CS262- Problem Set 1

CS262- Database Systems
2021-CS-33 — Muhammad Hamad Hassan

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Consider the following schema.
Company(name, city)
Description Relation list the company name and location of company in city attribute.

Product(name, maker, cost, year)
Description Each product has name, and manufacturer of product in maker, cost as purchase price, and year as the launch year of that particular product. product name is unique for all problems except problem No.4

Purchase(id, product, buyer, price)
Description Relation list the purchases made by customer listed in buyer columns, price as sale price, and product as name of product.

To-Do For each of the problems given below you are required to provide Relational algebra expression and at least five equivalent solutions in SQL, out of which one solution should be performed using

1. Cartesian product
2. Joins
3. Subquery

Problem 1. Find the products(names only) whose cost is more than the average cost.

Solution.

$$\pi\text{name}(\sigma\text{cost} > \text{AVG (cost)}(\text{Product}))$$

1. SELECT name FROM Product WHERE cost > (SELECT AVG(cost)FROM Product)
2. SELECT pr.name FROM Product Pr CROSS JOIN Product Pr1 GROUP BY Pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)
3. SELECT pr.name FROM Product Pr CROSS JOIN Product Pr1 WHERE PR.maker=PR1.maker GROUP BY pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)
4. SELECT pr.name FROM Product Pr JOIN Product Pr1 ON PR.maker=PR1.maker GROUP BY pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)
5. SELECT pr.name FROM Product Pr JOIN Product Pr1 ON PR.maker¿PR1.maker GROUP BY pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)
6. SELECT pr.name FROM Product Pr LEFT OUTER JOIN Product Pr1 ON PR.maker=PR1.maker GROUP BY pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)
7. SELECT pr.name FROM Product Pr Right OUTER JOIN Product Pr1 ON PR.maker=PR1.maker GROUP BY pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)
8. SELECT pr.name FROM Product Pr FULL OUTER JOIN Product Pr1 ON PR.maker=PR1.maker GROUP BY pr.name,Pr.cost HAVING Pr.cost > AVG(Pr1.cost)

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Problem 2. List the name of companies whose products are bought by Aslam.

Solution.

$$(\pi\text{C.name}(\sigma\text{Pu.buyer='Aslam'}(\text{Company C} \bowtie (\text{Product Pr} \bowtie (\text{Purchase Pu}))))$$

1. SELECT C.name FROM Company C,Product Pr, Purchase Pu WHERE C.name=Pr.maker AND Pr.name=Pu.product AND pu.buyer ='Aslam'
2. SELECT C.name FROM Company C WHERE C.name IN (SELECT Pr.maker FROM Product Pr, Purchase Pu WHERE pu.buyer ='Aslam' AND Pr.name=Pu.product)
3. SELECT C.name FROM Company C WHERE C.name IN (SELECT Pr.maker FROM Product Pr WHERE Pr.name IN (SELECT Pu.product FROM Purchase Pu WHERE pu.buyer='Aslam'))
4. SELECT Pr.maker FROM Product Pr WHERE Pr.name IN (SELECT Pu.product FROM Purchase Pu WHERE Pu.buyer='Aslam')
5. SELECT C.name FROM Company C CROSS JOIN Product Pr CROSS JOIN Purchase Pu WHERE C.name=Pr.maker AND Pr.name=Pu.product AND pu.buyer ='Aslam'
6. SELECT C.name FROM Company C FULL OUTER JOIN Product Pr ON C.name=Pr.maker FULL OUTER JOIN Purchase Pu ON Pr.name=Pu.product WHERE pu.buyer ='Aslam'
7. SELECT C.name FROM Company C LEFT OUTER JOIN Product Pr ON C.name=Pr.maker LEFT OUTER JOIN Purchase Pu ON Pr.name=Pu.product WHERE pu.buyer ='Aslam'
8. SELECT C.name FROM Company C RIGHT OUTER JOIN Product Pr ON C.name=Pr.maker RIGHT OUTER JOIN Purchase Pu ON Pr.name=Pu.product WHERE pu.buyer ='Aslam'
9. SELECT C.name FROM Company C LEFT OUTER JOIN Product Pr ON C.name=Pr.maker RIGHT OUTER JOIN Purchase Pu ON Pr.name=Pu.product WHERE pu.buyer ='Aslam'
10. SELECT C.name FROM Company C LEFT OUTER JOIN Product Pr ON C.name=Pr.maker WHERE PR.name IN (SELECT Pu.product FROM Purchase Pu WHERE pu.buyer ='Aslam')
11. SELECT C.name FROM Company C JOIN Product Pr ON C.name=Pr.maker JOIN Purchase Pu ON Pr.name=Pu.product WHERE pu.buyer ='Aslam'

