CS 353 Spring 2020
Homework 3 Solutions
Due: 13 March, Wednesday till 17:00

Q.1 [60 pts] (Each part, except (e), (g), and (h) are 5 points; (e), (g), and (h) are 10 points.)
Consider the computer product database schema below.

Product(maker, model, type)
PC(model, speed, ram, hd, price)
Laptop(model, speed, ram, hd, screen, price)
Printer(model, color, type, price)

Maker of a product is the manufacturer firm. models are numbers for PCs, Laptops, and Printers. Type of a product is "pc", "laptop", or "printer." Color for printer is true for color printers, false for black and white printers. Printer type is "laser" or "inkjet". PC models are four-digit numbers 1XXX. Laptop models are four-digit numbers 2XXX. Printer models are four-digit numbers 3XXX.

Write the following queries in SQL:
a) Find the model number and price for all color laser printers.
b) Find the manufacturers that produce PC's or Laptops, but not printers.
c) Find the manufacturers that produce laptops who have a hard disk higher than 120 GB and a memory (RAM) of at least 1024 MB and a screen size of at least 17.0 inch, together with the laptop models and prices of the models.
d) Find the manufacturer pairs that produce the same PC models with the speeds of at least 2.5 MHz. Report the pairs only once.
e) Find the Laptop models that are produced by at least three different manufacturers. Do this i) without aggregate operators, ii) with aggregate operators.
f) Find the manufacturers that produce all PCs and laptops whose speed is at least 2.50.
g) Find the manufacturers who produce exactly one PC, one Laptop, and one Printer model. Do this i) without aggregate operators, ii) with aggregate operators.
h) Find the manufacturer(s) who produce Laptops with the highest speed. Do this i) without aggregate operators, ii) with aggregate operators.
i) Find the pairs of laptops (model) with the same speed, RAM, and screen size. Report the pairs only once.

Solution:
a)
```
SELECT P.model, P.price
FROM Printer P
WHERE color = "true" AND type = "laser"
```

b)
```
(SELECT P.maker
 FROM Product P )
EXCEPT
(SELECT P.maker
 FROM Product P
 WHERE type = "printer")
```

c)
```
SELECT P.maker, L.model, L.price
 FROM Product P, Laptop L
WHERE P.model = L.model AND
      hd > 120 AND ram  >= 1024 AND screen >= 17.0
```

d) SELECT P1.maker, P2.maker
FROM PRODUCT P1, PRODUCT P2, PC
WHERE P1.maker < P2.maker AND P1.model = P2.model AND
P1.model = PC.model AND PC.speed >=2.50

e) i)

```
SELECT P1.model
FROM PRODUCT P1, PRODUCT P2, PRODUCT P3
WHERE P1.type = "laptop" AND P1.model = P2.model AND P2.model = P3.model AND
        P1.maker <> P2.maker AND P2.maker <> P3.maker AND P1.maker <> P3.maker
```

ii)

```
SELECT P1.model
FROM PRODUCT P1
WHERE P1.type = "laptop"
GROUP BY model
HAVING COUNT(*) >= 3
```

f)

```
SELECT P1.maker, P1.model
FROM PRODUCT P1
WHERE NOT EXIST
    (((SELECT PC2.model
       FROM PC PC2
       WHERE speed >= 2.50)
       UNION
      (SELECT L2.model
       FROM LAPTOP L2
       WHERE speed >= 2.50))
     EXCEPT
     ((SELECT PC1.model
       FROM PC PC1
       WHERE P1.model = PC1.model)
       UNION
      (SELECT L1.model
       FROM LAPTOP L1
       WHERE P1.model = L1.model)))
```

g) i)

```
((SELECT P1.maker
 FROM PRODUCT P1
 WHERE P1.type = "pc")
 EXCEPT
 (SELECT P2.maker
  FROM PRODUCT P2, PRODUCT P3
  WHERE P2.maker = P3.maker AND P2.model <> P3.model AND
        P2.type = "pc" AND P3.type = "pc"))
INTERSECT
((SELECT P1.maker
 FROM PRODUCT P1
 WHERE P1.type = "laptop")
 EXCEPT
```

```
(SELECT P2.maker
 FROM PRODUCT P2, PRODUCT P3
 WHERE P2.maker = P3.maker AND P2.model <> P3.model AND
   P2.type = "laptop" AND P3.type = "laptop"))
INTERSECT
((SELECT P1.maker
 FROM PRODUCT P1
 WHERE P1.type = "printer")
 EXCEPT
 (SELECT P2.maker
  FROM PRODUCT P2, PRODUCT P3
  WHERE P2.maker = P3.maker AND P2.model <> P3.model AND
    P2.type = "printer" AND P3.type = "printer"))
```

