Assignment 03

Emily Sundberg

September 24, 2025

# 1. Load the Data Set

import pandas as pd  
import plotly.express as px  
import plotly.io as pio  
from pyspark.sql import SparkSession  
import re  
import numpy as np  
import plotly.graph\_objects as go  
from pyspark.sql.functions import col, split, explode, regexp\_replace, transform, when  
from pyspark.sql import functions as F  
from pyspark.sql.functions import col, monotonically\_increasing\_id  
  
np.random.seed(42)  
  
pio.renderers.default = "notebook"  
  
spark = SparkSession.builder.appName("LightcastData").getOrCreate()  
  
df = spark.read.option("header", "true").option("inferSchema", "true").option("multiLine","true").option("escape", "\"").csv("/home/ubuntu/assignment-03-emily-sundberg-1/data/lightcast\_job\_postings.csv")  
df.createOrReplaceTempView("job\_postings")  
  
#print("---This is Diagnostic check, No need to print it in the final doc---")  
  
#df.printSchema() # comment this line when rendering the submission  
df.show(5)

[Stage 23:> (0 + 1) / 1]

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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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|1f57d95acf4dc67ed...| 9/6/2024| 2024-09-06 20:32:...| 0|6/2/2024| 6/8/2024| 6| [\n "Company"\n]|[\n "brassring.c...|[\n "https://sjo...| []| NULL|Enterprise Analys...|31-May-2024\n\nEn...| 6/8/2024| 6| 894731| Murphy USA| Murphy USA| false| [\n 2\n]| [\n "Bachelor's ...| 2| Bachelor's degree| NULL| NULL| 1|Full-time (> 32 h...| 2| 2| false| NULL| 0| [None]| NULL| NULL| NULL|{\n "lat": 33.20...|RWwgRG9yYWRvLCBBUg==|El Dorado, AR| 5139| Union, AR|20980| El Dorado, AR| 5| Arkansas| 5139| Union, AR| 5139| Union, AR| 20980| El Dorado, AR| 20980| El Dorado, AR| 44| Retail Trade| 441|Motor Vehicle and...| 4413|Automotive Parts,...| 44133|Automotive Parts ...|441330|Automotive Parts ...|ET29C073C03D1F86B4|Enterprise Analysts|enterprise analys...|[\n "KS126DB6T06...|[\n "Merchandisi...|[\n "KS126DB6T06...| [\n "Merchandisi...| []| []|[\n "KS126706DPF...|[\n "Mathematics...|[\n "KS440W865GC...|[\n "SQL (Progra...|15-2051.01|Business Intellig...|15-2051.01|Business Intellig...|[\n "45.0601",\n...|[\n "Economics, ...|[\n "45.06",\n ...|[\n "Economics",...|[\n "45",\n "27...|[\n "Social Scie...| 15-0000|Computer and Math...| 15-2000|Mathematical Scie...| 15-2050|Data Scientists| 15-2051|Data Scientists| 23|Information Techn...| 231010|Business Intellig...| 23101011| General ERP Analy...| 2310| Business Intellig...| 23101011| General ERP Analy...| 231010| Business Intellig...| 2310| Business Intellig...| 23| Information Techn...|15-0000|Computer and Math...|15-2000|Mathematical Scie...|15-2050|Data Scientists|15-2051|Data Scientists| [\n 7\n]| [\n "Artificial ...| 44| Retail Trade| 441|Motor Vehicle and...| 4413|Automotive Parts,...| 44133|Automotive Parts ...| 441330|Automotive Parts ...|  
|0cb072af26757b6c4...| 8/2/2024| 2024-08-02 17:08:...| 0|6/2/2024| 8/1/2024| NULL| [\n "Job Board"\n]| [\n "maine.gov"\n]|[\n "https://job...| []| NULL|Oracle Consultant...|Oracle Consultant...| 8/1/2024| NULL| 133098|Smx Corporation L...| SMX| true| [\n 99\n]| [\n "No Educatio...| 99|No Education Listed| NULL| NULL| 1|Full-time (> 32 h...| 3| 3| false| NULL| 1| Remote| NULL| NULL| NULL|{\n "lat": 44.31...| QXVndXN0YSwgTUU=| Augusta, ME| 23011| Kennebec, ME|12300|Augusta-Watervill...| 23| Maine| 23011| Kennebec, ME| 23011| Kennebec, ME| 12300|Augusta-Watervill...| 12300|Augusta-Watervill...| 56|Administrative an...| 561|Administrative an...| 5613| Employment Services| 56132|Temporary Help Se...|561320|Temporary Help Se...|ET21DDA63780A7DC09| Oracle Consultants|oracle consultant...