REPUBLIQUE DU SENEGAL

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MINISTERE DE L'ENSEIGNEMENT SUPERIEURE DE LA RECHERCHE ET DE L'INNOVATION

UNIVERSITE GASTON BERGER

L'excellence au service du développement

INSTITUT POLYTECHNIQUE DE SAINT-LOUIS

Université Gaston Berger

UFR Institut Polytechnique de Saint-Louis

Projet : Ingestion de données dans Big Data

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I. Introduction

Ce rapport présente les résultats d'un projet d'ingestion et de traitement de données Big Data en utilisant Apache Sqoop et Apache Hive. Le projet s'inscrit dans le cadre du cours de Big encadré par Dr. Djibril MBOUP.

II. Objectifs du TP

L'objectif principal de ce projet est de démontrer la capacité à ingérer des données d'une base de données relationnelle vers un environnement Big Data, ainsi qu'à effectuer des requêtes analytiques avancées sur ces données pour en extraire des informations pertinentes.

III. PART I : Ingestion des données avec Apache Sqoop

Mettre les données dans la base de données local

On se connecte avec l'utilisateur retail_user et on utilise la base de données retail_db

```
C:\Users\LENOVO>mysql -u retail_user -p
Enter password: ************
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 32
Server version: 5.5.5-10.4.32-MariaDB mariadb.org binary distribution

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> use retail_db
Database changed
mysql> shows tables;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version f
or the right syntax to use near 'shows tables' at line 1
mysql> show tables;
+---------------------+
| Tables_in_retail_db |
+---------------------+
| categories          |
| customers           |
| departments         |
| order_items         |
| orders              |
| products            |
+---------------------+
6 rows in set (0.00 sec)
```

```
mysql> source /vagrant/hadoop/sharepartager/retail_db.sql
Query OK, 0 rows affected (0.01 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected, 1 warning (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.01 sec)
```

Démarrer le cluster et le hadoop

- **Le cluster**

```
LENOVO@DESKTOP-3LBOAEV MINGW64 ~/Downloads/hadoopVagrant-main (1)/hadoopVagrant-main (main)
$ vagrant up
Bringing machine 'default' up with 'virtualbox' provider...
==> default: Box 'SopeKhadim/hadoopVM' could not be found. Attempting to find and install...
    default: Box Provider: virtualbox
    default: Box Version: 2.0
==> default: Loading metadata for box 'SopeKhadim/hadoopVM'
    default: URL: https://vagrantcloud.com/api/v2/vagrant/SopeKhadim/hadoopVM
==> default: Adding box 'SopeKhadim/hadoopVM' (v2.0) for provider: virtualbox
    default: Downloading: https://vagrantcloud.com/SopeKhadim/boxes/hadoopVM/versions/2.0/providers/virtualbox/unknown/vagrant.box
==> default: Box download is resuming from prior download progress
    default:
==> default: Successfully added box 'SopeKhadim/hadoopVM' (v2.0) for 'virtualbox'!
==> default: Importing base box 'SopeKhadim/hadoopVM'...
==> default: Matching MAC address for NAT networking...
==> default: Checking if box 'SopeKhadim/hadoopVM' version '2.0' is up to date...
==> default: Setting the name of the VM: hadoopVagrant-main_default_1721953649304_44366
Vagrant is currently configured to create VirtualBox synced folders with
the `SharedFoldersEnableSymlinksCreate` option enabled. If the Vagrant
guest is not trusted, you may want to disable this option. For more
information on this option, please refer to the VirtualBox manual:
```

```
LENOVO@DESKTOP-3LBOAEV MINGW64 ~/Downloads/hadoopVagrant-main (1)/hadoopVagrant-main (main)
$ vagrant ssh
Last login: Sun Nov 28 11:04:44 2021 from 10.0.2.2
[vagrant@10 ~]$ ls
C:                metastore_db         mysql57-community-release-el7-10.noarch.rpm  mysql-connector-java-5.1.49.zip  sqoop-1.4.7.bin__hadoop-2.6.0.tar.gz
derby.log         mysql-5.7.33         mysql-connector-java-5.1.48                  README.md                        wget-log
itversity-books   mysql-5.7.33.tar.gz  mysql-connector-java-5.1.48.tar.gz           shareFolder
[vagrant@10 ~]$
```

