Relational Model Exercises

1. Consider this schema:

   One(this, that, other)
   Two(tweedledee, tweedledum)
   One[this] ⊆ Two[tweedledee]

   Suppose relation One has 20 tuples. What do we know about the number of tuples in Two? Circle the one statement below that is the strongest thing we can be certain of.

   (a) The number of tuples in relation Two must be ≥ 20.
   (b) The number of tuples in relation Two must be ≤ 20.
   (c) The number of tuples in relation Two must be 20.
   (d) The number of tuples in relation Two must be ≥ 1.
   (e) The number of tuples in relation Two must be ≥ 0.

   Solution:

   (d) The number of tuples in relation Two must be ≥ 1.

2. Consider this schema:

   Hare(queen, knave)
   Turtle(alice, hatter)
   Turtle[hatter] ⊆ Hare[queen]

   Suppose relation Hare has 15 tuples. What do we know about the number of tuples in Turtle? Circle the one statement below that is the strongest thing we can be certain of.

   (a) The number of tuples in relation Turtle must be ≥ 15.
   (b) The number of tuples in relation Turtle must be ≤ 15.
   (c) The number of tuples in relation Turtle must be 15.
   (d) The number of tuples in relation Turtle must be ≥ 1.
   (e) The number of tuples in relation Turtle must be ≥ 0.

   Solution:

   (d) The number of tuples in relation Turtle must be ≤ 15.
3. Recall the Movies schema:

   Movies\( (mID, \text{title}, \text{director}, \text{year}, \text{length}) \)
   Artists\( (aID, \text{aName}, \text{nationality}) \)
   Roles\( (mID, aID, \text{character}) \)

   Roles\[mID\] \(\subseteq\) Movies\[mID\]
   Roles\[aID\] \(\subseteq\) Artists\[aID\]

Suppose we add this constraint: Movies\[mID\] \(\subseteq\) Roles\[mID\]

(a) Make a very small instance of the database that violates this constraint but otherwise satisfies the schema. You will only need one or two rows.

   **Solution:**
   Any instance that includes an mID in the Movies table that does not occur as an mID in the Roles table violates this constraint.

(b) Restate this constraint in plain English.

   **Solution:**
   “Every movie in the database must have at least one role.”

(c) Is this a foreign-key constraint? Explain.

   **Solution:**
   No, because mID is not a key in the Roles table. It is part of a key, but it is not a key.

4. Are the following expressions equivalent?

   \[ \Pi_{\text{director}, \text{length}}(\sigma_{\text{length}>140} \text{Movies}) \]
   \[ \sigma_{\text{length}>140}(\Pi_{\text{director}, \text{length}} \text{Movies}) \]

   That is, do they have the same value for all possible instances of our schema?

(a) Yes. In fact, you can always reverse a project and a select and get an equivalent expression.

(b) Yes, these two are equivalent. But you cannot always reverse a project and a select and get an equivalent expression. It depends on the circumstances.

(c) No. They do not they have the same value for all possible instances.

(d) These are not both valid expressions, so we can’t even discuss whether or not they are equivalent!
Solution:

(b) Yes, these two are equivalent. But you cannot always reverse a project and a select and get an equivalent expression. It depends on the circumstances.