SQL & Python

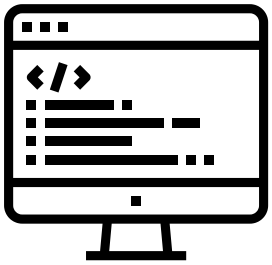
Project Title	Exploratory Analysis of Compensation Trends in Sample HR Dataset

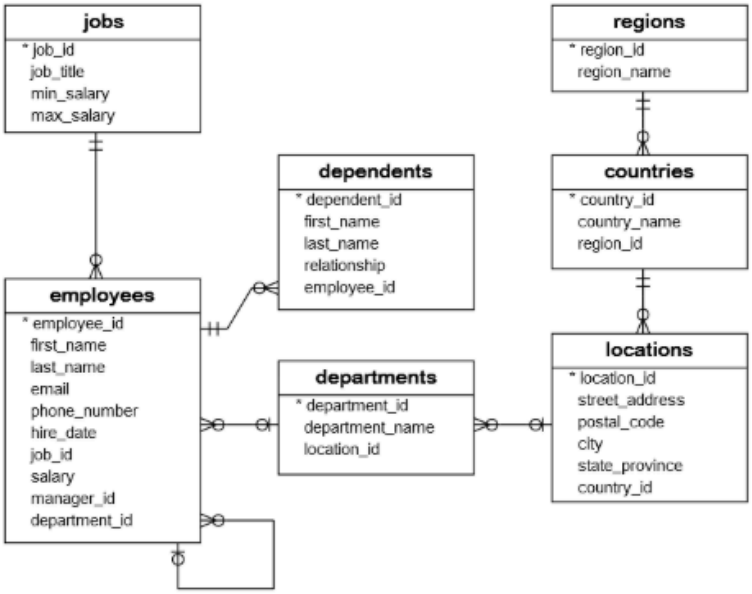
Project Date	Summer 2025

Project Overview

Sample SQLite Data was used from the following source: sqltutorial.org/sql-sample-database/. The sample data contains seven tables: jobs, employees, dependents, departments, regions, countries, and locations. The sample data was analyzed in Juptyer Notebook, using descriptive and inferetial statiscal methods. Python modules utilized were pandas, matplotlib, statsmodel, and sqlite3.

Data Schema





Key Highlights/Deliverables

- Created a normalized employee database with department and salary info
- Wrote complex SQL queries including joins, CTEs, and aggregations
- Built salary quartile classifications and analyzed tenure vs. pay
- Visualized pay disparities using bar charts and scatter plots
- Interpreted regression results to model salary predictors

In [25]:

```
#Import Needed Modules
import sqlite3
import pandas as pd

# Create a connection to the database, result is a Connection object
conn = sqlite3.connect("compensation1.db")
# Create a Cursor object that allows user to execute SQL commands and fetch results from the database
cursor = conn.cursor()

# Creates tables with designated columns
#Foreign keys are designated and referenced to table that holds its primary key for database integrity
cursor.executescript("""
CREATE TABLE IF NOT EXISTS regions (
        region_id INTEGER PRIMARY KEY AUTOINCREMENT NOT NULL,
        region_name text NOT NULL
);

CREATE TABLE IF NOT EXISTS countries (
        country_id text NOT NULL,
        country_name text NOT NULL,
        region_id INTEGER NOT NULL,
        PRIMARY KEY (country_id ASC),
        FOREIGN KEY (region_id) REFERENCES regions (region_id) ON DELETE CASCADE ON UPDATE CASCADE
);

CREATE TABLE IF NOT EXISTS locations (
        location_id INTEGER PRIMARY KEY AUTOINCREMENT NOT NULL,
        street_address text,
        postal_code text,
        city text NOT NULL,
        state_province text,
        country_id INTEGER NOT NULL,
        FOREIGN KEY (country_id) REFERENCES countries (country_id) ON DELETE CASCADE ON UPDATE CASCADE
);

CREATE TABLE IF NOT EXISTS departments (
        department_id INTEGER PRIMARY KEY AUTOINCREMENT NOT NULL,
        department_name text NOT NULL,
        location_id INTEGER NOT NULL,
        FOREIGN KEY (location_id) REFERENCES locations (location_id) ON DELETE CASCADE ON UPDATE CASCADE
```

```
);

CREATE TABLE IF NOT EXISTS jobs (
        job_id INTEGER PRIMARY KEY AUTOINCREMENT NOT NULL,
        job_title text NOT NULL,
        min_salary double NOT NULL,
        max_salary double NOT NULL
);

CREATE TABLE IF NOT EXISTS employees (
        employee_id INTEGER PRIMARY KEY AUTOINCREMENT NOT NULL,
        first_name text,
        last_name text NOT NULL,
        email text NOT NULL,
        phone_number text,
        hire_date text NOT NULL,
        job_id INTEGER NOT NULL,
        salary double NOT NULL,
        manager_id INTEGER,
        department_id INTEGER NOT NULL,
        FOREIGN KEY (job_id) REFERENCES jobs (job_id) ON DELETE CASCADE ON UPDATE CASCADE,
        FOREIGN KEY (department_id) REFERENCES departments (department_id) ON DELETE CASCADE ON UPDATE CASCADE,
        FOREIGN KEY (manager_id) REFERENCES employees (employee_id) ON DELETE CASCADE ON UPDATE CASCADE
);

CREATE TABLE IF NOT EXISTS dependents (
        dependent_id INTEGER PRIMARY KEY AUTOINCREMENT NOT NULL,
        first_name text NOT NULL,
        last_name text NOT NULL,
        relationship text NOT NULL,
        employee_id INTEGER NOT NULL,
        FOREIGN KEY (employee_id) REFERENCES employees (employee_id) ON DELETE CASCADE ON UPDATE CASCADE
);
""")
```