- **Hadoop**

```
[vagrant@localhost ~]$ start-all.sh
WARNING: Attempting to start all Apache Hadoop daemons as vagrant in 10 seconds.
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [localhost]
Starting datanodes
Starting secondary namenodes [localhost.localdomain]
Starting resourcemanager
Starting nodemanagers
```

Affichage des bases de données et les tables

- Afficher les bases de données

```
[vagrant@192 ~]$ sqoop list-databases   --connect jdbc:mysql://192.168.1.3:3
306   --username retail_user   --password hadoop
Warning: /usr/lib/sqoop/../hbase does not exist! HBase imports will fail.
Please set $HBASE_HOME to the root of your HBase installation.
Warning: /usr/lib/sqoop/../hcatalog does not exist! HCatalog jobs will fail.
Please set $HCAT_HOME to the root of your HCatalog installation.
Warning: /usr/lib/sqoop/../accumulo does not exist! Accumulo imports will fa
il.
Please set $ACCUMULO_HOME to the root of your Accumulo installation.
Warning: /usr/lib/sqoop/../zookeeper does not exist! Accumulo imports will f
ail.
Please set $ZOOKEEPER_HOME to the root of your Zookeeper installation.
2024-07-25 16:12:41,405 INFO sqoop.Sqoop: Running Sqoop version: 1.4.7
2024-07-25 16:12:41,804 WARN tool.BaseSqoopTool: Setting your password on th
e command-line is insecure. Consider using -P instead.
2024-07-25 16:12:42,250 INFO manager.MySQLManager: Preparing to use a MySQL
streaming resultset.
Thu Jul 25 16:12:43 UTC 2024 WARN: Establishing SSL connection without serve
r's identity verification is not recommended. According to MySQL 5.5.45+, 5.
6.26+ and 5.7.6+ requirements SSL connection must be established by default
if explicit option isn't set. For compliance with existing applications not
using SSL the verifyServerCertificate property is set to 'false'. You need e
ither to explicitly disable SSL by setting useSSL=false, or set useSSL=true
and provide truststore for server certificate verification.
information_schema
performance_schema
retail_db
```

- Afficher les tables contenues dans retail_db

```
[vagrant@192 ~]$ sqoop list-tables   --connect jdbc:mysql://192.168.1.3:3306
/retail_db   --username retail_user   --password hadoop
Warning: /usr/lib/sqoop/../hbase does not exist! HBase imports will fail.
Please set $HBASE_HOME to the root of your HBase installation.
Warning: /usr/lib/sqoop/../hcatalog does not exist! HCatalog jobs will fail.
Please set $HCAT_HOME to the root of your HCatalog installation.
Warning: /usr/lib/sqoop/../accumulo does not exist! Accumulo imports will fail.
Please set $ACCUMULO_HOME to the root of your Accumulo installation.
Warning: /usr/lib/sqoop/../zookeeper does not exist! Accumulo imports will fail.
Please set $ZOOKEEPER_HOME to the root of your Zookeeper installation.
2024-07-25 16:13:51,708 INFO sqoop.Sqoop: Running Sqoop version: 1.4.7
2024-07-25 16:13:52,011 WARN tool.BaseSqoopTool: Setting your password on the co
2024-07-25 16:13:52,401 INFO manager.MySQLManager: Preparing to use a MySQL strea
Thu Jul 25 16:13:53 UTC 2024 WARN: Establishing SSL connection without server's i
+ and 5.7.6+ requirements SSL connection must be established by default if explic
L the verifyServerCertificate property is set to 'false'. You need either to expl
truststore for server certificate verification.
categories
customers
departments
order_items
orders
products
```

Importation des tables de la base de données dans Hive

```
[vagrant@192 ~]$ sqoop import \
>   --connect jdbc:mysql://192.168.1.3:3306/retail_db \
>   --username retail_user \
>   --password hadoop \
>   --table categories \
>   --as-parquetfile \
>   --target-dir /user/hive/warehouse/retail_db/categories \
>   --delete-target-dir

Transferred 10.8818 KB in 113.0012 seconds (98.6095 bytes/sec)
Retrieved 58 records.
```

