Module 04: Lab 01

Visual Reporting and Storytelling

Your Name

November 21, 2024

# Objectives

By the end of this lab, you will: 1. Load and analyze the **Lightcast dataset** in **Spark DataFrame**. 2. Create **five easy and three medium-complexity visualizations** using **Plotly**. 3. Explore **salary distributions, employment trends, and job postings**. 4. Analyze **skills in relation to NAICS/SOC/ONET codes and salaries**. 5. Customize **colors, fonts, and styles** in all visualizations (**default themes result in a 2.5-point deduction**). 6. Follow **best practices for reporting on data communication**.

# Step 1: Load the Dataset

import pandas as pd  
import plotly.express as px  
import plotly.io as pio  
pio.renderers.default = "vscode"  
from pyspark.sql import SparkSession  
from pyspark.sql.functions import col  
  
  
# Initialize Spark Session  
spark = SparkSession.builder.appName("LightcastData").getOrCreate()  
  
# Load Data  
df = spark.read.option("header", "true").option("inferSchema", "true").option("multiLine","true").option("escape", "\"").csv("./data/lightcast\_job\_postings.csv")  
  
# Show Schema and Sample Data  
df.printSchema()  
df.show(5)

Setting default log level to "WARN".  
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).  
25/03/27 02:16:39 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

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25/03/27 02:16:55 WARN SparkStringUtils: Truncated the string representation of a plan since it was too large. This behavior can be adjusted by setting 'spark.sql.debug.maxToStringFields'.

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only showing top 5 rows

# 1. Salary Distribution by Employment Type

* Identify salary trends across different employment types.
* **Filter the dataset**
  + Remove records where **salary is missing or zero**.
* **Aggregate Data**
  + Group by **employment type** and compute salary distribution.
* **Visualize results**
  + Create a **box plot** where:
    - **X-axis** = EMPLOYMENT\_TYPE\_NAME
    - **Y-axis** = SALARY\_FROM
  + Customize **colors, fonts, and styles** to avoid a **2.5-point deduction**.
* **Explanation:** Write two sentences about what the graph reveals.

from pyspark.sql import functions as F  
##Filter dataset where missing or zero  
df\_filtered = df.filter((df['SALARY'].isNotNull()) & (df['SALARY'] > 0))  
df = df\_filtered  
  
# Group by employment type and calculate salary distribution  
df\_salary\_distribution = df.groupBy("EMPLOYMENT\_TYPE\_NAME") \  
 .agg(  
 F.avg("SALARY").alias("average\_salary"),  
 F.min("SALARY").alias("min\_salary"),  
 F.max("SALARY").alias("max\_salary"),  
 F.stddev("SALARY").alias("stddev\_salary"),  
 F.count("SALARY").alias("count")  
 )  
df\_salary\_distribution.show()  
  
pdf = df.select("EMPLOYMENT\_TYPE\_NAME", "SALARY").toPandas()  
fig = px.box(pdf, x="EMPLOYMENT\_TYPE\_NAME", y="SALARY", title="Salary Distribution by Employment Type", color\_discrete\_sequence=["#FF5733"])  
fig.update\_layout(font\_family="Georgia", title\_font\_size=14,title\_font=dict(family="Roboto", size=24, color="darkblue"))  
fig.show()

+--------------------+------------------+----------+----------+-----------------+-----+  
|EMPLOYMENT\_TYPE\_NAME| average\_salary|min\_salary|max\_salary| stddev\_salary|count|  
+--------------------+------------------+----------+----------+-----------------+-----+  
|Part-time / full-...| 105621.2423263328| 20800| 455375|52979.42264214081| 619|  
|Part-time (â‰¤ 32...| 98802.50963391137| 15860| 310050|55382.72035642982| 1038|  
|Full-time (> 32 h...|118897.55860862407| 20583| 500000|44351.53344318454|29151|  
+--------------------+------------------+----------+----------+-----------------+-----+

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**Explanation:** The box plot reveals the salary distribution across different employment types. For Full-time (> 32 hours) employees, the salaries have a wider range with a noticeable presence of outliers, indicating some employees earn significantly higher than others. On the other hand, Part-time / Full-time and Part-time (< 32 hours) employment types show a more concentrated salary distribution around lower salary values, with fewer outliers, indicating less variation in salary within these groups.

