אלגברת היחסים

Query 1

```
SELECT COUNT(*)  FROM book_instock INNER JOIN book_extension INNER JOIN book WHERE
book_instock.book_extension_id = book_extension.book_extension_id AND
book_extension.book_id = book.book_id AND book.book_name = 'input';
```

$$\pi\ COUNT(*)\ (\sigma\ bookInStock.bookExtensionId = bookExtension.bookExtensionId\ \wedge bookExtension.bookId = book.bookId\ \wedge book.bookName =\ input\ )(bookInStock\ \bowtie\ book)$$

Query 2

```
SELECT first_name, last_name
FROM customer WHERE customer_id =
(SELECT MIN(customer_id) FROM customer)
```

$$\pi\ firstName\ ,lastName\ (\sigma\ customerId = \big(\pi\ Min(customerId)(customer)\big)(customer)$$

Query 3

```
SELECT book_name FROM book_instock
INNER JOIN book_extension INNER JOIN book
WHERE book_instock.book_extension_id = book_extension.book_extension_id AND
book_extension.book_id = book.book_id
AND(SELECT MIN(date_in) FROM book_instock)
LIMIT 1
```

$$\pi\ bookName\ (\ \sigma\ bookInStock.bookExtensionId = bookExtension.BookExtensionId\ \wedge bookExtension.bookId = book.bookId\ \wedge book.bookId = \big(\pi\ Min(dateIn)(bookInStock)\big))(bookInStock\ \bowtie\ book)$$

Query 4

```
SELECT order_id, date_in, book_name , language , publisher_name ,publish_year , first_name,
last_name, mobile_number
FROM orders INNER JOIN book_extension INNER JOIN book INNER JOIN customer
WHERE book_extension.book_extension_id = orders.book_extension_id AND
book_extension.book_id = book.book_id AND customer.customer_id =
orders.customer_id
ORDER BY date_in
```

$$\pi\ orderId\ ,dateIn\ ,bookName\ ,language\ ,$$
$$publisherName\ ,publishYear\ ,firstName\ ,lastName\ ,mobileNumber\ (\sigma\ bookExtension.bookExtensi$$
$$= orders.bookExstensionId\ \wedge bookExtension.bookId$$
$$= book.bookId\ \wedge customer.customerId = orders.customerId\ )(\tau\ dateIn)(orders$$
$$\bowtie bookExtension\ \bowtie book\ \bowtie customer)$$

Query 5

```
SELECT COUNT(*) FROM books_sales
INNER JOIN book_extension INNER JOIN book
WHERE books_sales.book_extension_id = book_extension.book_extension_id AND
book_extension.book_id = book.book_id AND book.book_name = 'input'
```

$$\pi\ COUNT(*)(\sigma\ booksSales.bookExtensionId$$
$$= bookExtension.bookExtensionId\ \wedge bookExtension.bookId$$
$$= book.bookId\ \wedge book.bookName$$
$$= 'input')(bookSales\ \bowtie bookExtension\ \bowtie book\ )$$

Query 6

```
SELECT first_name , last_name , COUNT(*)
FROM books_sales INNER JOIN book_extension INNER JOIN book_author_relation INNER JOIN
authors
WHERE books_sales.book_extension_id = book_extension.book_extension_id AND
book_extension.book_id = book_author_relation.book_id AND book_author_relation.author_id =
authors.author_id AND sale_date BETWEEN 'input1' AND 'input2' GROUP BY first_name ,
last_name LIMIT 1;
```

$$\pi\ firstName\ ,lastName\ ,COUNT(*)\big(\sigma\ booksSales.bookExtensionId$$
$$= bookExtension.bookExtensionId\ \wedge bookExtension.bookId$$
$$= bookAuthorRelation.bookId\ \wedge bookAuthorRelation.authorId$$
$$= authors.authorId\ \wedge\ saleDate$$
$$\geq\ 'input1'\ \wedge saleDate \leq\ 'input2'\ \Im\ firstName\ \wedge lastName\big)\ (booksSales$$
$$\bowtie\ bookExtension\ \bowtie\ bookAuthorRelation\ \bowtie authors)$$