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Problem 3. List the name of products that are more expensive that all the products produced by Unilever.

Solution.

πPr.name($\neg$(σPu.maker='Unilever') AND (Pr1.cost> Sum(Pr.cost)(Product Pr $\bowtie$ (Product Pr1))))

1. DECLARE @SUM as int =(Select SUM(Pr.cost) FROM Product Pr WHERE Pr.maker='Unilever') (SELECT Pr.name FROM Product Pr WHERE NOT Pr.maker='Unilever' AND Pr.cost>@SUM)
2. SELECT Pr.name FROM Product Pr WHERE NOT Pr.maker='Unilever' AND Pr.cost>(Select SUM(Pr.cost) FROM Product Pr WHERE Pr.maker='Unilever')
3. SELECT DISTINCT Pr.name FROM Product Pr CROSS JOIN Product Pr1 WHERE NOT Pr.maker='Unilever' AND Pr.cost>(Select SUM(Pr.cost) FROM Product Pr WHERE Pr.maker='Unilever')
4. SELECT Pr.name FROM Product Pr FULL OUTER JOIN Product Pr1 ON Pr.name=Pr1.name WHERE NOT Pr.maker='Unilever' AND Pr.cost>(Select SUM(Pr.cost) FROM Product Pr WHERE Pr.maker='Unilever')
5. SELECT Pr.name FROM Product Pr Left OUTER JOIN Product Pr1 ON Pr.name=Pr1.name WHERE NOT Pr.maker='Unilever' AND Pr.cost>(Select SUM(Pr.cost) FROM Product Pr WHERE Pr.maker='Unilever')
6. SELECT Pr.name FROM Product Pr Right OUTER JOIN Product Pr1 ON Pr.name=Pr1.name WHERE NOT Pr.maker='Unilever' AND Pr.cost>(Select SUM(Pr.cost)FROM Product Pr WHERE Pr.maker='Unilever')

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Problem 4. List the copy cat products along with manufacturer, i.e. the products that have the same name as produced by Unilever.

Solution. 1. SELECT Pr.maker FROM Product Pr Where Pr.name = (SELECT Pr1.name FROM Product Pr1 Where Pr.name=Pr1.name)

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Problem 5. Buyers of products produced in Lahore.

Solution.

$$\pi \text{Pr.name}(\sigma \text{city='Lahore'} AND \text{Pr.maker} = \text{C.name (Product Pr} \bowtie \text{(Company C)))}$$

1. SELECT Pr.name FROM Company C,Product Pr WHERE Pr.maker=C.name AND C.city='Lahore'
2. SELECT Pr.name FROM Product Pr CROSS JOIN Company C WHERE Pr.maker=C.name AND C.city='Lahore'
3. SELECT Pr.name FROM Product Pr JOIN Company C ON Pr.maker=C.name WHERE C.city='Lahore'
4. SELECT Pr.name FROM Product Pr FULL OUTER JOIN Company C ON Pr.maker=C.name WHERE C.city='Lahore' AND Pr.name IS NOT NULL
5. SELECT Pr.name FROM Product Pr LEFT OUTER JOIN Company C ON Pr.maker=C.name WHERE C.city='Lahore' AND Pr.name IS NOT NULL
6. SELECT Pr.name FROM Product Pr RIGHT OUTER JOIN Company C ON Pr.maker=C.name WHERE C.city='Lahore' AND Pr.name IS NOT NULL
7. SELECT Pr.name FROM Product Pr WHERE Pr.maker IN (SELECT C.name FROM Company C WHERE C.city='Lahore')

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Problem 6. List of buyers, who only buy the products 'Made in Karachi'.

