Module 04: Lab 01

Visual Reporting and Storytelling

Christine Chen

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, count, expr, split, explode  
  
  
# 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).  
25/03/23 21:30:40 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable  
 25/03/23 21:31:02 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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| ID|LAST\_UPDATED\_DATE|LAST\_UPDATED\_TIMESTAMP|DUPLICATES| POSTED| EXPIRED|DURATION| SOURCE\_TYPES| SOURCES| URL|ACTIVE\_URLS|ACTIVE\_SOURCES\_INFO| TITLE\_RAW| BODY|MODELED\_EXPIRED|MODELED\_DURATION| COMPANY| COMPANY\_NAME|COMPANY\_RAW|COMPANY\_IS\_STAFFING|EDUCATION\_LEVELS|EDUCATION\_LEVELS\_NAME|MIN\_EDULEVELS| MIN\_EDULEVELS\_NAME|MAX\_EDULEVELS|MAX\_EDULEVELS\_NAME|EMPLOYMENT\_TYPE|EMPLOYMENT\_TYPE\_NAME|MIN\_YEARS\_EXPERIENCE|MAX\_YEARS\_EXPERIENCE|IS\_INTERNSHIP|SALARY|REMOTE\_TYPE|REMOTE\_TYPE\_NAME|ORIGINAL\_PAY\_PERIOD|SALARY\_TO|SALARY\_FROM| LOCATION| CITY| CITY\_NAME|COUNTY| COUNTY\_NAME| MSA| MSA\_NAME|STATE|STATE\_NAME|COUNTY\_OUTGOING|COUNTY\_NAME\_OUTGOING|COUNTY\_INCOMING|COUNTY\_NAME\_INCOMING|MSA\_OUTGOING| MSA\_NAME\_OUTGOING|MSA\_INCOMING| MSA\_NAME\_INCOMING|NAICS2| NAICS2\_NAME|NAICS3| NAICS3\_NAME|NAICS4| NAICS4\_NAME|NAICS5| NAICS5\_NAME|NAICS6| NAICS6\_NAME| TITLE| TITLE\_NAME| TITLE\_CLEAN| SKILLS| SKILLS\_NAME| SPECIALIZED\_SKILLS|SPECIALIZED\_SKILLS\_NAME| CERTIFICATIONS| CERTIFICATIONS\_NAME| COMMON\_SKILLS| COMMON\_SKILLS\_NAME| SOFTWARE\_SKILLS|SOFTWARE\_SKILLS\_NAME| ONET| ONET\_NAME| ONET\_2019| ONET\_2019\_NAME| CIP6| CIP6\_NAME| CIP4| CIP4\_NAME| CIP2| CIP2\_NAME|SOC\_2021\_2| SOC\_2021\_2\_NAME|SOC\_2021\_3| SOC\_2021\_3\_NAME|SOC\_2021\_4|SOC\_2021\_4\_NAME|SOC\_2021\_5|SOC\_2021\_5\_NAME|LOT\_CAREER\_AREA|LOT\_CAREER\_AREA\_NAME|LOT\_OCCUPATION| LOT\_OCCUPATION\_NAME|LOT\_SPECIALIZED\_OCCUPATION|LOT\_SPECIALIZED\_OCCUPATION\_NAME|LOT\_OCCUPATION\_GROUP|LOT\_OCCUPATION\_GROUP\_NAME|LOT\_V6\_SPECIALIZED\_OCCUPATION|LOT\_V6\_SPECIALIZED\_OCCUPATION\_NAME|LOT\_V6\_OCCUPATION|LOT\_V6\_OCCUPATION\_NAME|LOT\_V6\_OCCUPATION\_GROUP|LOT\_V6\_OCCUPATION\_GROUP\_NAME|LOT\_V6\_CAREER\_AREA|LOT\_V6\_CAREER\_AREA\_NAME| SOC\_2| SOC\_2\_NAME| SOC\_3| SOC\_3\_NAME| SOC\_4| SOC\_4\_NAME| SOC\_5| SOC\_5\_NAME|LIGHTCAST\_SECTORS|LIGHTCAST\_SECTORS\_NAME|NAICS\_2022\_2| NAICS\_2022\_2\_NAME|NAICS\_2022\_3| NAICS\_2022\_3\_NAME|NAICS\_2022\_4| NAICS\_2022\_4\_NAME|NAICS\_2022\_5| NAICS\_2022\_5\_NAME|NAICS\_2022\_6| NAICS\_2022\_6\_NAME|  
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|85318b12b3331fa49...| 9/6/2024| 2024-09-06 20:32:...| 1|6/2/2024| 7/7/2024| 35| [\n "Job Board"\n]|[\n "dejobs.org"\n]|[\n "https://dej...| []| NULL| Data Analyst|Taking care of pe...| 6/10/2024| 8|39063746| Sedgwick| Sedgwick| false| [\n 2\n]| [\n "Bachelor's ...| 2| Bachelor's degree| NULL| NULL| 1|Full-time (> 32 h...| 5| NULL| false| NULL| 0| [None]| NULL| NULL| NULL|{\n "lat": 32.77...| RGFsbGFzLCBUWA==| Dallas, TX| 48113| Dallas, TX|19100|Dallas-Fort Worth...| 48| Texas| 48113| Dallas, TX| 48113| Dallas, TX| 19100|Dallas-Fort Worth...| 19100|Dallas-Fort Worth...| 52|Finance and Insur...| 524|Insurance Carrier...| 5242|Agencies, Brokera...| 52429|Other Insurance R...