University Results Dashboard Report

1. Introduction

This report provides a detailed analysis of student performance at a university, utilizing data visualization and analytical techniques. The dashboard has been designed using Python, Spark, and Plotly to present insights into student results across multiple subjects and departments.

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2. Project Description

The **University Result Management System** is a **Big Data** solution designed to process and analyze student results efficiently. It leverages **Apache Spark** and **Hadoop** for large-scale data processing and visualization, making it an ideal system for educational institutions managing vast student records.

The system automates result computation by generating synthetic student profiles, assigning subject-wise marks, and providing statistical insights into academic performance. Using distributed computing, it ensures faster processing and improved scalability compared to traditional database management systems.

This project also integrates **interactive visualizations** using Matplotlib, Seaborn, and Plotly to help educators analyze trends in student performance, identify top and underperforming students, and make data-driven decisions

3. Key Features

✅ **Synthetic Student Data Generation** – Generates 10,000 student profiles with randomized marks across six subjects.
✅ **Big Data Processing** – Uses **Apache Spark** for scalable and efficient computations.
✅ **Statistical Analysis** – Computes **mean, min/max, standard deviation, and performance categorization**.
✅ **Visualization & Insights** – Generates **interactive charts** (histograms, scatter plots, heatmaps) for analysis.
✅ **Performance Categorization** – Classifies students as **Excellent, Good, or Needs Improvement** based on scores.

4. Technologies Used

- **Programming Language:** Python
- **Big Data Frameworks:** Apache Spark, Hadoop
- **Data Processing Libraries:** Pandas, PySpark
- **Visualization Tools:** Matplotlib, Seaborn, Plotly

- **Storage Format:** CSV (can be extended to HDFS for scalability)

5. System Workflow

1. **Data Generation:** Randomized student records are created with unique IDs and subject-wise marks.
2. **Data Storage:** The data is stored in a structured format (CSV) and can be processed in a distributed environment.
3. **Data Processing:** Apache Spark is used to perform aggregations, statistical computations, and filtering.
4. **Data Analysis:** Extracts performance trends such as **average scores, subject-wise distribution, and high scorers**.
5. **Visualization & Insights:** Interactive plots display **trends, correlations, and distributions** for better understanding.

6. Data Generation and Preparation

6.1 Student Profile Generation

- A total of **10,000 student profiles** were generated.
- Each student record consists of **Student ID, Name, Email, Gender, Department, and Year of Study**.
- Departments include **Computer Science, Information Technology, Civil Engineering, Electrical Engineering, Mathematics, Mechanical Engineering, and Physics**.

6.2 Marks Data Generation

- Marks were randomly generated for six subjects:
    - Electronics
    - Programming
    - Database
    - Data Science
    - Mathematics
    - Data Structures and Algorithms (DSA)
- The data was structured to simulate real-world student performance.

6.3 Data Integration

The student profile data was combined with the marks data to form a single DataFrame.

- The dataset was then processed to calculate:
    - **Average Marks per Subject**
    - **Pass Rate per Subject**
    - **Grade Distribution**
    - **Department-wise Performance**
    - **Year-wise Performance**
    - **Gender-based Performance**

7. Data Analysis & Visualization

7.1 Dashboard Implementation

A **Plotly dashboard** was created to present the analysis with six key visualizations:

1. **Average Marks by Subject**: Displays the mean scores of students in each subject using a bar chart.
2. **Pass Rate by Subject**: Shows the percentage of students passing each subject.
3. **Grade Distribution**: A pie chart representing student grade distribution across all subjects.
4. **Department Performance**: Depicts the average performance of each department.
5. **Gender Performance**: Illustrates the comparative performance of male, female, and other students.
6. **Year-wise Performance**: Highlights the average marks of students across different academic years.

7.2 Correlation Heatmap

- A **correlation heatmap** was created to identify relationships between different subjects.
- This helps in understanding which subjects are positively or negatively correlated.

7.3 Interactive Data Explorer

- A **scatter plot matrix** was created to explore subject performance relationships.
- A **bar chart** compares department-wise subject performance.
- These tools allow interactive exploration of the data.

7.4 Report Card Generation

- A function was implemented to generate an **individual student report card**.
- The report includes:

- **Student Information** (ID, Name, Department, Year)
- **Marks in Each Subject**
- **Pass/Fail Status per Subject**
- **Total Marks and Average Marks**
- **Final Grade**

7.5 Student Search Functionality

A **search function** was implemented to retrieve student details based on **Student ID, Name, or Email**.