Out[25]: <sqlite3.Cursor at 0x1e5f7887340>

In [ ]:
```
#Inserts values into each table created using INSERT INTO table_name(columns) VALUES (values)
cursor.executescript("""
INSERT INTO regions(region_id,region_name) VALUES (1,'Europe');
INSERT INTO regions(region_id,region_name) VALUES (2,'Americas');
INSERT INTO regions(region_id,region_name) VALUES (3,'Asia');
```

```
INSERT INTO regions(region_id,region_name) VALUES (4,'Middle East and Africa');
INSERT INTO countries(country_id,country_name,region_id) VALUES ('AR','Argentina',2);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('AU','Australia',3);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('BE','Belgium',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('BR','Brazil',2);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('CA','Canada',2);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('CH','Switzerland',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('CN','China',3);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('DE','Germany',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('DK','Denmark',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('EG','Egypt',4);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('FR','France',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('HK','HongKong',3);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('IL','Israel',4);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('IN','India',3);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('IT','Italy',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('JP','Japan',3);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('KW','Kuwait',4);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('MX','Mexico',2);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('NG','Nigeria',4);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('NL','Netherlands',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('SG','Singapore',3);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('UK','United Kingdom',1);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('US','United States of America',2);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('ZM','Zambia',4);
INSERT INTO countries(country_id,country_name,region_id) VALUES ('ZW','Zimbabwe',4);
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (1400,'2014 Jabbe
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (1500,'2011 Inter
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (1700,'2004 Chara
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (1800,'147 Spadir
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (2400,'8204 Arthu
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (2500,'Magdalen C
INSERT INTO locations(location_id,street_address,postal_code,city,state_province,country_id) VALUES (2700,'Schwanthal
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (1,'Public Accountant',4200.00,9000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (2,'Accounting Manager',8200.00,16000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (3,'Administration Assistant',3000.00,6000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (4,'President',20000.00,40000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (5,'Administration Vice President',15000.00,30000.00)
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (6,'Accountant',4200.00,9000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (7,'Finance Manager',8200.00,16000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (8,'Human Resources Representative',4000.00,9000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (9,'Programmer',4000.00,10000.00);
```

```
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (10,'Marketing Manager',9000.00,15000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (11,'Marketing Representative',4000.00,9000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (12,'Public Relations Representative',4500.00,10500.0
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (13,'Purchasing Clerk',2500.00,5500.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (14,'Purchasing Manager',8000.00,15000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (15,'Sales Manager',10000.00,20000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (16,'Sales Representative',6000.00,12000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (17,'Shipping Clerk',2500.00,5500.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (18,'Stock Clerk',2000.00,5000.00);
INSERT INTO jobs(job_id,job_title,min_salary,max_salary) VALUES (19,'Stock Manager',5500.00,8500.00);
INSERT INTO departments(department_id,department_name,location_id) VALUES (1,'Administration',1700);
INSERT INTO departments(department_id,department_name,location_id) VALUES (2,'Marketing',1800);
INSERT INTO departments(department_id,department_name,location_id) VALUES (3,'Purchasing',1700);
INSERT INTO departments(department_id,department_name,location_id) VALUES (4,'Human Resources',2400);
INSERT INTO departments(department_id,department_name,location_id) VALUES (5,'Shipping',1500);
INSERT INTO departments(department_id,department_name,location_id) VALUES (6,'IT',1400);
INSERT INTO departments(department_id,department_name,location_id) VALUES (7,'Public Relations',2700);
INSERT INTO departments(department_id,department_name,location_id) VALUES (8,'Sales',2500);
INSERT INTO departments(department_id,department_name,location_id) VALUES (9,'Executive',1700);
INSERT INTO departments(department_id,department_name,location_id) VALUES (10,'Finance',1700);
INSERT INTO departments(department_id,department_name,location_id) VALUES (11,'Accounting',1700);
INSERT INTO employees(employee_id,first_name,last_name,email,phone_number,hire_date,job_id,salary,manager_id,departme
INSERT INTO employees(employee_id,first_name,last_name,email,phone_number,hire_date,job_id,salary,manager_id,departme
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INSERT INTO employees(employee_id,first_name,last_name,email,phone_number,hire_date,job_id,salary,manager_id,departme
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INSERT INTO employees(employee_id,first_name,last_name,email,phone_number,hire_date,job_id,salary,manager_id,departme
INSERT INTO employees(employee_id,first_name,last_name,email,phone_number,hire_date,job_id,salary,manager_id,departme
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INSERT INTO employees(employee_id,first_name,last_name,email,phone_number,hire_date,job_id,salary,manager_id,departme
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (1,'Penelope','Gietz','Chil
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (2,'Nick','Higgins','Child'
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (3,'Ed','Whalen','Child',20
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (4,'Jennifer','King','Child
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (5,'Johnny','Kochhar','Chil
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (6,'Bette','De Haan','Child
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (7,'Grace','Faviet','Child'
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (8,'Matthew','Chen','Child'
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (9,'Joe','Sciarra','Child',
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (10,'Christian','Urman','Ch
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (11,'Zero','Popp','Child',1
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (12,'Karl','Greenberg','Chi
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (13,'Uma','Mavris','Child',
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (14,'Vivien','Hunold','Chil
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (15,'Cuba','Ernst','Child',
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (16,'Fred','Austin','Child'
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (17,'Helen','Pataballa','Ch
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (18,'Dan','Lorentz','Child'
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (19,'Bob','Hartstein','Chil
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (20,'Lucille','Fay','Child'
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (21,'Kirsten','Baer','Child
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (22,'Elvis','Khoo','Child',
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (23,'Sandra','Baida','Child
```

```
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (24,'Cameron','Tobias','Chi
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (25,'Kevin','Himuro','Child
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (26,'Rip','Colmenares','Chi
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (27,'Julia','Raphaely','Chi
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (28,'Woody','Russell','Chil
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (29,'Alec','Partners','Chil
INSERT INTO dependents(dependent_id,first_name,last_name,relationship,employee_id) VALUES (30,'Sandra','Taylor','Chil
""")
```

