NYU Tandon School of Engineering
Computer Science and Engineering
CS-UY 3083, Introduction to Database Systems, Fall 2018 Prof Frankl

HOMEWORK #5

Problem 1

A database for maintaining information about cities in the United States has the following relation schema:

$$Info(\underline{city\_name, state}, governor, mayor)$$

The `city_name` attribute is the name of a city, `state` is the abbreviation for state the city is in, `governor` is the name of the governor of the state the city is in, and `mayor` is the name of the mayor of the city. For example, the tuple ('New York','NY','Andrew Cuomo','Bill diBlasio') gives information about New York City. Two cities may have the same name (for example there are at least two cities named Portland in the US), but two cities *in the same state* cannot have the same name. Two states cannot have the same abbreviation. Each city has exactly one mayor and each state has exactly one governor.

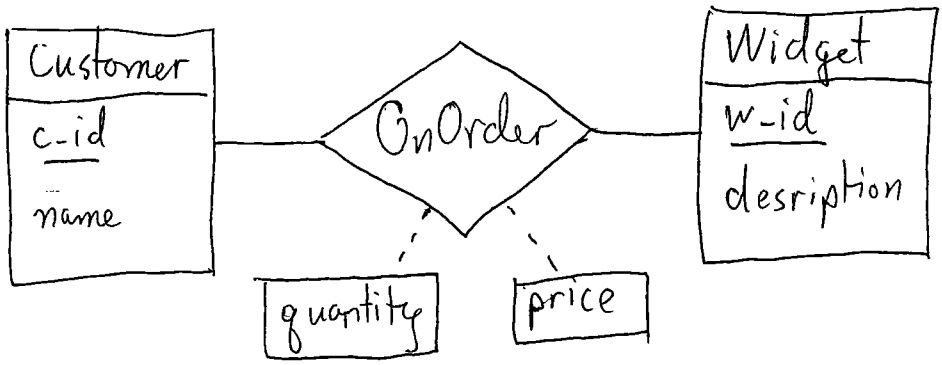
1. State whether each of these is **A.** a superkey, **B.** a superkey that is also a candidate key, or **C.** not a superkey:
   - $\{city\_name, state\}$
   - $\{city\_name, state, mayor\}$
   - $\{city\_name\}$
   - $\{state, governor\}$
2. If there are 500 cities from NY state in a relation of this schema, how many rows will need to be updated when NY gets a new governor?
3. We will say that a functional dependency $\alpha \rightarrow \beta$ is *trivial* if β is a subset of α. Give an example of a trivial functional dependency in this schema.
4. Give an example of a non-trivial functional dependency in this schema for which the left-hand side *is* a superkey.
5. Give an example of a non-trivial functional dependency in this schema for which the left-hand side *is not* a superkey.

6. Decompose the schema into two schemas that are in Boyce-Codd Normal Form (BCNF).

7. If there are 500 cities from NY state in relations of the BCNF schemas, how many rows will need to be updated when NY gets a new governor?

Problem 2

Consider the following flawed ER diagram representing customers' widget orders:



The `w_id` of a widget determines its `price` and its `description`. Each customer has a unique `c_id`. A customer may order different widgets with different `w_ids` and may order different `quantity` of each of them.

1. Following the rules we studied, convert the ER diagram into a relational schema.

2. The resulting schema is not in BCNF. Identify a non-trivial functional dependency where the left-hand side is not a superkey.

3. Decompose into schemas that are in BCNF.

4. Modify the ER diagram so that it corresponds to the normalized schema and briefly explain what the problem was with the original design.