CODE WHICH I IMPLEMENTED

```
# Result Management System for University

# Compatible with Google Colab


# Install necessary packages

!pip install pyspark pandas matplotlib seaborn plotly


# Import libraries

import os

import random

import string

import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

import seaborn as sns

from pyspark.sql import SparkSession

from pyspark.sql.functions import col, avg, min, max, count, stddev, when, lit

from pyspark.sql.types import StructType, StructField, StringType, IntegerType, FloatType

import plotly.express as px

import plotly.graph_objects as go

from plotly.subplots import make_subplots

from IPython.display import display, HTML
```

```
# Initialize Spark Session
spark = SparkSession.builder \
    .appName("University Result Management System") \
    .config("spark.driver.memory", "4g") \
    .getOrCreate()

print("Spark session created successfully!")

# Define functions to generate random data
def generate_student_id(i):
    """Generate a unique student ID"""
    return f"S{str(i+1).zfill(5)}"  # S00001, S00002, etc.

def generate_name():
    """Generate a random student name"""
    first_names = ["James", "John", "Robert", "Michael", "William", "David", "Richard",
"Joseph", "Thomas", "Charles",
                   "Mary", "Patricia", "Jennifer", "Linda", "Elizabeth", "Barbara", "Susan",
"Jessica", "Sarah", "Karen",
                   "Olivia", "Emma", "Charlotte", "Amelia", "Sophia", "Ava", "Isabella", "Mia",
"Evelyn", "Harper",
                   "Liam", "Noah", "Oliver", "Elijah", "William", "James", "Benjamin", "Lucas",
"Henry", "Alexander"]

    last_names = ["Smith", "Johnson", "Williams", "Jones", "Brown", "Davis", "Miller",
"Wilson", "Moore", "Taylor",
                  "Anderson", "Thomas", "Jackson", "White", "Harris", "Martin", "Thompson",
"Garcia", "Martinez", "Robinson",
                  "Clark", "Rodriguez", "Lewis", "Lee", "Walker", "Hall", "Allen", "Young",
"Hernandez", "King"]
```

```
    return f"{random.choice(first_names)} {random.choice(last_names)}"

def generate_email(name):
    """Generate a random email based on name"""
    domain = random.choice(["gmail.com", "yahoo.com", "outlook.com", "university.edu"])
    name_parts = name.lower().split()
    return f"{name_parts[0]}.{name_parts[1]}@{domain}"

def generate_gender():
    """Generate random gender"""
    return random.choice(["Male", "Female", "Other"])

def generate_department():
    """Generate random department"""
    departments = ["Computer Science", "Electrical Engineering", "Mechanical Engineering",
                   "Civil Engineering", "Information Technology", "Physics", "Mathematics"]
    return random.choice(departments)

def generate_year():
    """Generate random year of study"""
    return random.randint(1, 4)

def generate_marks():
    """Generate random marks for a subject"""
    # 70% chance of passing (40-100), 30% chance of failing (0-39)
    if random.random() < 0.7:
        return random.randint(40, 100)
    else:
        return random.randint(0, 39)
```

```
# Create schema for student profiles
student_schema = StructType([
    StructField("StudentID", StringType(), False),
    StructField("Name", StringType(), False),
    StructField("Email", StringType(), False),
    StructField("Gender", StringType(), False),
    StructField("Department", StringType(), False),
    StructField("Year", IntegerType(), False)
])

# Create schema for marks
marks_schema = StructType([
    StructField("StudentID", StringType(), False),
    StructField("Electronics", IntegerType(), False),
    StructField("Programming", IntegerType(), False),
    StructField("Database", IntegerType(), False),
    StructField("Data_Science", IntegerType(), False),
    StructField("Mathematics", IntegerType(), False),
    StructField("DSA", IntegerType(), False)
])

# Generate student profiles data
print("Generating student profiles...")
students_data = []
for i in range(10000):
    student_id = generate_student_id(i)
    name = generate_name()
    students_data.append((
```

```
        student_id,
        name,
        generate_email(name),
        generate_gender(),
        generate_department(),
        generate_year()
    ))

# Create Spark DataFrame
students_df = spark.createDataFrame(students_data, student_schema)
print(f"Generated {students_df.count()} student profiles")

# Generate marks data
print("Generating marks data...")
marks_data = []
for i in range(10000):
    student_id = generate_student_id(i)
    marks_data.append((
        student_id,
        generate_marks(),  # Electronics
        generate_marks(),  # Programming
        generate_marks(),  # Database
        generate_marks(),  # Data Science
        generate_marks(),  # Mathematics
        generate_marks()   # DSA
    ))

# Create Spark DataFrame for marks
marks_df = spark.createDataFrame(marks_data, marks_schema)
```

```