|524291| Claims Adjusting|ET3037E0C947A02404| Data Analysts| data analyst|[\n "KS1218W78FG...|[\n "Management"...|[\n "ESF3939CE1F...| [\n "Exception R...|[\n "KS683TN76T7...|[\n "Security Cl...|[\n "KS1218W78FG...|[\n "Management"...|[\n "KS126HY6YLT...|[\n "Microsoft O...|15-2051.01|Business Intellig...|15-2051.01|Business Intellig...| []| []| []| []| []| []| 15-0000|Computer and Math...| 15-2000|Mathematical Scie...| 15-2050|Data Scientists| 15-2051|Data Scientists| 23|Information Techn...| 231113|Data / Data Minin...| 23111310| Data Analyst| 2311| Data Analysis and...| 23111310| Data Analyst| 231113| Data / Data Minin...| 2311| Data Analysis and...| 23| Information Techn...|15-0000|Computer and Math...|15-2000|Mathematical Scie...|15-2050|Data Scientists|15-2051|Data Scientists| NULL| NULL| 52|Finance and Insur...| 524|Insurance Carrier...| 5242|Agencies, Brokera...| 52429|Other Insurance R...| 524291| Claims Adjusting|  
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+--------------------+-----------------+----------------------+----------+--------+---------+--------+--------------------+--------------------+--------------------+-----------+-------------------+--------------------+--------------------+---------------+----------------+--------+--------------------+-----------+-------------------+----------------+---------------------+-------------+-------------------+-------------+------------------+---------------+--------------------+--------------------+--------------------+-------------+------+-----------+----------------+-------------------+---------+-----------+--------------------+--------------------+-------------+------+--------------+-----+--------------------+-----+----------+---------------+--------------------+---------------+--------------------+------------+--------------------+------------+--------------------+------+--------------------+------+--------------------+------+--------------------+------+--------------------+------+--------------------+------------------+-------------------+--------------------+--------------------+--------------------+--------------------+-----------------------+--------------------+--------------------+--------------------+--------------------+--------------------+--------------------+----------+--------------------+----------+--------------------+--------------------+--------------------+--------------------+--------------------+--------------------+--------------------+----------+--------------------+----------+--------------------+----------+---------------+----------+---------------+---------------+--------------------+--------------+--------------------+--------------------------+-------------------------------+--------------------+-------------------------+-----------------------------+----------------------------------+-----------------+----------------------+-----------------------+----------------------------+------------------+-----------------------+-------+--------------------+-------+--------------------+-------+---------------+-------+---------------+-----------------+----------------------+------------+--------------------+------------+--------------------+------------+--------------------+------------+--------------------+------------+--------------------+  
only showing top 5 rows

