H_2

Homework Assignment II

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Q. 1 Given the following relation schema R(A, B, C, D, E) and the database, answer the following questions (diagram not reproduced).

Q. 1.1 List all super keys of R.

Attributes C and D are candidate keys of relation R becuase they are unique to each tuple in R.

$$\text{where } K \in \{C, D\}, \text{ and } t \text{ is a tuple } \in R \tag{1.1.1}$$
$$t_1[K] \neq t_2[K] \neq t_3[K] \neq t_4[K] \tag{1.1.2}$$
$$\therefore \forall t \in R, t_n[K] \neq t_m[K] \tag{1.1.3}$$

Since we now have C and D as candidate keys, we can narrow the list of super keys to the tuples as follows:

Our minimal superkeys, or keys are

$$(C), (D) \tag{1.1.4}$$

Other superkeys are any set of C or D with any other key (including C or D) as long as the key.

$$\{K \subset R \mid (C \vee D) \cup K\} \tag{1.1.5}$$

Meaning the set of C or D or both, unioned with any set of other elements, including the null set, ϕ.

The complete list is as follows:

$$(C), (D), (C, D), (A, B, C, E), (A, C), (B, C), (C, E), (A, B, C),$$
$$(A, C, E), (B, C, E), (A, B, D, E), (A, D), (B, D), (E, D), (A, B, D),$$
$$(A, D, E), (B, D, E), (A, B, C, D, E), (A, C, D), (B, C, D),$$
$$(C, D, E), (A, B, C, D), (A, C, D, E), (B, C, D, E)$$

Q. 1.2 List all keys of R.

As indicated in the prelude of Q. 1.1, C and D are the keys of R because keys are defined as superkeys that cannot have an element removed and remain a superkey.

Q. 1.3 List all candidate keys of R.

As indicated in the prelude of Q. 1.1, C and D are the candidate keys of R. As candidate keys are defined as a key in the case where a relational schema has more than one key, both keys are candidate keys.

Q. 1.4 Suggest a primary key for R.

Both candidate keys C and D will work as primary keys for R.

Q. 2 Short Answers

Q. 2.1 Explain the differences among an entity, an entity type, and an entity set.

An entity is one record or instance with certain attributes. An entity type is a set of entities that share the same attributes. An entity set is all the elements of the same entity type in the database at any point.

$$e_0 \in E_t, \text{ where } E_t \text{ is the entity type.} \tag{2.1.1}$$

$$E_s = E_t \cap D, \text{ where } D \text{ is the database.} \tag{2.1.2}$$

Here 2.1.1 shows an entity e_0 as an element of an entity type E_t while 2.1.2 shows the set of all elements of a type, E_s, the entity set, in the database D.

Q. 2.2 Explain the difference between an attribute and a value set.

An attribute is a quality that describes an entity, while a value set is the set of possible values for an attribute. An attribute is a member of its value set.

$$a \in V_s \tag{2.2.3}$$

Q. 3 Consider the following relational database schema (schema not reproduced).

Q. 3.1 Answer true if the statement is necessarily true; false otherwise.

Q. 3.1.1 A tuple with the `NULL` value on `C_ID` can be inserted to the `COURSE` relation.

False, `C_ID` serves as the primary key (probably) for `COURSE` and is used as a foriegn key elsewhere, and NULL is not a proper for a foreign key that points to a value.

Q. 3.1.2 `C_ID` in the `SECTION` schema is a superkey.

False, there would theoretically be many sections of the same course.

Q. 3.2 Short Answers

Q. 3.2.1 Name the foreign key(s) of the `STUDENT` schema in the diagram.

`D_ID` Foriegn key to the `DEPARTMENT` schema.

`P_ID` Foriegn key to the `PROFESSOR` schema.

Q. 3.2.2 Name the primary key of the `ENROLL` schema.

A student can probably retake a course, meaning (`S_ID`, `C_ID`, `SEC_ID`) is the primary key.

Q. 4 Answer true if the statement is necessarily true; false otherwise.

Q. 4.1 The operations `UNION`, `INTERSECTION`, `SET DIFFERENCE` and `CROSS PRODUCT` require the relations on which they are applied be union compatible.

True.

Q. 4.2 The operations `UNION`, `INTERSECTION`, and `SET DIFFERENCE` are commutative.

True.

Q. 4.3 Which of the following queries is true? (options not reproduced)

b is true.

Q. 5 Short Answers: Consider the relations r and s below, $r(a, b, c, d)$ and $s(e, f, g)$. (relations not reproduced)

Q. 5.1 Show the results of the operation `select * from` r `UNION select * from` s? If there is an error, explain why?

This errors, the relations are not union compatible as they have differing numbers of elements.

Q. 5.2 Show the results of the operation, `select count(*), avg(`g`) from` s?

It will yeild $(4, 10)$.

Q. 6 Consider the following tales, answer the questions in `SQL`.

Q. 6.1 List the students (`ID`, `NAME`) for either computer science or electrical engineering majors.

```
select ID, NAME from EEE_MAJORS UNION select ID, NAME from CSE_MAJORS;
```

Q. 6.2 List the students (`ID`, `NAME`) for either computer science or electrical engineering majors.

```
select NAME from TEACHES where (COURSE_ID='CPSC2376' OR
COURSE_ID='CPSC3375');
```

Q. 6.3 List the students (`NAME`) for computer science majors, who are not double majors in electrical engineering.

```
select NAME from IEE_MAJORS LEFT JOIN select NAME from CSE_MAJORS;
```