In [5]:
```
#First, we will explore the tables within the database using sqlite_master, the special internal table for SQLite dat
tables_df = pd.read_sql("SELECT name FROM sqlite_master WHERE type='table';", conn)

#Outputs the names of all tables, as well as sqlite_sequence another special internal table that tracks last value fo
print(tables_df)
```

```
            name
0        regions
1  sqlite_sequence
2      countries
3      locations
4    departments
5           jobs
6      employees
7     dependents
```

In [6]:
```
#Next, lets take a look at the employees table
employees_table= pd.read_sql("SELECT * FROM employees LIMIT 5;", conn)
print(employees_table)
```

```
   employee_id first_name last_name                            email  \
0          100     Steven      King       steven.king@sqltutorial.org
1          101      Neena   Kochhar     neena.kochhar@sqltutorial.org
2          102        Lex   De Haan       lex.de haan@sqltutorial.org
3          103  Alexander    Hunold  alexander.hunold@sqltutorial.org
4          104      Bruce     Ernst       bruce.ernst@sqltutorial.org

   phone_number   hire_date  job_id   salary  manager_id  department_id
0  515.123.4567  1987-06-17       4  24000.0         NaN              9
1  515.123.4568  1989-09-21       5  17000.0       100.0              9
2  515.123.4569  1993-01-13       5  17000.0       100.0              9
3  590.423.4567  1990-01-03       9   9000.0       102.0              6
4  590.423.4568  1991-05-21       9   6000.0       103.0              6
```

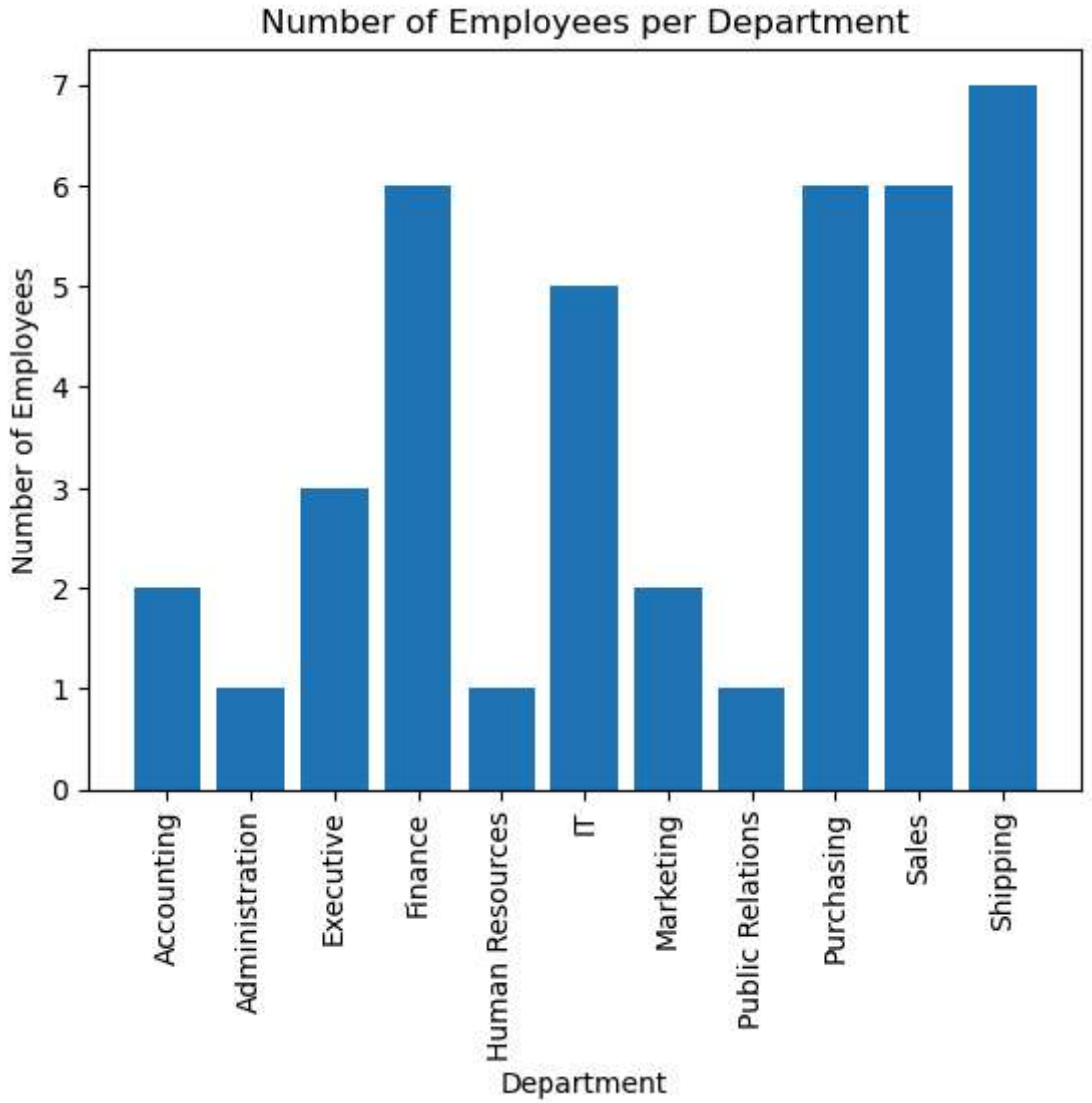
In [7]:
```
#Let's import matplotlib so we can graph some of our inquiries later
import matplotlib.pyplot as plt

#Let's begin by asking questions surrounding the employee table to better understand this organization

#How many employees are there?
num_employee = pd.read_sql("SELECT COUNT(employee_id) AS 'Number of Employees' FROM employees;", conn)
print(num_employee)
```

```
   Number of Employees
0                   40
```