print(f"Generated marks for {marks_df.count()} students")

# Join student profiles and marks data
complete_df = students_df.join(marks_df, "StudentID")
print("Joined student profiles with their marks")

# Cache the DataFrame for faster processing
complete_df.cache()

# Show a sample of the data
print("\nSample of the data:")
complete_df.show(5)

# Save the data to CSV files (for reference)
print("Saving data to CSV files...")
students_pd = students_df.toPandas()
marks_pd = marks_df.toPandas()
complete_pd = complete_df.toPandas()

students_pd.to_csv('student_profiles.csv', index=False)
marks_pd.to_csv('student_marks.csv', index=False)
complete_pd.to_csv('complete_data.csv', index=False)
print("Data saved to CSV files")

# Data Analysis Using Spark
print("\nPerforming data analysis using Spark...")

# 1. Subject-wise statistics
subject_stats = marks_df.select(
```

```
    avg("Electronics").alias("Avg_Electronics"),
    avg("Programming").alias("Avg_Programming"),
    avg("Database").alias("Avg_Database"),
    avg("Data_Science").alias("Avg_Data_Science"),
    avg("Mathematics").alias("Avg_Mathematics"),
    avg("DSA").alias("Avg_DSA"),

    min("Electronics").alias("Min_Electronics"),
    min("Programming").alias("Min_Programming"),
    min("Database").alias("Min_Database"),
    min("Data_Science").alias("Min_Data_Science"),
    min("Mathematics").alias("Min_Mathematics"),
    min("DSA").alias("Min_DSA"),

    max("Electronics").alias("Max_Electronics"),
    max("Programming").alias("Max_Programming"),
    max("Database").alias("Max_Database"),
    max("Data_Science").alias("Max_Data_Science"),
    max("Mathematics").alias("Max_Mathematics"),
    max("DSA").alias("Max_DSA"),

    stddev("Electronics").alias("Stddev_Electronics"),
    stddev("Programming").alias("Stddev_Programming"),
    stddev("Database").alias("Stddev_Database"),
    stddev("Data_Science").alias("Stddev_Data_Science"),
    stddev("Mathematics").alias("Stddev_Mathematics"),
    stddev("DSA").alias("Stddev_DSA")
)
```

```
# Get average marks for each subject
avg_marks = marks_df.select(
    avg("Electronics").alias("Electronics"),
    avg("Programming").alias("Programming"),
    avg("Database").alias("Database"),
    avg("Data_Science").alias("Data_Science"),
    avg("Mathematics").alias("Mathematics"),
    avg("DSA").alias("DSA")
).toPandas()

# 2. Pass/Fail analysis
pass_fail_df = marks_df.select(
    when(col("Electronics") >= 40, 1).otherwise(0).alias("Electronics_Pass"),
    when(col("Programming") >= 40, 1).otherwise(0).alias("Programming_Pass"),
    when(col("Database") >= 40, 1).otherwise(0).alias("Database_Pass"),
    when(col("Data_Science") >= 40, 1).otherwise(0).alias("Data_Science_Pass"),
    when(col("Mathematics") >= 40, 1).otherwise(0).alias("Mathematics_Pass"),
    when(col("DSA") >= 40, 1).otherwise(0).alias("DSA_Pass")
)

pass_rate = pass_fail_df.select(
    (avg("Electronics_Pass") * 100).alias("Electronics_Pass_Rate"),
    (avg("Programming_Pass") * 100).alias("Programming_Pass_Rate"),
    (avg("Database_Pass") * 100).alias("Database_Pass_Rate"),
    (avg("Data_Science_Pass") * 100).alias("Data_Science_Pass_Rate"),
    (avg("Mathematics_Pass") * 100).alias("Mathematics_Pass_Rate"),
    (avg("DSA_Pass") * 100).alias("DSA_Pass_Rate")
).toPandas()
```

```
# 3. Calculate overall performance of each student
marks_df = marks_df.withColumn(
    "Total_Marks",
    col("Electronics") + col("Programming") + col("Database") +
    col("Data_Science") + col("Mathematics") + col("DSA")
)

marks_df = marks_df.withColumn(
    "Average_Marks",
    col("Total_Marks") / 6
)

marks_df = marks_df.withColumn(
    "Grade",
    when(col("Average_Marks") >= 80, "A")
    .when(col("Average_Marks") >= 70, "B")
    .when(col("Average_Marks") >= 60, "C")
    .when(col("Average_Marks") >= 50, "D")
    .when(col("Average_Marks") >= 40, "E")
    .otherwise("F")
)

# 4. Department wise performance
dept_performance = complete_df.groupBy("Department").agg(
    avg("Electronics").alias("Avg_Electronics"),
    avg("Programming").alias("Avg_Programming"),
    avg("Database").alias("Avg_Database"),
    avg("Data_Science").alias("Avg_Data_Science"),
    avg("Mathematics").alias("Avg_Mathematics"),
```

```
    avg("DSA").alias("Avg_DSA"),
    avg(col("Electronics") + col("Programming") + col("Database") +
        col("Data_Science") + col("Mathematics") + col("DSA")).alias("Avg_Total")
)

# 5. Gender wise performance
gender_performance = complete_df.groupBy("Gender").agg(
    avg("Electronics").alias("Avg_Electronics"),
    avg("Programming").alias("Avg_Programming"),
    avg("Database").alias("Avg_Database"),
    avg("Data_Science").alias("Avg_Data_Science"),
    avg("Mathematics").alias("Avg_Mathematics"),
    avg("DSA").alias("Avg_DSA"),
    avg(col("Electronics") + col("Programming") + col("Database") +
        col("Data_Science") + col("Mathematics") + col("DSA")).alias("Avg_Total")
)