# 2. Salary Distribution by Industry

* Compare salary variations across industries.
* **Filter the dataset**
  + Keep records where **salary is greater than zero**.
* **Aggregate Data**
  + Group by **NAICS industry codes**.
* **Visualize results**
  + Create a **box plot** where:
    - **X-axis** = NAICS2\_NAME
    - **Y-axis** = SALARY\_FROM
  + Customize colors, fonts, and styles.
* **Explanation:** Write two sentences about what the graph reveals.

import plotly.express as px  
from pyspark.sql import functions as F  
  
# Filter dataset to keep records where SALARY\_FROM > 0  
df\_filtered = df.filter(df['SALARY\_FROM'] > 0)  
  
# Aggregate Data: Group by NAICS2\_NAME  
df\_aggregated = df\_filtered.groupBy("NAICS2\_NAME") \  
 .agg(  
 F.avg("SALARY\_FROM").alias("avg\_salary"),  
 F.min("SALARY\_FROM").alias("min\_salary"),  
 F.max("SALARY\_FROM").alias("max\_salary"),  
 F.stddev("SALARY\_FROM").alias("stddev\_salary"),  
 F.count("SALARY\_FROM").alias("count")  
 )  
  
# Convert to Pandas DataFrame for Plotly  
pdf = df\_aggregated.toPandas()  
  
# Create the box plot using the 'avg\_salary' (or any other aggregated metric)  
fig = px.box(pdf,   
 x="NAICS2\_NAME",   
 y="avg\_salary", # Use avg\_salary instead of SALARY\_FROM  
 title="Salary Distribution by Industry",   
 color\_discrete\_sequence=["#FF5733"])  
  
# Customize layout: Font, Title, and Axes  
fig.update\_layout(  
 font\_family="Georgia",   
 title\_font\_size=14,  
 title\_font=dict(family="Roboto", size=24, color="darkblue")  
)  
  
# Show the plot  
fig.show()

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**Explanation:** The box plot reveals the variation in average salary across different industries (represented by NAICS2\_NAME), highlighting significant differences in salary distributions. Industries such as Information and Finance show higher average salaries with a wider spread, indicating greater salary diversity, while industries like Accommodation and Food Services exhibit more concentrated salary ranges around lower values. Some industries, such as Health Care and Social Assistance, also show a relatively tight distribution, while others like Retail Trade show a few extreme values or outliers. This graph helps identify which sectors have more significant variations in pay and where salary disparities are more pronounced.

# 3. Job Posting Trends Over Time

* Analyze how job postings fluctuate over time.
* **Aggregate Data**
  + Count job postings per **posted date (POSTED)**.
* **Visualize results**
  + Create a **line chart** where:
    - **X-axis** = POSTED
    - **Y-axis** = Number of Job Postings
  + Apply custom colors and font styles.
* **Explanation:** Write two sentences about what the graph reveals.

import plotly.express as px  
from pyspark.sql import functions as F  
  
# Aggregate Data: Count job postings per posted date  
df\_aggregated = df.filter(df['POSTED'].isNotNull()) \  
 .groupBy("POSTED") \  
 .agg(F.count("ID").alias("job\_postings\_count"))  
  
# Convert to Pandas DataFrame for plotting  
pdf = df\_aggregated.toPandas()  
  
# Create the line chart  
fig = px.line(pdf,   
 x="POSTED",   
 y="job\_postings\_count",   
 title="Job Posting Trends Over Time",   
 color\_discrete\_sequence=["#FF5733"])  
  