In [8]:
```
#How many employees are in each department?
q_num_dept = """
    WITH temp_table AS (
        SELECT department_id,
               COUNT(*) AS num_emp
        FROM employees
        GROUP BY department_id
        )
    SELECT d.department_name as 'Department',
           num_emp as 'Number of Employees'
    FROM departments d
    JOIN temp_table
        ON d.department_id = temp_table.department_id
    ORDER BY d.department_name;
    """
num_employee = pd.read_sql(q_num_dept, conn)
print(num_employee, end = "\n\n")
```

	Department	Number of Employees
0	Accounting	2
1	Administration	1
2	Executive	3
3	Finance	6
4	Human Resources	1
5	IT	5
6	Marketing	2
7	Public Relations	1
8	Purchasing	6
9	Sales	6
10	Shipping	7

In [9]:
```
#Let's plot this into a bar chart for a visual representation
plt.bar(num_employee['Department'], num_employee['Number of Employees'])
plt.xticks(rotation=90)
plt.title('Number of Employees per Department')
plt.xlabel('Department')
plt.ylabel('Number of Employees')
plt.show()
```



In [10]:
```
#What is the lowest and highest salary in each department?
q_low_high = """
    WITH temp_table AS (
        SELECT department_id,
               MIN(salary) as low_salary,
               MAX(salary) as high_salary
        FROM employees
        GROUP BY department_id
```

```
        )
    SELECT d.department_name as 'Department',
           low_salary as 'Lowest Salary',
           high_salary as 'Highest Salary'
    FROM departments d
    JOIN temp_table
        ON d.department_id = temp_table.department_id
    ORDER BY department_name;
    """
low_high = pd.read_sql(q_low_high, conn)
print(low_high, end = "\n\n")
```

```
         Department  Lowest Salary  Highest Salary
0        Accounting         8300.0         12000.0
1    Administration         4400.0          4400.0
2         Executive        17000.0         24000.0
3           Finance         6900.0         12000.0
4   Human Resources         6500.0          6500.0
5                IT         4200.0          9000.0
6         Marketing         6000.0         13000.0
7   Public Relations        10000.0         10000.0
8        Purchasing         2500.0         11000.0
9             Sales         6200.0         14000.0
10         Shipping         2700.0          8200.0
```

In [11]:
```
#For each employee's salary, let's calculate which quartile they are in based on their job's salary range
#For example, if an employee makes $25,000 and the salary range is $21,000 to $32,000, then they are in Quartile 1.

#First, we gather the table that shows the name of the employee, their salary, their position, and the salary range
#for their position.
q_quartiles = """
    WITH temp_table AS (
        SELECT e.first_name,
               e.last_name,
               e. salary,
               j.min_salary,
               j.max_salary
        FROM employees e
        JOIN jobs j
            ON e.job_id = j.job_id
            )
```

```
    SELECT * FROM temp_table;
    """
quartiles = pd.read_sql(q_quartiles,conn)
print(quartiles)
```

	first_name	last_name	salary	min_salary	max_salary
0	Steven	King	24000.0	20000.0	40000.0
1	Neena	Kochhar	17000.0	15000.0	30000.0
2	Lex	De Haan	17000.0	15000.0	30000.0
3	Alexander	Hunold	9000.0	4000.0	10000.0
4	Bruce	Ernst	6000.0	4000.0	10000.0
5	David	Austin	4800.0	4000.0	10000.0
6	Valli	Pataballa	4800.0	4000.0	10000.0
7	Diana	Lorentz	4200.0	4000.0	10000.0
8	Nancy	Greenberg	12000.0	8200.0	16000.0
9	Daniel	Faviet	9000.0	4200.0	9000.0
10	John	Chen	8200.0	4200.0	9000.0
11	Ismael	Sciarra	7700.0	4200.0	9000.0
12	Jose Manuel	Urman	7800.0	4200.0	9000.0
13	Luis	Popp	6900.0	4200.0	9000.0
14	Den	Raphaely	11000.0	8000.0	15000.0
15	Alexander	Khoo	3100.0	2500.0	5500.0
16	Shelli	Baida	2900.0	2500.0	5500.0
17	Sigal	Tobias	2800.0	2500.0	5500.0
18	Guy	Himuro	2600.0	2500.0	5500.0
19	Karen	Colmenares	2500.0	2500.0	5500.0
20	Matthew	Weiss	8000.0	5500.0	8500.0
21	Adam	Fripp	8200.0	5500.0	8500.0
22	Payam	Kaufling	7900.0	5500.0	8500.0
23	Shanta	Vollman	6500.0	5500.0	8500.0
24	Irene	Mikkilineni	2700.0	2000.0	5000.0
25	John	Russell	14000.0	10000.0	20000.0
26	Karen	Partners	13500.0	10000.0	20000.0
27	Jonathon	Taylor	8600.0	6000.0	12000.0
28	Jack	Livingston	8400.0	6000.0	12000.0
29	Kimberely	Grant	7000.0	6000.0	12000.0
30	Charles	Johnson	6200.0	6000.0	12000.0
31	Sarah	Bell	4000.0	2500.0	5500.0
32	Britney	Everett	3900.0	2500.0	5500.0
33	Jennifer	Whalen	4400.0	3000.0	6000.0
34	Michael	Hartstein	13000.0	9000.0	15000.0
35	Pat	Fay	6000.0	4000.0	9000.0
36	Susan	Mavris	6500.0	4000.0	9000.0
37	Hermann	Baer	10000.0	4500.0	10500.0
38	Shelley	Higgins	12000.0	8200.0	16000.0
39	William	Gietz	8300.0	4200.0	9000.0

