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Lab No. Lab#.py

Git Repo/ Colab Link:
https://colab.research.google.com/drive/1fL6T6BWVz0kxrJW4SItViYbAtLQCoaLr?usp=sharing

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Objective

The objective of this lab is to explore partitioning strategies and transformation techniques in Apache Spark. The focus is on optimizing data distribution using partitioning methods and performing key transformations such as summarization, sorting, and filtering to extract insights from dataset collected.

Introduction

Apache Spark is a powerful distributed computing framework designed for processing large-scale datasets efficiently. This lab focuses on fundamental data transformation techniques using PySpark, specifically partitioning strategies, data transformations, and aggregations. Partitioning strategies include understanding how data is distributed across partitions using repartition(), repartitionByRange(), and partitioning by column. The key data transformations include summarizing data by counting bookings per hotel type, sorting data based on arrival dates, and filtering records based on country. Additionally, aggregations and analysis are performed by grouping data to analyze trends in booking volume and pricing (ADR - Average Daily Rate) across different years.

The dataset used in this lab is sourced from Kaggle and contains hotel booking records. It includes key fields such as hotel, lead_time, arrival_date_year, arrival_date_month, stays_in_weekend_nights, stays_in_week_nights, adults, children, meal, country, market_segment, reserved_room_type, assigned_room_type, booking_changes, deposit_type, days_in_waiting_list, customer_type, adr (average daily rate), total_of_special_requests, reservation_status, and reservation_status_date, among others. These fields provide critical information for analyzing booking trends, customer behavior, and pricing patterns.

Methodology

1. Data Loading
   1.1. Read the dataset hotel_bookings.csv into a PySpark DataFrame.
   1.2. Print the schema to understand column data types.
2. Partitioning Strategies
   2.1. Partition by Column: Partition the data by hotel type.
   2.2. Repartitioning: Adjust the number of partitions to 4 using repartition(4).

2.3. Range Partitioning: Apply repartitionByRange() based on adr and arrival_date_year to optimize data distribution.

3. Data Transformations
   3.1. Summarization: Count bookings per hotel type.
   3.2. Sorting: Order data by arrival_date_year and arrival_date_month in descending order.
   3.3. Filtering: Extract bookings where country is "USA".
   3.4. Aggregation:
      3.4.1. Categorize ADR values into "Low", "Medium", and "High" ranges.
      3.4.2. Compute the average ADR per year (2015, 2016, 2017).

Results and Analysis

The results demonstrate that city hotels had a significantly higher number of bookings compared to resort hotels. Sorting the data by arrival date revealed a steady increase in hotel reservations over the years, with notable peaks in certain months. Filtering by country showed that the USA had a substantial number of bookings, contributing significantly to the overall dataset.

Further analysis of the ADR values indicated that most bookings fell within the "Medium" category (ADR between 50 and 150), while "Low" ADR bookings (ADR < 50) were relatively rare. The average ADR increased consistently from 2015 to 2017, highlighting a trend of rising room rates over time. This suggests potential factors such as inflation, higher demand, or seasonal price adjustments influencing the ADR values. Additionally, range partitioning by ADR and arrival year optimized the data distribution, improving query performance and analysis efficiency.

