# Customer Data Managment

Team:

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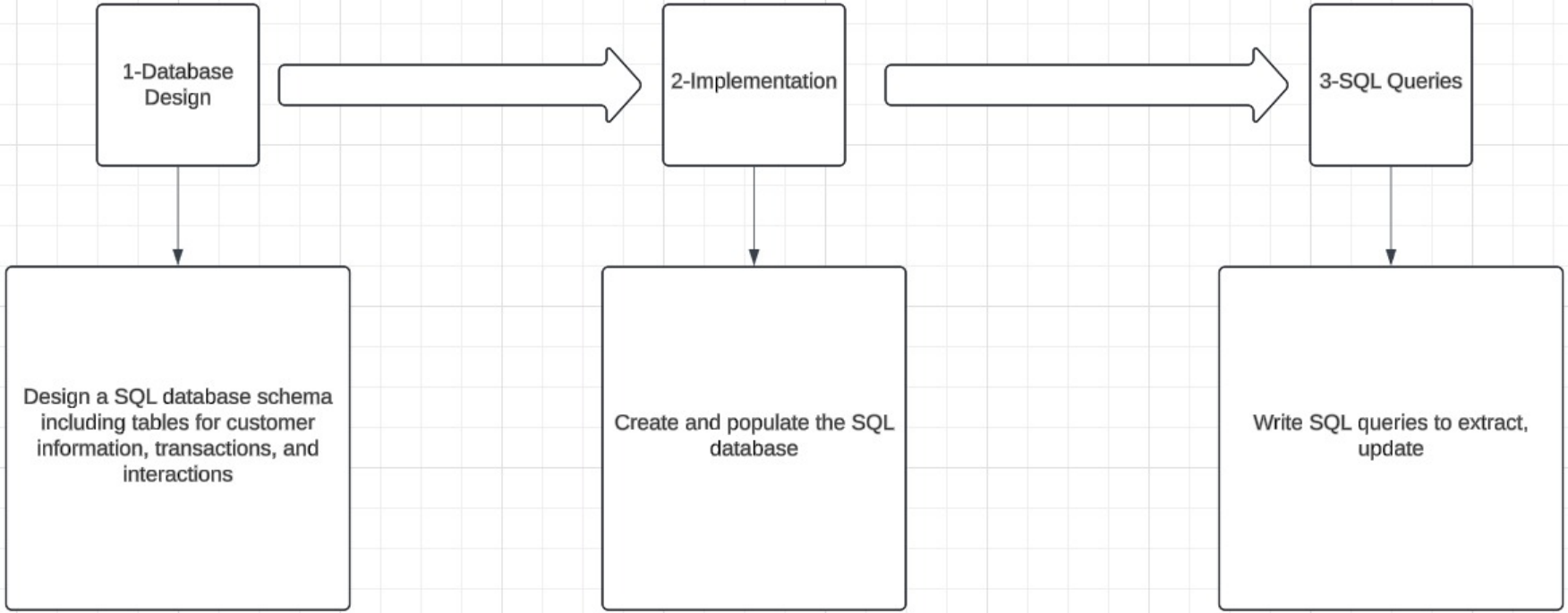
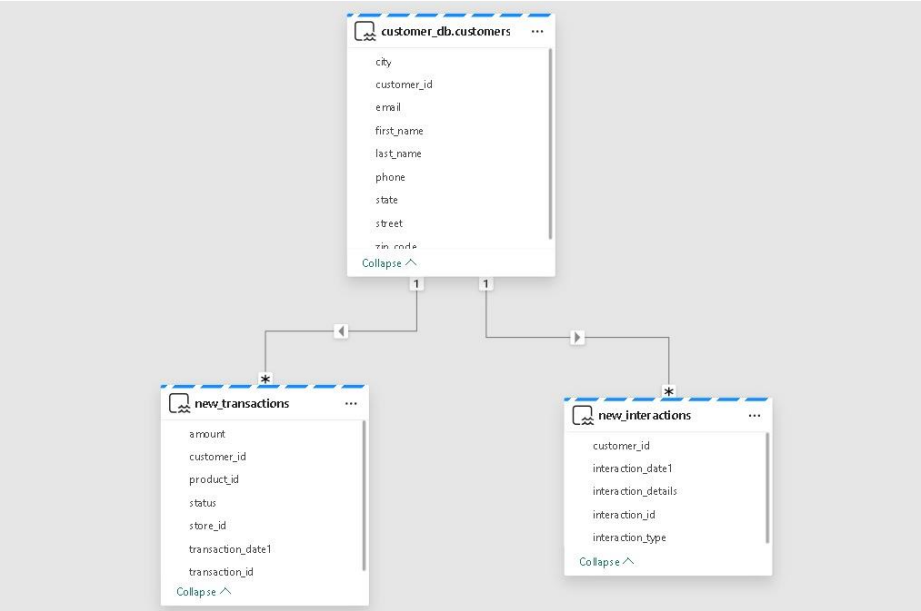
| **Week 1** | Data Managment & SQL Database Setup |
| **Week 2** | Data Warehousing & Python Programming |
| **Week 3** | Data Science & Model Building |
| **Week 4** | Using Predictive Model & Final presentation |

# Week 1: Data Management and SQL Database Setup

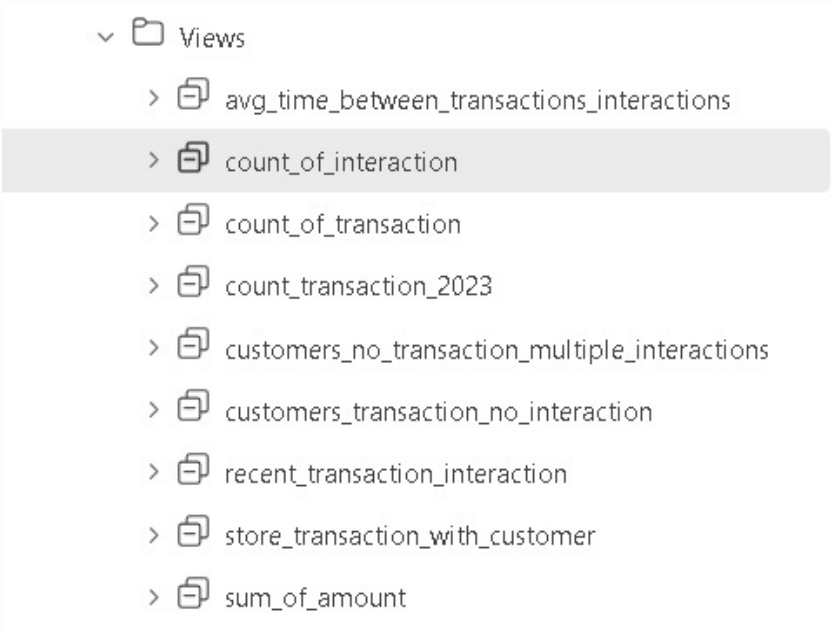


# Here is the schemas of week 1




Contains the tables of the customers info like shown

# Views for week 1




Views to extract the data of the customers

# Views data preview

Data preview - count_of_interaction

Showing 1000 rows

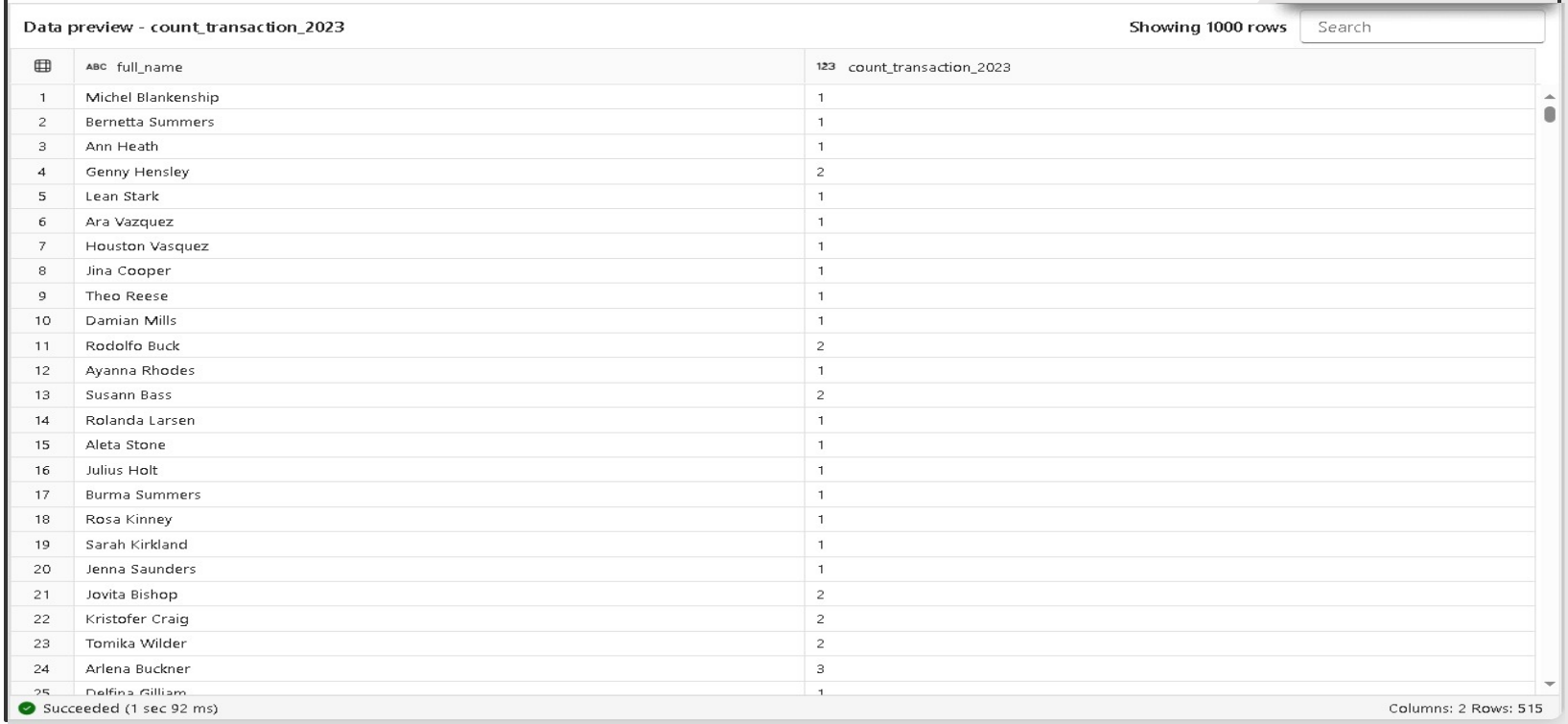
Search

| | first_name | count_of_interaction |
|---|---|---|
| 1 | Marylyn | 2 |
| 2 | Ciera | 1 |
| 3 | Ling | 1 |
| 4 | Divina | 2 |
| 5 | Pinkie | 2 |
| 6 | Shirely | 1 |
| 7 | Jerome | 3 |
| 8 | Lissa | 3 |
| 9 | Klara | 8 |
| 10 | Vernetta | 3 |
| 11 | Takako | 1 |
| 12 | Antony | 1 |
| 13 | Joaquin | 3 |
| 14 | Adam | 4 |
| 15 | Ami | 1 |
| 16 | Domingo | 3 |
| 17 | Rosa | 2 |
| 18 | Syreeta | 1 |
| 19 | Melani | 1 |
| 20 | Kimberli | 2 |
| 21 | Zelma | 2 |
| 22 | Addie | 1 |
| 23 | Sheba | 1 |
| 24 | Mariette | 1 |
| 25 | Williemae | 1 |