In [12]:
```
#Since each employee has their own individual salary range, we will need to find their relative position in that sala
#This will be stored in new column named "Salary Range Position"
quartiles['Salary Range Position'] = round((quartiles['salary'] - quartiles['min_salary']) / (quartiles['max_salary']

quartiles.head()
```

Out[12]:

	first_name	last_name	salary	min_salary	max_salary	Salary Range Position
0	Steven	King	24000.0	20000.0	40000.0	0.20
1	Neena	Kochhar	17000.0	15000.0	30000.0	0.13
2	Lex	De Haan	17000.0	15000.0	30000.0	0.13
3	Alexander	Hunold	9000.0	4000.0	10000.0	0.83
4	Bruce	Ernst	6000.0	4000.0	10000.0	0.33
5	David	Austin	4800.0	4000.0	10000.0	0.13
6	Valli	Pataballa	4800.0	4000.0	10000.0	0.13
7	Diana	Lorentz	4200.0	4000.0	10000.0	0.03
8	Nancy	Greenberg	12000.0	8200.0	16000.0	0.49
9	Daniel	Faviet	9000.0	4200.0	9000.0	1.00
10	John	Chen	8200.0	4200.0	9000.0	0.83
11	Ismael	Sciarra	7700.0	4200.0	9000.0	0.73
12	Jose Manuel	Urman	7800.0	4200.0	9000.0	0.75
13	Luis	Popp	6900.0	4200.0	9000.0	0.56
14	Den	Raphaely	11000.0	8000.0	15000.0	0.43
15	Alexander	Khoo	3100.0	2500.0	5500.0	0.20
16	Shelli	Baida	2900.0	2500.0	5500.0	0.13
17	Sigal	Tobias	2800.0	2500.0	5500.0	0.10
18	Guy	Himuro	2600.0	2500.0	5500.0	0.03
19	Karen	Colmenares	2500.0	2500.0	5500.0	0.00
20	Matthew	Weiss	8000.0	5500.0	8500.0	0.83
21	Adam	Fripp	8200.0	5500.0	8500.0	0.90

	first_name	last_name	salary	min_salary	max_salary	Salary Range Position
22	Payam	Kaufling	7900.0	5500.0	8500.0	0.80
23	Shanta	Vollman	6500.0	5500.0	8500.0	0.33
24	Irene	Mikkilineni	2700.0	2000.0	5000.0	0.23
25	John	Russell	14000.0	10000.0	20000.0	0.40
26	Karen	Partners	13500.0	10000.0	20000.0	0.35
27	Jonathon	Taylor	8600.0	6000.0	12000.0	0.43
28	Jack	Livingston	8400.0	6000.0	12000.0	0.40
29	Kimberely	Grant	7000.0	6000.0	12000.0	0.17
30	Charles	Johnson	6200.0	6000.0	12000.0	0.03
31	Sarah	Bell	4000.0	2500.0	5500.0	0.50
32	Britney	Everett	3900.0	2500.0	5500.0	0.47
33	Jennifer	Whalen	4400.0	3000.0	6000.0	0.47
34	Michael	Hartstein	13000.0	9000.0	15000.0	0.67
35	Pat	Fay	6000.0	4000.0	9000.0	0.40
36	Susan	Mavris	6500.0	4000.0	9000.0	0.50
37	Hermann	Baer	10000.0	4500.0	10500.0	0.92
38	Shelley	Higgins	12000.0	8200.0	16000.0	0.49
39	William	Gietz	8300.0	4200.0	9000.0	0.85

In [13]:
```
#This function will be able to assign a quartile based on the position value (from 0 to 1) that we added
def get_quartile(p):
    if p <= 0.25:
        return 'Q1'
    if p <= 0.5:
        return 'Q2'
    if p <= 0.75:
```

```
        return 'Q3'
    else:
        return 'Q4'

#This applies the function to create new column, Salary Quartile
quartiles['Salary Quartile'] = quartiles['Salary Range Position'].apply(get_quartile)

quartiles.head()
```