Ensuite nous allons vérifier si les données ont été ingérés dans le warehouse de Hive.

```
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:56 /user/hive/warehouse/retail_db/.temp
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:25 /user/hive/warehouse/retail_db/categories
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:32 /user/hive/warehouse/retail_db/customers
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:38 /user/hive/warehouse/retail_db/departments
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:54 /user/hive/warehouse/retail_db/order_items
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:41 /user/hive/warehouse/retail_db/orders
drwxr-xr-x   - vagrant supergroup          0 2024-07-25 16:56 /user/hive/warehouse/retail_db/products
```

IV. PART II: Data Processing avec Apache Hive

Dans cette partie, nous allons voir le traitement et la transformation des données dans le Big Data avec Apache Hive (https://hive.apache.org/).

- On va correspondre les tables dans HIVE aux tables de MYSQL

```
hive> CREATE EXTERNAL TABLE IF NOT EXISTS products(
    > product_id INT ,
    > product_category_id INT,
    > product_name STRING,
    > product_description STRING,
    > product_price float ,
    > product_image STRING
    > )
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > STORED AS PARQUET
    > LOCATION 'hdfs:///user/hive/warehouse/retail_db/products';
OK
Time taken: 0.212 seconds
```

- Verification

```
hive> show tables;
OK
categories
customers
departments
order_items
orders
products
Time taken: 0.043 seconds, Fetched: 6 row(s)
```

IV. Réponses aux questions en fournissant la requête SQL

1. Trouver le nombre total de commandes passées par chaque client au cours de l'année 2014. Le statut de la commande doit être COMPLET, le format order_date est au format unix_timestamp

```
SELECT
    c.customer_id,
    c.customer_fname,
    c.customer_lname,
    COUNT(o.order_id) AS total_orders
FROM
    customers c
JOIN
```

```
    orders o ON c.customer_id = o.order_customer_id
WHERE
    o.order_status = 'COMPLET'
    AND o.order_date BETWEEN UNIX_TIMESTAMP('2014-01-01 00:00:00') AND
UNIX_TIMESTAMP('2014-12-31 23:59:59')
GROUP BY
    c.customer_id, c.customer_fname, c.customer_lname;
```

```
Empty set (0.45 sec)
```

2. Afficher le nom et le prénom des clients qui n'ont passé aucune commande, triés par customer_lname puis customer_fname.

```
SELECT
    c.customer_fname,
    c.customer_lname
FROM
    customers c
LEFT JOIN
    orders o ON c.customer_id = o.order_customer_id
WHERE
    o.order_id IS NULL
ORDER BY
    c.customer_lname, c.customer_fname;
```

customer_fname	customer_lname
Mary	Bolton
Albert	Ellison
Carolyn	Green
Mary	Greene
Mary	Harrell
Mary	Lewis
Mary	Mueller
Matthew	Patel
Mary	Shaw
Amanda	Smith
Ashley	Smith
Carl	Smith
Emma	Smith
Grace	Smith
James	Smith
Joan	Smith
Kenneth	Smith
Kevin	Smith
Mary	Smith
Mary	Smith
Mary	Smith
Mary	Smith
Randy	Smith
Stephen	Smith
Donna	Stephens
Jose	Tanner
Dorothy	Vazquez
Gary	Walker
Mary	Williams

3. Afficher les détails des top 5 clients par revenue pour chaque mois. Vous devez obtenir tous les détails du client ainsi que le mois et les revenus par mois. Les données doivent être triées par mois dans l'ordre croissant et les revenus par mois dans l'ordre décroissant

