Introduction to Databases (winter term 2005/2006)

Assignment 6

hand in on December 12, 2005 during the tutorial

Please hand in your solutions in groups of up to 3 students.
Do not forget to write down your name and matriculation number on the solutions you hand in. Please also add your study course (e.g. Dipl.-Inf., Master SSE, ...).

Task 6.1 (Music Database) (4 Points)
Consider an extract from the Amazon.com online shop database concerning music products (transferred with the help of the Amazon Web Services). It is stored in the AMAZ schema of our Oracle test database. To access its tables you must use this schema's name as a prefix to the table name (e.g. in SELECT * from AMAZ.album).

a) Reverse-engineer the underlying conceptual data model and depict it as an Entity-Relationship diagram. The following commands and queries may be helpful as a starting point for your schema investigation:

<table>
<thead>
<tr>
<th>Command/Query</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECT * FROM dict</td>
<td>lists all tables/views of the data dictionary</td>
</tr>
<tr>
<td>SELECT * FROM ALL_TABLES</td>
<td>lists all tables in schemas</td>
</tr>
<tr>
<td>DESC album</td>
<td>describes the schema of table album</td>
</tr>
<tr>
<td>SELECT * FROM ALL_CONSTRAINTS</td>
<td>lists all defined constraints visible for the current user. The attribute CONSTRAINT_TYPE specifies the type of the constraint (e.g. primary key, foreign key, ...)</td>
</tr>
</tbody>
</table>

b) Formulate the following queries in SQL:

1. List all record labels with the number of records they offer sorted by this number in descending order.
2. List all artists with the mean and variance of the sales ranks of their records.
3. List all artists who recorded an album that occurs on the same ListMania list as a record by Sting.
4. List all artists whose records are judged to be similar to an album by Metallica.
5. List the average user rating of records grouped by the number of tracks. Only records with track information should be taken into account.
6. List all albums that are judged to be similar to a record that they occur with on a ListMania list. Sort the result by the number of lists that show this co-occurrence.
Task 6.2 (Functional Dependencies) (3 Points)

a) Given is the following relation \( r \):

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>a1</td>
<td>b1</td>
<td>c1</td>
<td>d1</td>
<td>e1</td>
</tr>
<tr>
<td>a2</td>
<td>b2</td>
<td>c2</td>
<td>d3</td>
<td>e1</td>
</tr>
<tr>
<td>a2</td>
<td>b1</td>
<td>c3</td>
<td>d2</td>
<td>e1</td>
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<tr>
<td>a2</td>
<td>b2</td>
<td>c4</td>
<td>d3</td>
<td>e1</td>
</tr>
<tr>
<td>a3</td>
<td>b1</td>
<td>c4</td>
<td>d2</td>
<td>e1</td>
</tr>
</tbody>
</table>

Which of the following functional dependencies apply to \( r \)?

\( A \rightarrow D, AB \rightarrow D, C \rightarrow E, E \rightarrow A, A \rightarrow E, CD \rightarrow B \)

b) Given is the following set of functional dependencies:

\( F = \{ AB \rightarrow E, BE \rightarrow I, E \rightarrow G, GI \rightarrow H \} \)

Can the dependency \( AB \rightarrow GH \) be derived from \( F \)? If yes, how?

Task 6.3 ( Equivalent FD sets) (2 Points)

Let \( V = \{ A, B, C, D, E, I \} \) be a set of attributes and \( F = \{ AB \rightarrow C, B \rightarrow A, AD \rightarrow E, BD \rightarrow I \} \) and \( G = \{ B \rightarrow AC, BD \rightarrow EI, AD \rightarrow E \} \) sets of functional dependencies.

Show:

a) \( F^+ = G^+ \)

b) Neither \( F \) nor \( G \) is redundant.

Task 6.4 (Keys) (2 Points)

Let \( R = (U, F) \) be a relation schema over the attribute set \( U \) and \( F \) a set of functional dependencies. We assume that \( R \) has a unique key (i.e. there is only one candidate key).

Prove the following proposition or give a counterexample\(^1\):

\( \forall X \subseteq U \forall A \in U : \ X \rightarrow A \in F^+ \land A \notin X \implies A \) is a non-prime attribute.

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\(^1\)\( F^+ \) is called the closure of \( F \), i.e. the set of all functional dependencies that can be inferred from \( F \).

\(^2\)If not, use a VPN client by the Rechenzentrum to get an IP from inside

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