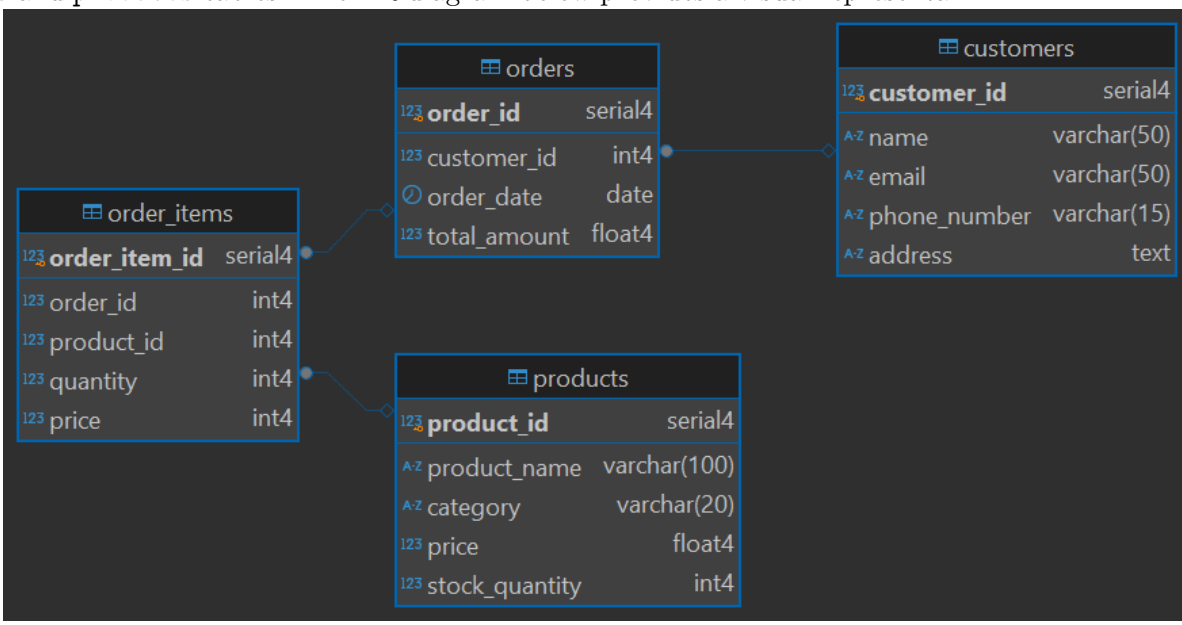
Ecommerce platform database modeling and analysis in PostrgreSQL

This project demonstrates the application of SQL skills in joins, aggregations and optimization to design and implement an efficient schema for an E-commerce platform.

The following is further documentation on each task for submission

Task 1: Database Design

The database contains for tables; `customers`, `products`, `orders` and `order_items`. We establish a relationship between the `orders` and `customers` table through a foreign key column `customer_id` in the `customers` table to the `customer_id` column in the `orders` table. The `order_items` table contains product and customer information for each made by customers. `order_id` and `product_id` columns in `order_item` link to the `order_id` and `product_id` columns in `orders` and `products` tables. The ER diagram below provides a visual representation of the schema



Task 2: Database Setup

To implement the schema in the database, we call `create table if not exists <table_name> (<col_1>,<col_2?>, ...)` for each table and the corresponding constraints

```sql
create table customers (
    customer_id serial primary key,
    name varchar(50) not null,
    email varchar(50) unique not null,
    phone_number varchar(15) unique not null,
    address text not null
);

create table products (
    product_id serial primary key,
    product_name varchar(100) unique not null,
    category varchar(20) not null,
    price float(2) not null,
    stock_quantity int
);

create table orders (
    order_id serial primary key,
    customer_id int references customers(customer_id),
    order_date date,
    total_amount float(2)
);

create table order_items (
    order_item_id serial primary key,
    order_id int references orders(order_id),
    product_id int references products(product_id),
    quantity int not null,
    price int not null
)
```

and relationships in the columns.