Out[13]:

	first_name	last_name	salary	min_salary	max_salary	Salary Range Position	Salary Quartile
0	Steven	King	24000.0	20000.0	40000.0	0.20	Q1
1	Neena	Kochhar	17000.0	15000.0	30000.0	0.13	Q1
2	Lex	De Haan	17000.0	15000.0	30000.0	0.13	Q1
3	Alexander	Hunold	9000.0	4000.0	10000.0	0.83	Q4
4	Bruce	Ernst	6000.0	4000.0	10000.0	0.33	Q2
5	David	Austin	4800.0	4000.0	10000.0	0.13	Q1
6	Valli	Pataballa	4800.0	4000.0	10000.0	0.13	Q1
7	Diana	Lorentz	4200.0	4000.0	10000.0	0.03	Q1
8	Nancy	Greenberg	12000.0	8200.0	16000.0	0.49	Q2
9	Daniel	Faviet	9000.0	4200.0	9000.0	1.00	Q4
10	John	Chen	8200.0	4200.0	9000.0	0.83	Q4
11	Ismael	Sciarra	7700.0	4200.0	9000.0	0.73	Q3
12	Jose Manuel	Urman	7800.0	4200.0	9000.0	0.75	Q3
13	Luis	Popp	6900.0	4200.0	9000.0	0.56	Q3
14	Den	Raphaely	11000.0	8000.0	15000.0	0.43	Q2
15	Alexander	Khoo	3100.0	2500.0	5500.0	0.20	Q1
16	Shelli	Baida	2900.0	2500.0	5500.0	0.13	Q1
17	Sigal	Tobias	2800.0	2500.0	5500.0	0.10	Q1
18	Guy	Himuro	2600.0	2500.0	5500.0	0.03	Q1
19	Karen	Colmenares	2500.0	2500.0	5500.0	0.00	Q1
20	Matthew	Weiss	8000.0	5500.0	8500.0	0.83	Q4
21	Adam	Fripp	8200.0	5500.0	8500.0	0.90	Q4

	first_name	last_name	salary	min_salary	max_salary	Salary Range Position	Salary Quartile
22	Payam	Kaufling	7900.0	5500.0	8500.0	0.80	Q4
23	Shanta	Vollman	6500.0	5500.0	8500.0	0.33	Q2
24	Irene	Mikkilineni	2700.0	2000.0	5000.0	0.23	Q1
25	John	Russell	14000.0	10000.0	20000.0	0.40	Q2
26	Karen	Partners	13500.0	10000.0	20000.0	0.35	Q2
27	Jonathon	Taylor	8600.0	6000.0	12000.0	0.43	Q2
28	Jack	Livingston	8400.0	6000.0	12000.0	0.40	Q2
29	Kimberely	Grant	7000.0	6000.0	12000.0	0.17	Q1
30	Charles	Johnson	6200.0	6000.0	12000.0	0.03	Q1
31	Sarah	Bell	4000.0	2500.0	5500.0	0.50	Q2
32	Britney	Everett	3900.0	2500.0	5500.0	0.47	Q2
33	Jennifer	Whalen	4400.0	3000.0	6000.0	0.47	Q2
34	Michael	Hartstein	13000.0	9000.0	15000.0	0.67	Q3
35	Pat	Fay	6000.0	4000.0	9000.0	0.40	Q2
36	Susan	Mavris	6500.0	4000.0	9000.0	0.50	Q2
37	Hermann	Baer	10000.0	4500.0	10500.0	0.92	Q4
38	Shelley	Higgins	12000.0	8200.0	16000.0	0.49	Q2
39	William	Gietz	8300.0	4200.0	9000.0	0.85	Q4

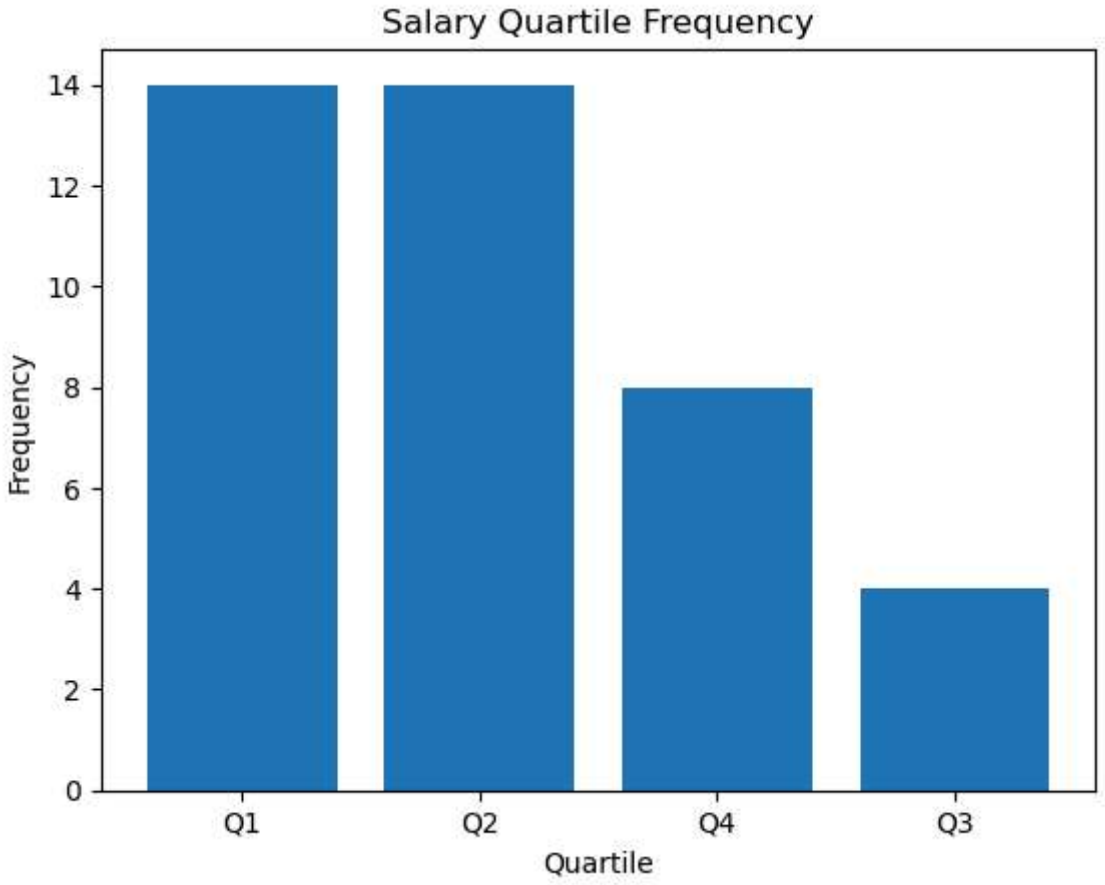
In [14]:
```
#Let's create a bar chart to see the distribution of employee salary among salary ranges
#First lets get a DataFrame of the counts of quartiles

quartile_counts = quartiles['Salary Quartile'].value_counts().reset_index()
quartile_counts.columns = ['Quartile', 'Frequency']

quartile_counts
```