Succeeded (0 sec 938 ms)

Columns: 2 Rows: 1000

# Views data preview



# Views data preview

Data preview - sum_of_amount

Showing 1000 rows

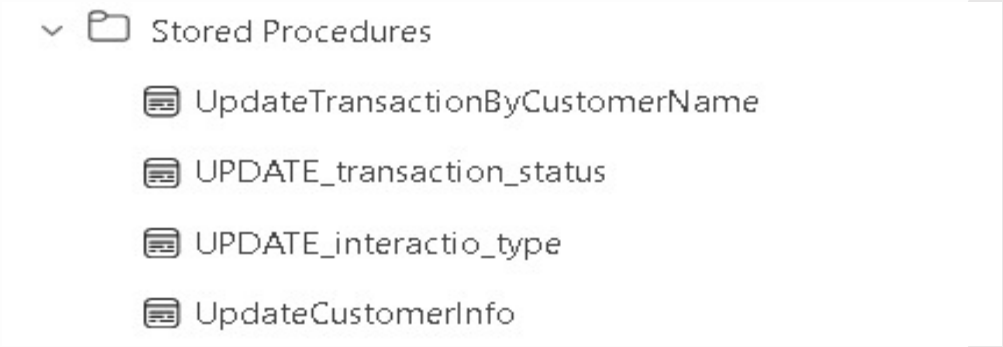
Search

| | full_name | sum_of_amount |
|---|---|---|
| 1 | Michel Blankenship | 4672.46 |
| 2 | Bernetta Summers | 5967.2 |
| 3 | Ara Vazquez | 1983.56 |
| 4 | Houston Vasquez | 3156.59 |
| 5 | Jina Cooper | 1694.73 |
| 6 | Theo Reese | 6341.89 |
| 7 | Renay Atkins | 1026.25 |
| 8 | Quyen Houston | 1079.26 |
| 9 | Miquel Neal | 1112.99 |
| 10 | Burma Summers | 4048.74 |
| 11 | Jovita Bishop | 9961.95 |
| 12 | Kristofer Craig | 5843.12 |
| 13 | Tomika Wilder | 3266.74 |
| 14 | Martha Burgess | 1603.66 |
| 15 | Carson Macias | 10584.03 |
| 16 | Evelina Manning | 2463.45 |
| 17 | Shawnda Glover | 9369.6 |
| 18 | Lynn Mcmahon | 6390.22 |
| 19 | Hope Cotton | 1968.94 |
| 20 | Basil Ballard | 2362.79 |
| 21 | Ann Heath | 4154.78 |
| 22 | Genny Hensley | 3854.02 |
| 23 | Rodolfo Buck | 3403.58 |
| 24 | Aleta Stone | 4072.68 |
| 25 | Julius Holt | 454.15 |

Succeeded (9 sec 755 ms)

Columns: 2 Rows: 1000

# Stored procedures




Procedures to update customer data

# Example of using stored procedures

```
4
5   SELECT * FROM[customer data management_1].[customer_db].[customers] WHERE customer_id = 22;
```

Messages | Results | Save as table | Open in Excel | Explore this data (preview) | Copy | Search

| | customer_id | first_name | last_name | phone | email | street | city | state | zip_code |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | Adelle | Larsen | *NULL* | adelle.larsen@gm... | 683 West Kirkland... | East Northport | NY | 11731 |

Before updating

# Example of using stored procedures

```
EXEC [customer data management_1].[customer_db].[UpdateCustomerInfo] @CustomerID = 22, @Email = 'john.new@example.com'
```

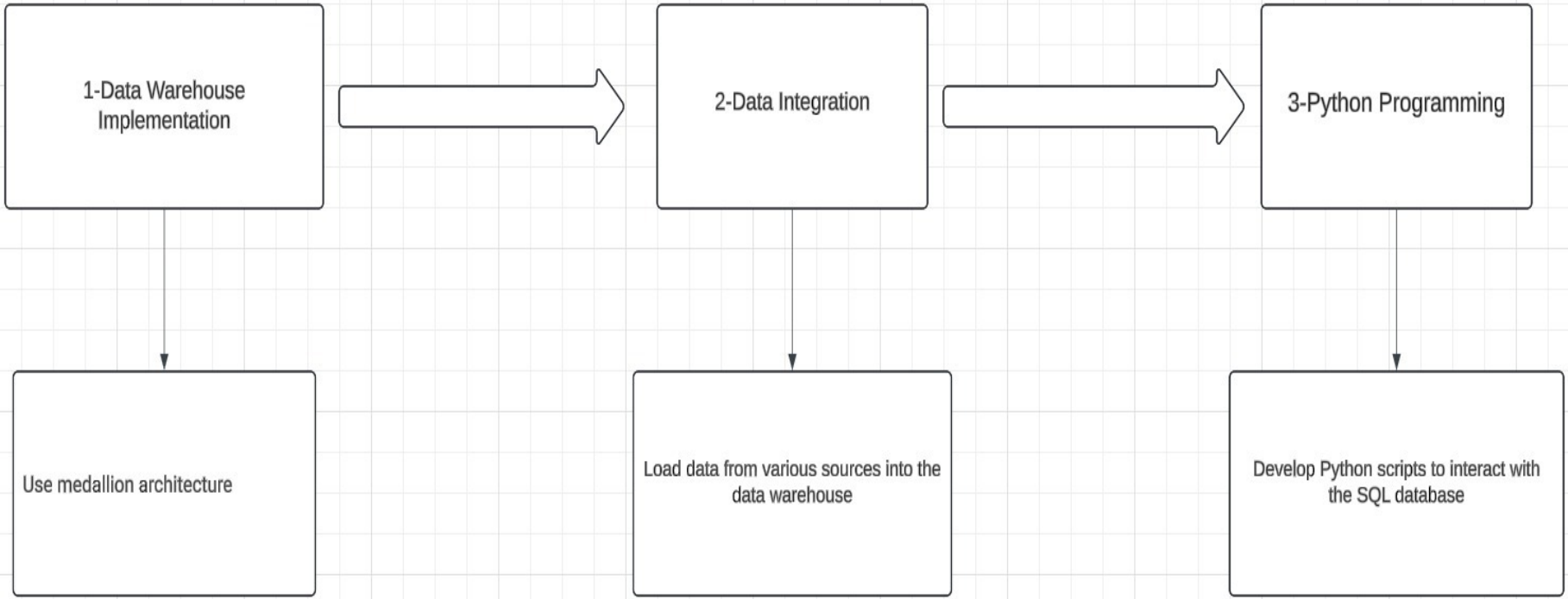
After applying the stored procedure

```
5   SELECT * FROM[customer data management_1].[customer_db].[customers] WHERE customer_id = 22;
```

Messages | Results | Save as table | Open in Excel | Explore this data (preview) | Copy | Search

| | 123 customer_id | ABC first_name | ABC last_name | ABC phone | ABC email | ABC street | ABC city | ABC state | 123 zip_code |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | Adelle | Larsen | *NULL* | john.new@exampl... | 683 West Kirkland... | East Northport | NY | 11731 |

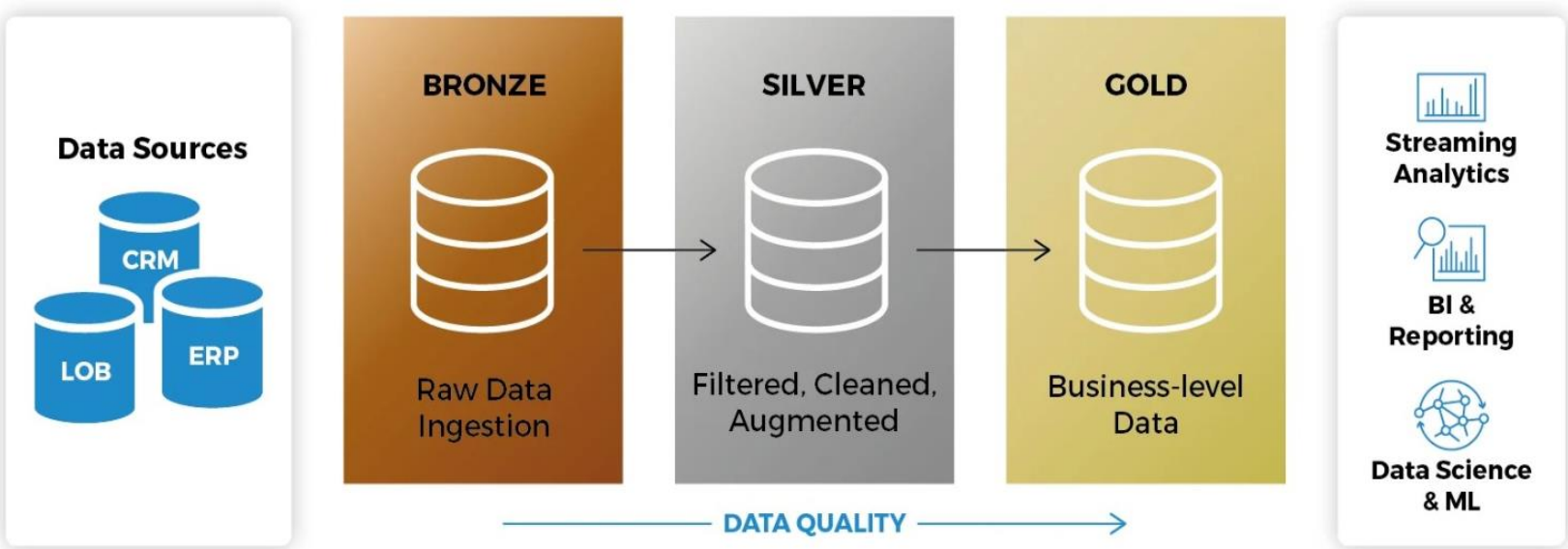
# Week 2: Data Warehousing and Python Programming