To persist data, we call `insert into <table_name> (<col_1>, <col_2>, ...) values (<val_1, <val_2>, ...)` for each table.

```sql
INSERT INTO customers (name, email, phone_number, address) VALUES
('Aisha Abubakar', 'aisha.abubakar@example.com', '0709117264', '123 Biashara Str
('Benson Kiprotich', 'b.kiprotich@company.net', '0721752252', '456 Koinange Stre
('Catherine Wanjiku', 'c.wanjiku@mail.org', '0735233833', '789 Tom Mboya Street
('David Omondi', 'david.omondi@web.io', '07100745296', '101 Moi Avenue, Nairobi
('Esther Akinyi', 'e.akinyi@email.co.ke', '0772491745', '222 Ronald Ngala Street
('Felix Musyoka', 'f.musyoka@online.com', '0766666666', '333 River Road, Nairobi
('Grace Atieno', 'grace.atieno@mymail.com', '07753924777', '444 Accra Road, Nair
('Hassan Mohammed', 'h.mohammed@domain.net', '0787833963', '555 Latema Road, Nai
('Ivy Chebet', 'ivy.chebet@site.org', '0753926484', '666 Kirinyaga Road, Nairobi
('John Kamau', 'john.kamau@mail.io', '0701234567', '777 Luthuli Avenue, Nairobi
('Khadija Ali', 'k.ali@email.com', '0712345678', '888 Moi Drive, Nairobi West');
```

```sql
INSERT INTO products (product_name, category, price, stock_quantity) VALUES
('Sony Bravia 55" TV', 'Electronics', 80000.00, 20),
('Savon Soap', 'Detergents', 80.00, 180),
('Garnier Micellar Water', 'Skincare', 600.00, 80),
('Kimbo Cooking Oil', 'Foods', 250.00, 80),
('Samsung Galaxy S23', 'Electronics', 120000.00, 30),
('Sunlight Dishwashing Liquid', 'Detergents', 180.00, 120),
('Pears Soap', 'Skincare', 100.00, 200),
('Raha Ugali', 'Foods', 120.00, 56),
('LG Refrigerator', 'Electronics', 60000.00, 15),
('Ariel Washing Powder', 'Detergents', 300.00, 75),
('Vaseline Petroleum Jelly', 'Skincare', 200.00, 150),
('Jogoo Maize Flour', 'Foods', 150.00, 100),
('Hisense Microwave', 'Electronics', 15000.00, 40),
('Jik Bleach', 'Detergents', 150.00, 90),
('Nivea Moisturizing Cream', 'Skincare', 450.00, 100),
('Brookside Milk', 'Foods', 60.00, 200),
('Skyworth 32" TV', 'Electronics', 25000.00, 35),
('Dettol Antiseptic Liquid', 'Detergents', 400.00, 60),
('Pemba Unga', 'Foods', 130.00, 90),
('Fresh Fri Cooking Oil', 'Foods', 280.00, 60);
```

```sql
INSERT INTO orders (customer_id, order_date, total_amount) VALUES
(22, '2024-06-15', 125.50),
(4, '2024-07-07', 300.00),
(45, '2024-09-20', 75.00),
(22, '2024-08-03', 450.75),
(8, '2024-09-11', 220.20),
(36, '2024-08-18', 95.80),
(27, '2024-09-09', 180.50),
(4, '2024-08-07', 375.25),
(29, '2024-08-06', 60.00),
(11, '2024-07-06', 520.90),
(38, '2024-06-07', 110.75),
```

```sql
INSERT INTO order_item
(1, 8, 1, 120),
(2, 4, 1, 250),
(3, 2, 1, 80),
(4, 5, 1, 120000),
(5, 1, 1, 80000),
```

Task 3 - Analytical Queries

Revenue Analysis

To calculate the total revenue by the platform we run the following query

```
-- Calculate all revenue for the
select sum(quantity*Price) as to
from order_items;
```

ustomers 1 products 2 orders 3 order_i

lect sum(quantity*Price) as total_revenue from

	total_revenue
1	2,525,660

To find the total revenue per product

```
-- Revenue per product
select p.category , sum(p.price*oi.quantity) as revenue
from products p
inner join order_items oi
on p.product_id = oi.product_id
group by p.category ;
```

ustomers 1 products 2 orders 3 order_items 4 products 5 ×

select p.category , sum(p.price*oi.quantity) as revenue fr Enter a SQL expression to

	category	revenue
1	Electronics	2,520,000
2	Detergents	2,420
3	Foods	3,240

Customer Insights

To extract the top 5 customers by spending we run

```
-- Top 5 customers by total spending
select c.name,c.phone_number , round(sum(o.total_amou
from orders o
inner join customers c
on o.customer_id =c.customer_id
group by c.customer_id
order by spending desc
limit 5;
```

ustomers 1 | products 2 | orders 3 | order_items 4 | customers 5 ×

select c.name,c.phone_number , round(sum(o.total_amo | Enter a SQL expressi

	name	phone_number	spending
1	David Omondi	07100745296	1,366
2	Victor Otieno	0724567890	1,198
3	Khadija Ali	0712345678	981
4	Robert Ochieng	0789012345	881
5	Peter Kioko	0767890123	876