Query 7

SELECT first_name , last_name , SUM(counter) FROM (SELECT customer.customer_id AS id, first_name, last_name , COUNT(*) AS counter
FROM deal INNER JOIN customer INNER JOIN deal_books_relation WHERE deal.customer_id = customer.customer_id AND deal_books_relation.deal_id = deal.deal_id
GROUP BY customer.customer_id
UNION
SELECT customer.customer_id AS id, first_name , last_name , COUNT(*) FROM delivery INNER JOIN delivery_books_relation INNER JOIN deal INNER JOIN customer WHERE delivery.delivery_id = delivery_books_relation.delivery_id AND delivery.deal_id = deal.deal_id AND deal.customer_id = customer.customer_id GROUP BY customer.customer_id) AS complex GROUP BY id LIMIT 3

$$\pi\ firstName\ ,lastName\ ,SUM(counter)(\Big(\pi\ customer.customerId\ ,firstName\ ,lastName\ ,COUNT$$
$$= custmer.customerId\ \wedge dealBooksRelation.dealId$$
$$= deal.dealId\ \Im\ customer.customerId)(deal\ \bowtie customer\ \bowtie dealBooksRelation\ )\Big)$$
$$\bowtie\ \big(\pi\ customer.customerId\ ,firstName\ ,lastName\ ,COUNT(*)\ (\sigma\ delivery.deliveryId$$
$$= deliveryBooksRelation.deliveryId\ \wedge delivery.dealId = deal.dealId\ \wedge deal.customerId$$
$$= customer.customerId\ \Im\ customer.customerId)\big(delivery\ \bowtie deliveryBooksRelation$$
$$\bowtie deal\ \bowtie customer\big)\ \Im\ customer.customerId\big)$$

Query 8

SELECT book_name , COUNT(*) FROM book_extension INNER JOIN book WHERE book_extension.book_id = book.book_id AND book_extension.language IS NOT NULL GROUP BY book_name LIMIT 1

$$\pi\ bookName\ ,COUNT(*)(\sigma\ bookExtension.bookId = book.bookId\ \wedge bookExtension.language$$
$$\neq NULL\ \Im\ bookName)(bookExtension\ \bowtie book)$$

Query 9

```
SELECT book_name, books_sales.price, sale_date  FROM deal INNER JOIN customer INNER JOIN
deal_books_relation INNER JOIN books_sales INNER JOIN book_extension INNER JOIN book
WHERE  deal.deal_id = deal_books_relation.deal_id AND deal.customer_id =
customer.customer_id AND books_sales.books_sale_id = deal_books_relation.book_sale_id AND
books_sales.book_extension_id = book_extension.book_extension_id AND book.book_id =
book_extension.book_id AND first_name = 'input1' AND last_name = 'input2'
UNION
SELECT book_name , books_sales.price , sale_date FROM delivery INNER JOIN
delivery_books_relation INNER JOIN deal INNER JOIN customer INNER JOIN books_sales INNER
JOIN book_extension INNER JOIN book WHERE delivery.deal_id = deal.deal_id AND
delivery_books_relation.delivery_id = delivery.delivery_id AND deal.customer_id =
customer.customer_id AND books_sales.books_sale_id = delivery_books_relation.book_sale_id
AND books_sales.book_extension_id = book_extension.book_extension_id AND book.book_id =
book_extension.book_id AND first_name = 'input1' AND last_name = 'input2'
```