ii)

```
(SELECT P1.maker
 FROM PRODUCT P1
 WHERE P1.type = "PC"
 GROUPBY P1.maker
 HAVING COUNT(*) =1)
INTERSECT
(SELECT P1.maker
 FROM PRODUCT P1
 WHERE P1.type = "laptop"
 GROUPBY P1.maker
 HAVING COUNT(*) =1)
INTERSECT
(SELECT P1.maker
 FROM PRODUCT P1
 WHERE P1.type = "printer"
 GROUPBY P1.maker
 HAVING COUNT(*) =1)
```

h) i)

```
SELECT P.maker
FROM PRODUCT P
WHERE P.model IN
((SELECT L1.model
  FROM LAPTOP L1)
  EXCEPT
 (SELECT L2.model
  FROM LAPTOP L2, LAPTOP L3
  WHERE L2.speed < L3.speed))
```

ii)

```
SELECT P.maker
FROM PRODUCT P
WHERE P.model IN
        ((SELECT L1.model
          FROM LAPTOP L1
          WHERE speed =
```

```
                    SELECT MAX(speed)
                    FROM LAPTOP L2)
```

i)
```
SELECT L1.model, L2.model
FROM LAPTOP L1, LAPTOP L2
WHERE L1.model < L2.model AND L1.speed = L2.speed AND
        L1.ram = L2.ram AND L1.screen = L2.screen
```

Q.2 [20 pts, 5 pts each]

World War II capital ships schema. Ships are built in "classes" from the same design, and the class is usually named for the first ship of that class. The relation Classes records the name of the class, the type ('bb' for battleship or 'bc' for battlecruiser), the country that built the ship, the number of main guns, and the displacement (weight, in tons). Relation Ships records the name of the ship, the name of its class, and the year in which the ship was launched. Relation Battles gives the name and date of battles involving these ships, and relation Outcomes gives the result ("sunk", "damaged", or "ok") for each in each battle.

Classes(<u>class</u>, type, country, numGuns, bore, displacement)
Ships(<u>name</u>, class, launched)
Battles(<u>name</u>, date)
Outcomes(<u>ship, battle</u>, result)

a) What does the following query mean (express the meaning in one English sentence)?
```
SELECT O.ship, O.battle, O.result, C.country
FROM OUTCOMES O, SHIPS S, CLASSES C
WHERE O.ship = S.name AND S.class = C.class AND O.result IN ( "damaged", "sunk")
```
b) Write an equivalent query **without** using IN (set membersip) operator and the set construct.

c) What does the following query mean (express the meaning in one English sentence)?

$\Pi_{name,\ country,\ type}$ (($\Pi_{ship,\ battle}$ (Outcomes) / Π_{battle} (Outcomes)) $\bowtie_{ship\ =\ name}$ Ships $\bowtie$ Classes)

d) Write the equivalent SQL query.

Solution:

a) Find the ships that are damaged or sunk in a battle, together with the name of the battle, the result ("damaged" or "sunk"), and the country that the ship belongs.

b)
```
SELECT O.ship, O.battle, O.result, C.country
FROM OUTCOMES O, SHIPS S, CLASSES C
WHERE O.ship = S.name AND S.class = C.class AND
        (O.result = "damaged" OR O.result = "sunk")
```

c) Find the ships involved in all battles, together with their countries and ship types (battleship or battlecruiser).

d)
```
SELECT O.ship, C.country, C.type
FROM OUTCOMES O, SHIPS S, CLASSES C
WHERE O.ship = S.name AND S.class = C.class AND
        NOT EXIST
        ((SELECT B.name
         FROM BATTLE B)
        EXCEPT
```

```
(SELECT O2.battle
  FROM OUTCOMES O2
  WHERE O.ship = O2.ship))
```

Q.3 [20 pts, 5 pts each]

Consider the schema provided in Question 1. Write the following queries in SQL:

a) Delete all laptops whose ram are less than 1024 MB.
b) Delete all printers that are produced by a manufactures that doesn't produce PC's and Laptops.
c) For each PC manufactured by manufacturer IBM, subtract 100 $ from the price and double amount of hard disk and ram.
d) Delete all ships from the Ships table that had sunk in a Battle.

Solution:

a)
```
DELETE FROM LAPTOP
WHERE ram < 1024
```

b)
```
DELETE FROM PRINTER
WHERE model IN
    (SELECT P1.model
     FROM PRODUCT P1
     WHERE P1.maker NOT IN
            (SELECT P2.maker
             FROM PRODUCT P2
             WHERE P2.model LIKE "1___" OR P2.model LIKE "2___"))
```

c)
```
UPDATE PC
SET PRICE = PRICE – 100, hd = hd *2, ram = ram * 2
WHERE model IN
    (SELECT model
     FROM PRODUCT
     WHERE maker = IBM)
```

d)
```
DELETE FROM SHIPS
WHERE name IN
    (SELECT ship
     FROM OUTCOME
     WHERE result = "sunk")
```