To identify the customers who have not made a purchase

```
-- Customers without purchases
select c.name
from customers c
left join orders o
on c.customer_id = o.customer_id
where o.customer_id is null ;
```

stomers 1 | products 2 | orders 3 | order_items

lect c.name from customers c left join orders o on c

	name
18	Edwin Wanjala
19	Faith Moraa
20	Halima Juma
21	Ian Omondi
22	Kevin Ouma
23	Moses Otieno
24	Naomi Wanjiru
25	Oscar Musyoka
26	Rachel Njeri

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Product Trends

To find the 3 best selling product we run

```
-- 3 best selling products
select oi.product_id ,sum(oi.quantity*oi.price) as sales
from order_items oi
inner join products p
on oi.product_id = p.product_id
group by oi.product_id
order by sales desc
limit 3;
```

stomers 1 | products 2 | orders 3 | order_items 4 | order_items 5 ×

elect oi.product_id ,sum(oi.quantity*oi.price) as sales fr | Enter a SQL expression to fi

	product_id	sales
1	5	1,200,000
2	1	960,000
3	9	360,000

To identify the products that have ran out of stock we call the following query.

```
-- Out of stock products
select product_name, stock_quantity
from products p
where p.stock_quantity = 0;
```

stomers 1 | products 2 | orders 3 | order_items 4

elect oi.product_id ,sum(oi.quantity*oi.price) as sales fr

	product_id	sales
1	5	1,200,000
2	1	960,000
3	9	360,000

Order Details

To retrieve all items in a specific order we call

```
-- Items in order
select oi.order_id,p.product_name , oi.quantity ,oi.pri
from  order_items oi
inner join products p
on p.product_id = oi.product_id
order by oi.order_id, oi.product_id ;
```

ustomers 1 | products 2 | orders 3 | order_items 4 | order_items 5 ×

elect oi.product_id ,sum(oi.quantity*oi.price) as sales fr | Enter a SQL expressio

	product_id	sales
1	5	1,200,000
2	1	960,000
3	9	360,000

To view the amount a given order call

```
-- Total amount of an order
select o.order_id, sum(oi.quantity*oi.price) as amount
from order_items oi
inner join orders o
on o.order_id = oi.order_id
where o.order_id = 7
group by o.order_id
order by order_id;
```

customers 1 | products 2 | orders 3 | order_items 4 | orders 5 ×

select o.order_id, sum(oi.quantity*oi.price) as amount fr | Enter a SQL expression

	order_id	amount
1	7	150

Monthly Trends

To calculate orders and revenue per month

```
-- Number of orders and revenue per month
select extract(month from o.order_date) as month,count(oi.order_id) as orders, sum(oi.q
from orders o
inner join order_items oi
on o.order_id  = oi.order_id
group by month
order by month;
```

stomers 1 products 2 orders 3 order_items 4 Results 5 ×

elect extract(month from o.order_date) as month,count Enter a SQL expression to filter results (use Ctrl+Space)

	month	orders	revenue
1	6	12	440,740
2	7	21	1,301,340
3	8	21	382,500
4	9	13	401,080

Task 4 - Advanced SQL Concepts

Joins

To query data from multiple tables joins as follows

```
-- Joins
select c.name, p.product_name,p.category, o.order_date a
from customers c
inner join
orders o
on c.customer_id = o.customer_id
left join order_items oi
on oi.order_id = o.order_id
left join products p
on p.product_id = oi.product_id ;
```

customers 1 products 2 orders 3 order_items 4 customers(+) 5 ×

select c.name, p.product_name,p.category, o.order_date Enter a SQL expression

	name	product_name	category	date
1	Victor Otieno	Raha Ugali	Foods	2024-06-15
2	David Omondi	Kimbo Cooking Oil	Foods	2024-07-07
3	Samuel Kiprono	Savon Soap	Detergents	2024-09-20
4	Victor Otieno	Samsung Galaxy S23	Electronics	2024-08-03
5	Hassan Mohammed	Sony Bravia 55" TV	Electronics	2024-09-11
6	Jane Wambui	Savon Soap	Detergents	2024-08-18
7	Abdi Hussein	Jogoo Maize Flour	Foods	2024-09-09
8	David Omondi	Kimbo Cooking Oil	Foods	2024-08-07
9	David Omondi	Jogoo Maize Flour	Foods	2024-08-07