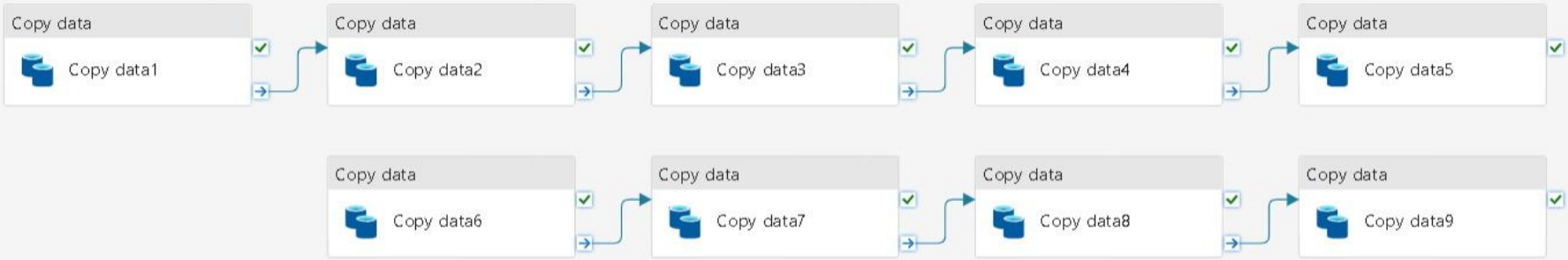
Firstly

# Data Warehousing

# Medallion Architecture

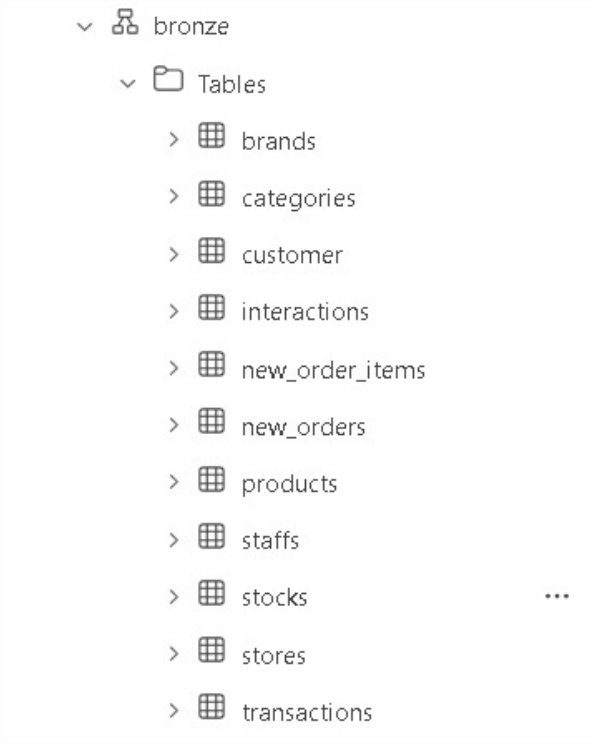


# Bronze pipline



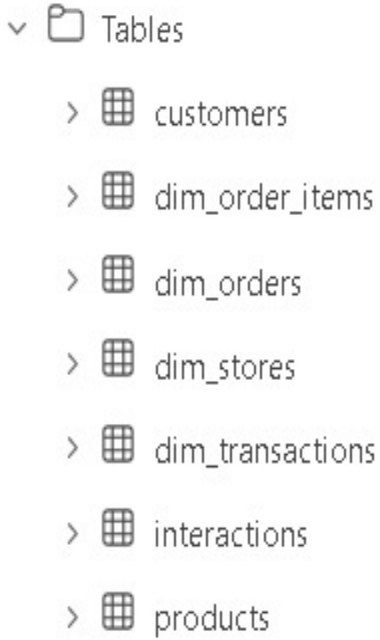

From the source to the bronze

# Bronze Schema



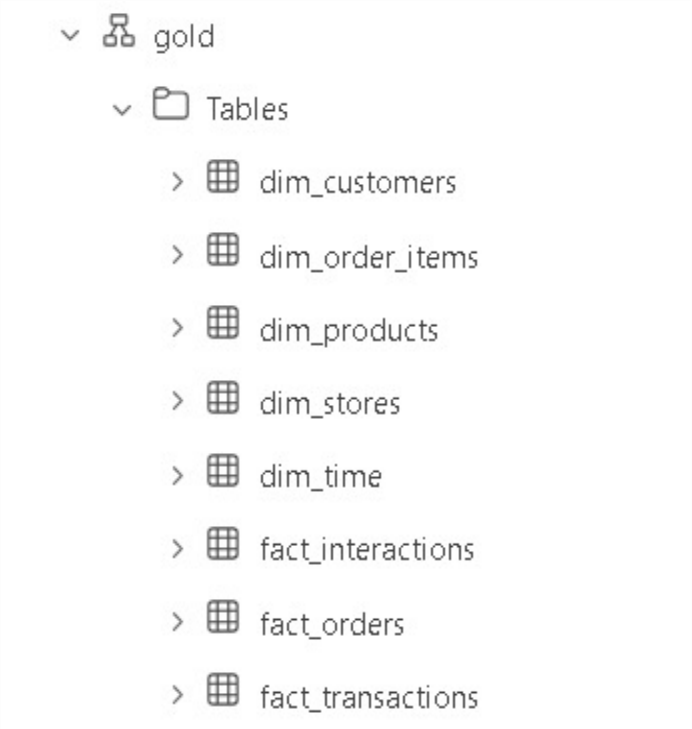

From the source to the bronze

# Silver Schema

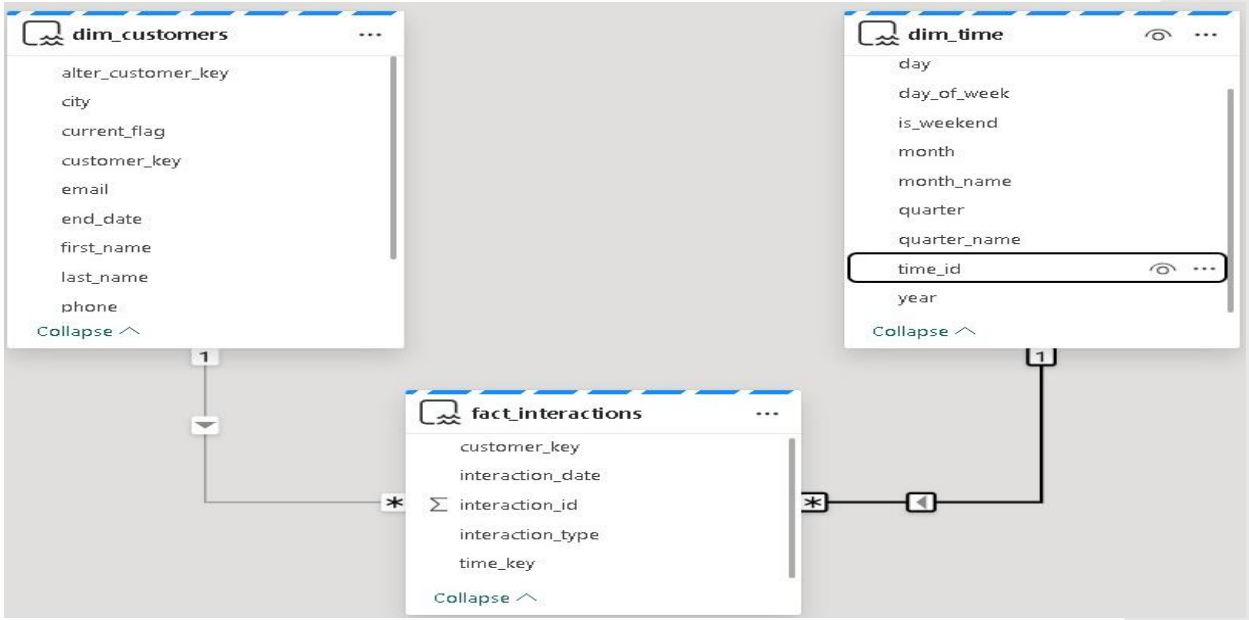


## Stored procedures to transfer data to the Silver Schema

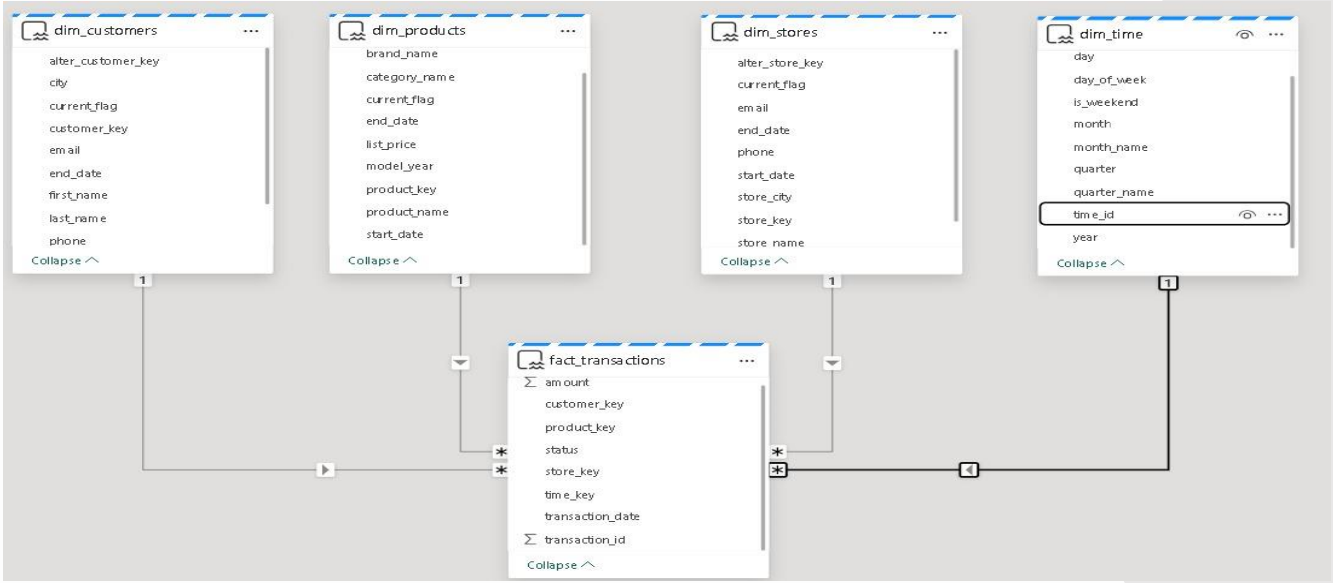
# Gold Schema


gold
Tables
dim_customers
dim_order_items
dim_products
dim_stores
dim_time
fact_interactions
fact_orders
fact_transactions