Solution.

πPu.buyer(σPu.product=Pr.nameANDPr.maker=C.nameANDPr.city='Lahore'(Product Pr)(Company C)(Purchase Pu)))

1. SELECT Pu.buyer FROM Purchase Pu WHERE Pu.product IN(SELECT Pr.name FROM Product Pr WHERE Pr.maker IN (SELECT C.name FROM Company C WHERE C.city='Lahore'))
2. SELECT Pu.buyer FROM Purchase Pu,Product Pr,Company C WHERE Pu.product=Pr.name AND Pr.maker =C.name AND C.city='Lahore'
3. SELECT Pu.buyer FROM Purchase Pu CROSS JOIN Product Pr CROSS JOIN Company C WHERE Pu.product=Pr.name AND Pr.maker =C.name AND C.city='Lahore'
4. SELECT Pu.buyer FROM Purchase Pu JOIN Product Pr ON Pu.product=Pr.name JOIN Company C ON Pr.maker =C.name WHERE C.city='Lahore'
5. SELECT Pu.buyer FROM Purchase Pu FULL OUTER JOIN Product Pr ON Pu.product=Pr.name FULL OUTER JOIN Company C ON Pr.maker =C.name WHERE C.city='Lahore'AND Pu.id IS NOT NULL
6. SELECT Pu.buyer FROM Purchase Pu LEFT OUTER JOIN Product Pr ON Pu.product=Pr.name LEFT OUTER JOIN Company C ON Pr.maker =C.name WHERE C.city='Lahore'AND Pu.id IS NOT NULL
7. SELECT Pu.buyer FROM Purchase Pu RIGHT OUTER JOIN Product Pr ON Pu.product=Pr.name RIGHT OUTER JOIN Company C ON Pr.maker =C.name WHERE C.city='Lahore'AND Pu.id IS NOT NULL

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Problem 7. Name and price of products bought by more than five customers.

Solution.

$$\pi \text{Name, AVG(price)} \ (\gamma \text{product(count(product)} \geq 5) \ \text{(Purchase))} \tag{1}$$

1. SELECT Pu.product as Name,AVG(Pu.price) as Price FROM Purchase Pu GROUP BY Pu.product HAVING COUNT(Pu.product)>=5
2. SELECT Pu.product as Name,AVG(Pu.price) as Price FROM Purchase Pu CROSS JOIN Purchase Pu1 WHERE Pu.id=Pu1.id GROUP BY Pu.product HAVING COUNT(Pu1.product)>=5
3. SELECT Pu.product as Name,AVG(Pu.price) as Price FROM Purchase Pu JOIN Purchase Pu1 ON Pu.id=Pu1.id GROUP BY Pu.product HAVING COUNT(Pu1.product)>=5

4. SELECT Pu.product as Name,AVG(Pu.price) as Price FROM Purchase Pu FULL OUTER JOIN Purchase Pu1 ON Pu.id=Pu1.id GROUP BY Pu.product HAVING COUNT(Pu1.product)>=5

5. SELECT Pu.product as Name,AVG(Pu.price) as Price FROM Purchase Pu LEFT OUTER JOIN Purchase Pu1 ON Pu.id=Pu1.id GROUP BY Pu.product HAVING COUNT(Pu1.product)>=5

6. SELECT Pu.product as Name,AVG(Pu.price) as Price FROM Purchase Pu RIGHT OUTER JOIN Purchase Pu1 ON Pu.id=Pu1.id GROUP BY Pu.product HAVING COUNT(Pu1.product)>=5

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Problem 8. List of products that are more expensive that all the products made by same company before 2015.