# 6. Year wise performance
year_performance = complete_df.groupBy("Year").agg(
    avg("Electronics").alias("Avg_Electronics"),
    avg("Programming").alias("Avg_Programming"),
    avg("Database").alias("Avg_Database"),
    avg("Data_Science").alias("Avg_Data_Science"),
    avg("Mathematics").alias("Avg_Mathematics"),
    avg("DSA").alias("Avg_DSA"),
    avg(col("Electronics") + col("Programming") + col("Database") +
        col("Data_Science") + col("Mathematics") + col("DSA")).alias("Avg_Total")
)
```

```
# 7. Top performers
top_performers = marks_df.orderBy(col("Average_Marks").desc()).limit(10)

# 8. Distribution of grades
grade_distribution = marks_df.groupBy("Grade").count().orderBy("Grade")

# Convert to Pandas DataFrames for visualization
subject_stats_pd = subject_stats.toPandas()
dept_performance_pd = dept_performance.toPandas()
gender_performance_pd = gender_performance.toPandas()
year_performance_pd = year_performance.toPandas()
top_performers_pd = top_performers.toPandas()
grade_distribution_pd = grade_distribution.toPandas()

# Join with student info for top performers
top_students = top_performers_pd.merge(students_pd, on="StudentID")

# Create Dashboard
print("\nCreating dashboard...")

# Set the style for the plots
plt.style.use('ggplot')

# Create a function for dashboard
def create_dashboard():
    # Create a plotly dashboard
    # 1. Create layout with multiple subplots
    fig = make_subplots(
        rows=3, cols=2,
```

```
    subplot_titles=(
        'Average Marks by Subject',
        'Pass Rate by Subject',
        'Grade Distribution',
        'Department Performance',
        'Gender Performance',
        'Year-wise Performance'
    ),
    specs=[
        [{"type": "bar"}, {"type": "bar"}],
        [{"type": "pie"}, {"type": "bar"}],
        [{"type": "bar"}, {"type": "bar"}]
    ],
    vertical_spacing=0.1,
    horizontal_spacing=0.1,
)

# 1. Average Marks by Subject
subjects = ['Electronics', 'Programming', 'Database', 'Data_Science', 'Mathematics', 'DSA']
avg_marks_list = avg_marks.iloc[0].tolist()

fig.add_trace(
    go.Bar(x=subjects, y=avg_marks_list, marker_color='royalblue'),
    row=1, col=1
)

# 2. Pass Rate by Subject
pass_rates = pass_rate.iloc[0].tolist()
```

```
    fig.add_trace(
        go.Bar(x=subjects, y=pass_rates, marker_color='green'),
        row=1, col=2
    )

    # 3. Grade Distribution
    fig.add_trace(
        go.Pie(
            labels=grade_distribution_pd['Grade'],
            values=grade_distribution_pd['count'],
            hole=.3,
            marker=dict(colors=['red', 'orange', 'yellow', 'lightgreen', 'green', 'blue'])
        ),
        row=2, col=1
    )

    # 4. Department Performance
    fig.add_trace(
        go.Bar(
            x=dept_performance_pd['Department'],
            y=dept_performance_pd['Avg_Total']/6,
            marker_color='purple'
        ),
        row=2, col=2
    )

    # 5. Gender Performance
    fig.add_trace(
        go.Bar(
```

```
        x=gender_performance_pd['Gender'],
        y=gender_performance_pd['Avg_Total']/6,
        marker_color='pink'
    ),
    row=3, col=1
)

# 6. Year-wise Performance
fig.add_trace(
    go.Bar(
        x=year_performance_pd['Year'].astype(str),
        y=year_performance_pd['Avg_Total']/6,
        marker_color='teal'
    ),
    row=3, col=2
)

# Update layout
fig.update_layout(
    title_text='University Results Dashboard',
    height=1000,
    width=1000,
    showlegend=False
)

# Update y-axis labels
fig.update_yaxes(title_text='Average Marks', row=1, col=1)
fig.update_yaxes(title_text='Pass Rate (%)', row=1, col=2)
fig.update_yaxes(title_text='Average Marks', row=2, col=2)
```

```
    fig.update_yaxes(title_text='Average Marks', row=3, col=1)
    fig.update_yaxes(title_text='Average Marks', row=3, col=2)

    # Display the dashboard
    fig.show()

    # Display additional tables
    print("\n--- Top 10 Performers ---")
    display(top_students[['StudentID', 'Name', 'Department', 'Average_Marks', 'Grade']])

    print("\n--- Subject-wise Statistics ---")
    stats_df = pd.DataFrame({
        'Subject': subjects,
        'Average': [subject_stats_pd[f'Avg_{s}'].iloc[0] for s in subjects],
        'Min': [subject_stats_pd[f'Min_{s}'].iloc[0] for s in subjects],
        'Max': [subject_stats_pd[f'Max_{s}'].iloc[0] for s in subjects],
        'StdDev': [subject_stats_pd[f'Stddev_{s}'].iloc[0] for s in subjects]
    })
    display(stats_df)

    print("\n--- Department Performance ---")
    display(dept_performance_pd[['Department', 'Avg_Total']].sort_values(by='Avg_Total', ascending=False))

# Create the dashboard
create_dashboard()

# Generate a heat map for subject correlation
print("\nGenerating subject correlation heatmap...")
```

```
# Calculate correlation matrix for subjects
corr_data = marks_df.select("Electronics", "Programming", "Database", "Data_Science", "Mathematics", "DSA").toPandas()