Window functions

```
-- Window functions RANK()
with spending as (
    select o.customer_id ,sum(oi.price *
    from orders o
    inner join order_items oi
    on oi.order_id = o.order_id
    group by o.customer_id
    )

select c.name, s.spending, rank() over (
from customers c
inner join spending s
on c.customer_id = s.customer_id;
```

customers 1 products 2 orders 3 order_items 4 cu

with spending as (select o.customer_id ,sum(oi.price * oi

	name	spending	rank
1	Caleb Kipkemboi	80	1
2	Samuel Kiprono	80	1
3	Peninah Atieno	80	1
4	Nicholas Ndegwa	80	1
5	Ivy Chebet	160	5
6	Geoffrey Mutua	230	6
7	Linet Chepkemoi	230	6
8	Winnie Achieng	400	8
9	Esther Akinyi	400	8

To rank customers based on total spending tun the following

To assign a unique number to each order for a customer run

```
-- Window functions ROW_NUMBER()
select c.name,row_number() over (order by name) as o
from customers c
inner join orders o
on c.customer_id = o.customer_id ;
```

ustomers 1 | products 2 | orders 3 | order_items 4 | customers(+) 5

select c.name,row_number() over (order by name) as orc | Enter a SQL expres

	name	order_number	order_date	total_am
1	Abdi Hussein	1	2024-08-01	
2	Abdi Hussein	2	2024-09-09	
3	Abdi Hussein	3	2024-08-12	
4	Caleb Kipkemboi	4	2024-08-06	
5	Catherine Wanjiku	5	2024-07-02	
6	David Omondi	6	2024-08-12	
7	David Omondi	7	2024-09-08	
8	David Omondi	8	2024-07-07	
9	David Omondi	9	2024-08-07	

CTEs and Sub-queries

To calculate total revenue per customer and find customers spending more than $500 proceed as follows

```sql
-- CTE - Total revenue per customer
with purchases as (
    select o.customer_id,oi.quantity, oi.price
    from orders o
    inner join order_items oi
    on o.order_id = oi.order_id
    )

select c.name, sum(p.quantity * p.price) as revenue
from purchases p
inner join customers c
on c.customer_id = p.customer_id
group by c.name
having sum(p.quantity * p.price) > 500;
```

ustomers 1 | products 2 | orders 3 | order_items 4 | customers 5 ×

with purchases as (select o.customer_id,oi.quantity, oi.pr | Enter a SQL expressio

	name	revenue
1	Catherine Wanjiku	160,150
2	Khadija Ali	500,160
3	David Omondi	261,280
4	Peter Kioko	260,630
5	Robert Ochieng	600,150
6	Victor Otieno	320,200
7	Abdi Hussein	650
8	Hassan Mohammed	80,000
9	Quentin Kamau	180,080

To find the product with the highest price use a sub-query as follows

```
-- Sub query - Highest price product
select product_name, price
from products p
where price = (select max(price) fr
```

ustomers 1 products 2 orders 3 order_items

ith purchases as (select o.customer_id,oi.quantity, oi

	name	revenue
1	Catherine Wanjiku	160,150
2	Khadija Ali	500,160
3	David Omondi	261,280
4	Peter Kioko	260,630
5	Robert Ochieng	600,150
6	Victor Otieno	320,200
7	Abdi Hussein	650
8	Hassan Mohammed	80,000

Indexing

```
create unique index if not exists

-- Check effect of indexing on qu
explain analyze
select *from customers
where email ilike '%.com%';
```

ustomers 1 products 2 orders 3 order_ite

xplain analyze select *from customers where emai

	QUERY PLAN
1	Seq Scan on customers (cost=0.00..1.58 row
2	Filter: ((email)::text ~~* '%.com%'::text)
3	Rows Removed by Filter: 34
4	Planning Time: 0.622 ms
5	Execution Time: 0.424 ms