import plotly.graph\_objects as go  
pio.templates["nike\_light\_pink"] = go.layout.Template(  
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 "font": {  
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 "size": 30,  
 "color": "#880E4F" # deep rose  
 }  
 },  
 "font": {  
 "family": "Helvetica Neue, Helvetica, Sans-serif",  
 "size": 16,  
 "color": "#880E4F" # matching font color  
 },  
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 "size": 20,  
 "color": "#880E4F"  
 }  
 )]  
 }  
)

# 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  
df1 = df.dropna(subset=['SALARY\_FROM'])  
df1 = df1[df1['SALARY\_FROM'] > 0]  
pdf = df1.select("EMPLOYMENT\_TYPE\_NAME", "SALARY\_FROM").toPandas()  
figa = px.box(pdf, x="EMPLOYMENT\_TYPE\_NAME", y="SALARY\_FROM", title="Salary Distribution by Employment Type", color\_discrete\_sequence=["#636EFA"])  
figa.update\_layout(font\_family="Arial", title\_font\_size=16)  
figa.show()  
figa.write\_image("output/figurea.svg")

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[Salary Distribution by Employment Type](output/figurea.svg)

Full-time jobs (>32 hours) have the highest median salary. Part-time roles (<32 hours) show lower and more consistent 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.

# Your code for 2nd question here  
pdf = df1.select("NAICS2\_NAME", "SALARY\_FROM").toPandas()  
figb = px.box(pdf, x="NAICS2\_NAME", y="SALARY\_FROM", title="Salary Distribution by Salary", color\_discrete\_sequence=["#EF553B"])  
figb.update\_layout(font\_family="Times New Roman", title\_font\_size=14)  
figb.show()  
figb.write\_image("output/figureb.svg")

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[Salary Distribution by Industry](output/figureb.svg)

Salaries vary widely across industries, with Public Administration and Manufacturing showing some of the highest upper ranges. Accommodation and Food Services and Arts & Entertainment have the lowest median salaries and tighter 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.

# Your code for 3rd question here  
df1 = df.dropna(subset=["POSTED"])  
df\_posted = df1.groupBy("POSTED").count().orderBy("POSTED")  
pdf = df\_posted.toPandas()  
  
figc = px.line(  
 pdf,  
 x="POSTED",  
 y="count",  
 title="Job Postings Over Time",  
 line\_shape="linear",  
 markers=True,  
 color\_discrete\_sequence=["#00CC96"]  
)  
  
figc.update\_layout(  
 font\_family="Verdana",  
 title\_font\_size=14,  
 xaxis\_title="POSTED",  
 yaxis\_title="Number of Job Postings"  
)  
figc.show()  
figc.write\_image("output/figurec.svg")

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[Job Postings Trend Over Time](output/figurec.svg)

Job postings fluctuate frequently, with noticeable peaks and drops across the observed months.  
There is no clear upward or downward trend, suggesting a dynamic job market with short-term variability.

# 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.

# Your code for 4th question here  
df1 = df.groupBy("TITLE\_NAME").count().orderBy("count", ascending=False).limit(10)  
pdf = df1.toPandas()  
figd = px.bar(pdf, x="TITLE\_NAME", y="count", title="Top 10 Job Titles by Count", color\_discrete\_sequence=["#AB63FA"]  
)  
figd.update\_layout(  
 font\_family="Helvetica",  
 title\_font\_size=20,  
 xaxis\_title="Job Title",  
 yaxis\_title="Job Count",  
 plot\_bgcolor="#F9F9F9",  
)  
figd.show()  
figd.write\_image("output/figured.svg")

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[Top 10 Job Titles by Count](output/figured.svg)

[Top 10 Job Titles by Count](output/figured.svg)

“Data Analysts” is the most frequently posted job title by a large margin. The remaining top titles have significantly lower counts, showing a steep drop in demand beyond the top role.

# 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.

# Your code for 5th question here  
df1 = df.groupBy("REMOTE\_TYPE\_NAME").count()  
pdf = df1.toPandas()  
fige = px.pie(  
 pdf,  
 names="REMOTE\_TYPE\_NAME",  
 values="count",  
 title="Remote vs On-Site Job Postings",  
 color\_discrete\_sequence=["#FFC0CB", "#FF69B4", "#FF1493"],  
 template="nike\_light\_pink"  
)  
fige.show()  
fige.write\_image("output/figuree.svg")

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[Remote vs Onsite Job Postings](output/figuree.svg)

The majority of job postings do not specify remote status, as shown by the dominant “[None]” category.  
Among the classified postings, Remote and Hybrid Remote roles make up a small but visible portion, indicating limited remote opportunities.

Most job postings are labeled as None, indicating missing or unspecified remote status. Among the defined categories, Remote and Hybrid Remote together make up a small but notable portion, showing limited adoption of flexible work options.

