Warmup #1  (Textbook Problem 8.6)
Compute the closure of the following set $F$ of functional dependencies for relation schema $R (A, B, C, D, E)$.

\[
\begin{align*}
A & \rightarrow BC \\
CD & \rightarrow E \\
B & \rightarrow D \\
E & \rightarrow A
\end{align*}
\]

List the candidate keys for $R$.

Warmup #2  (Textbook Problem 8.7)
Using the functional dependencies from the previous exercise, compute the canonical cover $F_c$.

Warmup #3  (Textbook Problem 8.9)
Given the database schema $R(a, b, c)$, and a relation $r$ on the schema $R$, write a SQL query to test whether the functional dependency $b \rightarrow c$ holds on relation $r$. Also write an SQL assertion that enforces the functional dependency; assume that no null values are present.

Warmup #4  (Textbook Problem 8.23)
Why are certain functional dependencies called trivial functional dependencies?

Warmup #5  (Textbook Problem 3.5)
Suppose that we have a relation $marks(ID, score)$ and we wish to assign grades to students based on the score as follows: grade $F$ if $score < 40$, grade $C$ if $40 \leq score < 60$, grade $B$ if $60 \leq score < 80$, and grade $A$ if $80 \leq score$. Write SQL queries to do the following:

a. Display the grade for each student, based on the marks relation.

b. Find the number of students with each grade.

Problem 6 (To Be Graded)

Following is the simplified schema for the database of Rhode Island State Police Highway Patrol Unit:

- Person(SSN, name, street_address, state)
- Car(license, year, model)
- Accident(license, accident_date_time, driver_ssn, damage_amount)
- Owns(SSN, license)

Where:
- Each car in an accident has a separate accident report.
- A car cannot be in multiple accidents at a given time.
- A driver_ssn can be in an accident with a car another person owns. (i.e. The driver_ssn in an accident is not always the car’s owner.)
- All accidents recorded in this database have occurred in RI. However some of the Person records can be from outside RI.
- State codes follows the general convention; RI, MA etc.

For each of the following queries give the equivalent SQL queries.

1. Find top 5 license plate numbers of Toyota (model) cars that have been in most accidents in 2015.

2. Find accident reports (license plate and time) where driver is not the car owner.

3. Find the name and address of people who have been involved in an accident (as a driver) where the damages are more than $1,000.

4. Find top 5 unique out-of-state drivers that have been involved in most costly accidents (in terms of damage amount).

Problem 7 (To Be Graded)

Consider the retailer database from previous homeworks. Following is a simplified schema for its database, which you should already be familiar with:

- regions(id, address)
- customers(id, status, street, city, zip, region_id, cc_number)
- orders(id, cid, total, qty)
- order_items(oid, iid, qty)
- items(id, price)

Where:
- cc_number is a credit card number, which is used by the customer for payments.
- region_id is a region that serves the customer.
Assume the following requirement: every region serves different zip areas, but a zip area may be served only by a single region.

(1) Does this requirement bring any functional dependencies?

Now assume an additional requirement: a customer can have multiple addresses and credit card numbers.

(2) Does this requirement bring any functional dependencies?

(3) Define SQL constraints with `ALTER DOMAIN` statements for the following requirements:

- `status` must be either “Basic” or “Subscriber”.
- `price` for every item must be non-negative and `qty` (quantity) of an item in an order must be greater than zero.
- `total` and `qty` in the `order` must correspond to the total price and total quantity of all items included in the order.