Module 04: Lab 01

Visual Reporting and Storytelling

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# 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  
import plotly.graph\_objects as go  
pio.renderers.default = "vscode"  
from pyspark.sql import SparkSession  
from pyspark.sql.functions import col  
from pyspark.sql.functions import col, split, explode, regexp\_replace, transform  
  
  
  
# 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.

# Your Code for 1st question here  
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=["#2acaea"])  
fig.update\_layout(font\_family="Times New Roman", title\_font\_size=25)  
fig.show()

Unable to display output for mime type(s): application/vnd.plotly.v1+json

ValueError:   
Image export using the "kaleido" engine requires the kaleido package,  
which can be installed using pip:  
 $ pip install -U kaleido

The box plot shows the distribution of salaries across different employment types. Full-time positions tend to have higher median salaries and a broader salary range, indicating more earning potential. Part-time and mixed roles generally show lower median salaries and a tighter distribution, though outliers suggest occasional high-paying exceptions. Overall, employment type significantly affects salary levels and variability.

# 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.

pdf = df.filter((col("SALARY\_FROM").isNotNull()) & (col("SALARY\_FROM") > 0)) \  
 .select("NAICS2\_NAME", "SALARY\_FROM").toPandas()  
  
fig = px.box(  
 pdf,  
 x="NAICS2\_NAME",  
 y="SALARY\_FROM",  
 title="Salary Distribution by Industry",  
 color\_discrete\_sequence=["#2acaea"]  
)  
fig.update\_layout(  
 font\_family="Times New Roman",  
 title\_font\_size=25,  
 xaxis\_title="Industry (NAICS2)",  
 yaxis\_title="Salary",  
 xaxis\_tickangle=90,  
 plot\_bgcolor="#407aab",  
 paper\_bgcolor="#e7f5f4",  
 font=dict(size=10)  
)  
fig.show()

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The chart highlights significant salary variation across different industries. Fields like Information, Professional Services, and Administrative Support show wider salary ranges and higher outliers, suggesting diverse roles and compensation levels, while industries such as Arts and Accommodation generally offer lower and more concentrated salary distributions.

# 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.

df\_aggregated = df.groupBy("POSTED").count()  
pdf = df\_aggregated.toPandas()  
pdf["POSTED"] = pd.to\_datetime(pdf["POSTED"])  
pdf = pdf.sort\_values("POSTED")  
fig = px.line(pdf, x="POSTED", y="count", title="Job Posting Trends Over Time",  
 line\_shape="linear", color\_discrete\_sequence=['#407aab'])  
fig.update\_layout(  
 font\_family="Times New Roman",  
 title\_font\_size=25,  
 title\_x=0.5,  
 xaxis\_title="Posted Date",  
 yaxis\_title="Number of Job Postings"  
)  
fig.show()

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The line chart shows the fluctuation of job postings over time from May to September 2024. Although there are frequent short-term spikes and dips, the overall trend remains relatively stable, suggesting consistent hiring activity without significant long-term increases or decreases.

# 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.

pdf = df.groupBy("TITLE\_NAME") \  
 .agg(count("\*").alias("JOB\_COUNT")) \  
 .orderBy(col("JOB\_COUNT").desc()) \  
 .limit(10) \  
 .toPandas()  
  
fig = px.bar(  
 pdf,  
 x="TITLE\_NAME",  
 y="JOB\_COUNT",  
 title="Top 10 Job Titles by Count",  
 color\_discrete\_sequence=["#2acaea"]  
)  
  
fig.update\_layout(  
 font\_family="Times New Roman",  
 title\_font\_size=25,  
 xaxis\_title="Job Title",  
 yaxis\_title="Job Count",  
 xaxis\_tickangle=45,  
 plot\_bgcolor="#407aab",  
 paper\_bgcolor="#e7f5f4",  
 font=dict(size=10)  
)  
  
fig.show()

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The chart reveals that Data Analyst is the most frequently posted job title by a significant margin, indicating strong demand in data-related roles. Other popular positions such as Business Intelligence Analyst and Enterprise Architects also reflect the market’s emphasis on analytics, architecture, and enterprise systems.

# 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.

pdf = df.filter(  
 (col("REMOTE\_TYPE\_NAME").isNotNull()) &  
 (col("REMOTE\_TYPE\_NAME") != "") &  
 (col("REMOTE\_TYPE\_NAME") != "[None]")  
).groupBy("REMOTE\_TYPE\_NAME") \  
 .agg(count("\*").alias("JOB\_COUNT")) \  
 .toPandas()  
  
fig = px.pie(  
 pdf,  
 names="REMOTE\_TYPE\_NAME",  
 values="JOB\_COUNT",  
 title="Remote vs On-Site Job Postings (Filtered)",  
 color\_discrete\_sequence=["#2acaea", "#407aab", "#1b4f72"]  
)  
fig.update\_layout(  
 font\_family="Times New Roman",  
 title\_font\_size=25,  
 plot\_bgcolor="#407aab",  
 paper\_bgcolor="#e7f5f4",  
 font=dict(size=10)  
)  
fig.show()

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The pie chart shows that the majority of job postings are for remote roles, making up nearly 79% of the total. Meanwhile, hybrid remote and not remote positions account for smaller shares, reflecting a strong shift toward fully remote work opportunities in the current job market.