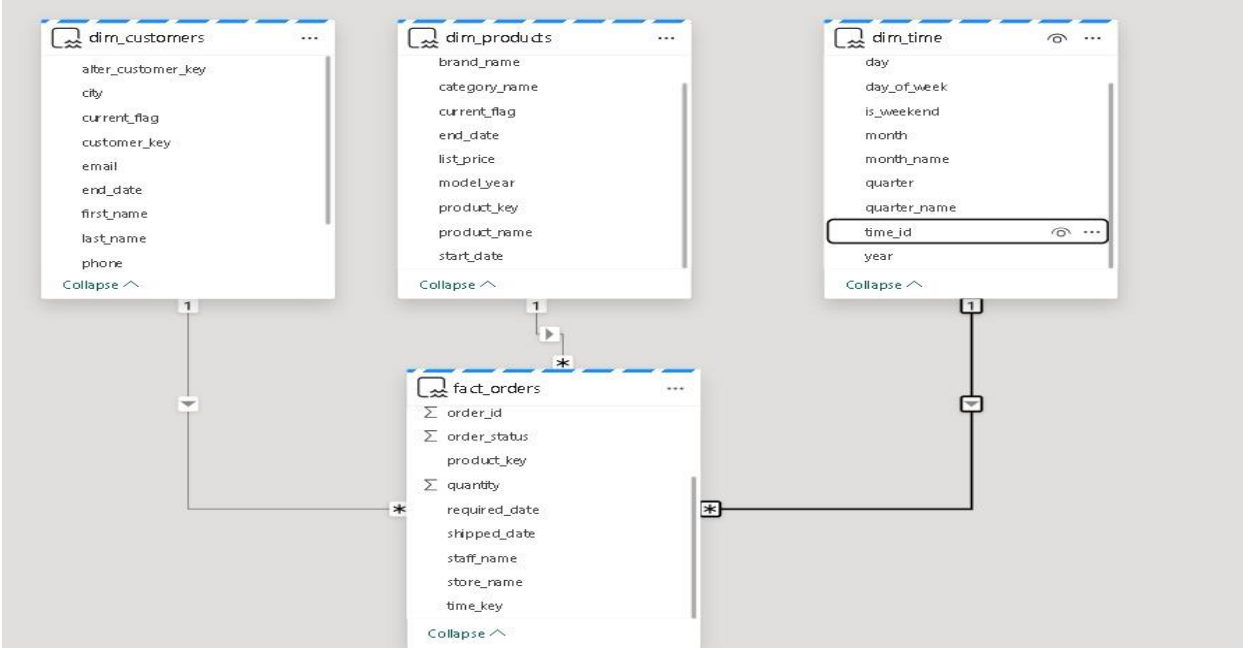
# Gold Schema


dim_customers
alter_customer_key
city
current_flag
customer_key
email
end_date
first_name
last_name
phone
Collapse
dim_time
day
day_of_week
is_weekend
month
month_name
quarter
quarter_name
time_id
year
Collapse
fact_interactions
customer_key
interaction_date
interaction_id
interaction_type
time_key
Collapse
1
*
1
*

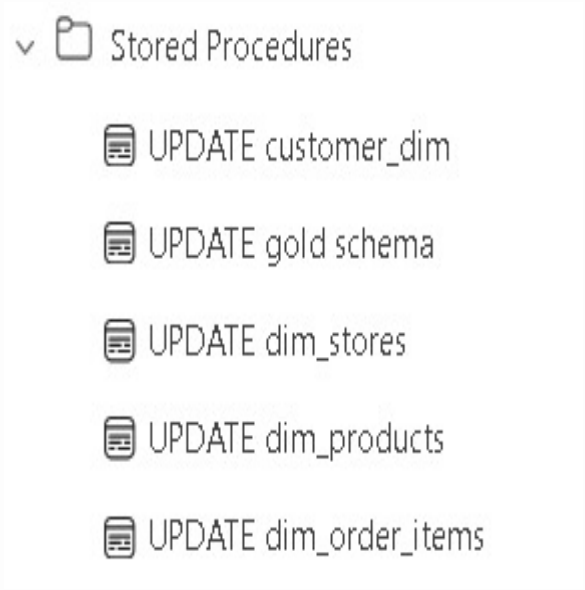
# Gold Schema


dim_customers
alter_customer_key
city
current_flag
customer_key
email
end_date
first_name
last_name
phone
Collapse
dim_products
brand_name
category_name
current_flag
end_date
list_price
model_year
product_key
product_name
start_date
Collapse
dim_stores
alter_store_key
current_flag
email
end_date
phone
start_date
store_city
store_key
store_name
Collapse
dim_time
day
day_of_week
is_weekend
month
month_name
quarter
quarter_name
time_id
year
Collapse
fact_transactions
amount
customer_key
product_key
status
store_key
time_key
transaction_date
transaction_id
Collapse

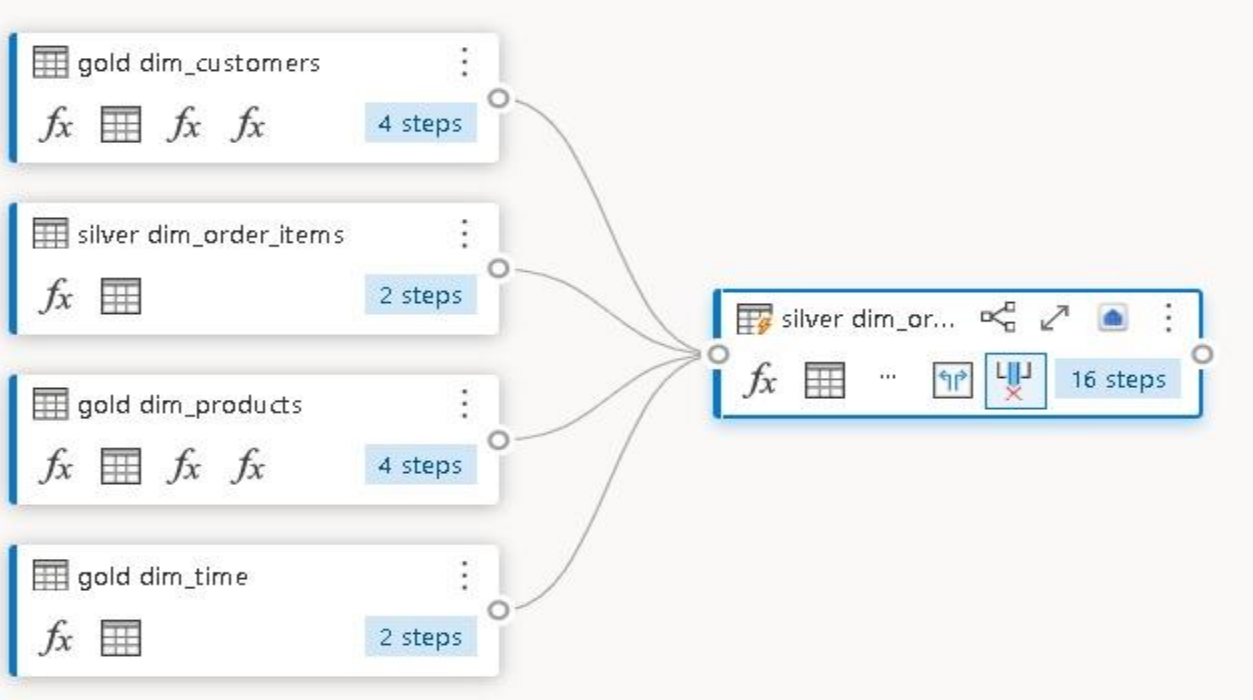
# Gold Schema


dim_customers
alter_customer_key
city
current_flag
customer_key
email
end_date
first_name
last_name
phone
Collapse
dim_products
brand_name
category_name
current_flag
end_date
list_price
model_year
product_key
product_name
start_date
Collapse
dim_time
day
day_of_week
is_weekend
month
month_name
quarter
quarter_name
time_id
year
Collapse
fact_orders
order_id
order_status
product_key
quantity
required_date
shipped_date
staff_name
store_name
time_key
Collapse

# Stored procedures to update gold schema



# Fact table by dataflow gen 2



# Data preview

Data preview - dim_stores

Showing 1000 rows

Search

| | store_key | alter_store_key | store_name | phone | email | store_city | store_state | start_date | end_date | current_flag |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 2 | Baldwin Bikes | 99839 | baldwin@bikes.shop | Baldwin | NY | 2024-10-07 | *NULL* | 1 |
| 2 | 1 | 1 | Santa Cruz Bikes | (831) 476-4321 | | Santa Cruz | CA | 2024-09-30 | *NULL* | 1 |
| 3 | 3 | 3 | Rowlett Bikes | (972) 530-5555 | rowlett@bikes.shop | Rowlett | TX | 2024-09-30 | *NULL* | 1 |
| 4 | 2 | 2 | Baldwin Bikes | (516) 379-8888 | baldwin@bikes.shop | Baldwin | NY | 2024-09-30 | 2024-10-07 | 0 |

secondly

# Python programming

# Python

```python
# Customer interaction report
customer_interaction_df = spark.sql("""
    SELECT
        dc.customer_key,
        dc.first_name,
        dc.last_name,
        fi.interaction_type,
        COUNT(fi.interaction_id) AS total_interactions,
        MIN(fi.interaction_date) AS first_interaction_date,
        MAX(fi.interaction_date) AS last_interaction_date
    FROM fact_interactions fi
    JOIN dim_customers dc ON fi.customer_key = dc.customer_key
    GROUP BY dc.customer_key, dc.first_name, dc.last_name, fi.interaction_type
""")

# Displaying the customer interaction report
customer_interaction_df.show()

```

✓ - Command executed in 3 sec 560 ms by Suez Gahar on 2:59:43 AM, 10/07/24

| customer_key | first_name | last_name | interaction_type | total_interactions | first_interaction_date | last_interaction_date |
|---|---|---|---|---|---|---|
| 673 | Adam | Henderson | Complaint | 1 | 2024-08-09 00:00:00 | 2024-08-09 00:00:00 |
| 1045 | Pasquale | Hogan | Complaint | 1 | 2024-07-01 00:00:00 | 2024-07-01 00:00:00 |
| 1361 | Destiny | Goodman | Complaint | 1 | 2024-02-04 00:00:00 | 2024-02-04 00:00:00 |
| 651 | Laure | Pena | Complaint | 1 | 2024-01-16 00:00:00 | 2024-01-16 00:00:00 |
| 1268 | Sung | Chambers | Review | 1 | 2023-09-23 00:00:00 | 2023-09-23 00:00:00 |
| 504 | Tiana | Henderson | Review | 1 | 2024-09-14 00:00:00 | 2024-09-14 00:00:00 |
| 855 | Lean | Stark | Inquiry | 1 | 2023-09-30 00:00:00 | 2023-09-30 00:00:00 |
| 253 | Maurice | Norton | Inquiry | 1 | 2024-07-07 00:00:00 | 2024-07-07 00:00:00 |
| 1299 | Shauna | Edwards | Inquiry | 2 | 2024-01-13 00:00:00 | 2024-05-24 00:00:00 |
| 124 | Jeni | Booker | Inquiry | 1 | 2024-09-02 00:00:00 | 2024-09-02 00:00:00 |
| 887 | Graig | Cannon | Inquiry | 1 | 2024-01-27 00:00:00 | 2024-01-27 00:00:00 |
| 794 | Donette | Mccarthy | Complaint | 1 | 2024-06-24 00:00:00 | 2024-06-24 00:00:00 |