WITH MonthlyRevenue AS (

```
    SELECT
        c.customer_id,
        c.customer_fname,
        c.customer_lname,
        c.customer_email,
        c.customer_street,
        c.customer_city,
        c.customer_state,
        c.customer_zipcode,
        DATE_FORMAT(FROM_UNIXTIME(o.order_date), '%Y-%m') AS order_month,
        SUM(oi.order_item_subtotal) AS monthly_revenue
    FROM
        customers c
    JOIN
        orders o ON c.customer_id = o.order_customer_id
    JOIN
        order_items oi ON o.order_id = oi.order_item_order_id
    GROUP BY
        c.customer_id, order_month
),
RankedRevenue AS (
    SELECT
        *,
        ROW_NUMBER() OVER (PARTITION BY order_month ORDER BY monthly_revenue
DESC) AS revenue_rank
    FROM
        MonthlyRevenue
)
```

```
SELECT
    customer_id,
    customer_fname,
    customer_lname,
    customer_email,
    customer_street,
    customer_city,
    customer_state,
    customer_zipcode,
    order_month,
    monthly_revenue
FROM
    RankedRevenue
WHERE
    revenue_rank <= 5
ORDER BY
    order_month ASC,
    monthly_revenue DESC;
```

```
+-------------+---------------+---------------+----------------+---------------------------+---------------+----------------+----
-------------+-------------+--------------------+
| customer_id | customer_fname | customer_lname | customer_email | customer_street           | customer_city | customer_state | cus
tomer_zipcode | order_month | monthly_revenue    |
+-------------+---------------+---------------+----------------+---------------------------+---------------+----------------+----
-------------+-------------+--------------------+
|         791 | Mary          | Smith         | XXXXXXXXX      | 6950 Honey Line           | Canton        | MI             | 481
37          | NULL        | 10524.170177459717 |
|        9371 | Mary          | Patterson     | XXXXXXXXX      | 2525 Thunder Loop         | Meridian      | ID             | 836
42          | NULL        |  9299.030206680298 |
|        8766 | Mary          | Duncan        | XXXXXXXXX      | 1011 Iron Pioneer Autoroute | Caguas      | PR             | 007
25          | NULL        |  9296.140186309814 |
|        1657 | Betty         | Phillips      | XXXXXXXXX      | 1475 Red Berry Village    | Caguas        | PR             | 007
25          | NULL        |  9223.710151672363 |
|        2641 | Betty         | Spears        | XXXXXXXXX      | 6398 Indian Brook Valley  | Carrollton    | TX             | 750
06          | NULL        |  9130.920223236084 |
+-------------+---------------+---------------+----------------+---------------------------+---------------+----------------+----
-------------+-------------+--------------------+
5 rows in set, 65535 warnings (8.66 sec)
```

4. Trouver toutes les commandes terminées ou fermées (completed ou closed), puis calculez le revenu total pour chaque jour pour chaque département. La sortie doit afficher : order_date, department_name et order_revenue

```
SELECT
    DATE(FROM_UNIXTIME(o.order_date)) AS order_date,
    d.department_name,
    SUM(oi.order_item_subtotal) AS order_revenue
FROM
    orders o
JOIN
    order_items oi ON o.order_id = oi.order_item_order_id
JOIN
    products p ON oi.order_item_product_id = p.product_id
JOIN
    categories c ON p.product_category_id = c.category_id
JOIN
    departments d ON c.category_department_id = d.department_id
WHERE
    o.order_status IN ('COMPLET', 'FERMÉ')
GROUP BY
    order_date, d.department_name
ORDER BY
    order_date ASC, d.department_name ASC;
```

```
Empty set, 1 warning (0.14 sec)
```

5. Trouver le rank de chaque catégorie par revenue obtenue dans chaque département à partir de toutes les transactions. Affichez les résultats par department_name et classez-les par ordre croissant.

```
WITH CategoryRevenue AS (
    SELECT
        d.department_name,
        c.category_name,
        SUM(oi.order_item_subtotal) AS category_revenue
    FROM
        order_items oi
    JOIN
        products p ON oi.order_item_product_id = p.product_id
    JOIN
        categories c ON p.product_category_id = c.category_id
    JOIN
        departments d ON c.category_department_id = d.department_id
    GROUP BY
        d.department_name, c.category_name
),
RankedCategoryRevenue AS (
    SELECT
        department_name,
        category_name,
        category_revenue,
        RANK() OVER (PARTITION BY department_name ORDER BY category_revenue DESC)
AS revenue_rank
    FROM
```

```
        CategoryRevenue
)
SELECT
    department_name,
    category_name,
    category_revenue,
    revenue_rank
FROM
    RankedCategoryRevenue
ORDER BY
    department_name ASC, revenue_rank ASC;
```