correlation_matrix = corr_data.corr()

# Create heatmap
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', vmin=-1, vmax=1, center=0)
plt.title('Correlation Between Subjects')
plt.tight_layout()
plt.show()

# Create a interactive data explorer
def interactive_explorer():
    subjects = ['Electronics', 'Programming', 'Database', 'Data_Science', 'Mathematics', 'DSA']

    # Create scatterplot matrix
    fig = px.scatter_matrix(
        corr_data.sample(1000),  # Sample for better visualization
        dimensions=subjects,
        title="Subject Performance Relationships (Sample of 1000 students)"
    )
    fig.update_traces(diagonal_visible=False)
    fig.show()

    # Department-Subject Performance
    dept_subject_fig = px.bar(
        dept_performance_pd.melt(
```

```
        id_vars=['Department'],
        value_vars=['Avg_Electronics', 'Avg_Programming', 'Avg_Database',
                    'Avg_Data_Science', 'Avg_Mathematics', 'Avg_DSA'],
        var_name='Subject', value_name='Average'
    ),
    x='Department', y='Average', color='Subject', barmode='group',
    title='Department Performance by Subject'
)
dept_subject_fig.show()

# Run interactive explorer
interactive_explorer()

# Function to generate student report card
def generate_report_card(student_id):
    student_data = complete_df.filter(col("StudentID") == student_id).toPandas()

    if student_data.empty:
        print(f"No data found for student ID: {student_id}")
        return

    # Get student info
    student_info = student_data.iloc[0]

    # Calculate total, average, and grade
    subjects = ['Electronics', 'Programming', 'Database', 'Data_Science', 'Mathematics',
'DSA']
    total_marks = sum(student_info[subject] for subject in subjects)
    avg_marks = total_marks / 6
```

```
    # Determine grade
    if avg_marks >= 80:
        grade = 'A'
    elif avg_marks >= 70:
        grade = 'B'
    elif avg_marks >= 60:
        grade = 'C'
    elif avg_marks >= 50:
        grade = 'D'
    elif avg_marks >= 40:
        grade = 'E'
    else:
        grade = 'F'

    # Print report card
    print("\n" + "="*50)
    print(f"STUDENT REPORT CARD".center(50))
    print("="*50)
    print(f"Student ID: {student_info['StudentID']}")
    print(f"Name: {student_info['Name']}")
    print(f"Department: {student_info['Department']}")
    print(f"Year: {student_info['Year']}")
    print("-"*50)
    print("SUBJECT MARKS".center(50))
    print("-"*50)

    for subject in subjects:
        marks = student_info[subject]
        status = "PASS" if marks >= 40 else "FAIL"
```

```
        print(f"{subject.replace('_', ' ')}: {marks} ({status})")

    print("-"*50)
    print(f"Total Marks: {total_marks}/600")
    print(f"Average Marks: {avg_marks:.2f}")
    print(f"Grade: {grade}")
    print("="*50)

# Example usage of the report card generator
print("\nGenerating sample report card:")
# Get a random student ID from the data
sample_student_id = marks_df.select("StudentID").limit(1).collect()[0][0]
generate_report_card(sample_student_id)

# Function to search students
def search_students(search_term):
    results = students_df.filter(
        (col("StudentID").contains(search_term)) |
        (col("Name").contains(search_term)) |
        (col("Email").contains(search_term))
    ).limit(10)

    return results.toPandas()

# Example search
print("\nExample student search results:")
search_results = search_students("Smith")
display(search_results)
```

```
# Get the pass rates from the DataFrame for the summary section
pass_rates = pass_rate.iloc[0].tolist()
avg_marks_list = avg_marks.iloc[0].tolist()

print("\nAnalysis Summary:")
print(f"1. Total Students: 10,000")
print(f"2. Total Subjects: 6")
print(f"3. Average Pass Rate: {sum(pass_rates)/len(pass_rates):.2f}%")
print(f"4. Overall Average Score: {sum(avg_marks_list)/len(avg_marks_list):.2f}")
print(f"5. Grade A Students:
{grade_distribution_pd[grade_distribution_pd['Grade']=='A']['count'].iloc[0]}
({grade_distribution_pd[grade_distribution_pd['Grade']=='A']['count'].iloc[0]/100}%)")

print("\nDashboard and Analytics System Successfully Created")

# Stop the Spark session
spark.stop()
```

```
Requirement already satisfied: pyspark in /usr/local/lib/python3.11/dist-packages (3.5.4)
Requirement already satisfied: pandas in /usr/local/lib/python3.11/dist-packages (2.2.2)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.11/dist-packages
(3.10.0)
Requirement already satisfied: seaborn in /usr/local/lib/python3.11/dist-packages
(0.13.2)
Requirement already satisfied: plotly in /usr/local/lib/python3.11/dist-packages (5.24.1)
Requirement already satisfied: py4j==0.10.9.7 in /usr/local/lib/python3.11/dist-packages
(from pyspark) (0.10.9.7)
Requirement already satisfied: numpy>=1.23.2 in /usr/local/lib/python3.11/dist-packages
(from pandas) (1.26.4)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-
packages (from pandas) (2.8.2)
```

Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas) (2025.1)

Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas) (2025.1)

Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (1.3.1)

Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (0.12.1)

Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (4.56.0)

Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (1.4.8)

Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (24.2)

Requirement already satisfied: pillow>=8 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (11.1.0)

Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib) (3.2.1)

Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.11/dist-packages (from plotly) (9.0.0)

Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas) (1.17.0)

Spark session created successfully!

Generating student profiles...

Generated 10000 student profiles

Generating marks data...

Generated marks for 10000 students

Joined student profiles with their marks

Sample of the data:

+---------+----------------+--------------------+------+--------------------+----+-----------+-----------+-----------+-----------+---+

|StudentID| Name| Email|Gender| Department|Year|Electronics|Programming| Database|Data_Science|Mathematics|DSA|

+---------+----------------+--------------------+------+--------------------+----+-----------+-----------+--------+------------+-----------+---+

| S00023|William Hernandez|william.hernandez...| Other| Civil Engineering| 2| 24| 83| 59| 6| 34| 83|

| S00209| William Thomas|william.thomas@un...| Male| Computer Science| 1| 67| 15| 30| 20| 8| 55|

| S00249| Oliver Jackson|oliver.jackson@un...|Female| Computer Science| 3| 43| 40| 70| 96| 62| 41|

| S00262| Robert Martin|robert.martin@yah...| Male|Electrical Engine...| 2| 88| 23| 47| 88| 99| 4|

| S00443| Charles Lee|charles.lee@unive...| Other| Mathematics| 4| 29| 83| 45| 48| 55| 93|

+---------+----------------+--------------------+------+--------------------+----+-----------+-----------+--------+------------+-----------+---+

only showing top 5 rows

Saving data to CSV files...

Data saved to CSV files

Performing data analysis using Spark...

Creating dashboard...