Out[14]:

	Quartile	Frequency
0	Q1	14
1	Q2	14
2	Q4	8
3	Q3	4

In [15]:

```
#Now we have a DataFrame that can be easily visualized with matplotlib.plot
plt.bar(quartile_counts['Quartile'], quartile_counts['Frequency'])
plt.xlabel('Quartile')
plt.ylabel('Frequency')
plt.title('Salary Quartile Frequency')
plt.show()

#In the graph below, we can see that the majority of salaries fall within the lower two quartiles.
#Without including more variables to better understand this distribution, we cannot infer much.
#It could be different scenarios: high turnover so there are new employees near the salary range minimum, or
#or a lack of raises or career progression for employees
```



In [23]:
```
#Let's now consider the tenure of an employee (in rounded years), in relation to their position
#in their salary range. This will let us see if more tenured employees are further in the salary range.

#Let's create a Dataframe that is the last name of the employee and the hire date

q_years = """
    SELECT last_name,
           hire_date,
           CAST ((julianday('now') - julianday(hire_date)) / 365 AS INT) AS years_employed
    FROM employees;
    """
```

```
df_years = pd.read_sql(q_years,conn)
df_years.head()
```

Out[23]:

	last_name	hire_date	years_employed
0	King	1987-06-17	38
1	Kochhar	1989-09-21	35
2	De Haan	1993-01-13	32
3	Hunold	1990-01-03	35
4	Ernst	1991-05-21	34

In [24]:
```
#Let's combine the years_df to our quartiles DataFrame in order to then create a scatterplot
#with axes Years Employed and Salary Range Position

#Warning! This merge only works because there are no duplicate last names, otherwise this should be done using employ

quartiles = quartiles.merge(df_years, on ='last_name', how='left')

quartiles.head()
```

Out[24]:

	first_name	last_name	salary	min_salary	max_salary	Salary Range Position	Salary Quartile	hire_date_x	years_employed_x	hire_date_y	years
0	Steven	King	24000.0	20000.0	40000.0	0.20	Q1	1987-06-17	38	1987-06-17	
1	Neena	Kochhar	17000.0	15000.0	30000.0	0.13	Q1	1989-09-21	35	1989-09-21	
2	Lex	De Haan	17000.0	15000.0	30000.0	0.13	Q1	1993-01-13	32	1993-01-13	
3	Alexander	Hunold	9000.0	4000.0	10000.0	0.83	Q4	1990-01-03	35	1990-01-03	
4	Bruce	Ernst	6000.0	4000.0	10000.0	0.33	Q2	1991-05-21	34	1991-05-21	