department_name	category_name	category_revenue	revenue_rank
Apparel	Cleats	4431942.783172607	1
Apparel	Men's Footwear	2891757.6622009277	2
Fan Shop	Fishing	6929653.690338135	1
Fan Shop	Camping & Hiking	4118425.570831299	2
Fan Shop	Water Sports	3113844.684753418	3
Fan Shop	Indoor/Outdoor Games	2888993.91355896	4
Fan Shop	Hunting & Shooting	56848.42007446289	5
Fitness	Baseball & Softball	94057.15254592896	1
Fitness	Hockey	48360.729736328125	2
Fitness	Tennis & Racquet	44585.09062957764	3
Fitness	Lacrosse	39464.78979682922	4
Fitness	Basketball	27099.329345703125	5
Fitness	Soccer	26477.049835205078	6

6. Afficher le pourcentage de chaque catégorie par revenue dans chaque département. Afficher les résultats par department_name et pourcentage par ordre décroissant.

```
WITH DepartmentTotalRevenue AS (
    SELECT
        d.department_name,
```

```
    SUM(oi.order_item_subtotal) AS total_revenue
  FROM
    order_items oi
  JOIN
    products p ON oi.order_item_product_id = p.product_id
  JOIN
    categories c ON p.product_category_id = c.category_id
  JOIN
    departments d ON c.category_department_id = d.department_id
  GROUP BY
    d.department_name
),
CategoryRevenue AS (
  SELECT
    d.department_name,
    c.category_name,
    SUM(oi.order_item_subtotal) AS category_revenue
  FROM
    order_items oi
  JOIN
    products p ON oi.order_item_product_id = p.product_id
  JOIN
    categories c ON p.product_category_id = c.category_id
  JOIN
    departments d ON c.category_department_id = d.department_id
  GROUP BY
    d.department_name, c.category_name
```

```
)
SELECT
    cr.department_name,
    cr.category_name,
    cr.category_revenue,
    (cr.category_revenue / dtr.total_revenue) * 100 AS percentage_revenue
FROM
    CategoryRevenue cr
JOIN
    DepartmentTotalRevenue dtr ON cr.department_name = dtr.department_name
ORDER BY
    cr.department_name ASC, percentage_revenue DESC;
```

