CSCE-608 Database Systems

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Assignment #2 Solution

1. Using the database schema of movies given in the textbook (page 244)

```
Movies(title, year, length, genre, studioName, producerC#)
StarsIn(movieTitle, movieYear, starName)
MovieStar(name, address, gender, birthdate)
MovieExec(name, address, cert#, netWorth)
Studio(name, address, proeC#),
```

Write the following queries in SQL:

a) Who were the male stars in Titanic?

Answer.

```
SELECT name
FROM MovieStar, StarsIn
WHERE name = starName AND gender = 'male' AND movieTitle = 'Titanic';
```

b) Which stars appeared in movies produced by MGM in 1995?

Answer.

```
SELECT starName
FROM Movies, StarsIn
WHERE title = movieTitle AND studioName = 'MGM' AND year = '1995';
```

c) Who is the president of MGM studios?

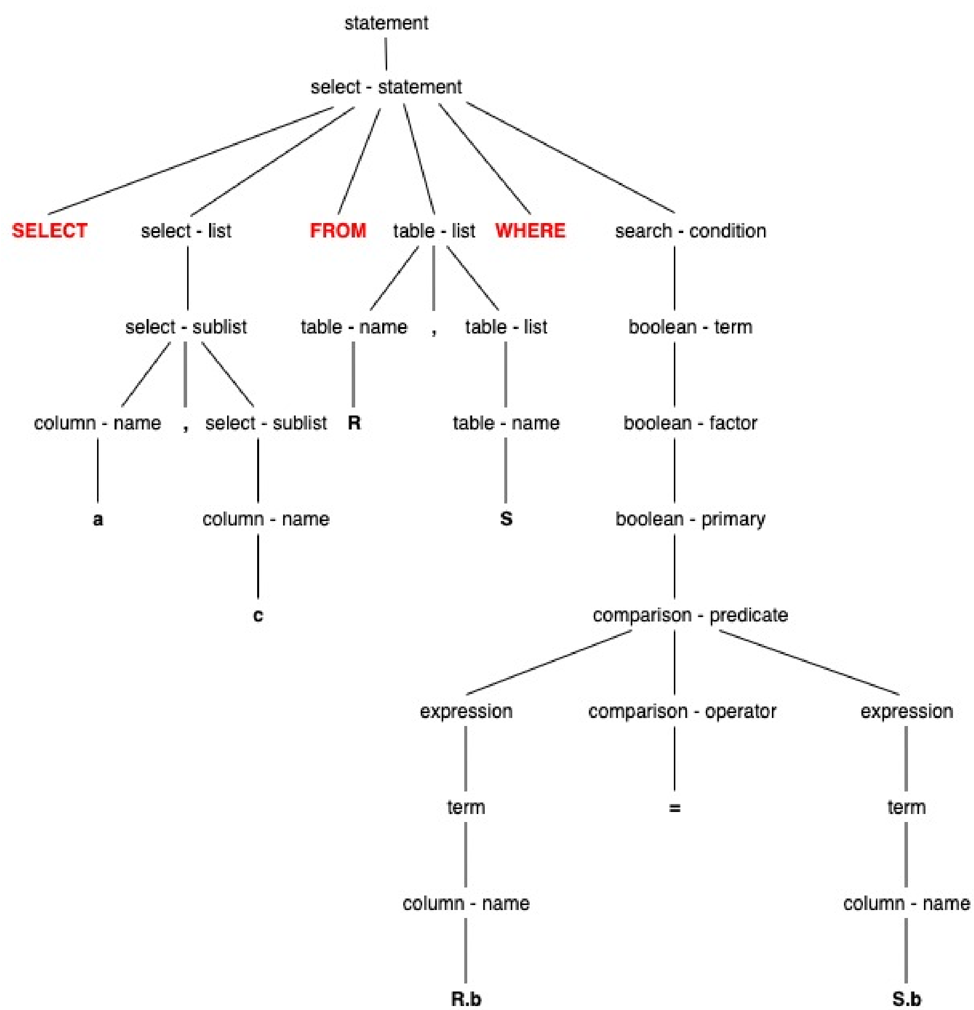
Answer.

```
SELECT MovieExec.name
FROM MovieExec, Studio
WHERE cert# = proeC# AND Studio.name = "MGM";
```

2. Using the grammar for TinySQL given in lecture 12, give the parse tree for the following query about relations $R(a, b)$ and $S(b, c)$:

```
SELECT a, c FROM R, S WHERE R.b = S.b
```

Answer. Below is the parse tree:



3. Some laws that hold for sets hold for bags; others do not. For each of the laws below that are true for sets, tell whether or not it is true for bags. Either give a proof showing the law is true for bags, or give a counterexample to show that the law is false:

a) $R \cup R = R$

Answer. False.
Counterexample: Consider $R = \{a\}$, where a is an element (a is a tuple if R is a relation). By the definition of bag uinion, we have

$$\textbf{LHS} = R \cup R = \{a\} \cup \{a\} = \{a, a\} \text{ and } \textbf{RHS} = R = \{a\}.$$

Thus, LHS $\neq$ RHS.

b) $R \cap R = R$

Answer. True.
Proof: For any two bags A and B, by the definition of bag intersection, the number of copies of an element a in the intersection $A \cap B$ is equal to the smaller of the number of copies of a in A and the number of copies of a in B. Therefore, for the bag intersection $R \cap R$ of the same bag R, the number of copies of an element a in the intersection $R \cap R$ is the same as the number of copies of a in R. This is true for all all elements a. As a result, $R \cap R = R$.

c) $R - R = \emptyset$

Answer. True.
Proof: Similar to that for b). For any two bags S and T, by the definition of bag difference, the number of copies of an element a in the difference $S - T$ is equal to $\max\{0, s_a - t_a\}$, where s_a and t_a are the numbers of copies of a in S and T, respectively. Therefore, for the bag difference $R - R$ of the same bag R, the number of copies of an element a in the difference $R - R$ is always 0, i.e., element a is not in $R - R$. This is true for all all elements a. As a result, $R - R = \emptyset$.

d) $R \cup (S \cap T) = (R \cup S) \cap (R \cup T)$

Answer. True.
Proof: We will denote by $n_a(B)$ the number of copies of the element a in the bag B. Now fix an element a. Because of the symmetry, we can assume $n_a(S) \geq n_a(T)$.

By the definition of bag intersection, $n_a(S \cap T) = \min\{n_a(S), n_a(T)\} = n_a(T)$, here we have used the assumption $n_a(S) \geq n_a(T)$. Now by the definition of bag union, for LHS, we have $n_a(R \cup (S \cap T)) = n_a(R) + n_a(S \cap T) = n_a(R) + n_a(T)$.

For RHS, we have $n_a(R \cup S) = n_a(R) + n_a(S)$ and $n_a(R \cup T) = n_a(R) + n_a(T)$. Since $n_a(S) \geq n_a(T)$, we have $n_a(R \cup S) \geq n_a(R \cup T)$. Therefore,

$$n_a((R \cup S) \cap (R \cup T)) = \min\{n_a(R \cup S), n_a(R \cup T)\} = n_a(R \cup T) = n_a(R) + n_a(T).$$

Therefore, for any element a, the number of copies of a on LHS is equal to that on RHS. Since a is an arbitrary element, we conclude LHS = RHS.