Module 04: Lab 01

Visual Reporting and Storytelling

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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 = "notebook"  
from pyspark.sql import SparkSession  
from pyspark.sql.functions import col  
import os  
os.makedirs("\_output", exist\_ok=True)  
  
  
# 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)

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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.

df = df.filter((col("SALARY\_FROM").isNotNull()) & (col("SALARY\_FROM") > 0))  
  
pdf = df.select("EMPLOYMENT\_TYPE\_NAME", "SALARY\_FROM").toPandas()  
  
fig = px.box(  
 pdf,  
 x="EMPLOYMENT\_TYPE\_NAME",  
 y="SALARY\_FROM",  
 title="Salary Distribution by Employment Type",  
 color="EMPLOYMENT\_TYPE\_NAME",  
 color\_discrete\_sequence=["#636EFA", "#EF553B", "#00CC96", "#AB63FA"]  
)  
  
fig.update\_layout(font\_family="Arial", title\_font\_size=16)  
fig.show()  
fig.write\_image("\_output/Salary\_Distribution\_by\_Employment\_Type.svg")

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Salary Distribution by Employment Type

The chart shows that full-time jobs (more than 32 hours) have significantly higher median salaries compared to other employment types. Part-time jobs, especially those with fewer than 32 hours, have lower and more concentrated salary distributions, indicating a trend of lower pay.

# 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.

df = df.filter(col("SALARY\_FROM") > 0)  
  
pdf = df.select("NAICS2\_NAME", "SALARY\_FROM").toPandas()  
  
fig = px.box(  
 pdf,  
 x="NAICS2\_NAME",  
 y="SALARY\_FROM",  
 title="Salary Distribution by Industry",  
 color="NAICS2\_NAME",   
 color\_discrete\_sequence=["#636EFA", "#EF553B", "#00CC96", "#AB63FA", "#FFA15A"],  
 height=1000   
)  
  
fig.update\_layout(  
 font\_family="Arial",  
 title\_font\_size=16  
)  
  
fig.show()  
fig.write\_image("\_output/Salary\_Distribution\_by\_Industry.svg")

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The salary distribution varies significantly across industries. For example, industries like Information and Professional, Scientific, and Technical Services tend to have higher median salaries and larger salary ranges. In contrast, industries such as Retail Trade and Accommodation and Food Services show lower salary levels overall.

# 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.

date\_counts = df.groupBy("POSTED").count().orderBy("POSTED")  
pdf = date\_counts.toPandas()  
  
fig = px.line(pdf,  
 x="POSTED",  
 y="count",  
 title="Job Posting Trends Over Time")  
  
fig.update\_traces(line=dict(color="green"))  
fig.update\_layout(font\_family="Arial", title\_font\_size=18)  
fig.show()  
fig.write\_image("\_output/Job\_Posting\_Trends\_Over\_Time.svg")

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The number of job postings fluctuates significantly from day to day, indicating variable demand for talent over time. While there is no perfectly smooth trend, there appears to be a general increase in job postings in early September, suggesting a potential seasonal hiring pattern.

# 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.

top\_titles = (  
 df.groupBy("TITLE\_NAME")  
 .count()  
 .orderBy("count", ascending=False)  
 .limit(10)  
 .toPandas()  
)  
  
fig = px.bar(  
 top\_titles,  
 x="TITLE\_NAME",  
 y="count",  
 title="Top 10 Job Titles by Count",   
 text="count",  
 color="count",   
 color\_continuous\_scale="Greens"  
)  
  
fig.update\_layout(  
 xaxis\_title="Job Title",  
 yaxis\_title="Job Count",  
 font\_family="Arial",  
 title\_font\_size=20  
)  
  
fig.show()  
fig.write\_image("\_output/Top\_10\_Job\_Titles\_by\_Count.svg")

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The most frequently posted job title is Data Analysts, with a count of 3922 postings — significantly higher than other titles. Other common job titles include Business Intelligence Analysts, Oracle Cloud HCM Consultants, and Enterprise Architects, all with posting counts above 700, indicating strong market demand in these roles.

# 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.

remote\_jobs = (  
 df.groupBy("REMOTE\_TYPE\_NAME")  
 .count()  
 .toPandas()  
)  
  
fig = px.pie(  
 remote\_jobs,  
 names="REMOTE\_TYPE\_NAME",  
 values="count",  
 title="Remote vs On-Site Job Postings",  
 color\_discrete\_sequence=px.colors.sequential.RdBu  
)  
  
fig.update\_layout(  
 font\_family="Arial",  
 title\_font\_size=20  
)  
fig.show()  
fig.write\_image("\_output/Remote\_vs\_OnSite\_Job\_Postings.svg")

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The majority of job postings (73.2%) have no specified remote status, which indicates that many employers did not clarify whether the position is remote or on-site. Among the classified job postings, remote positions (21.3%) are significantly more common than hybrid (3.55%) or fully on-site roles (1.94%).