Use `explain analyze` to demonstrate efficiency of adding index columns

```
-- Adding an index on customers table marginally increases query speed
create unique index customer_index on customers (customer_id);

explain analyze
select * from customers
where email ilike '%.com%';
```

ustomers 1 products 2 orders 3 order_items 4 Results 5 × Statistics 5

create unique index customer_index on customers (custo Enter a SQL expression to filter results (use Ctr

	QUERY PLAN
1	Seq Scan on customers (cost=0.00..1.58 rows=1 width=320) (actual time=0.017..0.086 rows=12 lo
2	Filter: ((email)::text ~~* '%.com%'::text)
3	Rows Removed by Filter: 34
4	Planning Time: 0.822 ms
5	Execution Time: 0.096 ms

Optimization

```sql
-- Optimization
-- Adjusting indexes, improving index coverage by using a composite index
create unique index if not exists product_name_index on products (product_id, product_name);

-- Join re-ordering
-- from
explain analyze
with purchases as (
    select o.customer_id,oi.quantity, oi.price
    from orders o
    inner join order_items oi
    on o.order_id = oi.order_id
    )

select c.name, sum(p.quantity * p.price) as revenue
from purchases p
inner join customers c
on c.customer_id = p.customer_id
group by c.name
having sum(p.quantity * p.price) > 500;
```

esults 1 ×

explain analyze with purchases as (select o.customer_id, Enter a SQL expression to filter results (use Ctrl+Space)

	QUERY PLAN
12	Buckets: 1024 Batches: 1 Memory Usage: 10kB
13	-> Seq Scan on orders o (cost=0.00..1.40 rows=40 width=8) (actual time=0.018..0.023 r
14	-> Hash (cost=1.46..1.46 rows=46 width=122) (actual time=0.045..0.045 rows=46 loops=1)
15	Buckets: 1024 Batches: 1 Memory Usage: 11kB
16	-> Seq Scan on customers c (cost=0.00..1.46 rows=46 width=122) (actual time=0.023..0.02
17	Planning Time: 8.906 ms
18	Execution Time: 0.418 ms

```sql
-- to
explain analyze
with purchases as (
    select o.customer_id,oi.quantity, oi.price
    from orders o
    inner join order_items oi
    on o.order_id = oi.order_id
    )

select c.name, sum(p.quantity * p.price) as revenue
from customers c
inner join purchases p
on c.customer_id = p.customer_id
group by c.name
having sum(p.quantity * p.price) > 500;
```

Results 1 ×

explain analyze with purchases as (select o.customer_id Enter a SQL expression to filter results (use Ctrl+Space)

	QUERY PLAN
12	Buckets: 1024 Batches: 1 Memory Usage: 10kB
13	-> Seq Scan on orders o (cost=0.00..1.40 rows=40 width=8) (actual time=0.019..0.023 r
14	-> Hash (cost=1.46..1.46 rows=46 width=122) (actual time=0.031..0.032 rows=46 loops=1)
15	Buckets: 1024 Batches: 1 Memory Usage: 11kB
16	-> Seq Scan on customers c (cost=0.00..1.46 rows=46 width=122) (actual time=0.019..0.02
17	Planning Time: 0.310 ms

Rewrite CTE to sub-query

```sql
-- Rewrite entire query
-- Subquery instead of CTE
select c.name, o.order_id, oi_details.product_id, oi_details.quantity, oi_detail
from customers c
inner join orders o
on
c.customer_id = o.order_id
inner join (
    select product_id, order_id, quantity, price
from order_items
) as oi_details on
o.order_id = oi_details.order_id;
```

customers(+) 1

Enter a SQL expression to filter results (use Ctrl+Space)

	name	order_id	product_id	quantity	price
1	Aisha Abubakar	1	8	1	120
2	Benson Kiprotich	2	4	1	250
3	Catherine Wanjiku	3	2	1	80
4	David Omondi	4	5	1	120,000
5	Esther Akinyi	5	1	1	80,000
6	Felix Musyoka	6	2	1	80
7	Grace Atieno	7	12	1	150
8	Hassan Mohammed	8	4	1	250
9	Hassan Mohammed	8	12	1	150

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