# 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.

# Your code for 6th question here  
from pyspark.sql.functions import split, explode  
df\_array = df.withColumn("SKILLS\_ARRAY", split(col("SKILLS"), ","))  
df\_exploded = df\_array.select("NAICS2\_NAME", explode(col("SKILLS\_ARRAY")).alias("SKILL"))  
  
df1 = df\_exploded.groupBy("NAICS2\_NAME", "SKILL") \  
 .agg(count("\*").alias("Skill\_Count"))  
pdf = df1.toPandas()  
  
figf = px.bar(pdf, x="NAICS2\_NAME", y="Skill\_Count", color="SKILL", title="Skill Demand Analysis by Industry (Stacked Bar Chart)",  
 barmode="stack", color\_discrete\_sequence=["#FFB6C1", "#FF69B4", "#FFC0CB", "#F8BBD0", "#E91E63"]  
)  
figf.update\_layout( font\_family="Times New Romans", title\_font\_size=20, title\_font\_color="darkred", xaxis\_title="Industry (NAICS2\_NAME)",  
 yaxis\_title="Skill Count", plot\_bgcolor="#FCE4EC"  
)  
figf.show()  
figf.write\_image("output/figuref.svg")

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[Skill Demand Analysis by Industry](output/figuref.svg)

This stacked bar chart highlights the variation in skill demand across industries, with some sectors like “Professional, Scientific, and Technical Services” showing the highest counts. The pink color segments represent distinct skills, helping visualize which industries rely more heavily on specific capabilities.

# 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  
df1 = df.groupBy("ONET\_NAME").agg( expr("percentile\_approx(SALARY\_FROM, 0.5)").alias("Median\_Salary"),  
 expr("count(\*)").alias("Job\_Count")  
)  
pdf = df1.toPandas()  
figg = px.scatter(pdf, x="ONET\_NAME", y="Median\_Salary", size="Job\_Count", title="Salary Analysis by ONET Occupation Type",  
 color="Median\_Salary", color\_continuous\_scale="Plasma", size\_max=50,template="nike\_light\_pink"  
)  
figg.show()  
figg.write\_image("output/figure.svg")

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[Salary Analysis by ONET Occupation Type](output/figureg.svg)

The chart shows that Business Intelligence Analysts have a median salary of approximately 88k. This occupation also has a relatively high number of job postings, as reflected by the large bubble size.

# 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  
df1 = df.groupBy("SOC\_2021\_2\_NAME", "SOC\_2021\_3\_NAME").agg(count("\*").alias("transitions"))  
pdf = df1.toPandas()  
  
labels = list(pd.unique(pdf["SOC\_2021\_2\_NAME"].tolist() + pdf["SOC\_2021\_3\_NAME"].tolist()))  
label\_to\_index = {label: idx for idx, label in enumerate(labels)}  
  
pdf["source\_id"] = pdf["SOC\_2021\_2\_NAME"].map(label\_to\_index)  
pdf["target\_id"] = pdf["SOC\_2021\_3\_NAME"].map(label\_to\_index)  
  
figh = go.Figure(data=[go.Sankey(  
 node=dict(  
 pad=20,  
 thickness=25,  
 line=dict(color="gray", width=0.5),  
 label=labels,  
 color="rgba(57, 106, 177, 0.8)"  
 ),  
 link=dict(  
 source=pdf["source\_id"],  
 target=pdf["target\_id"],  
 value=pdf["transitions"],  
 color="rgba(255, 138, 101, 0.4)"  
 )  
)])  
figh.update\_layout(  
 title\_text="Career Pathway Trends by SOC Classification",  
 font=dict(  
 family="Times New Romans",  
 size=15,  
 color="#222"  
 ),  
 paper\_bgcolor="#F6F6F6",  
 plot\_bgcolor="#AAAAAA"  
)  
figh.show()  
figh.write\_image("output/figureh.svg")

/tmp/ipykernel\_1855/1956088013.py:5: FutureWarning:   
  
unique with argument that is not not a Series, Index, ExtensionArray, or np.ndarray is deprecated and will raise in a future version.

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[Career Pathway Trends](output/figureh.svg)

The Sankey diagram reveals a notable career transition from Computer and Mathematical Occupations to Mathematical Science Occupations. This indicates a strong progression pathway between these two SOC classifications, likely due to overlapping skill sets and domain relevance.