# 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.

top\_skills = (  
 df.groupBy("SKILLS\_NAME")  
 .count()  
 .orderBy("count", ascending=False)  
 .limit(10)   
 .toPandas()  
)  
  
top\_skill\_list = top\_skills["SKILLS\_NAME"].tolist()  
  
skill\_by\_industry = (  
 df.filter(col("SKILLS\_NAME").isin(top\_skill\_list))  
 .groupBy("NAICS2\_NAME", "SKILLS\_NAME")  
 .count()  
 .toPandas()  
)  
  
fig = px.bar(  
 skill\_by\_industry,  
 x="NAICS2\_NAME",  
 y="count",  
 color="SKILLS\_NAME",  
 title="Top Skills by Industry",  
 text\_auto=True,  
 color\_discrete\_sequence=px.colors.sequential.Greens  
)  
  
fig.update\_layout(  
 xaxis\_title="Industry",  
 yaxis\_title="Skill Count",  
 barmode="stack",  
 font\_family="Arial",  
 title\_font\_size=20,  
 xaxis\_tickangle=-45,   
 legend\_title\_text='Skill',  
 legend=dict(  
 orientation="h",   
 yanchor="bottom",  
 y=-0.5,   
 xanchor="center",  
 x=0.5  
 ),  
 height=1000   
)  
  
  
fig.show()  
fig.write\_image("\_output/Top\_Skills\_by\_Industry.svg")

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The chart shows the most in-demand skills across different industries.For example, the “Professional, Scientific, and Technical Services” industry shows a high demand for multiple skills, including three major ones. The “Construction” and “Health Care and Social Assistance” industries each have one or two dominant skills. This suggests that different industries require different skill sets.

# 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.

from pyspark.sql.functions import col, avg, count, expr  
  
df\_salary = df.filter(  
 (col("SALARY\_FROM").isNotNull()) &   
 (col("SALARY\_TO").isNotNull())  
)  
  
df\_salary = df\_salary.withColumn("MEDIAN\_SALARY", (col("SALARY\_FROM") + col("SALARY\_TO")) / 2)  
  
df\_onet = df\_salary.groupBy("ONET\_NAME") \  
 .agg(  
 avg("MEDIAN\_SALARY").alias("Median\_Salary"),  
 count("\*").alias("Job\_Count")  
 ) \  
 .orderBy("Median\_Salary", ascending=False) \  
 .limit(30) \  
 .toPandas()  
  
fig = px.scatter(  
 df\_onet,  
 x="ONET\_NAME",  
 y="Median\_Salary",  
 size="Job\_Count",  
 color="Median\_Salary",  
 title="Median Salary by ONET Occupation Type",  
 color\_continuous\_scale=px.colors.sequential.Greens   
)  
  
fig.update\_layout(  
 xaxis\_title="ONET Occupation",  
 yaxis\_title="Median Salary",  
 font\_family="Arial",  
 title\_font\_size=20  
)  
  
fig.show()  
  
fig.write\_image("\_output/Median\_Salary\_by\_ONET\_Occupation\_Type.svg")

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The bubble chart shows the median salary for the occupation type Business Intelligence Analysts based on ONET classification. The size of the bubble indicates the number of job postings for this occupation. Since there is only one ONET occupation type in the dataset, the chart displays just one bubble. This means the dataset is limited in terms of occupational diversity, so a broader comparison across different occupations is not possible 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.

import plotly.graph\_objects as go  
  
df\_transition = df.groupBy("SOC\_2021\_2\_NAME", "SOC\_2021\_3\_NAME") \  
 .count() \  
 .withColumnRenamed("count", "Transitions") \  
 .toPandas()  
  
labels = list(pd.unique(df\_transition[["SOC\_2021\_2\_NAME", "SOC\_2021\_3\_NAME"]].values.ravel()))  
label\_map = {label: i for i, label in enumerate(labels)}  
  
df\_transition["source\_id"] = df\_transition["SOC\_2021\_2\_NAME"].map(label\_map)  
df\_transition["target\_id"] = df\_transition["SOC\_2021\_3\_NAME"].map(label\_map)  
  
fig = go.Figure(data=[go.Sankey(  
 node=dict(  
 pad=15,  
 thickness=20,  
 line=dict(color="black", width=0.5),  
 label=labels,  
 color="lightblue"  
 ),  
 link=dict(  
 source=df\_transition["source\_id"],  
 target=df\_transition["target\_id"],  
 value=df\_transition["Transitions"]  
 )  
)])  
  
fig.update\_layout(title\_text="Career Pathway Trends", font\_family="Arial", font\_size=12)  
fig.show()  
fig.write\_image("\_output/Career\_Pathway\_Trends.svg")

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This Sankey diagram shows a single career transition from Computer and Mathematical Occupations to Mathematical Science Occupations. The width of the flow represents the number of transitions, but since there is only one path in the data, it dominates the entire diagram. The limited data restricts insights into broader career pathways. A richer dataset with more transition examples would allow for deeper analysis of occupational mobility.