# 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.

df\_split = df.withColumn("SKILLS\_NAME", split(col("SKILLS\_NAME"), ",\n "))  
df\_split = df\_split.withColumn("SKILLS\_NAME",  
 transform(col("SKILLS\_NAME"), lambda x: regexp\_replace(x, r'\n', '')))  
df\_exploded = df\_split.withColumn("Skill", explode(col("SKILLS\_NAME")))  
  
  
df\_aggregated = df\_exploded.groupBy("NAICS2\_NAME", "Skill").count()  
  
  
pdf = df\_aggregated.toPandas()  
top\_skills = pdf.groupby('Skill')['count'].sum().nlargest(10).index  
pdf\_filtered = pdf[pdf['Skill'].isin(top\_skills)].dropna(subset=['Skill'])  
pdf\_filtered['Skill'] = pdf\_filtered['Skill'].astype(str)  
  
fig = px.bar(  
 pdf\_filtered,  
 x='NAICS2\_NAME',  
 y='count',  
 color='Skill',  
 title='Skill Demand by Industry',  
 labels={'NAICS2\_NAME': 'Industry', 'count': 'Skill Count', 'Skill': 'Skill'},  
 barmode='stack',  
 color\_discrete\_sequence=px.colors.sequential.Viridis  
)  
  
fig.update\_layout(  
 font\_family="Times New Roman",  
 title\_font\_size=25,  
 xaxis\_title\_font\_size=10,  
 yaxis\_title\_font\_size=15,  
 legend\_title\_font\_size=10,  
 xaxis\_tickangle=45,  
 plot\_bgcolor="#407aab",  
 paper\_bgcolor="#e7f5f4"  
)  
  
fig.show()

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The stacked bar chart illustrates the top 10 most in-demand skills across various industries. It reveals that industries like “Unclassified Industry,” “Construction,” and “Administrative and Support Services” have the highest skill demands overall, with “Data Analysis,” “SQL,” and “Communication” consistently ranking among the most required skills across multiple sectors.

# 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, count, percentile\_approx  
filtered\_df = df.filter(  
 (col("SALARY\_FROM").isNotNull()) &  
 (col("SALARY\_FROM") > 0) &  
 (col("ONET\_NAME").isNotNull()) &  
 (col("ONET\_NAME") != "")  
)  
summary\_df = filtered\_df.groupBy("ONET\_NAME") \  
 .agg(  
 percentile\_approx("SALARY\_FROM", 0.5).alias("MEDIAN\_SALARY"),  
 count("\*").alias("JOB\_COUNT")  
 ) \  
 .toPandas()  
fig = px.scatter(  
 summary\_df,  
 x="ONET\_NAME",  
 y="MEDIAN\_SALARY",  
 size="JOB\_COUNT",  
 title="Salary Analysis by ONET Occupation Type",  
 color\_discrete\_sequence=["#2acaea"]  
)  
fig.update\_layout(  
 font\_family="Times New Roman",  
 title\_font\_size=25,  
 xaxis\_title="ONET Occupation",  
 yaxis\_title="Median Salary",  
 xaxis\_tickangle=45,  
 plot\_bgcolor="#407aab",  
 paper\_bgcolor="#e7f5f4",  
 font=dict(size=10)  
)  
fig.show()

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The chart shows the median salary for the ONET occupation Business Intelligence Analysis, which stands at around $88,000.

# 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.

pdf = df.filter(  
 (col("SOC\_2021\_2\_NAME").isNotNull()) &  
 (col("SOC\_2021\_3\_NAME").isNotNull()) &  
 (col("SOC\_2021\_2\_NAME") != col("SOC\_2021\_3\_NAME"))  
).groupBy("SOC\_2021\_2\_NAME", "SOC\_2021\_3\_NAME") \  
 .agg(count("\*").alias("TRANSITIONS")) \  
 .toPandas()  
labels = list(set(pdf['SOC\_2021\_2\_NAME']).union(set(pdf['SOC\_2021\_3\_NAME'])))  
label\_to\_index = {label: i for i, label in enumerate(labels)}  
  
pdf["source"] = pdf["SOC\_2021\_2\_NAME"].map(label\_to\_index)  
pdf["target"] = pdf["SOC\_2021\_3\_NAME"].map(label\_to\_index)  
import plotly.graph\_objects as go  
  
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=pdf["source"],  
 target=pdf["target"],  
 value=pdf["TRANSITIONS"],  
 color="rgba(44,202,234,0.4)"  
 )  
)])  
fig.update\_layout(  
 title\_text="Career Pathway Trends (SOC Transitions)",  
 font=dict(family="Times New Roman", size=10),  
 title\_font\_size=25,  
 plot\_bgcolor="#407aab",  
 paper\_bgcolor="#e7f5f4"  
)  
  
fig.show()

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The Sankey diagram illustrates a clear career transition trend from “Computer and Mathematical Occupations” to “Mathematical Science Occupations.” This suggests that many professionals within the broader tech field are moving toward more specialized roles focused on mathematical and analytical expertise.