|[\n "KS122626T55...|[\n "Procurement...|[\n "KS122626T55...| [\n "Procurement...| []| []| []| []|[\n "BGSBF3F508F...|[\n "Oracle Busi...|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...| 231010|Business Intellig...| 23101012| Oracle Consultant...| 2310| Business Intellig...| 23101012| Oracle Consultant...| 231010| Business Intellig...| 2310| Business Intellig...| 23| Information Techn...|15-0000|Computer and Math...|15-2000|Mathematical Scie...|15-2050|Data Scientists|15-2051|Data Scientists| NULL| NULL| 56|Administrative an...| 561|Administrative an...| 5613| Employment Services| 56132|Temporary Help Se...| 561320|Temporary Help Se...|  
|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|  
|1b5c3941e54a1889e...| 9/6/2024| 2024-09-06 20:32:...| 1|6/2/2024|7/20/2024| 48| [\n "Job Board"\n]|[\n "disabledper...|[\n "https://www...| []| NULL|Sr. Lead Data Mgm...|About this role:\...| 6/12/2024| 10|37615159| Wells Fargo|Wells Fargo| false| [\n 99\n]| [\n "No Educatio...| 99|No Education Listed| NULL| NULL| 1|Full-time (> 32 h...| 3| NULL| false| NULL| 0| [None]| NULL| NULL| NULL|{\n "lat": 33.44...| UGhvZW5peCwgQVo=| Phoenix, AZ| 4013| Maricopa, AZ|38060|Phoenix-Mesa-Chan...| 4| Arizona| 4013| Maricopa, AZ| 4013| Maricopa, AZ| 38060|Phoenix-Mesa-Chan...| 38060|Phoenix-Mesa-Chan...| 52|Finance and Insur...| 522|Credit Intermedia...| 5221|Depository Credit...| 52211| Commercial Banking|522110| Commercial Banking|ET2114E0404BA30075|Management Analysts|sr lead data mgmt...|[\n "KS123QX62QY...|[\n "Exit Strate...|[\n "KS123QX62QY...| [\n "Exit Strate...| []| []|[\n "KS7G6NP6R6L...|[\n "Reliability...|[\n "KS4409D76NW...|[\n "SAS (Softwa...|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| [\n 6\n]| [\n "Data Privac...| 52|Finance and Insur...| 522|Credit Intermedia...| 5221|Depository Credit...| 52211| Commercial Banking| 522110| Commercial Banking|  
|cb5ca25f02bdf25c1...| 6/19/2024| 2024-06-19 07:00:00| 0|6/2/2024|6/17/2024| 15|[\n "FreeJobBoar...|[\n "craigslist....|[\n "https://mod...| []| NULL|Comisiones de $10...|Comisiones de $10...| 6/17/2024| 15| 0| Unclassified| LH/GM| false| [\n 99\n]| [\n "No Educatio...| 99|No Education Listed| NULL| NULL| 3|Part-time / full-...| NULL| NULL| false| 92500| 0| [None]| year| 150000| 35000|{\n "lat": 37.63...| TW9kZXN0bywgQ0E=| Modesto, CA| 6099|Stanislaus, CA|33700| Modesto, CA| 6|California| 6099| Stanislaus, CA| 6099| Stanislaus, CA| 33700| Modesto, CA| 33700| Modesto, CA| 99|Unclassified Indu...| 999|Unclassified Indu...| 9999|Unclassified Indu...| 99999|Unclassified Indu...|999999|Unclassified Indu...|ET0000000000000000| Unclassified|comisiones de por...| []| []| []| []| []| []| []| []| []| []|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...| 231010|Business Intellig...| 23101012| Oracle Consultant...| 2310| Business Intellig...| 23101012| Oracle Consultant...| 231010| Business Intellig...| 2310| Business Intellig...| 23| Information Techn...|15-0000|Computer and Math...|15-2000|Mathematical Scie...|15-2050|Data Scientists|15-2051|Data Scientists| NULL| NULL| 99|Unclassified Indu...| 999|Unclassified Indu...| 9999|Unclassified Indu...| 99999|Unclassified Indu...| 999999|Unclassified Indu...|  
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only showing top 5 rows

# 2. Data Cleaning

## 2.1 Casting salary and experience columns

df = df.withColumn("SALARY\_FROM", col ("SALARY\_FROM").cast("float"))\  
 .withColumn("SALARY\_TO", col("SALARY\_TO").cast("float")) \  
 .withColumn("MAX\_YEARS\_EXPERIENCE", col("MAX\_YEARS\_EXPERIENCE").cast("float"))\  
 .withColumn("MIN\_YEARS\_EXPERIENCE", col("MIN\_YEARS\_EXPERIENCE").cast("float"))\  
 .withColumn("SALARY", col("SALARY").cast("float"))