$$\pi\ bookName\ ,booksSales.price\ ,saleDate\ (\text{deal.dealId} = \text{deal}_{\text{booksRelation}}.\text{dealId} \wedge \text{deal.customerId} = \text{customer.customerId} \wedge \text{books}_{\text{sales}}.\text{booksSaleId} = \text{dealBooksRelation.book}_{\text{sale}_{\text{id}}} \wedge \text{books}_{\text{sales}}.\text{bookExtensionId} = \text{bookExtension.bookExtensionId} \wedge \text{book.bookId} = \text{bookExtension.bookId} \wedge \text{first}_{\text{name}} = \text{'input1'} \wedge \text{last}_{\text{name}} = \text{'input2'})\ (\text{deal} \bowtie \text{customer} \bowtie \text{dealBooksRelation} \bowtie \text{booksSales} \bowtie \text{bookExtension} \bowtie \text{book}) \bowtie (\pi\ bookName\ ,booksSales.price\ ,saleDate\ (\sigma\ \text{delivery.deal}_{\text{id}} = \text{deal.deal}_{\text{id}} \wedge \text{deliveryB}ooksRelation.deliveryId = \text{delivery.}deliveryId \wedge \text{deal.}customerId = \text{customer.}customerId \wedge booksSales.booksSalesId = deliveryBooksRelation.bookSaleId \wedge booksSalesId.bookExtensionId = bookExtension.bookExtensionId \wedge \text{book.}bookId = \text{bookExtension.bookId} \wedge firstName = \text{'input1'} \wedge lastName = \text{'input2'})(delivery \bowtie deliveryBooksRelation \bowtie deal \bowtie customer \bowtie booksSales \bowtie bookExtension \bowtie book))$$

Query 10

```
SELECT book_name , date_in , isArrived , isBought FROM orders INNER JOIN book_extension
INNER JOIN book INNER JOIN customer WHERE orders.book_extension_id =
book_extension.book_extension_id AND book_extension.book_id = book.book_id AND
orders.customer_id = customer.customer_id AND customer.first_name = 'input1' AND
customer.last_name = 'input2' ORDER BY date_in
```

$$(\pi\ \text{book\_name , date\_in , isArrived , isBought})(\sigma\ \text{orders.book\_extension\_id} = \text{book\_extension.book\_extension\_id} \wedge \text{book\_extension.book\_id} = \text{book.book\_id} \wedge \text{orders.customer\_id} = \text{customer.customer\_id} \wedge \text{customer.first\_name} = \text{'input1'} \wedge \text{customer.last\_name} = \text{'input2'}\ \tau\ \text{date\_in})(\text{orders} \bowtie \text{book\_extension} \bowtie \text{book} \bowtie \text{customer})$$

Query 11

*The query depends on number of inputs by the user – the example shows 1 input

SELECT SUM(weight) FROM book_instock INNER JOIN book_extension WHERE book_instock.book_extension_id = book_extension.book_extension_id AND book_instock_id = 'input'

$$(\pi\ \text{SUM(weight)})(\sigma\ \text{book\_instock.book\_extension\_id} = \text{book\_extension.book\_extension\_id} \wedge \text{book\_instock\_id} = \text{'input'})(\text{book\_instock} \bowtie \text{book\_extension})$$

Query 12

SELECT tracking_id, delivery_status, courier_company, delivery_type, deal.date_in FROM delivery INNER JOIN deal WHERE delivery.deal_id = deal.deal_id AND delivery.deal_id = (SELECT deal.deal_id FROM delivery INNER JOIN deal INNER JOIN customer WHERE delivery.deal_id = deal.deal_id AND customer.customer_id = deal.customer_id AND first_name = 'input1' AND last_name = 'input2' HAVING COUNT(deal.deal_id) > 1)

$$\pi\ \text{tracking\_id, delivery\_status, courier\_company, delivery\_type, deal.date\_in}\ (\sigma\ \text{delivery.deal\_id} = \text{deal.deal\_id AND delivery.deal\_id} = ((\pi\ \text{deal.deal\_id})(\sigma\ \text{delivery.deal\_id} = \text{deal.deal\_id} \wedge \text{customer.customer\_id} = \text{deal.customer\_id} \wedge \text{first\_name} = 'input1' \wedge \text{last\_name} = 'input2' \wedge \text{COUNT(deal.deal\_id)} > 1)(\text{delivery} \bowtie \text{deal} \bowtie \text{customer}))) (\text{delivery} \bowtie \text{deal})$$

Query 13

SELECT delivery_status FROM delivery WHERE delivery_id = input

$$\pi\ \text{delivery\_status}\ (\sigma\ \text{delivery\_id} = \text{input})(\text{delivery})$$