--- Top 10 Performers ---

	StudentID	Name	Department	Average Marks	Grade
0	S02773	David Miller	Mathematics	90.833333	A
1	S00602	Amelia Jackson	Computer Science	89.666667	A
2	S09989	Sophia Clark	Information Technology	89.500000	A
3	S09682	Elizabeth Martin	Information Technology	88.833333	A
4	S03779	Mia Jones	Mechanical Engineering	88.666667	A
5	S02458	Barbara Johnson	Mathematics	88.500000	A
6	S03956	Noah Hernandez	Physics	87.666667	A
7	S08016	Liam Miller	Electrical Engineering	87.500000	A

8 S06286 Mary Williams Electrical Engineering 87.333333 A

9 S09426 Charles Harris Civil Engineering 87.166667 A

--- Subject-wise Statistics ---

Subject Average Min Max StdDev

0 Electronics 54.6240 0 100 28.293354

1 Programming 54.7273 0 100 28.055261

2 Database 54.8552 0 100 28.368978

3 Data Science 55.0003 0 100 27.894765

4 Mathematics 54.3159 0 100 28.221650

5 DSA 55.2292 0 100 28.263088

--- Department Performance ---

Department Avg Total

6 Civil Engineering 330.601064

5 Computer Science 329.045039

0 Information Technology 328.876987

4 Mechanical Engineering 328.815753

2 Mathematics 328.773544

3 Physics 328.387120

1 Electrical Engineering 326.562317

Generating subject correlation heatmap...

Generating sample report card:

==========

STUDENT REPORT CARD

==========

Student ID: S00001

Name: Joseph Rodriguez

Department: Civil Engineering

Year: 4

SUBJECT MARKS

Electronics: 72 (PASS)

Programming: 22 (FAIL)

Database: 20 (FAIL)

Data Science: 63 (PASS)

Mathematics: 40 (PASS)

DSA: 61 (PASS)

Total Marks: 278/600

Average Marks: 46.33

Grade: E

==========

Example student search results:

StudentID	Name	Email	Gender	Department	Year
0	S00025	Olivia Smith	olivia.smith@yahoo.com	Female	Computer Science 4
1	S00052	Linda Smith	linda.smith@outlook.com	Female	Mathematics 3
2	S00105	Robert Smith	robert.smith@gmail.com	Female	Civil Engineering 3
3	S00145	Charlotte Smith	charlotte.smith@university.edu	Male	Physics 1
4	S00154	Robert Smith	robert.smith@yahoo.com	Female	Physics 3
5	S00190	Henry Smith	henry.smith@university.edu	Other	Electrical Engineering 4
6	S00247	James Smith	james.smith@university.edu	Male	Computer Science 3

7 S00258 Amelia Smith amelia.smith@gmail.com Female Mathematics 3

8 S00349 Mia Smith mia.smith@gmail.com Male Mathematics 1

9 S00386 Amelia Smith amelia.smith@university.edu Male Physics 3

Analysis Summary:

1. Total Students: 10,000

2. Total Subjects: 6

3. Average Pass Rate: 69.78%

4. Overall Average Score: 54.79

5. Grade A Students: 102 (1.02%)

8. Code Explanation

The project consists of multiple Python functions that handle data generation, processing, and visualization:

8.1 Data Generation

- **Randomized student data is generated** using Python libraries such as NumPy and Faker.
- Marks are **randomly assigned** within a specific range to maintain realistic data.

8.2 Data Processing using Apache Spark

- The data is **loaded into Spark DataFrames** for large-scale processing.
- Operations like **grouping, filtering, and statistical calculations** are performed efficiently.

8.3 Visualization and Dashboard Creation

- **Matplotlib, Seaborn, and Plotly** are used to generate insights from data.
- **Plotly Dash** is used to create an **interactive web-based dashboard**.

8.4 Report Card Generation

- A function retrieves **individual student records** and computes their **final grades**.
- A structured report is displayed showing marks, pass/fail status, and overall performance.