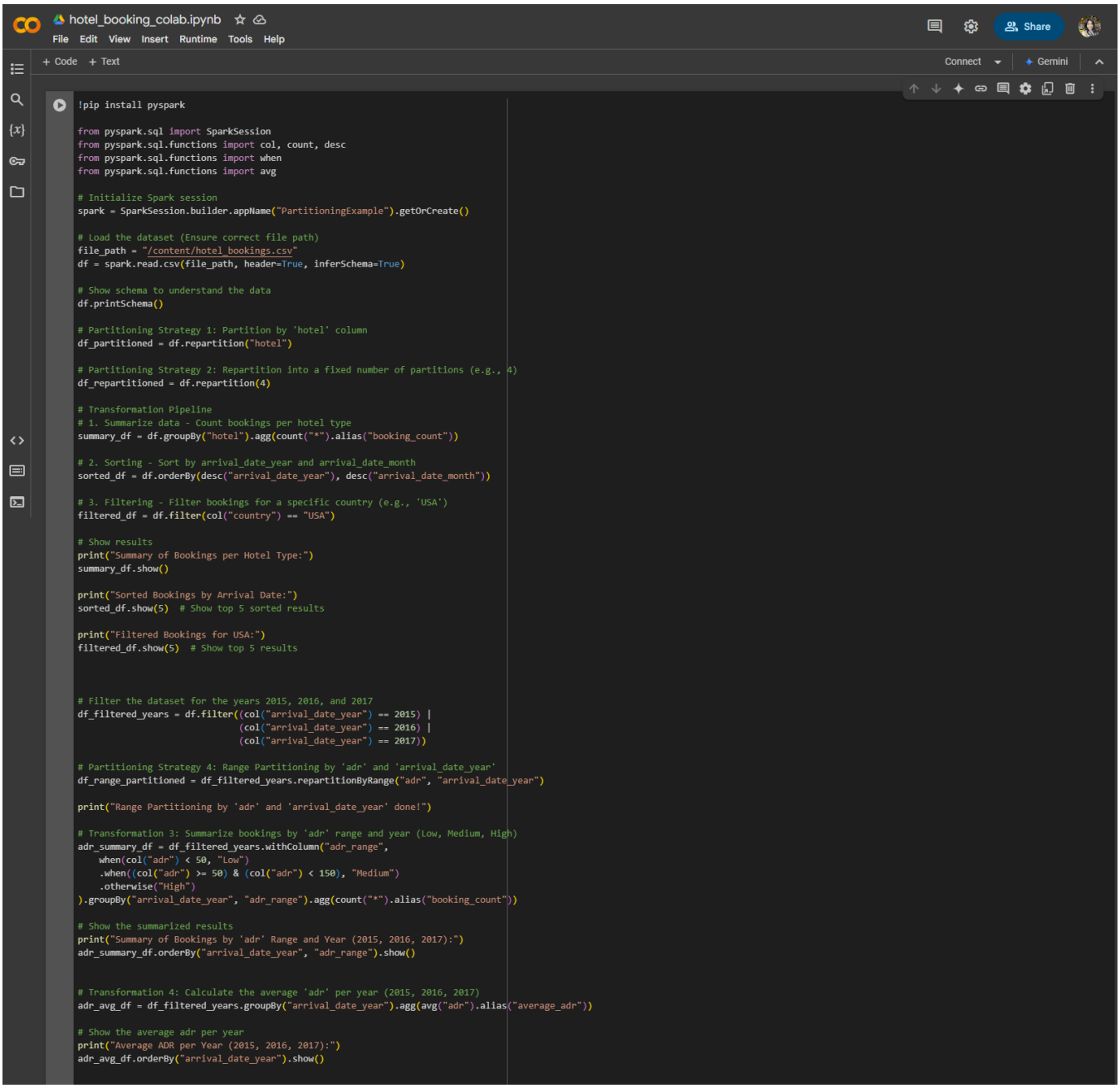
Challenges and Solutions

One of the main challenges encountered in this lab was handling the large dataset efficiently, as operations such as sorting and aggregations were slow. To address this, we applied partitioning strategies, including repartitioning and range partitioning, to optimize data distribution and improve query performance.

Conclusion

This lab demonstrated effective partitioning and transformation techniques using PySpark. By leveraging different partitioning strategies, we optimized data distribution, leading to improved performance. The transformation pipeline provided key insights into hotel booking trends, ADR variations, and country-wise booking distributions. The increasing trend in ADR suggests a rise in pricing over the years, and range partitioning further enhanced efficiency in analyzing pricing trends. The lab reinforced the importance of data partitioning, filtering, sorting, and aggregation in large-scale data processing.

