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Факультет «Информатика и системы управления»

Кафедра ИУ5 «Системы обработки информации и управления»

Курс «Базы данных»

Отчет по лабораторной работе №5

«Использование триггеров и хранимых процедур PostgreSQL»

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Цель лабораторно работ:
изучить хранимые процедуры и триггеры в базах данных, приобрести практические навыки создания хранимых процедур и триггеров в среде PostgreSQL.

a. Пример из теоретической части:

```sql
CREATE OR REPLACE PROCEDURE InsertNewProducts()
LANGUAGE SQL
AS $$
INSERT INTO products (product_name, price, description)
VALUES
    ('Product 6', 19.99, 'Description of Product 6'),
    ('Product 7', 34.99, 'Description of Product 7'),
    ('Product 8', 42.99, 'Description of Product 8');
$$;
```

Data Output | Messages | Notifications

```
CREATE PROCEDURE

Query returned successfully in 57 msec.
```

```sql
CALL InsertNewProducts();
```

1.функция

a. Пример из теоретической части:
1)

```
CREATE OR REPLACE FUNCTION OrderPrice(x NUMERIC)
RETURNS TABLE(order_id INT, total NUMERIC) AS $$
BEGIN
   RETURN QUERY
   SELECT
      o.order_id,
      SUM(i.quantity * p.price) AS total
   FROM
      orders o
   JOIN
      items i ON o.order_id = i.order_id
   JOIN
      products p ON i.product_id = p.product_id
   GROUP BY
      o.order_id
   HAVING
      SUM(i.quantity * p.price) > x
   ORDER BY
      o.order_id;
END;
$$ LANGUAGE plpgsql;
```

```sql

CREATE OR REPLACE FUNCTION OrderPrice(x NUMERIC)
RETURNS TABLE(order_id INT, total NUMERIC) AS $$
BEGIN
    RETURN QUERY
    SELECT
        o.order_id,
        SUM(i.quantity * p.price) AS total
    FROM
        orders o
    JOIN
        items i ON o.order_id = i.order_id
    JOIN
        products p ON i.product_id = p.product_id
    GROUP BY
        o.order_id
    HAVING
        SUM(i.quantity * p.price) > x
    ORDER BY
        o.order_id;
END;
$$ LANGUAGE plpgsql;

```

Эта функция рассчитает общую цену для каждого заказа, умножив количество заказанных товаров на соответствующую цену за единицу, а затем суммируя эти значения. Он вернет order_id и общую цену для ордеров, общая цена которых превышает входной параметр x.

```sql

SELECT * FROM OrderPrice(15)

```

Data Output | Messages | Notifications

	order_id integer	total numeric
1	1	147.94
2	2	91.97
3	3	159.94

2)

CREATE OR REPLACE PROCEDURE

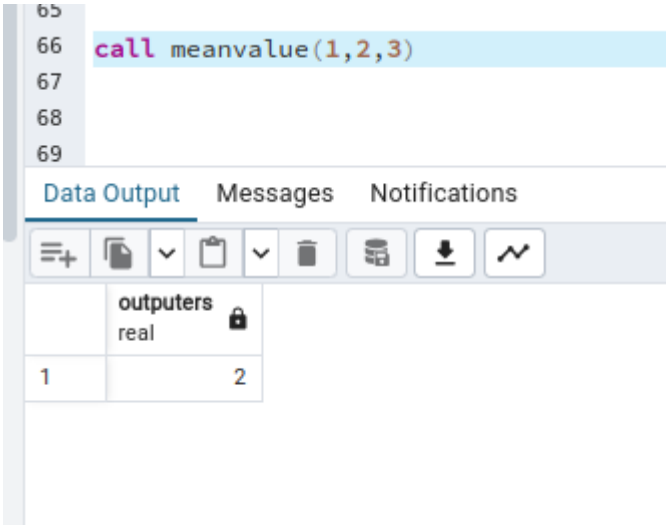
MeanValue (
    Value1 REAL DEFAULT 0,
    Value2 REAL DEFAULT 0,
    Value3 REAL DEFAULT 0,
        INOUT outputers REAL DEFAULT 0

