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Here are some relations that exist in a database for a symphony.

Person(email, name, age)

- This relation stores anyone who has signed up for our mailing list. Tuples in this relation may not be listed in Purchase.

Show(id, year, month, date, showing, attendanceNumber) ✓

- Showing describes whether a show was during morning, afternoon, or evening

Song(composer, title)

SongsPerformed(showID, composer, title)

- showID is a foreign key referring to Show
- composer and title are foreign keys referring to attributes of the same name in Song

Purchase(email, showID, price)

- email is a foreign key referring to the email attribute in Person
- showID is a foreign key referring to Show

Musician(id, name, instrument, position, nationality)

PerformedIn(id, showID)

- id refers to the attribute of the same name in Musician
- showID is a foreign key referring to Show

Write relational algebra statements to answer the following questions:

1. Find the emails of the people who have attended a show in January 2020 and February 2020.
2. What songs were performed in the shows with the most attendance? In the event of a tie, list all the songs that were performed in the shows.
3. Find the email addresses of people who have purchased a ticket for every performance that includes a piece composed by Tchaikovsky.

1

$$\text{Show}_{01/2020} = \sigma_{(\text{year}=2020 \wedge \text{month}='Jan')}(\text{Show})$$

$$\text{Show}_{02/2020} = \sigma_{(\text{year}=2020 \wedge \text{month}='Feb')}(\text{Show})$$

$$\text{Purchase}_{01/2020} = \text{Show}_{01/2020} \bowtie \text{Purchase}$$

$$\text{Purchase}_{02/2020} = \text{Show}_{02/2020} \bowtie \text{Purchase}$$

$$\text{Result} \leftarrow \pi_{\text{email}}(\text{Purchase}_{01/2020}) \cap \pi_{\text{email}}(\text{Purchase}_{02/2020})$$
2. $\text{show}_1(\text{Show}), \text{show}_2(\text{Show})$

$$\text{BothShows} \leftarrow \text{Show}_1 \bowtie \text{Show}_2$$

$$\text{ShowsWithLess} = \sigma_{(\text{show}_1.\text{Attendance} \leq \text{show}_2.\text{Attendance} \wedge \text{show}_1.\text{id} \neq \text{show}_2.\text{id})}(\text{BothShows})$$

$$\text{MaxAttendance} \leftarrow \pi_{\text{id}}(\text{Show}) - \pi_{\text{id}}(\text{ShowsWithLess})$$

$$\text{Result} \leftarrow \text{SongsPerformed} \bowtie \text{MaxAttendance}$$
3. $\text{AllShows} \leftarrow \pi_{(\text{id})}(\text{Show})$

$$\text{TShow} \leftarrow \pi_{(\text{showId})}(\sigma_{(\text{composer}='Tchaikovsky')}(\text{SongsPerformed}))$$

$$\text{AllEmails} \leftarrow \pi_{(\text{email})}(\text{Purchase})$$

$$\text{AllComb} \leftarrow \text{AllShows} \times \text{AllEmails}$$

$$\text{CurrentComb} \leftarrow \pi_{(\text{email}, \text{showId})}(\text{Purchase})$$

$$\text{MissingComb} \leftarrow \pi_{(\text{email})}(\text{AllComb} - \text{CurrentComb})$$

$$\text{Everyone} \leftarrow (\text{AllEmails} - \text{MissingComb}) \bowtie \text{Purchase}$$

$$\text{Result} \leftarrow \pi_{(\text{email})}(\text{Everyone} \bowtie \text{TShow})$$