Solution. 1. SELECT Pr.name FROM Product Pr WHERE Pr.cost> (SELECT AVG(Pr1.cost) FROM Product Pr1 WHERE Pr1.maker=Pr.maker AND YEAR(Pr1.years)<'2015')

2. SELECT DISTINCT Pr.name FROM Product Pr CROSS JOIN Product Pr1 WHERE Pr1.maker=Pr.maker OR Pr.cost>(SELECT AVG(Pr2.cost) FROM Product Pr2 WHERE YEAR(Pr2.years)<'2015')

3. SELECT Pr.name FROM Product Pr JOIN Product Pr1 ON Pr1.maker=Pr.maker WHERE Pr.cost>(SELECT AVG(Pr.cost) FROM Product Pr WHERE YEAR(Pr.years)<'2015')

4. SELECT Pr.name FROM Product Pr FULL OUTER JOIN Product Pr1 ON Pr1.maker=Pr.maker WHERE Pr.cost> (SELECT AVG(Pr.cost) FROM Product Pr WHERE YEAR(Pr.years)<'2015')

5. SELECT Pr.name FROM Product Pr LEFT OUTER JOIN Product Pr1 ON Pr1.maker=Pr.maker WHERE Pr.cost> (SELECT AVG(Pr.cost) FROM Product Pr WHERE YEAR(Pr.years)<'2015')

6. SELECT Pr.name FROM Product Pr RIGHT OUTER JOIN Product Pr1 ON Pr1.maker=Pr.maker WHERE Pr.cost>(SELECT AVG(Pr.cost) FROM Product Pr WHERE YEAR(Pr.years)<'2015')

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Problem 9. List of companies who never sale products with loss.

Solution.

$$\pi \text{ name}(\sigma \text{ C.name} = \text{Pr.maker} \,\&\, \text{Pr.name} = \text{Pu.product} \,\&\, \text{Pr.cost} < \text{Pu.price})(\text{Company C} \bowtie \text{Product Pr} \bowtie \text{Purchase Pu}) \tag{2}$$

1. SELECT C.name FROM Company C WHERE C.name IN (SELECT Pr.maker FROM Product Pr WHERE Pr.name IN(SELECT Pu.product FROM Purchase Pu WHERE Pr.cost<Pu.price))

2. SELECT DISTINCT C.nameFROM Company C,Product Pr,Purchase Pu WHERE C.name=Pr.maker AND Pr.name = Pu.product AND Pr.cost< Pu.price

3. SELECT DISTINCT C.name FROM Company C CROSS JOIN Product Pr CROSS JOIN Purchase Pu WHERE C.name=Pr.maker AND Pr.name = Pu.product AND Pr.cost<

4. SELECT DISTINCT C.name FROM Company C JOIN Product Pr ON C.name=Pr.maker JOIN Purchase Pu ON Pr.name = Pu.product WHERE Pr.cost< Pu.price

5. SELECT DISTINCT C.name FROM Company C FULL OUTER JOIN Product Pr ON C.name=Pr.maker FULL OUTER JOIN Purchase Pu ON Pr.name = Pu.product WHERE Pr.cost< Pu.price

6. SELECT DISTINCT C.name FROM Company C LEFT OUTER JOIN Product Pr ON C.name=Pr.maker LEFT OUTER JOIN Purchase Pu ON Pr.name = Pu.product WHERE Pr.cost< Pu.price

7. SELECT DISTINCT C.name FROM Company C RIGHT OUTER JOIN Product Pr ON C.name=Pr.maker RIGHT OUTER JOIN Purchase Pu ON Pr.name = Pu.product WHERE Pr.cost< Pu.price

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Problem 10. List the products which have more than average revenue in 2015 but below average revenue in 2016

Solution. 1. (SELECT DISTINCT Pr.name FROM Product Pr JOIN Purchase Pu ON Pr.name=Pu.product WHERE (Pr.cost-Pu.price)¿ (SELECT AVG(Pr1.cost- Pu1.price) FROM Product Pr1,Purchase Pu1 WHERE YEAR(Pr1.years)='2015') AND (Pr.cost-Pu.price)¿(SELECT AVG(Pr.cost-Pu.price) FROM Product Pr JOIN Purchase Pu ON Pr.name=Pu.product WHERE YEAR(Pr.Years)='2016'))

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