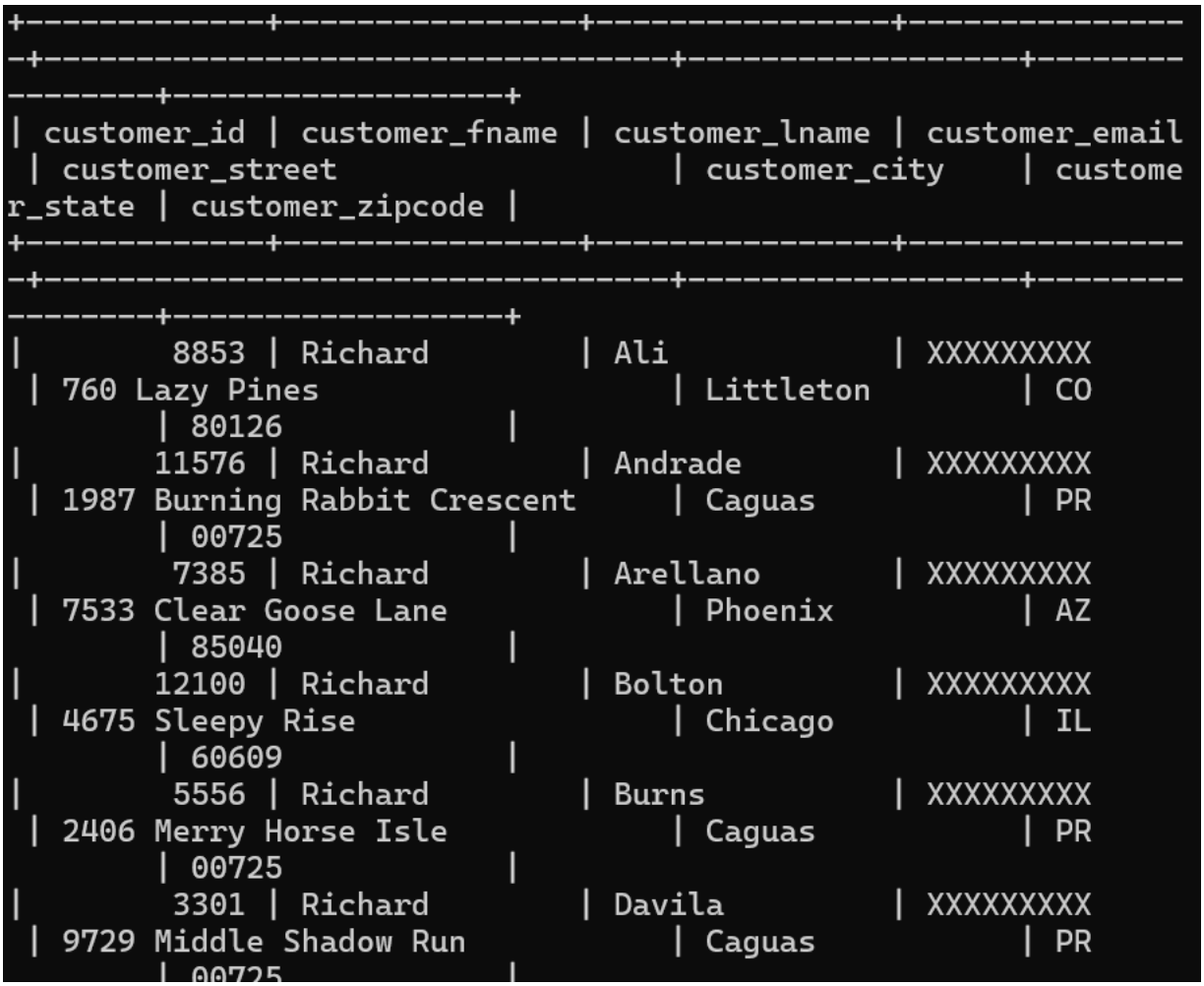
```
+-----------------+---------------------+--------------------+-
------------------+
| department_name | category_name       | category_revenue   |
percentage_revenue |
+-----------------+---------------------+--------------------+-
------------------+
| Apparel         | Cleats              |  4431942.783172607 |
 60.51507453410818 |
| Apparel         | Men's Footwear      | 2891757.6622009277 |
 39.48492546589183 |
| Fan Shop        | Fishing             |  6929653.690338135 |
40.505894089861684 |
| Fan Shop        | Camping & Hiking    |  4118425.570831299 |
 24.07342667378385 |
| Fan Shop        | Water Sports        |  3113844.684753418 |
18.201351560866556 |
| Fan Shop        | Indoor/Outdoor Games |   2888993.91355896 |
 16.88703169280082 |
| Fan Shop        | Hunting & Shooting  |  56848.42007446289 |
0.3322959826870944 |
| Fitness         | Baseball & Softball |  94057.15254592896 |
  33.5865452893558 |
| Fitness         | Hockey              | 48360.729736328125 |
 17.26896674574892 |
| Fitness         | Tennis & Racquet    |  44585.09062957764 |
15.920736755549974 |
| Fitness         | Lacrosse            |  39464.78979682922 |
14.092346131772004 |
```

7. Afficher tous les clients qui ont passé une commande d'un montant supérieur à 200 $.

8. Afficher les clients de la "customers" dont les noms customer_fname commence par "Rich"

```
SELECT
    customer_id,
    customer_fname,
```

```
    customer_lname,
    customer_email,
    customer_street,
    customer_city,
    customer_state,
    customer_zipcode
FROM
    customers
WHERE
    customer_fname LIKE 'Rich%'
ORDER BY
    customer_fname ASC, customer_lname ASC;
```



customer_id	customer_fname	customer_lname	customer_email	customer_street	customer_city	customer_state	customer_zipcode
8853	Richard	Ali	XXXXXXXXX	760 Lazy Pines	Littleton	CO	80126
11576	Richard	Andrade	XXXXXXXXX	1987 Burning Rabbit Crescent	Caguas	PR	00725
7385	Richard	Arellano	XXXXXXXXX	7533 Clear Goose Lane	Phoenix	AZ	85040
12100	Richard	Bolton	XXXXXXXXX	4675 Sleepy Rise	Chicago	IL	60609
5556	Richard	Burns	XXXXXXXXX	2406 Merry Horse Isle	Caguas	PR	00725
3301	Richard	Davila	XXXXXXXXX	9729 Middle Shadow Run	Caguas	PR	00725