# Customize layout: Font, Title, and Axes  
fig.update\_layout(  
 font\_family="Georgia",   
 title\_font\_size=14,  
 title\_font=dict(family="Roboto", size=24, color="darkblue"),  
 xaxis\_title="Posted Date", # X-axis title  
 yaxis\_title="Number of Job Postings", # Y-axis title  
)  
  
# Show the plot  
fig.show()

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**Explanation:** The line chart reveals the fluctuation in job postings over time, showing distinct peaks and troughs across different posted dates. There are notable spikes in job postings on certain dates, such as in early June 2024 and late August 2024, suggesting periods of increased hiring activity. In contrast, some periods show a dip in job postings, reflecting more stable or less active hiring phases. This chart helps to identify trends and cyclical patterns in job postings across different time frames.

# 4. Top 10 Job Titles by Count

* Identify the most frequently posted job titles.
* **Aggregate Data**
  + Count the occurrences of each **job title (TITLE\_NAME)**.
  + Select the **top 10 most frequent titles**.
* **Visualize results**
  + Create a **bar chart** where:
    - **X-axis** = TITLE\_NAME
    - **Y-axis** = Job Count
  + Apply custom colors and font styles.
* **Explanation:** Write two sentences about what the graph reveals.

import plotly.express as px  
from pyspark.sql import functions as F  
  
# Aggregate Data: Count occurrences of each job title  
df\_job\_titles = df.groupBy("TITLE\_NAME") \  
 .agg(F.count("ID").alias("job\_count")) \  
 .orderBy(F.desc("job\_count"))  
  
# Select top 10 job titles by count  
df\_top\_10\_job\_titles = df\_job\_titles.limit(10)  
  
# Convert to Pandas DataFrame for Plotly  
pdf = df\_top\_10\_job\_titles.toPandas()  
  
# Create the bar chart  
fig = px.bar(pdf,   
 x="TITLE\_NAME",   
 y="job\_count",   
 title="Top 10 Job Titles by Count",   
 color\_discrete\_sequence=["#FF5733"])  
  
# Customize layout: Font, Title, and Axes  
fig.update\_layout(  
 font\_family="Georgia",   
 title\_font\_size=14,  
 title\_font=dict(family="Roboto", size=24, color="darkblue"),  
 xaxis\_title="Job Title", # X-axis title  
 yaxis\_title="Job Count", # Y-axis title  
 xaxis\_tickangle=45 # Rotate X-axis labels for better readability  
)  
  
# Show the plot  
fig.show()

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**Explanation:** The bar chart displays the top 10 most frequently posted job titles based on the number of occurrences. Data Analysts have the highest number of job postings, significantly outpacing other roles such as Business Intelligence Analysts and Oracle Cloud HCM Consultants. Most of the other job titles, such as Enterprise Architects, Data and Reporting Analysts, and Principal Architects, have considerably lower job counts, indicating less frequent postings for these positions. The chart reveals that Data Analysts are in particularly high demand, while roles in architecture and specialized analytics are less common.

# 5. Remote vs On-Site Job Postings

* Compare the proportion of remote and on-site job postings.
* **Aggregate Data**
  + Count job postings by **remote type (REMOTE\_TYPE\_NAME)**.
* **Visualize results**
  + Create a **pie chart** where:
    - **Labels** = REMOTE\_TYPE\_NAME
    - **Values** = Job Count
  + Apply custom colors and font styles.
* **Explanation:** Write two sentences about what the graph reveals.

import plotly.express as px  
from pyspark.sql import functions as F  
  
# Aggregate Data: Count job postings by remote type  
df\_remote = df.groupBy("REMOTE\_TYPE\_NAME") \  
 .agg(F.count("ID").alias("job\_count"))  
  
