} \neq K_3.\ \text{word}}(X)$
   $Z := \sigma_{K_1.\text{event} = K_2.\text{event} \wedge K_1.\text{event} = K_3.\text{event}}(Y)$

   Select events with at least 2 keywords:
   $A := \rho_{\text{K}_4}(\text{keyword}) \times \rho_{\text{K}_4}(\text{keyword})$
   $B := \sigma_{K_4.\text{word} \neq K_5.\text{word}}(A)$
   $C := \sigma_{K_4.\text{event} = K_5.\text{event}}(B)$

   Select events with exactly 3 keywords:
   $\pi_{K_4.event}(C) \setminus \pi_{K_1.event}(Z)$

5. (a) $X := \rho_{R_1}(\text{review}) \times \rho_{R_2}(\text{review})$

   Keep reviews from R_1 that are not from latest date:
   $Y := \sigma_{R_1.\text{reviewdate} < R_2.\text{reviewdate} \wedge R_1.\text{user} = R_2.\text{user}}(X)$

   Select user id and event id for which the user wrote a review most recently:
   $Z := \pi_{\text{user,event}}(\text{review}) \setminus \pi_{R_1.\text{user},R_1.\text{event}}(Y)$

(b) $A := \rho_{R_1}(\text{review}) \times \rho_{R_2}(\text{review}) \times \rho_{E_1}(\text{event}) \times \rho_{E_2}(\text{event})$
$B := \sigma_{R_1.\text{user} = R_2.\text{user} \wedge R_1.\text{event} = E_1.\text{eid} \wedge R_2.\text{event} = E_2.\text{eid}}(A)$

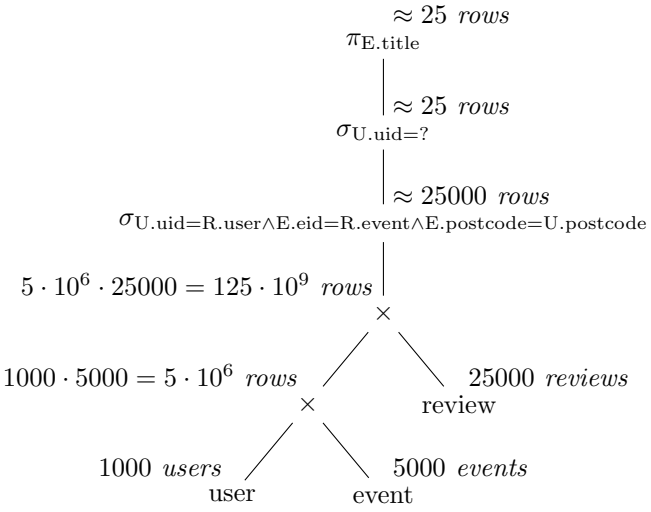
Select reviews whose E_1.enddate are not from the latest:
$C := \sigma_{E_1.\text{enddate} < E_2.\text{enddate}(B)}$

Select user id and event id of the most-recent event (according to enddate) for which the user wrote a review:
$D := \pi_{R_1.\text{user}, E_1.\text{eid}}(B \setminus C)$

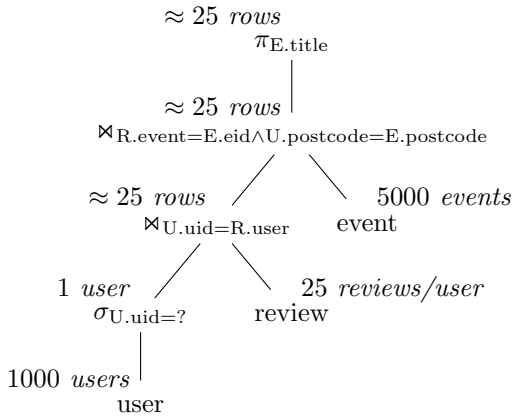
(c) $\pi_{\text{LR.user,LR.lreview,LE.levent}}(\rho_{\text{LR(user,lreview)}}(Z) \bowtie_{\text{LR.user} = \text{LE.user}} \rho_{\text{LE(user,levent)}}(D))$

Effiency of queries

7.



8.



From the query execution plan in question 7, we can see that the result of the cross product of the 3 tables, *user*, *review* and *event* would have $125 \cdot 10^9$ rows, which is enormous. We can reduce this significantly by first selecting the row from the table *user* where the *uid* is equal to the required user id (in this case, denoted as ?). This will result in only 1 rows since each *uid* is unique. After that, we will join the result with the *review*. Although the table *review* has 25000 rows, each user only has 25 reviews and since we have selected only 1 user, the result of this join would have approximately 25 rows. Then, we join this result with the table *event*. Again, although the table *event* has 5000 rows, since the previous result only has approximately 25 rows, there are only approximately 25 different event id. Thus, the result of this join only contains approximately 25 rows. Projecting just takes the specified column so the result of the whole query execution plan would have approximately 25 rows. This execution plan is good since the returned table in each intermediate step is significantly small.

9. The answer for question 9 is given in the answer for question 8.

10.
```
SELECT DISTINCT E.title
FROM user U, event E, review R
WHERE U.uid = ? AND
        R.user = U.uid AND
        R.event = E.eid AND
        U.postcode = E.postcode;
```

11. The given SQL query can be simplified to

```
SELECT DISTINCT K.word
FROM user U, review Rv, keyword K, event E, region
Rg
WHERE U.uid = ?1 AND
```

```
Rv.user = U.uid AND
Rv.event = K.eid AND
E.postcode = Rg.postcode AND
Rg.name = ?2 AND
K.event = E.eid;
```

Thus, the relational algebra for the SQL query is
$X := \rho_{\mathrm{U}}(\mathrm{user}) \times \rho_{\mathrm{Rv}}(\mathrm{review}) \times \rho_{\mathrm{K}}(\mathrm{keyword}) \times \rho_{\mathrm{E}}(\mathrm{event}) \times \rho_{\mathrm{Rg}}(\mathrm{region})$
$Y := \sigma_{\mathrm{U.uid}=?_1 \wedge \mathrm{Rv.user}=\mathrm{U.uid} \wedge \mathrm{Rv.event}=\mathrm{K.event} \wedge \mathrm{E.postcode}=\mathrm{Rg.postcode} \wedge \mathrm{Rg.name}=?_2 \wedge \mathrm{K.event}=\mathrm{E.eid}}(X)$
$\pi_{\mathrm{K.word}}(Y)$