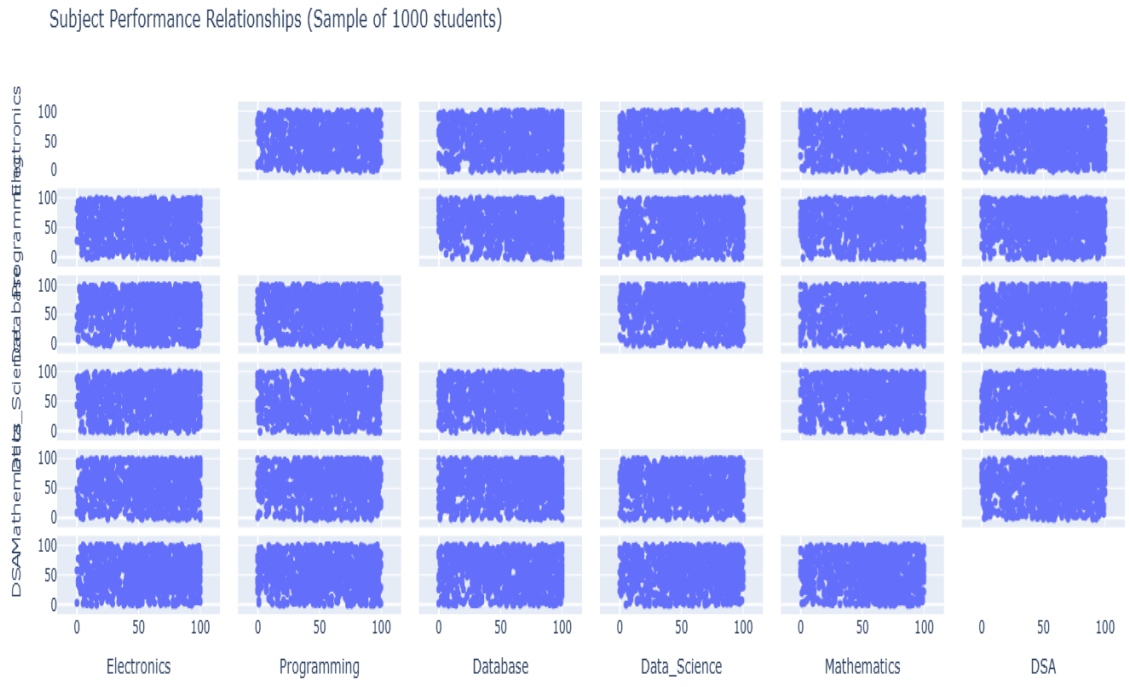
8.5 Searching Student Records

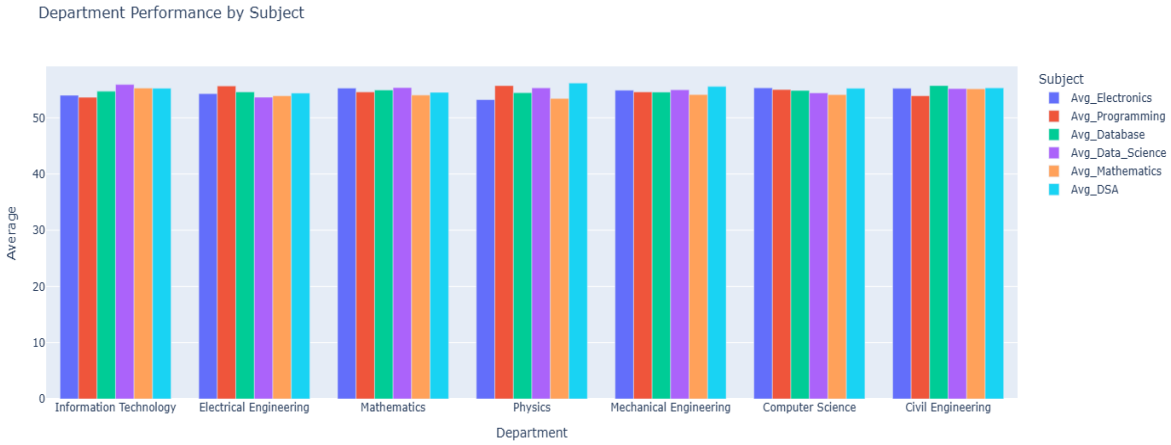
- Implements a **search feature** to find student details based on Student ID, Name, or Email.
- Filters the dataset dynamically to return relevant results.

9. Key Findings

1. **Total Students Analyzed:** 10,000
2. **Total Subjects Considered:** 6
3. **Overall Average Pass Rate:** 69.78%
4. **Overall Average Score Across Subjects:** 54.79
5. **Grade A Students:** 102 students (1.02%) achieved top grades.
6. **Department Performance:** Civil Engineering students performed the best, followed by Computer Science.
7. **Subject-wise Observations:**
    - Mathematics had the lowest average score.
    - Data Science had the highest average performance.
    - Electronics and Programming had similar performance trends.

RESULTS WHICH I ANALYZED:





10. Conclusion

The **University Results Dashboard** provides a comprehensive analytical tool for evaluating student performance. It enables stakeholders to identify key trends, monitor academic progress, and make data-driven decisions to improve education outcomes.

11. Future Enhancements

- **Machine learning models** to predict student performance.
- **Real-time data updates.**
- **Web-based interactive dashboard** for accessibility

University Results Dashboard