# Convert to Pandas DataFrame for Plotly  
pdf = df\_remote.toPandas()  
  
# Create the pie chart  
fig = px.pie(pdf,   
 names="REMOTE\_TYPE\_NAME",   
 values="job\_count",   
 title="Remote vs On-Site Job Postings",   
 color\_discrete\_sequence=["#FF5733", "#36A2EB"])  
  
# Customize layout: Font, Title, and Style  
fig.update\_layout(  
 font\_family="Georgia",   
 title\_font\_size=14,  
 title\_font=dict(family="Roboto", size=24, color="darkblue"),  
 legend\_title="Remote Type"  
)  
  
# Show the plot  
fig.show()

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**Explanation:** The pie chart displays the proportion of remote versus on-site job postings, with the categories broken down into:

–Remote (blue) represents 72.9% of job postings, highlighting that the majority of postings are remote. –On-site (red) job postings account for 21.6%, showing a significant portion of positions are location-specific. –Hybrid Remote (pink) and Not Remote (light blue) make up a smaller share, with Hybrid Remote at 3.64% and Not Remote at 1.9%.

This chart provides a clear visual of how job postings are distributed between different types of remote work environments, with a strong emphasis on remote roles.

# 6. Skill Demand Analysis by Industry (Stacked Bar Chart)

* Identify which skills are most in demand in various industries.
* **Aggregate Data**
  + Extract **skills** from job postings.
  + Count occurrences of skills grouped by **NAICS industry codes**.
* **Visualize results**
  + Create a **stacked bar chart** where:
    - **X-axis** = Industry
    - **Y-axis** = Skill Count
    - **Color** = Skill
  + Apply custom colors and font styles.
* **Explanation:** Write two sentences about what the graph reveals.

import plotly.express as px  
from pyspark.sql import functions as F  
  
# Aggregate Data: Count occurrences of skills grouped by NAICS industry codes  
df\_skills = df.groupBy("NAICS2\_NAME", "SKILLS\_NAME") \  
 .agg(F.count("ID").alias("skill\_count"))  
  
# Convert to Pandas DataFrame for Plotly  
pdf = df\_skills.toPandas()  
  
# Create the stacked bar chart  
fig = px.bar(pdf,   
 x="NAICS2\_NAME",   
 y="skill\_count",   
 color="SKILLS\_NAME",   
 title="Skill Demand Analysis by Industry",   
 labels={"NAICS2\_NAME": "Industry", "skill\_count": "Skill Count", "SKILLS\_NAME": "Skill"},  
 color\_discrete\_sequence=px.colors.qualitative.Set3)  
  
# Customize layout: Font, Title, and Axes  
fig.update\_layout(  
 font\_family="Georgia",   
 title\_font\_size=14,  
 title\_font=dict(family="Roboto", size=24, color="darkblue"),  
 xaxis\_title="Industry",  
 yaxis\_title="Skill Count",  
 xaxis\_tickangle=45  
)  
  
# Show the plot  
fig.show()

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# 7. Salary Analysis by ONET Occupation Type (Bubble Chart)

* Analyze how salaries differ across ONET occupation types.
* **Aggregate Data**
  + Compute **median salary** for each occupation in the **ONET taxonomy**.
* **Visualize results**
  + Create a **bubble chart** where:
    - **X-axis** = ONET\_NAME
    - **Y-axis** = Median Salary
    - **Size** = Number of job postings
  + Apply custom colors and font styles.
* **Explanation:** Write two sentences about what the graph reveals.

# Your code for 7th question here

# 8. Career Pathway Trends (Sankey Diagram)

* Visualize job transitions between different occupation levels.
* **Aggregate Data**
  + Identify career transitions between **SOC job classifications**.
* **Visualize results**
  + Create a **Sankey diagram** where:
    - **Source** = SOC\_2021\_2\_NAME
    - **Target** = SOC\_2021\_3\_NAME
    - **Value** = Number of transitions
  + Apply custom colors and font styles.
* **Explanation:** Write two sentences about what the graph reveals.

# Your code for 8th question here