## 2.2 Computing medians for salary columns

def compute\_median(sdf, col\_name):  
 q = sdf.approxQuantile(col\_name, [0.5], 0.01)  
 return q[0] if q else None  
  
  
median\_from = compute\_median(df, "SALARY\_FROM")  
median\_to = compute\_median(df, "SALARY\_TO")  
median\_sal = compute\_median(df,"SALARY")  
  
print("Medians:", median\_from, median\_to, median\_sal)

[Stage 25:> (0 + 1) / 1] [Stage 26:> (0 + 1) / 1] [Stage 27:> (0 + 1) / 1]

Medians: 87295.0 130042.0 115024.0

## 2.3 Impute missing salaries

df = df.fillna({  
 "SALARY\_FROM": median\_from,  
 "SALARY\_TO": median\_to,  
 "SALARY": median\_sal  
})

## 2.4 Cleaning Education Column

df = df.withColumn("EDUCATION\_LEVELS\_NAME", regexp\_replace(col("EDUCATION\_LEVELS\_NAME"), "[\n\r]", ""))

## 2.5 Compute Average Salary

df = df.withColumn("AVG\_SALARY", (col("SALARY\_FROM")+col("SALARY\_TO"))/2)

## 2.6 Exporting Cleaned Data

df\_selected = df.select(  
 "EDUCATION\_LEVELS\_NAME",  
 "REMOTE\_TYPE\_NAME",  
 "MAX\_YEARS\_EXPERIENCE",  
 "AVG\_SALARY",  
 "LOT\_V6\_SPECIALIZED\_OCCUPATION\_NAME",  
 "NAICS2\_NAME")

## 2.7 Save to CSV

pdf = df\_selected.toPandas()  
  
pdf.to\_csv("./data/lightcast\_cleaned.csv", index=False)  
  
print("Data Cleaning Complete. Rows retained:", len(pdf))

[Stage 28:> (0 + 1) / 1]

Data Cleaning Complete. Rows retained: 72498

# 3. Salary Distribution by Industry and Employment Type

## 3.1 Remove records where salary is missing or zero

pdf = df.filter(df["SALARY"] >0).select("EMPLOYMENT\_TYPE\_NAME", "SALARY","NAICS2\_NAME").toPandas()  
  
#pdf["EMPLOYMENT\_TYPE\_NAME"] = pdf["EMPLOYMENT\_TYPE\_NAME"].apply(lambda x: re.sub(r"[^\x00-\x7F]+","",x))

[Stage 29:> (0 + 1) / 1]

## 3.2 Aggregate Data

median\_salaries = pdf.groupby("EMPLOYMENT\_TYPE\_NAME")["SALARY"].median()  
  
sorted\_employment\_types = median\_salaries.sort\_values(ascending = False).index  
  
pdf["EMPLOYMENT\_TYPE\_NAME"] = pd.Categorical(  
 pdf["EMPLOYMENT\_TYPE\_NAME"],  
 categories=sorted\_employment\_types,  
 ordered=True  
)

## 3.3 Visualize Results

import matplotlib.pyplot as plt  
import seaborn as sns  
import plotly.express as px  
  
fig = px.box(  
 pdf,  
 x = "NAICS2\_NAME",  
 y = "SALARY",  
 color = "EMPLOYMENT\_TYPE\_NAME",  
 title = "Salary Distribution by Employment Type",  
 #color\_discrete\_sequence = ["orange"],  
 boxmode = "group",  
 points = "all"   
)  
  
fig.show()

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The plot above shows us that the medians of these industries average around 100K but there are several career fields with the opportunity to make significantly more. Both admin support and information have outliers in the $500K range.

# 4. Salary Analysis by ONET Occupation Type

## 4.1 Aggregate Data

salary\_analysis = spark.sql("""  
 SELECT  
 TITLE\_NAME AS ONET\_NAME,  
 PERCENTILE(SALARY, 0.5) AS Median\_Salary,  
 Count(\*) AS Job\_Postings  
 FROM job\_postings  
 GROUP BY TITLE\_NAME  
 ORDER BY Job\_Postings DESC  
 LIMIT 10  
""")  
  
salary\_pd = salary\_analysis.toPandas()

[Stage 30:> (0 + 1) / 1]

## 4.2 Bubble Plot

fig = px.scatter(  
 salary\_pd,  
 x="ONET\_NAME",  
 y="Median\_Salary",  
 size="Job\_Postings",  
 title ="Salary Analysis by ONET Occupation Type (Bubble Chart)"  
)  
  
fig.show()

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This tells us that data analysts have a significant amount of job postings in the less than $100K range.