)
LANGUAGE plpgsql

AS $$
BEGIN
    SELECT (Value1 + Value2 + Value3) / 3 INTO outputers;

END; $$;

```
50
51  CREATE OR REPLACE PROCEDURE
52  MeanValue (
53      Value1 REAL DEFAULT 0,
54      Value2 REAL DEFAULT 0,
55      Value3 REAL DEFAULT 0,
56      INOUT outputers REAL DEFAULT 0
57  )
58  LANGUAGE plpgsql
59  AS $$
60  BEGIN
61      SELECT (Value1 + Value2 + Value3) / 3 INTO outputers;
62  END; $$;
63
64
65
```



c. Хранимая процедуру для поиска по диапазону цен.

```
CREATE OR REPLACE FUNCTION GetProductsByPriceRange(min_price NUMERIC, max_price
NUMERIC)
RETURNS TABLE(product_name VARCHAR, price MONEY) AS $$
BEGIN
   RETURN QUERY
   SELECT
      products.product_name,
      products.price::MONEY  -- Cast the price column to MONEY type
   FROM
      products
   WHERE
      products.price BETWEEN min_price AND max_price;
END;
$$ LANGUAGE plpgsql;
```

```sql
CREATE OR REPLACE FUNCTION GetProductsByPriceRange(min_price NUMERIC, max_price NUMERIC)
RETURNS TABLE(product_name VARCHAR, price MONEY) AS $$
BEGIN
    RETURN QUERY
    SELECT
        products.product_name,
        products.price::MONEY  -- Cast the price column to MONEY type
    FROM
        products
    WHERE
        products.price BETWEEN min_price AND max_price;
END;
$$ LANGUAGE plpgsql;
```

```sql
100
101
102 SELECT * FROM GetProductsByPriceRange(15.99, 24.99);
103
104
```

Data Output | Messages | Notifications

	product_name character varying	price money
1	Product 4	$15.99
2	Product 2	$24.99

d. Хранимая процедура для поиска заказов по дате заказа и диапазону дат заказа. „

```
CREATE OR REPLACE FUNCTION GetOrdersByDateRange(start_date DATE, end_date
DATE)
RETURNS TABLE(order_id INT, customer_name CHAR, order_date DATE)
AS $$
BEGIN
   RETURN QUERY
   SELECT
      o.order_id,
      c.customer_name::CHAR,  -- Explicitly cast to CHAR type
      o.order_date
   FROM
      orders o
   JOIN
      customers c ON o.customer_id = c.customer_id
   WHERE
      o.order_date BETWEEN start_date AND end_date;
END;
$$ LANGUAGE plpgsql;
```

```
119
120 -- CREATE OR REPLACE FUNCTION GetOrdersByDateRange(start_date DATE, end_date DATE)
121 -- RETURNS TABLE(order_id INT, customer_name CHAR, order_date DATE)
122 -- AS $$
123 -- BEGIN
124 --     RETURN QUERY
125 --     SELECT
126 --         o.order_id,
127 --         c.customer_name::CHAR,  -- Explicitly cast to CHAR type
128 --         o.order_date
129 --     FROM
130 --         orders o
131 --     JOIN
132 --         customers c ON o.customer_id = c.customer_id
133 --     WHERE
134 --         o.order_date BETWEEN start_date AND end_date;
135 -- END;
136 -- $$ LANGUAGE plpgsql;
137
138
139 SELECT * FROM GetOrdersByDateRange('2024-02-01', '2024-02-22');
140
141
142
```

Data Output | Messages | Notifications

	order_id integer	customer_name character	order_date date
1	4	J	2024-02-22
2	1	J	2024-02-19
3	3	J	2024-02-21
4	2	J	2024-02-20

e. По заданию: варифнта

1) получить сгруппированный по городу список с инйормацей (№заказа, дата заказа, дата доставки) за итервал временной. Отсортировать список по дате доставки. Интервал вводятся как параметры.

```
DROP FUNCTION IF EXISTS GetOrdersByCityAndDateRange(date, date);

CREATE OR REPLACE FUNCTION GetOrdersByCityAndDateRange(start_date
DATE, end_date DATE)
RETURNS TABLE(city TEXT, order_id INT, order_date DATE, ship_date
DATE)
AS $$
BEGIN
    RETURN QUERY
    SELECT
        c.address AS city,
        o.order_id,
        o.order_date,
        o.ship_date
    FROM
        orders o
    JOIN
        customers c ON o.customer_id = c.customer_id
    WHERE
        o.ship_date BETWEEN start_date AND end_date
    ORDER BY
        o.ship_date;
END;
$$ LANGUAGE plpgsql;


--- - SELECT * FROM GetOrdersByCityAndDateRange('2024-02-01', '2024-02-
28');
```

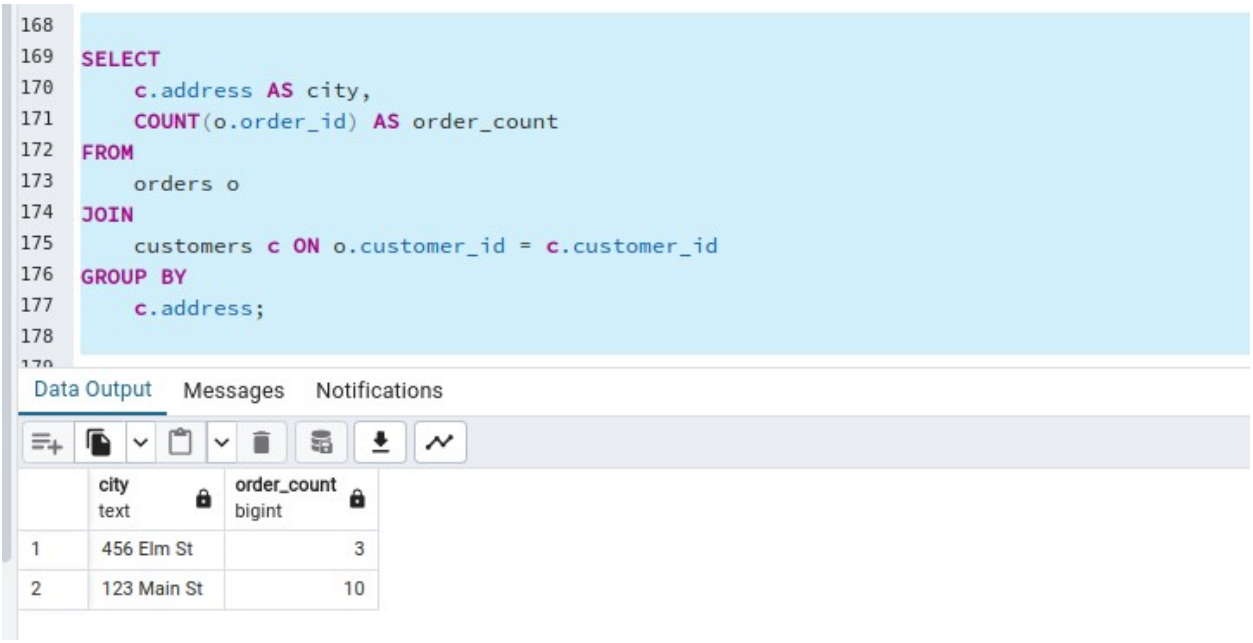
```sql
CREATE OR REPLACE FUNCTION GetOrdersByCityAndDateRange(start_date DATE, end_date DATE)
RETURNS TABLE(city TEXT, order_id INT, order_date DATE, ship_date DATE)
AS $$
BEGIN
    RETURN QUERY
    SELECT
        c.address AS city,
        o.order_id,
        o.order_date,
        o.ship_date
    FROM
        orders o
    JOIN
        customers c ON o.customer_id = c.customer_id
    WHERE
        o.ship_date BETWEEN start_date AND end_date
    ORDER BY
        o.ship_date;
END;
$$ LANGUAGE plpgsql;


SELECT * FROM GetOrdersByCityAndDateRange('2024-02-01', '2024-02-28');
```

Data Output | Messages | Notifications

	city text	order_id integer	order_date date	ship_date date
1	123 Main St	4	2024-02-22	2024-02-23
2	123 Main St	5	2024-02-23	2024-02-24
3	123 Main St	6	2024-02-24	2024-02-25
4	456 Elm St	7	2024-02-25	2024-02-26
5	123 Main St	8	2024-02-26	2024-02-27
6	123 Main St	9	2024-02-27	2024-02-28

2) подсчитать количество заказов по городам

```
SELECT
    c.address AS city,
    COUNT(o.order_id) AS order_count
FROM
    orders o
JOIN
    customers c ON o.customer_id = c.customer_id
GROUP BY
    c.address;
```



```
168
169 SELECT
170     c.address AS city,
171     COUNT(o.order_id) AS order_count
172 FROM
173     orders o
174 JOIN
175     customers c ON o.customer_id = c.customer_id
176 GROUP BY
177     c.address;
178
```

Data Output | Messages | Notifications

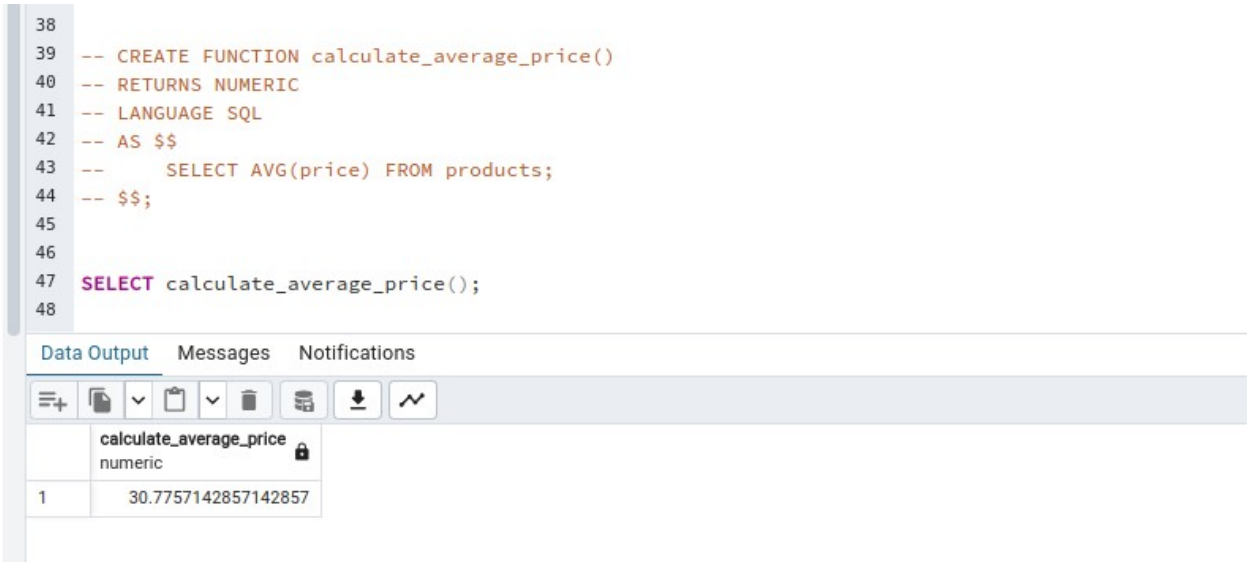
	city text	order_count bigint
1	456 Elm St	3
2	123 Main St	10

создать функция

```
CREATE FUNCTION calculate_average_price()
RETURNS NUMERIC
LANGUAGE SQL
AS $$
   SELECT AVG(price) FROM products;
$$;
```

вызывать функция

```
SELECT calculate_average_price();
```



This function calculates the average price of all products in your products table. You can call this function to get the average price.

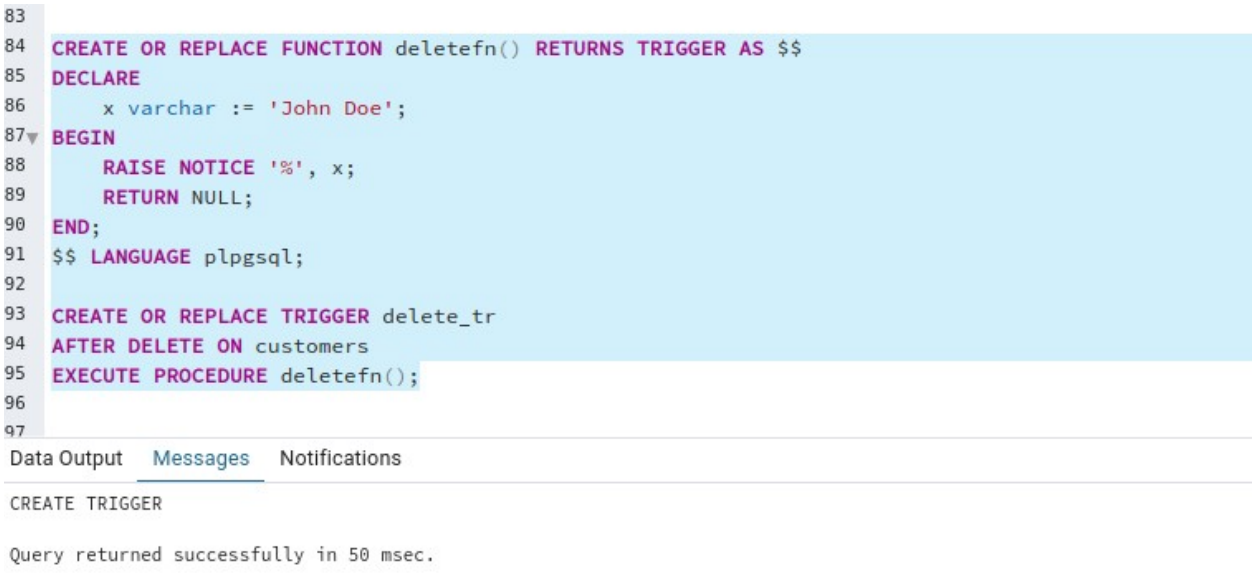
3. Создать триггер INSERT

```
CREATE OR REPLACE FUNCTION update_product_stock()
RETURNS TRIGGER AS $$
BEGIN
    -- Decrease the stock quantity of the ordered product
    UPDATE products
    SET stock_quantity = stock_quantity - NEW.quantity
    WHERE product_id = NEW.product_id;

    RETURN NULL;
END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER update_stock_on_order
AFTER INSERT ON items
FOR EACH ROW
EXECUTE FUNCTION update_product_stock();
```

```
55
56  CREATE OR REPLACE FUNCTION update_product_stock()
57  RETURNS TRIGGER AS $$
58  BEGIN
59      -- Decrease the stock quantity of the ordered product
60      UPDATE products
61      SET stock_quantity = stock_quantity - NEW.quantity
62      WHERE product_id = NEW.product_id;
63
64      RETURN NULL;
65  END;
66  $$ LANGUAGE plpgsql;
67
68  CREATE TRIGGER update_stock_on_order
69  AFTER INSERT ON items
70  FOR EACH ROW
71  EXECUTE FUNCTION update_product_stock();
72
```

4. Создать триггер DELETE

```
CREATE OR REPLACE FUNCTION deletefn() RETURNS TRIGGER AS $$
DECLARE
   x varchar := 'John Doe';
BEGIN
   RAISE NOTICE '%', x;
   RETURN NULL;
END;
$$ LANGUAGE plpgsql;

CREATE OR REPLACE TRIGGER delete_tr
AFTER DELETE ON customers
EXECUTE PROCEDURE deletefn();
```



Создать триггер UPDATE:

```
28
29  CREATE OR REPLACE FUNCTION products_update_trigger()
30  RETURNS TRIGGER AS $$
31  BEGIN
32      -- Вставляем обновленные данные в таблицу products_audit
33      INSERT INTO products_audit (product_id, old_product_name, new_product_name, old_price, new_price, old_description, new_description,
34      VALUES (OLD.product_id, OLD.product_name, NEW.product_name, OLD.price, NEW.price, OLD.description, NEW.description, NOW());
35
36      RETURN NEW;
37  END;
38  $$ LANGUAGE plpgsql;
39
40  CREATE TRIGGER update_products_trigger
41  AFTER UPDATE ON products
42  FOR EACH ROW
43  EXECUTE FUNCTION products_update_trigger();
44
45
```