# Python

```
# Customer transaction report
customer_transaction_df = spark.sql("""
    SELECT
        dc.customer_key,
        dc.first_name,
        dc.last_name,
        COUNT(ft.transaction_id) AS total_transactions,
        SUM(ft.amount) AS total_amount_spent,
        AVG(ft.amount) AS avg_transaction_value,
        MIN(ft.transaction_date) AS first_transaction_date,
        MAX(ft.transaction_date) AS last_transaction_date
    FROM fact_transactions ft
    JOIN dim_customers dc ON ft.customer_key = dc.customer_key
    GROUP BY dc.customer_key, dc.first_name, dc.last_name
""")

# Displaying the customer transaction report
customer_transaction_df.show()

```

[3] ✓ - Command executed in 3 sec 498 ms by Suez Gahar on 2:59:47 AM, 10/07/24

| customer_key | first_name | last_name | total_transactions | total_amount_spent | avg_transaction_value | first_transaction_date | last_transaction_date |
|---|---|---|---|---|---|---|---|
| 1393 | Vivian | Deleon | 1 | 1678.46 | 1678.46 | 2024-05-21 00:00:00 | 2024-05-21 00:00:00 |
| 32 | Araceli | Golden | 2 | 2063.76 | 1031.88 | 2024-02-06 00:00:00 | 2024-02-06 00:00:00 |
| 1321 | Shantel | Gregory | 3 | 3964.63 | 1321.5433333333333 | 2024-02-18 00:00:00 | 2024-07-19 00:00:00 |
| 334 | Somer | Jordan | 2 | 2860.83 | 1430.415 | 2024-08-10 00:00:00 | 2024-09-05 00:00:00 |
| 857 | Inga | Koch | 2 | 1965.3899999999999 | 982.6949999999999 | 2024-04-01 00:00:00 | 2024-07-12 00:00:00 |
| 53 | Saturnina | Garner | 3 | 8591.380000000001 | 2863.7933333333335 | 2023-09-26 00:00:00 | 2024-06-27 00:00:00 |
| 34 | Brittney | Woodward | 2 | 3196.7400000000002 | 1598.3700000000001 | 2023-10-19 00:00:00 | 2023-11-07 00:00:00 |
| 146 | Stefany | Potter | 3 | 1768.55 | 589.5166666666667 | 2024-01-26 00:00:00 | 2024-05-04 00:00:00 |
| 990 | Casimira | Chapman | 4 | 8302.87 | 2075.7175 | 2024-03-01 00:00:00 | 2024-06-28 00:00:00 |
| 15 | Linnie | Branch | 3 | 5529.76 | 1843.2533333333333 | 2023-10-16 00:00:00 | 2024-04-29 00:00:00 |
| 385 | Rochelle | Ward | 2 | 4946.93 | 2473.465 | 2023-12-29 00:00:00 | 2024-04-09 00:00:00 |
| 1268 | Sung | Chambers | 3 | 2525.14 | 841.7133333333333 | 2023-11-01 00:00:00 | 2023-12-24 00:00:00 |

# Python

```
# Top selling products report
top_selling_products_df = spark.sql("""
    SELECT
        dp.product_key,
        dp.product_name,
        COUNT(ft.transaction_id) AS total_sales,
        SUM(ft.amount) AS total_revenue,
        AVG(ft.amount) AS avg_sale_price
    FROM fact_transactions ft
    JOIN dim_products dp ON ft.product_key = dp.product_key
    GROUP BY dp.product_key, dp.product_name
    ORDER BY total_sales DESC
    LIMIT 10
""")

# Displaying the top selling products report
top_selling_products_df.show()

```

[4] ✓ - Command executed in 1 sec 503 ms by Suez Gahar on 2:59:49 AM, 10/07/24

| product_key | product_name | total_sales | total_revenue | avg_sale_price |
|---|---|---|---|---|
| 100 | Haro Shredder Pro... | 53 | 63996.240000000005 | 1207.4762264150945 |
| 99 | Haro Shredder Pro... | 53 | 63996.240000000005 | 1207.4762264150945 |
| 197 | Trek Lift+ Lawste... | 31 | 64769.61000000002 | 2089.342258064517 |
| 196 | Trek Lift+ Lawste... | 31 | 64769.61000000002 | 2089.342258064517 |
| 328 | Electra Townie Or... | 30 | 45086.29000000001 | 1502.8763333333336 |
| 302 | Electra Sweet Rid... | 28 | 34393.50000000001 | 1228.339285714286 |
| 303 | Electra Sweet Rid... | 28 | 34393.50000000001 | 1228.339285714286 |
| 41 | Haro Flightline T... | 28 | 47656.020000000004 | 1702.0007142857144 |
| 46 | Trek Fuel EX 9.8 ... | 24 | 17392.41 | 724.68375 |
| 301 | Electra Sweet Rid... | 22 | 35061.870000000002 | 1593.7213636363645 |

# Python

```python
# Top customers by sales
top_customers_df = spark.sql("""
    SELECT
        dc.customer_key,
        dc.first_name,
        dc.last_name,
        SUM(ft.amount) AS total_spent
    FROM fact_transactions ft
    JOIN dim_customers dc ON ft.customer_key = dc.customer_key
    GROUP BY dc.customer_key, dc.first_name, dc.last_name
    ORDER BY total_spent DESC
    LIMIT 10
""")

# Displaying the top customers by sales
top_customers_df.show()

```

[6] ✓ - Command executed in 1 sec 483 ms by Suez Gahar on 2:59:53 AM, 10/07/24

```
+------------+----------+---------+------------------+
|customer_key|first_name|last_name|       total_spent|
+------------+----------+---------+------------------+
|         875|   Tanesha|   Sawyer|14009.699999999999|
|        1283|      Mica|    Barry|           13533.36|
|         399|      Bart|     Hess|12508.850000000002|
|         286|    Virgil|    Frost|           12160.31|
|         366|   Lavonne| Anderson|11928.689999999999|
|         267|  Angelina|    Lloyd|11881.369999999999|
|         206|Stephaine|   Riddle|11723.289999999999|
|        1183|       Kim|    Clark|11428.079999999998|
|         376|    Elanor|  Patrick|11383.580000000002|
|        1190|     Romeo|   Steele|           11249.46|
+------------+----------+---------+------------------+
```

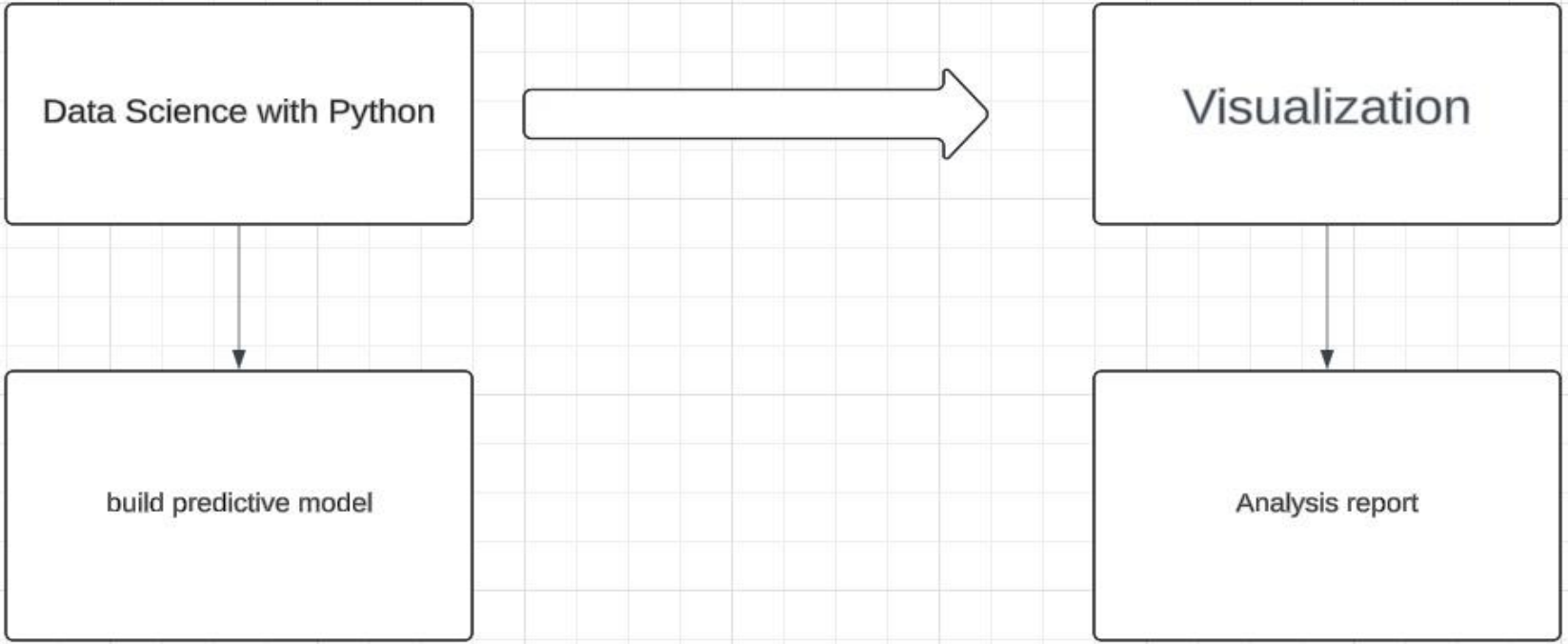
# Python

```
# Top selling products report
top_selling_products_df = spark.sql("""
    SELECT
        dp.product_key,
        dp.product_name,
        COUNT(ft.transaction_id) AS total_sales,
        SUM(ft.amount) AS total_revenue,
        AVG(ft.amount) AS avg_sale_price
    FROM fact_transactions ft
    JOIN dim_products dp ON ft.product_key = dp.product_key
    GROUP BY dp.product_key, dp.product_name
    ORDER BY total_sales DESC
    LIMIT 10
""")

# Displaying the top selling products report
top_selling_products_df.show()

```

[4] ✓ - Command executed in 1 sec 503 ms by Suez Gahar on 2:59:49 AM, 10/07/24

| product_key | product_name | total_sales | total_revenue | avg_sale_price |
|---|---|---|---|---|
| 100 | Haro Shredder Pro... | 53 | 63996.240000000005 | 1207.4762264150945 |
| 99 | Haro Shredder Pro... | 53 | 63996.240000000005 | 1207.4762264150945 |
| 197 | Trek Lift+ Lawste... | 31 | 64769.61000000002 | 2089.342258064517 |
| 196 | Trek Lift+ Lawste... | 31 | 64769.61000000002 | 2089.342258064517 |
| 328 | Electra Townie Or... | 30 | 45086.29000000001 | 1502.8763333333336 |
| 302 | Electra Sweet Rid... | 28 | 34393.50000000001 | 1228.339285714286 |
| 303 | Electra Sweet Rid... | 28 | 34393.50000000001 | 1228.339285714286 |
| 41 | Haro Flightline T... | 28 | 47656.020000000004 | 1702.0007142857144 |
| 46 | Trek Fuel EX 9.8 ... | 24 | 17392.41 | 724.68375 |
| 301 | Electra Sweet Rid... | 22 | 35061.870000000002 | 1593.7213636363645 |