9. Fournir le nombre total de clients dans chaque état (state) dont le prénom commence par « M »

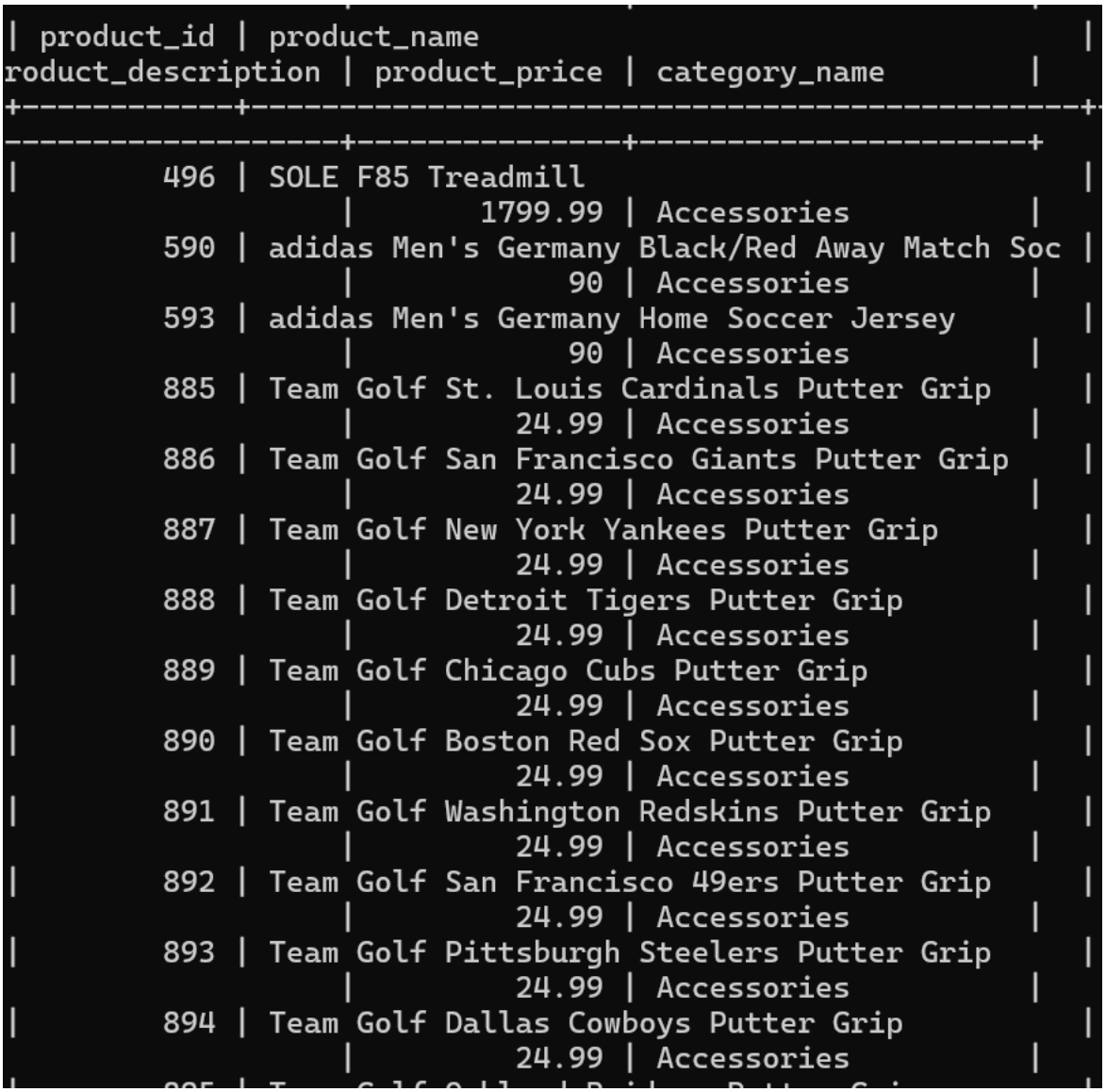
```
SELECT
    customer_state,
    COUNT(*) AS total_customers
FROM
    customers
WHERE
    customer_fname LIKE 'M%'
```

```
GROUP BY
    customer_state
ORDER BY
    customer_state ASC;
```

customer_state	total_customers
AL	1
AR	3
AZ	98
CA	850
CO	51
CT	34
DC	17
DE	9
FL	162
GA	86
HI	34
IA	2
ID	4
IL	222
IN	16
KS	11
KY	13
LA	24
MA	43
MD	73
MI	114
MN	14
MO	35
MT	5
NC	74
ND	6
NJ	87
NM	22
NV	43