Data Output | Messages | Notifications

```
CREATE TRIGGER

Query returned successfully in 118 msec.
```

```
46  UPDATE products
47  SET product_name = 'New Product Name'
48  WHERE product_id = 1;
49
```

Data Output | Messages | Notifications

```
UPDATE 1

Query returned successfully in 55 msec.
```

6. Создать триггер, который при удалении записи из таблицы Products сначала
удаляет все связанные с ней записи из таблицы Items, а затем удаляет саму запись из таблицы Products.

Допустим, у вас есть две таблицы: товары и заказы, и вы хотите удалить все заказы, связанные с удаленным товаром, прежде чем удалять сам товар. Вот как можно создать такой триггер:

```
63
64  CREATE OR REPLACE FUNCTION delete_orders_for_product()
65  RETURNS TRIGGER AS $$
66  BEGIN
67      -- Delete all orders related to the deleted product
68      DELETE FROM orders WHERE product_id = OLD.product_id;
69
70      RETURN OLD;
71  END;
72  $$ LANGUAGE plpgsql;
73
74  CREATE TRIGGER delete_orders_for_product_trigger
75  BEFORE DELETE ON products
76  FOR EACH ROW
77  EXECUTE FUNCTION delete_orders_for_product();
78
```

Data Output | Messages | Notifications

```
CREATE TRIGGER

Query returned successfully in 44 msec.
```

7. Создать триггер, с использованием временной таблицы NEW.

```
CREATE OR REPLACE FUNCTION before_insert_products_trigger()
RETURNS TRIGGER AS $$
BEGIN
    -- Выводим новые значения перед вставкой в таблицу
    RAISE NOTICE 'New product_id: %, product_name: %, price: %', NEW.product_id, NEW.product_name, NEW.price;

    -- Возвращаем NEW, чтобы продолжить вставку
    RETURN NEW;
END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER before_insert_products_trigger
BEFORE INSERT ON products
FOR EACH ROW
EXECUTE FUNCTION before_insert_products_trigger();

```

Data Output | Messages | Notifications

```
CREATE TRIGGER

Query returned successfully in 43 msec.
```

```
INSERT INTO products (product_name, price, description)
VALUES ('New Product', 29.99, 'Description of the new product');

```

Data Output | Messages | Notifications

```
NOTICE:  New product_id: 33, product_name: New Product, price: 29.99
INSERT 0 1

Query returned successfully in 213 msec.
```

8. Создать триггер DDL, который предотвратит удаление или изменение таблиц в базе данных.

Запрет всех команд работы с таблицами

```
102 CREATE OR REPLACE FUNCTION prevent_ddl_changes()
103 RETURNS event_trigger AS $$
104 BEGIN
105     IF (TG_OP = 'DROP TABLE' OR TG_OP = 'ALTER TABLE') THEN
106         RAISE EXCEPTION 'Changes to tables are not allowed';
107     END IF;
108 END;
109 $$ LANGUAGE plpgsql;
110
111 CREATE EVENT TRIGGER prevent_ddl_trigger
112 ON ddl_command_start
113 EXECUTE FUNCTION prevent_ddl_changes();
114
115
```

Data Output | Messages | Notifications

```
CREATE EVENT TRIGGER

Query returned successfully in 141 msec.
```

```
118 DROP TABLE products_audit;
119
120
```

Data Output | Messages | Notifications

```
ERROR:  column "tg_op" does not exist
LINE 1: (TG_OP = 'DROP TABLE' OR TG_OP = 'ALTER TABLE')
         ^
QUERY:  (TG_OP = 'DROP TABLE' OR TG_OP = 'ALTER TABLE')
CONTEXT:  PL/pgSQL function prevent_ddl_changes() line 3 at IF

SQL state: 42703
```

Выводы:

Изучены хранимые процедуры и триггеры в базах данных, приобретены практические навыки создания хранимых процедур и триггеров в среде PostgreSQL.