# Week 3: Data Science

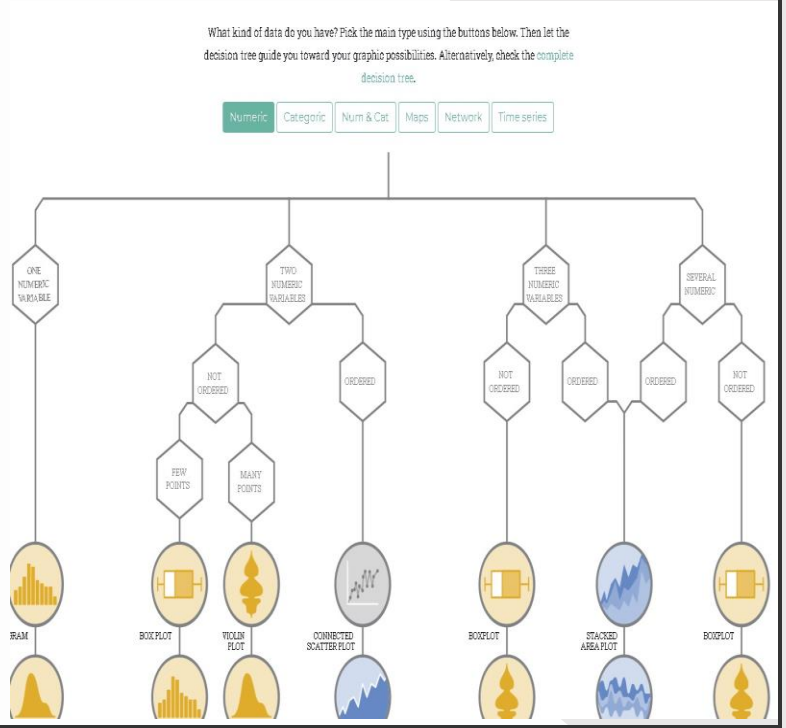


**Firstly**

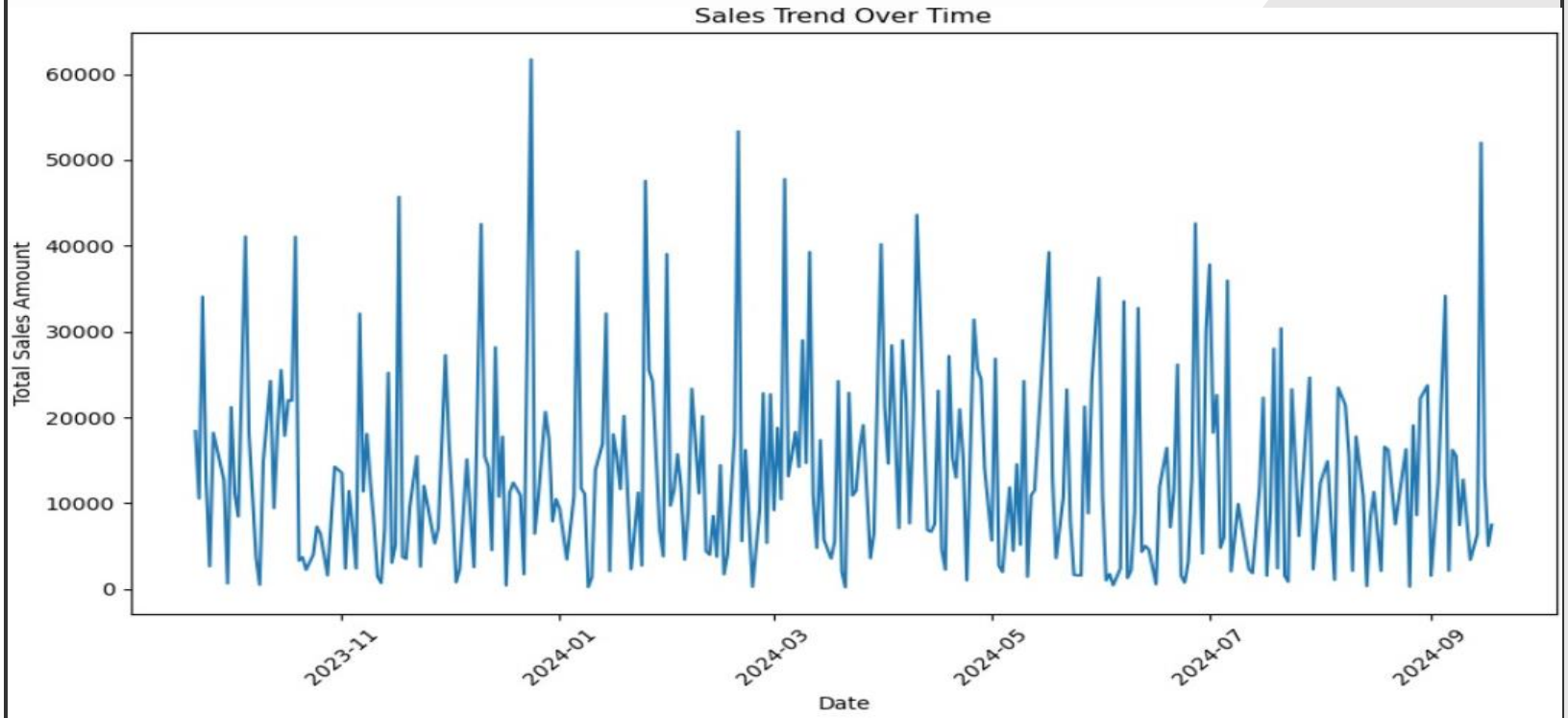
# Data science

# methods

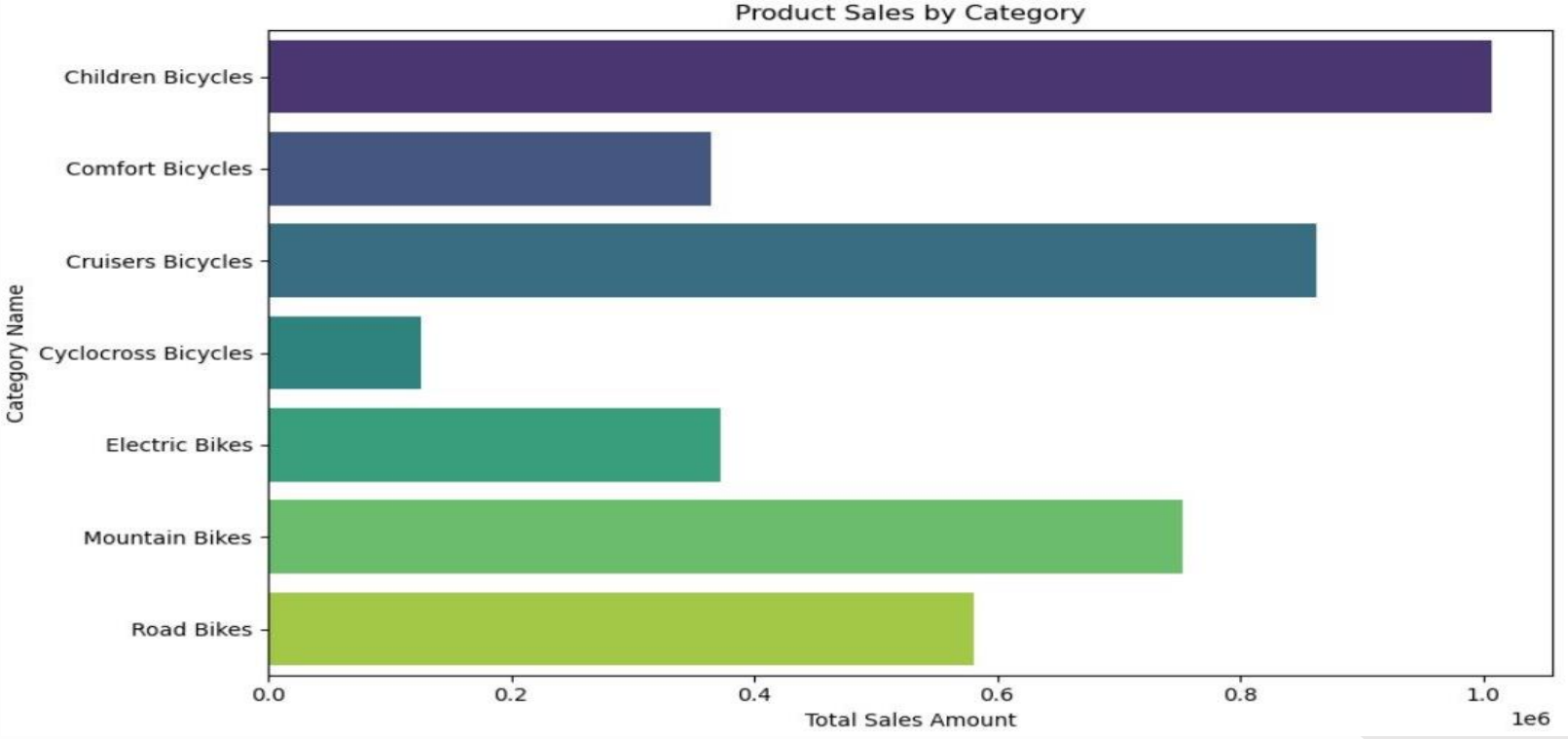

from Data to Viz
From Data to Viz leads you to the most appropriate graph for your data. It links to the code to build it and lists common caveats you should avoid.
EXPLORE
SEE POSTER


What kind of data do you have? Pick the main type using the buttons below. Then let the decision tree guide you toward your graphic possibilities. Alternatively, check the complete decision tree.
Numeric
Categoric
Num & Cat
Maps
Network
Time series
ONE NUMERIC VARIABLE
TWO NUMERIC VARIABLES
THREE NUMERIC VARIABLES
SEVERAL NUMERIC
NOT ORDERED
ORDERED
NOT ORDERED
ORDERED
ORDERED
NOT ORDERED
FEW POINTS
MANY POINTS
HAM
BOX PLOT
VIOLIN PLOT
CONNECTED SCATTER PLOT
BOXPLOT
STACKED AREA PLOT
BOXPLOT