Documentation



```
Requirement already satisfied: pyspark in /usr/local/lib/python3.11/dist-packages (3.5.4)
Requirement already satisfied: py4j==0.10.9.7 in /usr/local/lib/python3.11/dist-packages (from pyspark) (0.10.9.7)
root
 |-- hotel: string (nullable = true)
 |-- is_canceled: integer (nullable = true)
 |-- lead_time: integer (nullable = true)
 |-- arrival_date_year: integer (nullable = true)
 |-- arrival_date_month: string (nullable = true)
 |-- arrival_date_week_number: integer (nullable = true)
 |-- arrival_date_day_of_month: integer (nullable = true)
 |-- stays_in_weekend_nights: integer (nullable = true)
 |-- stays_in_week_nights: integer (nullable = true)
 |-- adults: integer (nullable = true)
 |-- children: string (nullable = true)
 |-- babies: integer (nullable = true)
 |-- meal: string (nullable = true)
 |-- country: string (nullable = true)
 |-- market_segment: string (nullable = true)
 |-- distribution_channel: string (nullable = true)
 |-- is_repeated_guest: integer (nullable = true)
 |-- previous_cancellations: integer (nullable = true)
 |-- previous_bookings_not_canceled: integer (nullable = true)
 |-- reserved_room_type: string (nullable = true)
 |-- assigned_room_type: string (nullable = true)
 |-- booking_changes: integer (nullable = true)
 |-- deposit_type: string (nullable = true)
 |-- agent: string (nullable = true)
 |-- company: string (nullable = true)
 |-- days_in_waiting_list: integer (nullable = true)
 |-- customer_type: string (nullable = true)
 |-- adr: double (nullable = true)
 |-- required_car_parking_spaces: integer (nullable = true)
 |-- total_of_special_requests: integer (nullable = true)
 |-- reservation_status: string (nullable = true)
 |-- reservation_status_date: string (nullable = true)

Summary of Bookings per Hotel Type:
+------------+-------------+
|       hotel|booking_count|
+------------+-------------+
|  City Hotel|        79330|
|Resort Hotel|        40060|
+------------+-------------+
```

```
Sorted Bookings by Arrival Date:
+-----------+----------+---------+-----------------+------------------+------------------------+-------------------------+-----------------------+----------------------+------+--------+------+----+------
|      hotel|is_canceled|lead_time|arrival_date_year|arrival_date_month|arrival_date_week_number|arrival_date_day_of_month|stays_in_weekend_nights|stays_in_week_nights|adults|children|babies|meal|countr
+-----------+----------+---------+-----------------+------------------+------------------------+-------------------------+-----------------------+----------------------+------+--------+------+----+------
|  City Hotel|         0|        1|             2017|               May|                      18|                        3|                      0|                     1|     1|       0|     0|  BB|    PR
|Resort Hotel|         1|       72|             2017|               May|                      18|                        1|                      1|                     2|     2|       2|     0|  BB|    ES
|  City Hotel|         0|        6|             2017|               May|                      19|                       10|                      0|                     2|     1|       0|     0|  BB|    PR
|Resort Hotel|         1|      208|             2017|               May|                      18|                        1|                      1|                     4|     2|       0|     0|  BB|    GB
|  City Hotel|         0|        1|             2017|               May|                      20|                       15|                      1|                     1|     1|       0|     0|  BB|    PR
+-----------+----------+---------+-----------------+------------------+------------------------+-------------------------+-----------------------+----------------------+------+--------+------+----+------
only showing top 5 rows

Filtered Bookings for USA:
+-----------+----------+---------+-----------------+------------------+------------------------+-------------------------+-----------------------+----------------------+------+--------+------+----+------
|      hotel|is_canceled|lead_time|arrival_date_year|arrival_date_month|arrival_date_week_number|arrival_date_day_of_month|stays_in_weekend_nights|stays_in_week_nights|adults|children|babies|meal|countr
+-----------+----------+---------+-----------------+------------------+------------------------+-------------------------+-----------------------+----------------------+------+--------+------+----+------
|Resort Hotel|         0|       68|             2015|              July|                      27|                        1|                      0|                     4|     2|       0|     0|  BB|    US
|Resort Hotel|         0|       14|             2015|              July|                      27|                        2|                      0|                     2|     2|       0|     0|  BB|    US
|Resort Hotel|         0|       10|             2015|              July|                      27|                        3|                      0|                     2|     2|       2|     0|  BB|    US
|Resort Hotel|         0|        9|             2015|              July|                      27|                        3|                      0|                     1|     2|       0|     0|  BB|    US
|Resort Hotel|         0|       51|             2015|              July|                      28|                        6|                      1|                     3|     2|       0|     0|  BB|    US
+-----------+----------+---------+-----------------+------------------+------------------------+-------------------------+-----------------------+----------------------+------+--------+------+----+------
only showing top 5 rows

Range Partitioning by 'adr' and 'arrival_date_year' done!
Summary of Bookings by 'adr' Range and Year (2015, 2016, 2017):
+-----------------+---------+------------+
|arrival_date_year|adr_range|booking_count|
+-----------------+---------+------------+
|             2015|     High|        2085|
|             2015|      Low|        3001|
|             2015|   Medium|       16910|
|             2016|     High|        6285|
|             2016|      Low|        5528|
|             2016|   Medium|       44894|
|             2017|     High|        8517|
|             2017|      Low|        3060|
|             2017|   Medium|       29110|
```