10. Trouver le produit le plus cher dans chaque catégorie

```
WITH MaxPricePerCategory AS (
    SELECT
        product_category_id,
        MAX(product_price) AS max_price
    FROM
        products
    GROUP BY
        product_category_id
)
SELECT
    p.product_id,
    p.product_name,
    p.product_description,
    p.product_price,
    c.category_name
FROM
    products p
JOIN
    MaxPricePerCategory mpc ON p.product_category_id = mpc.product_category_id AND
p.product_price = mpc.max_price
JOIN
    categories c ON p.product_category_id = c.category_id
ORDER BY
    c.category_name ASC;
```



product_id	product_name	product_description	product_price	category_name
496	SOLE F85 Treadmill		1799.99	Accessories
590	adidas Men's Germany Black/Red Away Match Soc		90	Accessories
593	adidas Men's Germany Home Soccer Jersey		90	Accessories
885	Team Golf St. Louis Cardinals Putter Grip		24.99	Accessories
886	Team Golf San Francisco Giants Putter Grip		24.99	Accessories
887	Team Golf New York Yankees Putter Grip		24.99	Accessories
888	Team Golf Detroit Tigers Putter Grip		24.99	Accessories
889	Team Golf Chicago Cubs Putter Grip		24.99	Accessories
890	Team Golf Boston Red Sox Putter Grip		24.99	Accessories
891	Team Golf Washington Redskins Putter Grip		24.99	Accessories
892	Team Golf San Francisco 49ers Putter Grip		24.99	Accessories
893	Team Golf Pittsburgh Steelers Putter Grip		24.99	Accessories
894	Team Golf Dallas Cowboys Putter Grip		24.99	Accessories

11. Trouvez les 10 meilleurs produits qui ont généré les revenus les plus élevés.

```
SELECT
    p.product_id,
    p.product_name,
    p.product_description,
    p.product_price,
    SUM(oi.order_item_subtotal) AS total_revenue
```

```
FROM
    products p
JOIN
    order_items oi ON p.product_id = oi.order_item_product_id
GROUP BY
    p.product_id, p.product_name, p.product_description, p.product_price
ORDER BY
    total_revenue DESC
LIMIT 10;
```

```
+------------+----------------------------------------------------+--
------------------+---------------+--------------------+
| product_id | product_name                                       | p
roduct_description | product_price | total_revenue      |
+------------+----------------------------------------------------+--
------------------+---------------+--------------------+
|       1004 | Field & Stream Sportsman 16 Gun Fire Safe          |
                   |        399.98 |  6929653.690338135 |
|        365 | Perfect Fitness Perfect Rip Deck                   |
                   |         59.99 |   4421143.14352417 |
|        957 | Diamondback Women's Serene Classic Comfort Bi      |
                   |        299.98 |  4118425.570831299 |
|        191 | Nike Men's Free 5.0+ Running Shoe                  |
                   |         99.99 |  3667633.196662903 |
|        502 | Nike Men's Dri-FIT Victory Golf Polo               |
                   |            50 |            3147800 |
|       1073 | Pelican Sunstream 100 Kayak                        |
                   |        199.99 |  3099845.085144043 |
|        403 | Nike Men's CJ Elite 2 TD Football Cleat            |
                   |        129.99 | 2891757.6622009277 |
|       1014 | O'Brien Men's Neoprene Life Vest                   |
                   |         49.98 |   2888993.91355896 |
|        627 | Under Armour Girls' Toddler Spine Surge Runni      |
                   |         39.99 | 1269082.6712722778 |
|        565 | adidas Youth Germany Black/Red Away Match Soc      |
                   |            70 |              67830 |
+------------+----------------------------------------------------+--
```