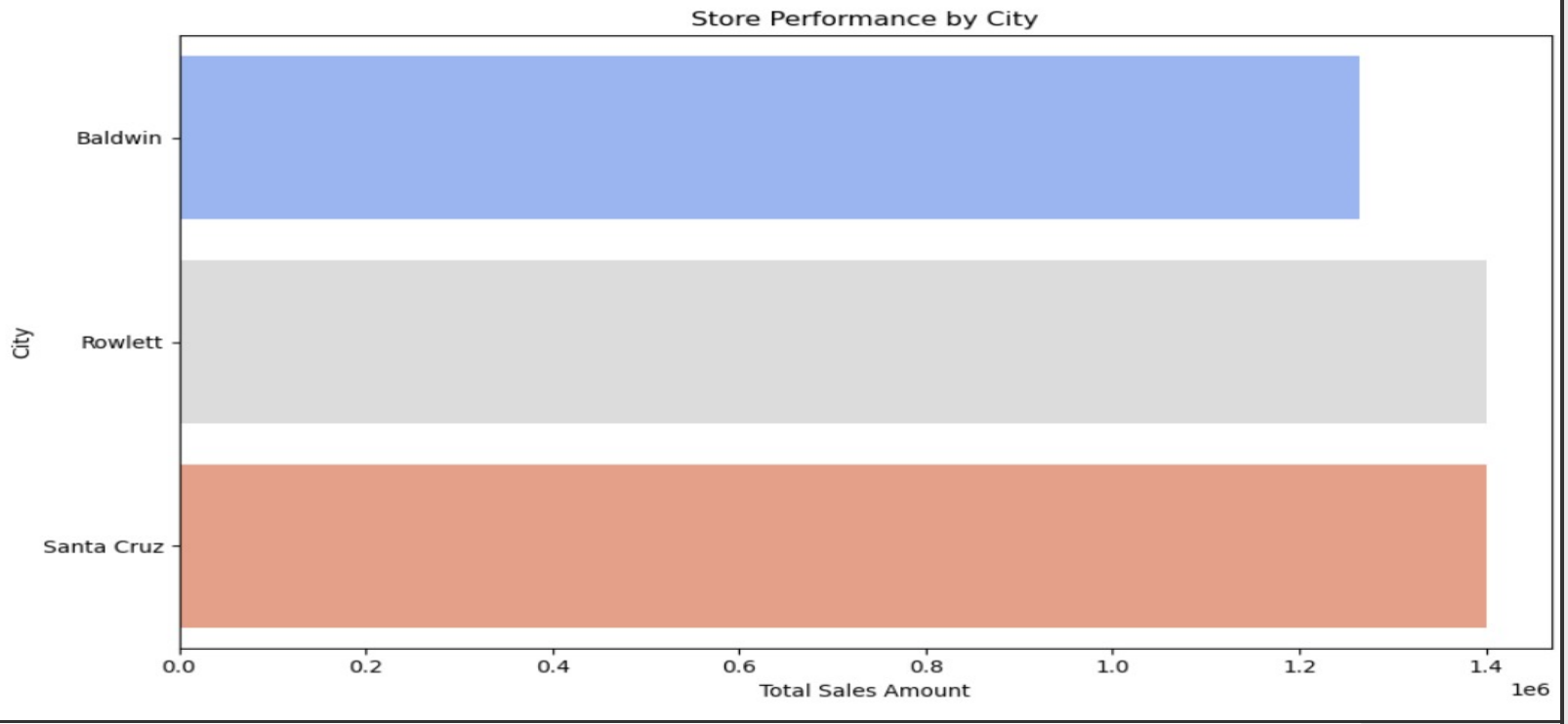
# Examples for visualization



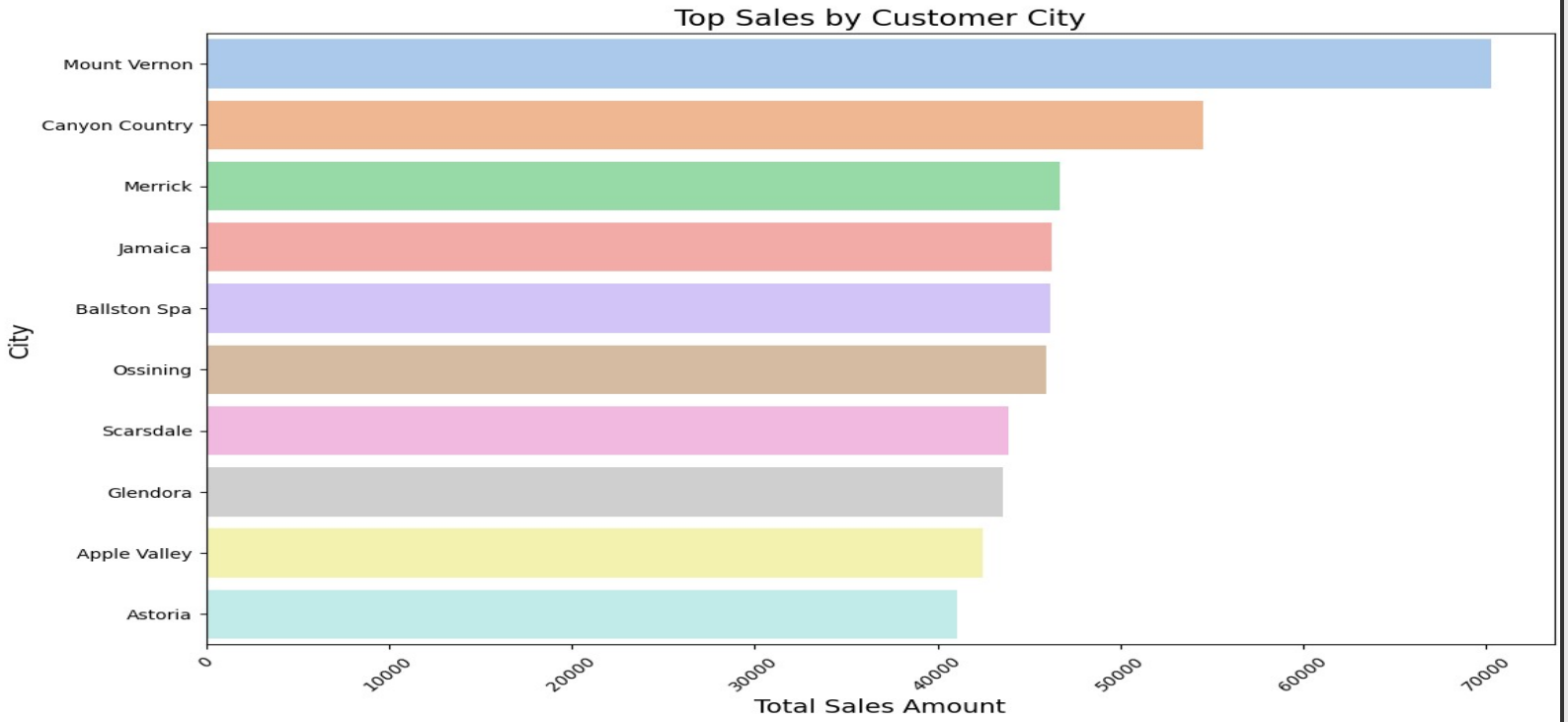
# Examples for visualization



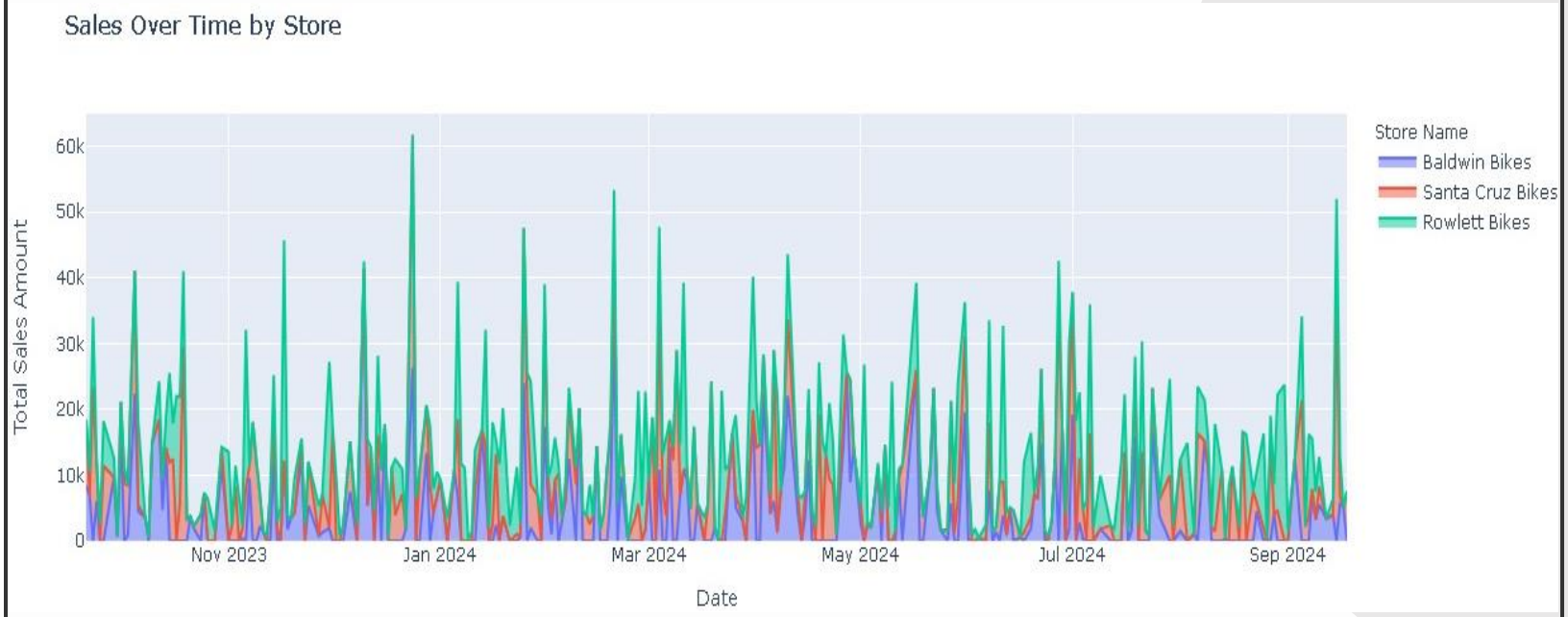
# Examples for visualization



# Examples for visualization



# Examples for visualization



secondly

# Model building

# Important libraries & loading the data (table reading)

```
1   from pyspark.ml.classification import RandomForestClassifier
2   from pyspark.ml.feature import VectorAssembler
3   from pyspark.ml.evaluation import BinaryClassificationEvaluator
4   from pyspark.ml.tuning import ParamGridBuilder, CrossValidator
5   from pyspark.sql import functions as F
6   from pyspark.ml import Pipeline
7
8   # قراءة الجداول
9   df_customers = spark.read.table('dim_customers')
10  df_products = spark.read.table('dim_products')
11  df_time = spark.read.table('dim_time')
12  df_stores = spark.read.table('dim_stores')
13  df_interactions = spark.read.table('fact_interactions')
14  df_transactions = spark.read.table('fact_transactions')
15  df_orders = spark.read.table('fact_orders')  # تم تعديل هذا الجزء
16
```

# Merging specific data

```
# دمج البيانات اللازمة
df_churn = df_customers \
    .join(df_interactions, 'customer_key', 'left') \
    .join(df_transactions, 'customer_key', 'left') \
    .join(df_orders, 'customer_key', 'left')  # تم تعديل هذا الجزء
```

