2 Databases (tg22)

Suppose we have a relational database with three tables

<table>
<thead>
<tr>
<th>table</th>
<th>key attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>S(sid, A)</td>
<td>sid</td>
</tr>
<tr>
<td>T(tid, B)</td>
<td>tid</td>
</tr>
<tr>
<td>R(sid, tid, C)</td>
<td>sid, tid, C</td>
</tr>
</tbody>
</table>

The following referential integrity constraints hold on the table R. Every sid-value in R is the key of a record in table S and tid-value in R is the key of a record in table T.

(a) What does it mean that the attribute C is included in R’s key? [2 marks]

(b) Write an SQL query to return records of the form sid where sid is the key of an S record that is not R-related to any records in table T. [2 marks]

(c) Consider the following two queries.

\[
Q1 = \text{SELECT } S1.A \text{ AS } A, R1.C \text{ AS } C \\
\text{FROM R AS R1} \\
\text{JOIN R AS R2 ON R2.tid = R1.tid} \\
\text{JOIN S AS S1 ON S1.sid = R1.sid} \\
\text{JOIN S AS S2 ON S2.sid = R2.sid}
\]

and

\[
Q2 = \text{SELECT DISTINCT } S1.A \text{ AS } A, R1.C \text{ AS } C \\
\text{FROM R AS R1} \\
\text{JOIN R AS R2 ON R2.tid = R1.tid} \\
\text{JOIN S AS S1 ON S1.sid = R1.sid} \\
\text{JOIN S AS S2 ON S2.sid = R2.sid}
\]

Note that the only difference is the use of DISTINCT in Q2.

(i) If Q1 and Q2 return the same results, what can you conclude about the data in this database? Justify your answer. [4 marks]

(ii) Suppose we add this where-clause to each query:

\[
\text{WHERE R1.C = R2.C AND S1.sid <> S2.sid}
\]

If the modified Q1 and Q2 return the same results, what can you conclude about the data in this database? Justify your answer. [4 marks]

(iii) Suppose we add the where-clause WHERE R1.tid <> R2.tid to each query. If the modified Q1 and Q2 return the same results, what can you conclude about the data in this database? Justify your answer. [4 marks]

(iv) Suppose we add this where-clause to each query:

\[
\text{WHERE R1.tid <> R2.tid AND S1.sid <> S2.sid}
\]

If the modified Q1 and Q2 return the same results, what can you conclude about the data in this database? Justify your answer. [4 marks]