Introduction to Databases (summer term 2007)

Assignment 6

hand in on June 4, 2007 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 AMZ 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 AMZ.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 that are accessible by the current user</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\(^1\).
3. List all artists whose records (all records of this artist!) are judged to be similar to an album by Metallica.
4. List all artists who recorded an album that occurs on the same ListMania list as a record by Sting.
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.

\(^1\)Use the aggregation functions **avg** and **variance**.

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Task 6.2 (Functional Dependencies)  
(2 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>a1</td>
<td>b1</td>
<td>c2</td>
<td>d1</td>
<td>e1</td>
</tr>
<tr>
<td>a1</td>
<td>b2</td>
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<td>d3</td>
<td>e1</td>
</tr>
</tbody>
</table>

Which of the following functional dependencies apply to \( r \)?
\( A \rightarrow D, B \rightarrow E, BD \rightarrow E, E \rightarrow AB \)

b) Given is the following set of functional dependencies:
\( F = \{ AB \rightarrow C, D \rightarrow AE, AF \rightarrow C, EF \rightarrow GA \} \).
Which of the following dependencies can be derived from \( F \)? Why?

1. \( DF \rightarrow G \)
2. \( AD \rightarrow C \)

Task 6.3 (Deduction Rules)  
(2 Points)

Give for each of the following deduction rules a formal proof of its correctness or provide a counterexample if you think it does not hold.

a) \( X \rightarrow Y \land YZ \rightarrow W \Rightarrow XZ \rightarrow W \)

b) \( XY \rightarrow Z \land Z \rightarrow X \Rightarrow Z \rightarrow Y \)

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\(^2\):

\[ \forall X \subseteq U \forall A \in U : \ X \rightarrow A \in F^+ \land A \not\in X \Rightarrow A \text{ is a non-prime attribute.} \]

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\(^2\) \( F^+ \) is called the closure of \( F \), i.e. the set of all functional dependencies that can be inferred from \( F \).

\(^3\) If not, use a VPN client by the Rechenzentrum to get an IP from inside.

For practical experience with a relational database management system we offer you the opportunity to access an Oracle DB-server via a web interface. This and the following exercise(s) contain tasks that can be solved using this DBMS. If you did not get an access ticket during the last tutorial session you can obtain one at our chair office.

If you are inside the network of the RWTH\(^3\) you can establish an iSQL*Plus session following the instruction on the ticket. After logging in you can create and query your private schema objects without disturbing other users.