# Creating new features

```
# إنشاء ميزات جديدة
df_churn = df_churn \
    .groupBy('customer_key') \
    .agg(
        F.count('order_id').alias('total_orders'),
        F.count('interaction_id').alias('total_interactions'),
        F.sum('amount').alias('total_spent'),
        F.max('interaction_date').alias('last_interaction_date'),
        F.min('interaction_date').alias('first_interaction_date')
    )
```

# Calculating relation time

```
# حساب مدة العلاقة
df_churn = df_churn \
    .withColumn('customer_lifetime', F.datediff(F.current_date(), 'first_interaction_date')) \
    .withColumn('churned', F.when(F.datediff(F.current_date(), 'last_interaction_date') > 30, 1).otherwise(0))
```

# Removing empty values

```
# إزالة القيم الفارغة
feature_columns = ['total_orders', 'total_interactions', 'total_spent', 'customer_lifetime']
df_churn_cleaned = df_churn.na.drop(subset=feature_columns)
```

# Splitting the data into train and test

```
# تقسيم البيانات
train_data, test_data = df_churn_cleaned.randomSplit([0.8, 0.2], seed=1234)
```

Train : 80%
Test : 20%

## Creating Vector assembler , Randomforest , Grid search , Cross-Validation

```
# إنشاء الـ VectorAssembler للميزات
assembler = VectorAssembler(inputCols=feature_columns, outputCol='features', handleInvalid='skip')
```

```
# إنشاء RandomForestClassifier
rf = RandomForestClassifier(labelCol='churned', featuresCol='features')
```

```
# إعداد شبكة المعلمات لـ Grid Search
paramGrid = (ParamGridBuilder()
             .addGrid(rf.numTrees, [50, 100, 150])
             .addGrid(rf.maxDepth, [5, 10, 15])
             .addGrid(rf.maxBins, [32, 64])
             .build())
```

```
# إعداد Cross-Validation مع 5 طيات
evaluator = BinaryClassificationEvaluator(labelCol="churned", rawPredictionCol="rawPrediction", metricName="areaUnderROC")
crossval = CrossValidator(estimator=rf,
                          estimatorParamMaps=paramGrid,
                          evaluator=evaluator,
                          numFolds=5)
```

```
# إنشاء Pipeline
pipeline = Pipeline(stages=[assembler, crossval])
```

# Model Training & Prediction

```
# تدريب النموذج
cvModel = pipeline.fit(train_data)

# التنبؤ على مجموعة الاختبار
predictions = cvModel.transform(test_data)
```

# Model Evaluation

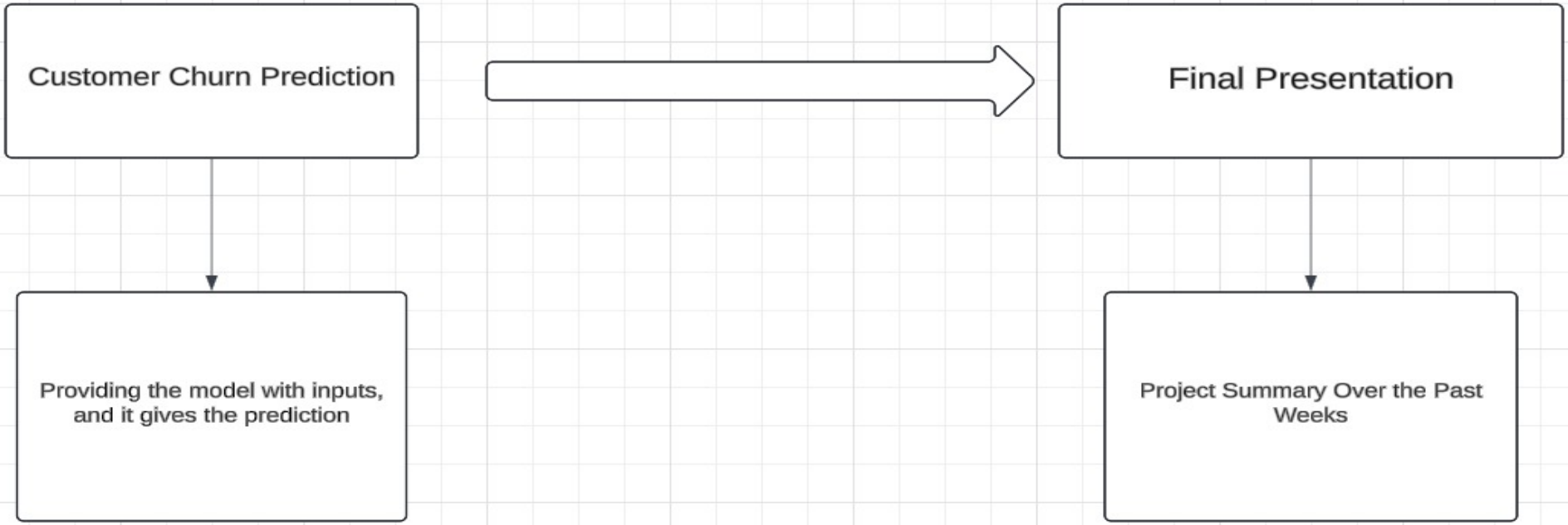
```
# تقييم النموذج باستخدام AUC
auc = evaluator.evaluate(predictions)
print(f"Area Under ROC: {auc}")

# استخراج أهمية الميزات من أفضل نموذج
best_rf_model = cvModel.stages[-1].bestModel  # استرجاع أفضل نموذج RandomForest
importances = best_rf_model.featureImportances
print(f"Feature Importances: {importances}")

feature_columns = ['total_orders', 'total_interactions', 'total_spent', 'customer_lifetime']
```

# Results

```
Feature Importances: (4,[0,1,2,3],[0.18801491955270033,0.11321680322382169,0.24472010817663795,0.4540481690468401])
```

| Run metrics (2) | |
|---|---|
| areaUnderROC_test_data | 0.8337325349301397 |
| accuracy_test_data | 0.9340659340659341 |

# Week 4: Using predictive model and Final Presentation



# Prediction according to input

```
input_data = spark.createDataFrame([
    (26, 5000.00, 20, 30)  # customer_lifetime, total_spent, total_orders, total_interactions
], ["customer_lifetime", "total_spent", "total_orders", "total_interactions"])

predictions = model.transform(input_data)
predictions.show()
```

✓ - Command executed in 830 ms by Suez Gahar on 11:29:44 AM, 10/09/24

```
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
|customer_lifetime|total_spent|total_orders|total_interactions|            features|       rawPrediction|         probability|prediction|
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
|               26|     5000.0|          20|                30|[20.0,30.0,5000.0...|[28.3826676907322...|[0.56765335381464...|       0.0|
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
```

```
input_data = spark.createDataFrame([
    (300, 15000.00, 30, 50)  # customer_lifetime, total_spent, total_orders, total_interactions
], ["customer_lifetime", "total_spent", "total_orders", "total_interactions"])

predictions = model.transform(input_data)
predictions.show()
```

✓ - Command executed in 900 ms by Suez Gahar on 11:22:51 AM, 10/09/24

```
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
|customer_lifetime|total_spent|total_orders|total_interactions|            features|       rawPrediction|         probability|prediction|
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
|              300|    15000.0|          30|                50|[30.0,50.0,15000....|[5.59409381457472...|[0.11188187629149...|       1.0|
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
```

# Prediction according to input

```
import mlflow
model_uri = "runs:/d8f40238-e76d-4b60-9f55-2a251854c0c3/model"
model = mlflow.spark.load_model(model_uri)

# تمرير بيانات متنوعة للتنبؤ
input_data = spark.createDataFrame([
    (50, 5000.75, 15, 20),  # مثال 1: العميل قضى 50 يومًا، أنفق 5000.75 دولار، قدم 15 طلبًا، وشارك في 20 تفاعل
    (120, 25000.99, 50, 100),  # مثال 2: العميل قضى 120 يومًا، أنفق 25000.99 دولار، قدم 50 طلبًا، وشارك في 100 تفاعل
    (30, 1500.25, 8, 15),  # مثال 3: العميل قضى 30 يومًا، أنفق 1500.25 دولار، قدم 8 طلبات، وشارك في 15 تفاعل
    (200, 50000.00, 100, 250),  # مثال 4: العميل قضى 200 يومًا، أنفق 50000 دولار، قدم 100 طلب، وشارك في 250 تفاعل
    (10, 100.50, 2, 5)  # مثال 5: العميل قضى 10 أيام، أنفق 100.50 دولار، قدم طلبين، وشارك في 5 تفاعلات
], ["customer_lifetime", "total_spent", "total_orders", "total_interactions"])

# إجراء التنبؤات باستخدام النموذج
predictions = model.transform(input_data)
predictions.show()
```

✓ - Command executed in 28 sec 103 ms by Suez Gahar on 11:16:19 AM, 10/09/24 — PySpark (Python)

```
2024/10/09 08:15:51 INFO mlflow.spark: 'runs:/d8f40238-e76d-4b60-9f55-2a251854c0c3/model' resolved as 'sds://onelakenortheurope.pbidedicated.windows.net/2d498147-60d2-487b-8282-3fb25813be4e/c13b5d78-500f-4567-919a-d0227f829292/d8f40238-e76d-4b60-9f55-2a251854c0c3/artifacts/model'
Downloading artifacts: 100% 1/1 [00:00<00:00, 11.80it/s]
Downloading artifacts: 100% 28/28 [00:00<00:00, 493.08it/s]
2024/10/09 08:15:52 INFO mlflow.store.artifact.artifact_repo: The progress bar can be disabled by setting the environment variable MLFLOW_ENABLE_ARTIFACTS_PROGRESS_BAR to false
2024/10/09 08:15:53 INFO mlflow.spark: File 'runs:/d8f40238-e76d-4b60-9f55-2a251854c0c3/model/sparkml' not found on DFS. Will attempt to upload the file.
2024/10/09 08:15:55 INFO mlflow.spark: Copied SparkML model to Files/tmp/mlflow/f527c2f7-84d9-4ca6-80a1-179ca57996b5
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
|customer_lifetime|total_spent|total_orders|total_interactions|            features|       rawPrediction|         probability|prediction|
+-----------------+-----------+------------+------------------+--------------------+--------------------+--------------------+----------+
|               50|    5000.75|          15|                20|[15.0,20.0,5000.7...|[5.60334545080591...|[0.11206690901611...|       1.0|
|              120|   25000.99|          50|               100|[50.0,100.0,25000...|[6.36641919680480...|[0.12732838393609...|       1.0|
|               30|    1500.25|           8|                15|[8.0,15.0,1500.25...|[19.6641018507174...|[0.39328203701434...|       1.0|
|              200|    50000.0|         100|               250|[100.0,250.0,5000...|[3.12654765055833...|[0.06253095301116...|       1.0|
|               10|      100.5|           2|                 5|[2.0,5.0,100.5,10.0]|[19.4713650457543...|[0.38942730091508...|       1.0|
```