

CS - 425 Database Organization Homework 1  
Fall 2023

Due Date: 10th September 2023 By 11:59 pm

**Instructions**

1. Try to answer all the questions using what you have learnt in class.
2. When writing a query, write the query in a way that it would work over all possible database instances and not just for the given example Instance!

Consider the following Employer database schema and example instance:

## Customers

CustomerID	name	address	city
E1001	Tom, Smith	123 Main St.	Naperville
E1002	Ann, Chin	456 Market Ave.	NY
E1003	Perry, Lee	31st Street	Chicago

## Orders

OrderID	CustomerID	OrderDate	TotalAmount
1	E1001	January 2020	4,800
2	E1002	June 2022	25,000
3	E1001	August 2022	50

## OrderDetails

OrderID	ProductID	Quantity
1	1	80
1	2	15
1	3	5
2	3	250
3	1	1
4	2	2
4	3	1

## Products

ProductID	Name	Category	Price
1	Product A	Electronics	50
2	Product B	Clothing	20
3	Product C	Jewelry	100
4	Product D	Books	10
5	Product E	Sports	30
6	Product F	Electronics	40

## Part 1.1 Relational Algebra (Total: 54 Points)

Give an expression in the relational algebra to express each of the following queries:

### Question 1.1.1 (6 Points)

a. For each relation, what is/are the appropriate primary key(s)?

Customers = CustomerID

Orders = OrderID

OrderDetails = no primary key

Products = ProductID

b. Given your choice of primary keys, identify appropriate foreign keys.

Customers = no foreign key

Orders = CustomerID

OrderDetails = OrderID, ProductID

Products = no foreign key

### Question 1.1.2 (3 Points)

List the names of all customers.

$\Pi_{\text{name}}(\text{Customers})$

### Question 1.1.3 (3 Points)

List the categories of all products.

$\Pi_{\text{Category}}(\text{Products})$

### Question 1.1.4 (3 Points)

List the names and the prices of all the products.

$\Pi_{\text{Name, Price}}(\text{Products})$

**Question 1.1.5 (3 Points)**

Find the name of the products with a price less than or equal to \$35.

$\sigma (\text{Price} \leq 35)(\text{Products})$

**Question 1.1.6 (3 Points)**

Find all the products with a price between \$10 and \$100.

$\sigma (\text{Price} \geq 10 \text{ AND Price} \leq 100)(\text{Products})$

**Question 1.1.7 (3 Points)**

List the names of customers who made an order in March 2022.

$\Pi (\text{name}) ((\text{Customers} \bowtie (\sigma \text{ OrderDate} = \text{'March 2022'} (\text{Orders}))))$

**Question 1.1.8 (3 Points)**

List names of customers who have made more than 2 orders.

$\Pi (\text{name}) (\text{Customers} \bowtie ((\sigma \text{ count} > 2) \gamma (\text{CustomerID}; \text{count} \leftarrow \text{COUNT}(\ast) \text{Orders})))$

**Question 1.1.9 (3 Points)**

Find all information about customers who made an order with a total amount greater than \$300.

$\Pi (\text{CustomerID}, \text{name}, \text{address}, \text{city}) (\text{Customers} \bowtie (\sigma (\text{TotalAmount} > 300) \text{Orders}))$

**Question 1.1.10 (3 Points)**

List the names of all customers who spent more than every customer on product 'Product A':

$\Pi (\text{name}) (\text{Customers} \bowtie (\sigma(\text{ProductID} = 1) (\text{OrderDetails} \bowtie \text{Orders})) \bowtie \gamma(\text{CustomerID}; \text{total\_amount} \leftarrow \text{SUM}(\text{TotalAmount})) (\sigma(\text{ProductID} = 1) (\text{OrderDetails} \bowtie \text{Orders})))$

**Question 1.1.11 (3 Points)**

Find the categories names of all products with price greater than \$100.

$\Pi (\text{Category}) (\sigma(\text{Price} > 100) \text{Products})$

**Question 1.1.12 (3 Points)**

Find all products located in every category of Electronics.

$\Pi (\text{ProductID}, \text{Name}) (\text{Products} \bowtie \sigma(\text{Category} = \text{'Electronics'}) \text{Products})$

**Question 1.1.13 (3 Points)**

Find the product with the highest total sales amount.

$\Pi (\text{Name}) (\text{Products} \bowtie (\sigma (\text{ProductID} = \text{MaxProductID}) (\gamma \text{ProductID}; \text{MaxProductID} \leftarrow \text{MAX}(\text{Quantity}) (\text{OrderDetails} \bowtie \text{Products}))))$

**Question 1.1.14 (3 Points)**

For each product, list the highest, lowest, and average order total amount.

$\Pi (\text{ProductID}, \text{Name}, \text{MaxTotalAmount}, \text{MinTotalAmount}, \text{AvgTotalAmount}) ((\text{Products} \bowtie (\text{OrderDetails} \bowtie \text{Orders})) \bowtie \gamma \text{ProductID}; \text{MaxTotalAmount} \leftarrow \text{MAX}(\text{TotalAmount}), \text{MinTotalAmount} \leftarrow \text{MIN}(\text{TotalAmount}), \text{AvgTotalAmount} \leftarrow \text{AVG}(\text{TotalAmount}) (\pi \text{ProductID}, \text{Name}, \text{TotalAmount} (\text{Products} \bowtie (\text{OrderDetails} \bowtie \text{Orders}))))$

**Question 1.1.15 (3 Points)**

Modify the database so that the customer with the name Smith now lives in Atlanta

```
UPDATE Customers
SET city = 'Atlanta'
WHERE name = 'Tom, Smith';
```

**Question 1.1.16 (3 Points)**

Give all orders in this database a 10 percent increase in total amount, unless the total amount would be greater than \$100,000. In such cases, give only a 5 percent increase.

```
UPDATE Orders
SET TotalAmount = CASE
    WHEN TotalAmount * 1.10 > 100000 THEN TotalAmount * 1.05
    ELSE TotalAmount * 1.10
END;
```

**Question 1.1.17 (3 Points)**

In February 2022, a new customer named "Manny Sammy" made an order. He lives in "Washington DC". Add the new customer and their order to the database.

```
INSERT INTO Customers (CustomerID, name, address, city)
VALUES ('e1004', 'Manny Sammy', 'street address', 'Washington DC');
```

```
INSERT INTO Orders (OrderID, CustomerID, OrderDate, TotalAmount)
VALUES (4, 'e1004', 'February 2022', 0);
```