Query 14

SELECT COUNT(*) FROM delivery INNER JOIN deal WHERE delivery.deal_id = deal.deal_id AND courier_company = 'Xpress' AND date_in BETWEEN 'input-01' AND 'input-31'

$$\pi\ \text{COUNT}(*)\ (\sigma\ \text{delivery.deal\_id} = \text{deal.deal\_id} \wedge \text{courier\_company} = 'Xpress' \wedge \text{date\_in} \geq 'input-01' \wedge \text{date\_in} \leq 'input-31')(\text{delivery} \bowtie \text{deal})$$

Query 15

SELECT SUM(price) FROM deal WHERE payment_type = 'Bit' AND date_in BETWEEN 'input-01' AND 'input-31'

$$\pi\ \text{SUM(price)}\ (\sigma\ \text{payment\_type} = 'Bit' \wedge \text{date\_in} \geq 'input-01' \wedge \text{date\_in} \leq 'input-31')(\text{deal})$$

Query 16

```
SELECT customer.first_name, customer.last_name, date_in, price, payment_type,
employee.first_name, employee.last_name FROM deal INNER JOIN customer INNER JOIN
employee WHERE deal.employee_id = employee.employee_id AND deal.customer_id =
customer.customer_id AND price > (SELECT AVG(price) FROM deal WHERE date_in >= NOW() -
INTERVAL 1 YEAR)
```

$$\pi\ \text{customer.first\_name, customer.last\_name, date\_in, price, payment\_type, employee.first\_name, emplo}$$
$$(\sigma\ \text{deal.employee\_id} = \text{employee.employee\_id} \wedge \text{deal.customer\_id}$$
$$= \text{customer.customer\_id} \wedge \text{price} > (\pi\ \text{AVG(price)}(\sigma\ \text{date\_in} >$$
$$= \text{NOW()} - \text{INTERVAL 1 YEAR})(\text{deal}))(\text{deal} \bowtie \text{customer} \bowtie \text{employee})$$

Query 17

```
SELECT COUNT(*) FROM delivery WHERE courier_company = 'Israel Post'
```

$$\pi\ \text{COUNT}(*)\ (\sigma\ \text{courier\_company} = \text{'Israel Post'})(\text{delivery})$$

```
SELECT COUNT(*) FROM delivery WHERE courier_company = 'Xpress'
```

$$\pi\ \text{COUNT}(*)\ (\sigma\ \text{courier\_company} = \text{'Xpress'})(\text{delivery})$$

Query 18

```
SELECT first_name, last_name FROM deal INNER JOIN employee WHERE employee.employee_id =
deal.employee_id AND MONTH(deal.date_in) = input GROUP BY employee.employee_id LIMIT 1
```

$$\pi\ \text{first\_name, last\_name}(\sigma\ \text{employee.employee\_id}$$
$$= \text{deal.employee\_id} \wedge \text{MONTH(deal.date\_in)}$$
$$= \text{input}\ \Im\ \text{employee.employee\_id})(\text{deal} \bowtie \text{employee})$$

Query 19

```
SELECT delivery.delivery_id, delivery.delivery_type, delivery.delivery_status, delivery.deal_id
FROM delivery INNER JOIN delivery_books_relation INNER JOIN books_sales INNER JOIN
book_extension WHERE delivery.delivery_id = delivery_books_relation.delivery_id AND
delivery_books_relation.book_sale_id = books_sales.books_sale_id AND
books_sales.book_extension_id = book_extension.book_extension_id GROUP BY book_id HAVING
COUNT(book_extension.book_extension_id) > 1 ;
```

$$\pi\ \text{delivery.delivery}_{\text{id}}, \text{delivery.delivery}_{\text{type}}, \text{delivery.delivery}_{\text{status}}, \text{delivery.deal}_{\text{id}}(\sigma\ \text{delivery.delivery\_}$$
$$= \text{delivery\_books\_relation.delivery\_id} \wedge \text{delivery\_books\_relation.book\_sale\_id}$$
$$= \text{books\_sales.books\_sale\_id} \wedge \text{books\_sales.book\_extension\_id}$$
$$= \text{book\_extension.book\_extension\_id} \wedge \text{COUNT(book\_extension.book\_extension\_id)}$$
$$> 1\ )(\text{delivery} \bowtie \text{delivery\_books\_relation} \bowtie \text{books\_sales} \bowtie \text{book\_extension})$$

Query 20

```
SELECT customer.first_name, customer.last_name, customer.phone_number,
customer.mobile_number FROM customer INNER JOIN deal WHERE deal.customer_id =
customer.customer_id AND deal.date_in <= NOW() - INTERVAL 24 MONTH GROUP BY
customer.customer_id
```

$$\pi\ \text{customer.first\_name, customer.last\_name, customer.phone\_number, customer.mobile\_number}\ (\sigma\ \text{deal.customer\_id} = \text{customer.customer\_id} \wedge \text{deal.date\_in} \leq \text{NOW}() - \text{INTERVAL 24 MONTH GROUP BY customer.customer\_id})(\text{customer} \bowtie \text{deal})$$

Query 21

```
SELECT * FROM orders WHERE isArrived = 1 AND date_arrived <= NOW() - INTERVAL 14 DAY AND
isBought = 0
```

$$\pi\ \mathit{AllAtributes}\ (\sigma\ \text{isArrived} = 1\ \text{AND date\_arrived} \leq \text{NOW}() - \text{INTERVAL 14 DAY} \wedge \text{isBought} = 0)(\text{orders})$$

Query 22

```
SELECT YEAR(date_in), MONTH(date_in), COUNT(*) FROM book_instock GROUP BY
MONTH(date_in), YEAR(date_in) ORDER BY date_in
```

$$\pi\ \text{YEAR(date\_in), MONTH(date\_in), COUNT(}*)\ (\Im\ \text{MONTH(date\_in), YEAR(date\_in)}\ \tau\ \text{date\_in})(\text{book\_instock})$$

Query 23

```
SELECT SUM(books_sales.price) - SUM(book_instock.price) FROM books_sales INNER JOIN
book_instock WHERE MONTH(books_sales.sale_date) =  input1 AND
MONTH(book_instock.date_in) = input1 AND YEAR(books_sales.sale_date) = input2 AND
YEAR(book_instock.date_in) = input2
```

$$\pi\ \text{SUM(books\_sales.price)} - \text{SUM(book\_instock.price)}(\ \sigma\ \text{MONTH(books\_sales.sale\_date)} = \text{input1} \wedge \text{MONTH(book\_instock.date\_in)} = \text{input1} \wedge \text{YEAR(books\_sales.sale\_date)} = \text{input2} \wedge \text{YEAR(book\_instock.date\_in)} = \text{input2})(\text{books\_sales} \bowtie \text{book\_instock})$$

Query 24

```
SELECT SUM(price) FROM deal WHERE date_in >= NOW() - INTERVAL 1 YEAR
```

$$\pi\ \text{SUM(price)}\ (\ \sigma\ \text{date\_in}\ \geq\ \text{NOW()}\ -\ \text{INTERVAL 1 YEAR})$$
$$=\ \text{input2}\ \wedge\ \text{YEAR(book\_instock.date\_in)}\ =\ \text{input2})(\text{deal})$$

Query 25

```
SELECT monthly_hours, salary FROM employee INNER JOIN employees_hours WHERE
employee.employee_id = employees_hours.employee_id AND employee.first_name = 'input1'
AND employee.last_name = 'input2' AND month = 'input3-01'
```

$$\pi\ \text{monthly\_hours, salary}\ (\ \sigma\ \text{employee.employee\_id}$$
$$=\ \text{employees\_hours.employee\_id}\ \wedge\ \text{employee.first\_name}$$
$$=\ 'input1'\ \wedge\ \text{employee.last\_name}\ =\ 'input2'\ \wedge\ \text{month}$$
$$=\ 'input3 - 01')(\text{employee}\ \bowtie\ \text{employees\_hours}\ )$$

Query 26

```
SELECT COUNT(*), SUM(deal.price) FROM deal WHERE deal.date_in BETWEEN 'input1' AND
'input2'
```

$$\pi\ \text{COUNT}(*), \text{SUM(deal.price)}(\ \sigma\ \text{deal.date\_in}\ \geq\ 'input1'\ \wedge \text{deal.date\_in}\ \geq\ 'input2')(\text{deal})$$