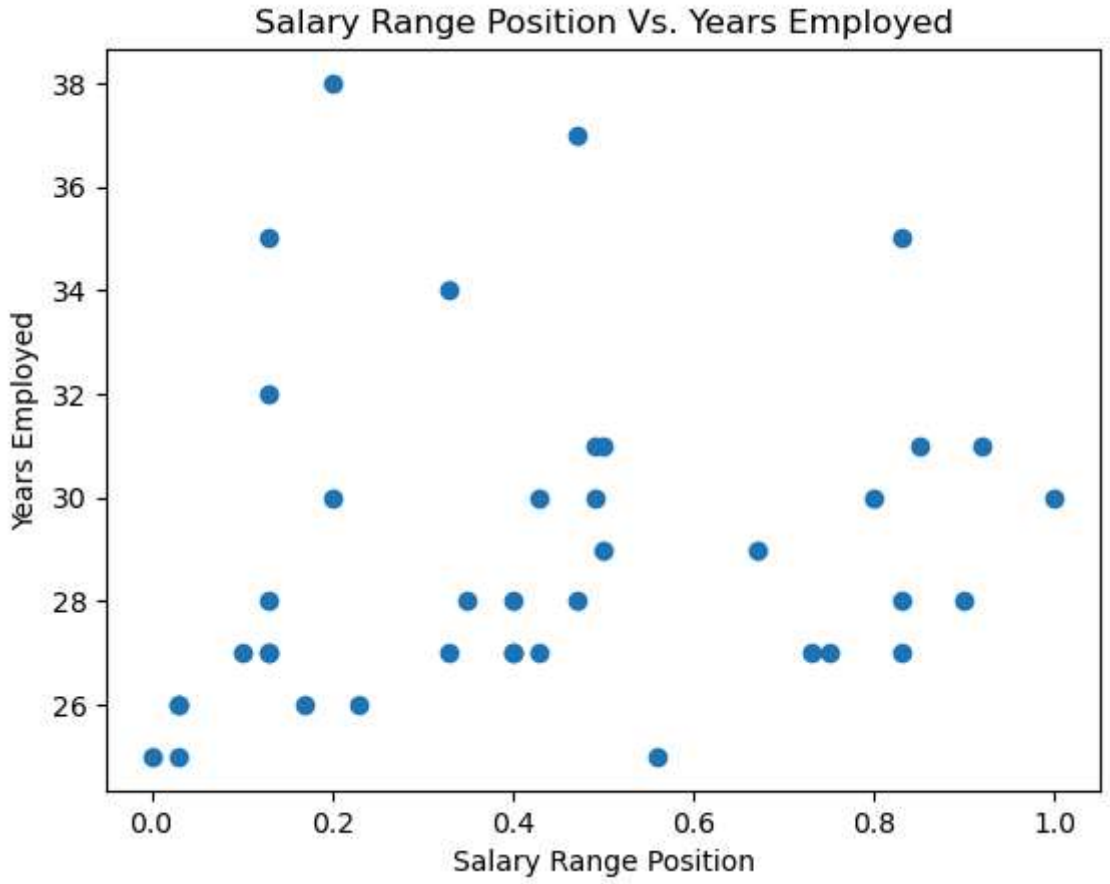
In [18]:
```
#Before we create our scatterplot, let's look at the min, max, and mean age to give us more context into this organiz

mean_years = quartiles['years_employed'].mean()
```

```
min_years = quartiles['years_employed'].min()
max_years = quartiles['years_employed'].max()

print("Mean Years Employed:", mean_years)
print("Minimum Years Employed:", min_years)
print("Maximum Years Employed:", max_years)

#As we can see, the employees of this organization are loyal! The Department of Labor reported that as of January 202
#the average stay for an employe is 3.9 years.
```

```
Mean Years Employed: 29.0
Minimum Years Employed: 25
Maximum Years Employed: 38
```

In [19]:

```
#Now let's create our scatterplot!

plt.scatter(quartiles['Salary Range Position'], quartiles['years_employed'])
plt.xlabel('Salary Range Position')
plt.ylabel('Years Employed')
plt.title('Salary Range Position Vs. Years Employed')

plt.show()

#Uh oh! This scatterplot does not evidence best practices for compensation strategies. As employees progress in a com
#they should also progress in their salary range. Assuming a 30-year tenure, an employee who has a tenure of 15 years
#be near the midpoint of their salary range. We are looking for a positive linear relationship.
```



In [20]:
```
#Let's return a filtered dataframe where employees have been with the organization more than 15 years
# are not past their salary ranges midpoint

not_at_midpoint_df = quartiles[(quartiles['years_employed'] >= 15) & (quartiles['Salary Range Position'] < 0.5)]
num_underpaid = len(not_at_midpoint_df['years_employed'])

#Please be cautious of below line. Coder knows that number of employees is 40, however this would change
#when employees leave or new employees are hired.
print((num_underpaid / 40)*100)

#The output shows us that 65% of employees are likely being underpaid based on their specific salary range and
#the years they have worked with the organization.
```

```
65.0
```

In [22]:

```python
#Let's use a linear regression to see how strongly years of experience can predict salary.
#We will need to import from the statsmodels.api module
import statsmodels.api as sm

#Initializing predictor (X) and target (y)
X = quartiles['years_employed']
y = quartiles['salary']

#Adds constant
X = sm.add_constant(X)

#Fits the model
model = sm.OLS(y, X).fit()

print(model.summary())


#To interpret the Intercept, whenever an employee has zero (0) years of experience, then this linear model predicts t
#the employee will have a salary of -$14,526. This result is misleading, as the average years employed is 28, meaning
#that 0 is far from this average, which is why the model outputs a negative intercept.

#The coefficient of years employed (778.8) indicates how much is earned with each additional year of experience, whic
#predicts to be $778 for each added year employed.

#We also see that the Adjsuted R-squared, or how much the dependent variable changes based on the predictor, is 0.279
#This indicates that 27.9% of change in salary can be explaned by years employed. For the p-value, we have a value <
#which indicates that years employed is very likely to have a non-zero impact on salary. Overall, this model is lacki
#explanatory power, due to the low Adjsuted R-squared value. The model could be improved by adding other variables, s
#location, department, or even manager.
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 salary   R-squared:                       0.297
Model:                            OLS   Adj. R-squared:                  0.279
Method:                 Least Squares   F-statistic:                     16.08
Date:                Wed, 09 Jul 2025   Prob (F-statistic):           0.000274
Time:                        18:12:39   Log-Likelihood:                -386.42
No. Observations:                  40   AIC:                             776.8
Df Residuals:                      38   BIC:                             780.2
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          -1.453e+04   5666.150     -2.564      0.014    -2.6e+04   -3056.295
years_employed   778.8557    194.227      4.010      0.000     385.663    1172.049
==============================================================================
Omnibus:                        0.472   Durbin-Watson:                   1.296
Prob(Omnibus):                  0.790   Jarque-Bera (JB):                0.048
Skew:                           0.038   Prob(JB):                        0.976
Kurtosis:                       3.152   Cond. No.                         269.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

In [ ]: