

```

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import StandardScaler,OneHotEncoder
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.pipeline import make_pipeline
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score,confusion_matrix,classification_report,roc_auc_score,roc_curve

```

```
df=pd.read_csv("HR-Employee-Attrition.csv")
```

```
df.head()
```



	Age	Attrition	BusinessTravel	DailyRate	Department	DistanceFromHome	Education
0	41	Yes	Travel_Rarely	1102	Sales	1	2
1	49	No	Travel_Frequently	279	Research & Development	8	1
2	37	Yes	Travel_Rarely	1373	Research & Development	2	2
3	33	No	Travel_Frequently	1392	Research & Development	3	4
4	27	No	Travel_Rarely	591	Research & Development	2	1

5 rows × 35 columns

```
from sklearn import set_config
set_config(display = "diagram")
```

```
from google.colab import drive
drive.mount("/content/drive")
```

Mounted at /content/drive

```
pd.set_option("display.max_columns",None)
```

```
df.shape
```

```
(1470, 35)
```

```
df.isnull().sum()
```

Age	0
Attrition	0
BusinessTravel	0
DailyRate	0
Department	0
DistanceFromHome	0
Education	0
EducationField	0
EmployeeCount	0
EmployeeNumber	0
EnvironmentSatisfaction	0
Gender	0
HourlyRate	0
JobInvolvement	0
JobLevel	0
JobRole	0
JobSatisfaction	0
MaritalStatus	0
MonthlyIncome	0

```

MonthlyRate      0
NumCompaniesWorked  0
Over18           0
OverTime         0
PercentSalaryHike  0
PerformanceRating  0
RelationshipSatisfaction  0
StandardHours     0
StockOptionLevel  0
TotalWorkingYears  0
TrainingTimesLastYear  0
WorkLifeBalance   0
YearsAtCompany    0
YearsInCurrentRole  0
YearsSinceLastPromotion  0
YearsWithCurrManager  0
dtype: int64

```

```
df.info()
```

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1470 entries, 0 to 1469
Data columns (total 35 columns):
 #   Column                Non-Null Count  Dtype
---  -
 0   Age                   1470 non-null  int64
 1   Attrition             1470 non-null  object
 2   BusinessTravel        1470 non-null  object
 3   DailyRate             1470 non-null  int64
 4   Department            1470 non-null  object
 5   DistanceFromHome      1470 non-null  int64
 6   Education              1470 non-null  int64
 7   EducationField         1470 non-null  object
 8   EmployeeCount          1470 non-null  int64
 9   EmployeeNumber        1470 non-null  int64
10   EnvironmentSatisfaction  1470 non-null  int64
11   Gender                1470 non-null  object
12   HourlyRate            1470 non-null  int64
13   JobInvolvement         1470 non-null  int64
14   JobLevel              1470 non-null  int64
15   JobRole                1470 non-null  object
16   JobSatisfaction        1470 non-null  int64
17   MaritalStatus          1470 non-null  object
18   MonthlyIncome          1470 non-null  int64
19   MonthlyRate           1470 non-null  int64
20   NumCompaniesWorked     1470 non-null  int64
21   Over18                 1470 non-null  object
22   OverTime              1470 non-null  object
23   PercentSalaryHike      1470 non-null  int64
24   PerformanceRating      1470 non-null  int64
25   RelationshipSatisfaction  1470 non-null  int64
26   StandardHours          1470 non-null  int64
27   StockOptionLevel       1470 non-null  int64
28   TotalWorkingYears      1470 non-null  int64
29   TrainingTimesLastYear  1470 non-null  int64
30   WorkLifeBalance        1470 non-null  int64
31   YearsAtCompany         1470 non-null  int64
32   YearsInCurrentRole     1470 non-null  int64
33   YearsSinceLastPromotion  1470 non-null  int64
34   YearsWithCurrManager   1470 non-null  int64
dtypes: int64(26), object(9)
memory usage: 402.1+ KB

```

```
df.describe()
```

```
numeric_feature = df.select_dtypes(exclude='object').columns
catagorical_feature = df.select_dtypes(include='object').columns
```

mean 36.023810 802.185714 0.102517 2.012025 1.0 1021.86

```
uni_cat = []
no_cat = []
null_vals = []
for cat_feature in catagorical_feature:
    uni_cat.append(df[cat_feature].unique())
    no_cat.append(df[cat_feature].nunique())
    null_vals.append(df[cat_feature].isnull().sum())
```

```
df_info = pd.DataFrame({
    "FEATURE NAME" : catagorical_feature,
    "NO UNI CAT" : no_cat,
    "NULL VALS" : null_vals,
    "UNIQUE CAT": uni_cat,
})
```

df\_info

	FEATURE NAME	NO UNI CAT	NULL VALS	UNIQUE CAT
0	Attrition	2	0	[Yes, No]
1	BusinessTravel	3	0	[Travel_Rarely, Travel_Frequently, Non-Travel]
2	Department	3	0	[Sales, Research & Development, Human Resources]
3	EducationField	6	0	[Life Sciences, Other, Medical, Marketing, Tec...
4	Gender	2	0	[Female, Male]
5	JobRole	9	0	[Sales Executive, Research Scientist, Laborato...
6	MaritalStatus	3	0	[Single, Married, Divorced]
7	Over18	1	0	[Y]

```
df = df.drop(['EmployeeNumber', "EmployeeCount", "Over18", "Attrition", "DistanceFromHome"],axis=1)
```

df.head()

	Age	BusinessTravel	DailyRate	Department	Education	EducationField	EnvironmentSatisfaction	...
0	41	Travel_Rarely	1102	Sales	2	Life Sciences	2	F
1	49	Travel_Frequently	279	Research & Development	1	Life Sciences	3	
2	37	Travel_Rarely	1373	Research & Development	2	Other	4	
3	33	Travel_Frequently	1392	Research & Development	4	Life Sciences	4	F
4	27	Travel_Rarely	591	Research & Development	1	Medical	1	

```
plt.subplots(3,3,figsize=(15,15))
```

```
hue = "Department")
```

```
plt.subplot(333)
sns.histplot(data = df,
             x     = "MonthlyIncome",
             bins  = 30,
             kde   = True,
             hue   = "Gender")
```

```
plt.subplot(334)
sns.histplot(data = df,
             x     = "MonthlyIncome",
             bins  = 30,
             kde   = True,
             hue   = "MaritalStatus")
```

```
plt.subplot(335)
sns.histplot(data = df,
             x     = 'MonthlyIncome',
             bins  = 30,
             kde   = True,
             hue   = 'JobRole')
```

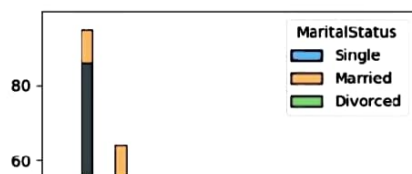
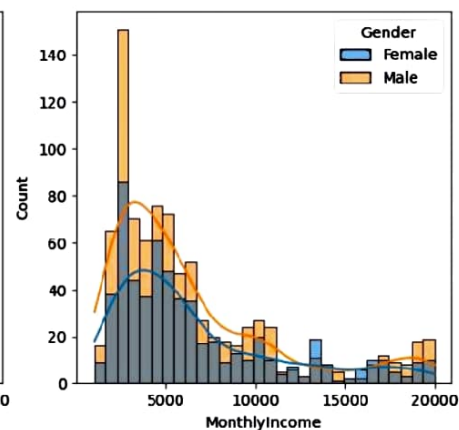
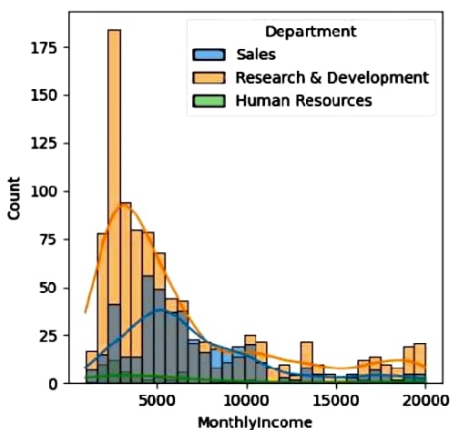
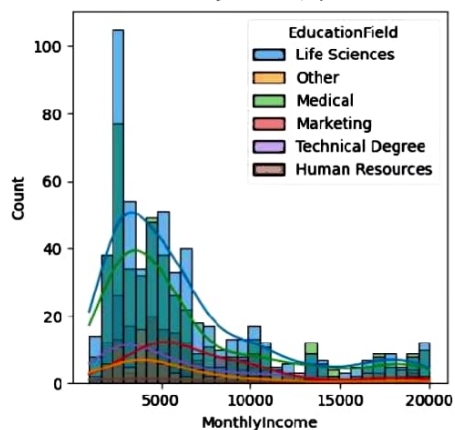
```
plt.subplot(336)
sns.histplot(data = df,
             x     = "MonthlyIncome",
             bins  = 30,
             kde   = True,
             hue   = "BusinessTravel")
```

```
plt.subplot(337)
sns.histplot(data = df,
             x     = "MonthlyIncome",
             bins  = 30,
             kde   = True,
             hue   = "OverTime")
```

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Assignment-4.ipynb - Colaboratory

&lt;Axes: xlabel='MonthlyIncome', ylabel='Count'&gt;



```
group_data = df.groupby("EducationField")
group_data.get_group("Human Resources")["MonthlyIncome"].unique()

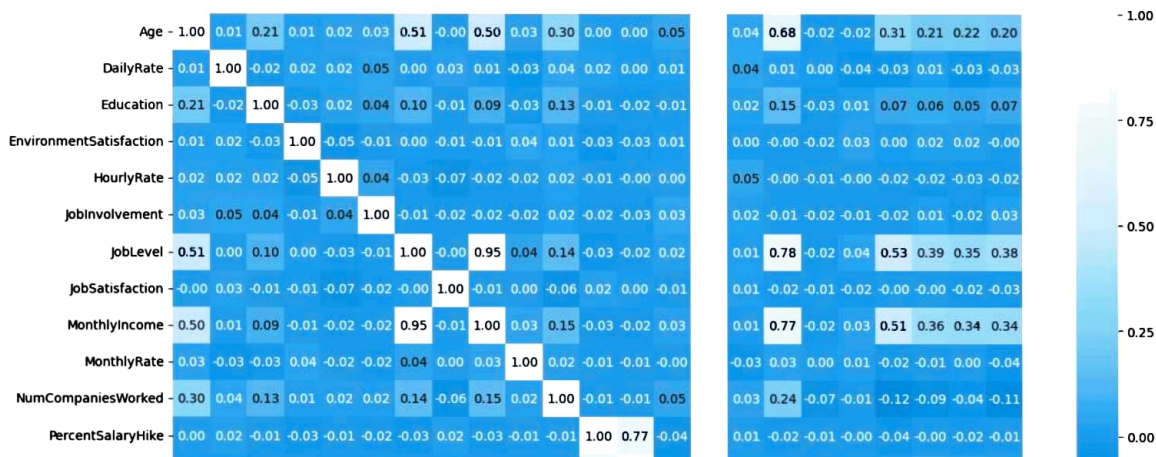
array([ 2073, 18844, 17328,  6347,  6410,  9950, 19141, 19189,  6389,
        2143,  3737,  2277,  2844,  3600, 16799,  6077,  5743, 1555,
        6430,  2180,  2592,  2956,  2335,  3886,  2863, 19636,  2187])
```

```
plt.figure(figsize=(15,12))
sns.heatmap(df.corr(),annot=True,fmt=".2f",vmin=-1,vmax=1,cmap=plt.cm.Blues_r)
plt.show()
```

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Assignment-4.ipynb - Colaboratory

```
<ipython-input-18-062427f61837>: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future version of pandas, only np.number values will be included by default. To include non-numeric values, use DataFrame.corr(numeric_only=False).
sns.heatmap(df.corr(),annot=True,fmt=".2f",vmin=-1,vmax=1,cmap=plt.cm.Blues,r)
```



```
def correlation(dataset,threshold):
    col_corr = set()
    corr_matrix = dataset.corr()
    for i in range(len(corr_matrix.columns)):
        for j in range(i):
            # if abs(corr_matrix.iloc[i,j]) > threshold: # this will remove the highly correlated feature including +ve and -ve
            if abs(corr_matrix.iloc[i,j]) > threshold: # this will only remove the highly +ve correlated features
                colname = corr_matrix.columns[i] # gets the column name
                col_corr.add(colname)
    return col_corr
```

```
corr_features = correlation(df,0.85)
corr_features
```

```
<ipython-input-19-ec6c49401ebd>:3: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future version
corr matrix = dataset.corr()
```



### DECISION TREE

```
y = df.iloc[:,11]
# the independant features will not include the 14th column
x = df.iloc[:,list(range(11)) + list(range(12,len(df.columns)))]
```

## CREATING A COMPLETE PIPELINE FOR DECISION TREE

```

categorical_processor = Pipeline(
    steps = [{"one_hot", OneHotEncoder(handle_unknown="ignore")}])
)

numeric_processor = Pipeline(
    steps = [{"scaler", StandardScaler()}])
)

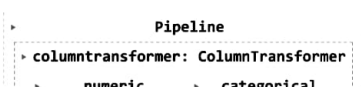
preprocessing = ColumnTransformer(
    transformers=[
        ("numeric", numeric_processor, x.select_dtypes(exclude='object').columns),
        ("categorical", categorical_processor, x.select_dtypes(include='object').columns)
    ]
)

pipe = make_pipeline(preprocessing, DecisionTreeClassifier())
pipe

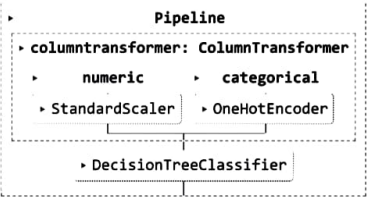
```

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Assignment-4.ipynb - Colaboratory

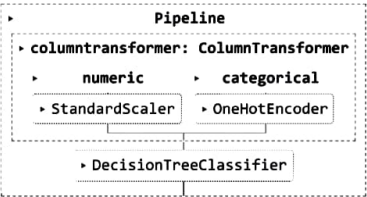






```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size = 20,random_state=42)

pipe.fit(x_train,y_train)
```



```
pred = pipe.predict(x_test)

temp = pd.DataFrame({"actual_values":y_test,
                     "predicted_values":pred
                     })

temp
```

	actual_values	predicted_values		
1041	Sales Executive	Sales Executive		
184	Manufacturing Director	Healthcare Representative		
1222	Human Resources	Human Resources		
67	Research Scientist	Manufacturing Director		
220	Laboratory Technician	Research Scientist		
494	Sales Representative	Sales Representative		
430	Laboratory Technician	Laboratory Technician		
240	Laboratory Technician	Laboratory Technician		
218	Sales Executive	Sales Executive		
49	Laboratory Technician	Research Scientist		
665	Sales Representative	Sales Representative		
926	Sales Executive	Sales Executive		
617	Healthcare Representative	Healthcare Representative		
361	Laboratory Technician	Research Scientist		
1423	Research Scientist	Research Scientist		
1244	Research Scientist	Research Scientist		
1250	Healthcare Representative	Laboratory Technician		
752	Laboratory Technician	Research Scientist		
271	Manager	Manager		
1055	Research Director	Research Director		

```
confusion_matrix(y_test,pred)

array([[1, 0, 1, 0, 0, 0, 0, 0, 0],
       [0, 1, 0, 0, 0, 0, 0, 0, 0],
       [0, 0, 2, 0, 0, 0, 4, 0, 0],
       [0, 0, 0, 1, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0, 0, 0, 0],
```

```
[0, 0, 0, 0, 0, 1, 0, 0, 0],
[0, 0, 0, 0, 1, 0, 2, 0, 0],
[0, 0, 0, 0, 0, 0, 0, 3, 0],
[0, 0, 0, 0, 0, 0, 0, 0, 2]])
```

```
print(classification_report(y_test,pred))

precision    recall  f1-score   support
```



```
confusion_matrix(y_test,pred)

array([[1, 0, 1, 0, 0, 0, 0, 0, 0],
       [0, 1, 0, 0, 0, 0, 0, 0, 0],
       [0, 0, 2, 0, 0, 0, 4, 0, 0],
       [0, 0, 0, 1, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0, 0, 0, 0],
```

<https://colab.research.google.com/drive/1XAZBxMhJPbjnQL0R4eC42c6bv4eQT0xU?authuser=0#scrollTo=lySmYKHUnHh8&printMode=true>

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Assignment-4.ipynb - Colaboratory

```
[0, 0, 0, 0, 0, 1, 0, 0, 0],
[0, 0, 0, 0, 1, 0, 2, 0, 0],
[0, 0, 0, 0, 0, 0, 0, 3, 0],
[0, 0, 0, 0, 0, 0, 0, 0, 2]])
```

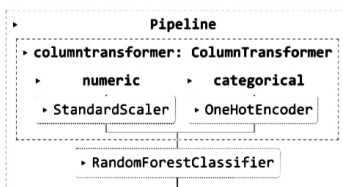
```
print(classification_report(y_test,pred))
```

	precision	recall	f1-score	support
Healthcare Representative	0.50	0.50	0.50	2
Human Resources	1.00	1.00	1.00	1
Laboratory Technician	0.67	0.33	0.44	6
Manager	1.00	1.00	1.00	1
Manufacturing Director	0.00	0.00	0.00	1
Research Director	1.00	1.00	1.00	1
Research Scientist	0.33	0.67	0.44	3
Sales Executive	1.00	1.00	1.00	3
Sales Representative	1.00	1.00	1.00	2
accuracy			0.65	20
macro avg	0.72	0.72	0.71	20
weighted avg	0.70	0.65	0.65	20

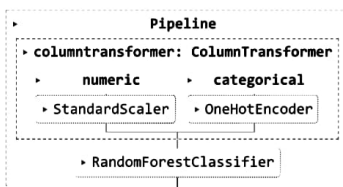
## RANDOM FOREST

## CREATING A COMPLETE PIPELINE FOR RANDOMFOREST

```
pipe2 = make_pipeline(preprocessing, RandomForestClassifier(n_estimators=20))
pipe2
```



```
pipe2.fit(x_train,y_train)
```



```
pred = pipe2.predict(x_test)
```

```
temp = pd.DataFrame({"actual_values":y_test,
                     "predicted_values":pred
                     })
temp
```

temp

<https://colab.research.google.com/drive/1XAZBxMhJPBjqL0R4eC42c6bv4eQT0xU?authuser=0#scrollTo=IySmYKHUnHh8&printMode=true>

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Assignment-4.ipynb - Colaboratory

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Assignment-4.ipynb - Colaboratory

```

    actual_values      predicted_values
1041      Sales Executive      Sales Executive
184      Manufacturing Director      Manufacturing Director
1222      Human Resources      Human Resources
67      Research Scientist      Healthcare Representative
220      Laboratory Technician      Healthcare Representative
494      Sales Representative      Sales Representative
430      Laboratory Technician      Research Scientist
240      Laboratory Technician      Research Scientist
218      Sales Executive      Sales Executive
49      Laboratory Technician      Research Scientist
665      Sales Representative      Sales Representative
926      Sales Executive      Sales Executive

confusion_matrix(y_test,pred)

array([[0, 0, 0, 0, 2, 0, 0, 0, 0],
       [0, 1, 0, 0, 0, 0, 0, 0, 0],
       [1, 0, 1, 0, 0, 0, 4, 0, 0],
       [0, 0, 0, 0, 0, 1, 0, 0, 0],
       [0, 0, 0, 0, 1, 0, 0, 0, 0],
       [0, 0, 0, 1, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0, 2, 0, 0],
       [0, 0, 0, 0, 0, 0, 0, 3, 0],
       [0, 0, 0, 0, 0, 0, 0, 0, 2]])

print(classification_report(y_test,pred))

              precision    recall  f1-score   support

Healthcare Representative    0.00    0.00    0.00         2
      Human Resources        1.00    1.00    1.00         1
    Laboratory Technician    1.00    0.17    0.29         6
              Manager        0.00    0.00    0.00         1
    Manufacturing Director    0.33    1.00    0.50         1
      Research Director      0.00    0.00    0.00         1
      Research Scientist      0.33    0.67    0.44         3
        Sales Executive      1.00    1.00    1.00         3
      Sales Representative    1.00    1.00    1.00         2

               accuracy
               macro avg   0.52    0.54    0.47         20
               weighted avg   0.67    0.50    0.48         20
```

LOGISTIC REGRESSION

```

y1 = df.iloc[:,7]
x1 = df.iloc[:,list(range(7)) + list(range(8,len(df.columns)))]

x1_train,x1_test,y1_train,y1_test = train_test_split(x1,y1,test_size = 20,random_state=42)
```

CREATING A COMPLETE PIPE LINE FOR LOGISTIC REGRESSION

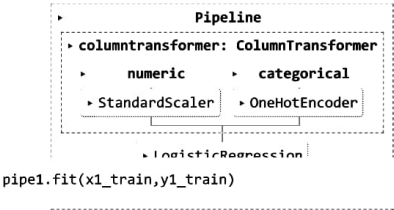
```

preprocessing = ColumnTransformer(
    transformers=[
        ("numeric", numeric_processor, x1.select_dtypes(exclude='object').columns),
        ("categorical", catagorical_processor, x1.select_dtypes(include='object').columns)
    ]
)

pipe1 = make_pipeline(preprocessing,LogisticRegression())
pipe1
```

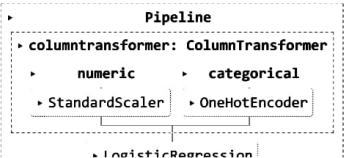
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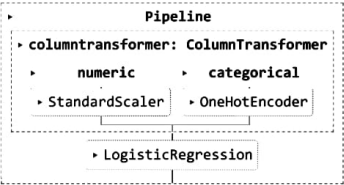


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Assignment-4.ipynb - Colaboratory



```
pipe1.fit(x1_train,y1_train)
```



```
pred = pipe1.predict(x1_test)
```

```
temp = pd.DataFrame({"actual_values":y1_test,
                     "predicted_values":pred
                     })
```

temp

	actual_values	predicted_values	
1041	Male	Male	
184	Female	Male	
1222	Male	Male	
67	Male	Male	
220	Male	Male	
494	Female	Male	
430	Male	Male	
240	Female	Male	
218	Female	Male	
49	Male	Male	
665	Female	Male	
926	Female	Male	
617	Male	Male	
361	Female	Male	
1423	Male	Male	
1244	Female	Male	
1250	Male	Female	
752	Female	Male	
271	Male	Male	
1055	Male	Male	

```
print(classification_report(y_test,pred))
```

	precision	recall	f1-score	support
Female	0.00	0.00	0.00	0.0
Healthcare Representative	0.00	0.00	0.00	2.0
Human Resources	0.00	0.00	0.00	1.0
Laboratory Technician	0.00	0.00	0.00	6.0
Male	0.00	0.00	0.00	0.0
Manager	0.00	0.00	0.00	1.0
Manufacturing Director	0.00	0.00	0.00	1.0
Research Director	0.00	0.00	0.00	1.0
Research Scientist	0.00	0.00	0.00	3.0

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Assignment-4.ipynb - Colaboratory

Sales Executive	0.00	0.00	0.00	3.0
Sales Representative	0.00	0.00	0.00	2.0
accuracy			0.00	20.0
macro avg	0.00	0.00	0.00	20.0
weighted avg	0.00	0.00	0.00	20.0

/usr/local/lib/python3.10/dist-packages/sklearn/metrics/\_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c  
warn prf(average, modifier, msg\_start, len(result))  
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/\_classification.py:1344: UndefinedMetricWarning: Recall and F-score are ill-defi  
warn prf(average, modifier, msg\_start, len(result))

id	gender	gender
752	Female	Male
271	Male	Male
1055	Male	Male

```
print(classification_report(y_test,pred))
```

	precision	recall	f1-score	support
Female	0.00	0.00	0.00	0.0
Healthcare Representative	0.00	0.00	0.00	2.0
Human Resources	0.00	0.00	0.00	1.0
Laboratory Technician	0.00	0.00	0.00	6.0
Male	0.00	0.00	0.00	0.0
Manager	0.00	0.00	0.00	1.0
Manufacturing Director	0.00	0.00	0.00	1.0
Research Director	0.00	0.00	0.00	1.0
Research Scientist	0.00	0.00	0.00	3.0

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Sales Executive	0.00	0.00	0.00	3.0
Sales Representative	0.00	0.00	0.00	2.0
accuracy			0.00	20.0
macro avg	0.00	0.00	0.00	20.0
weighted avg	0.00	0.00	0.00	20.0

```
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c
_warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Recall and F-score are ill-defi
_warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c
_warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Recall and F-score are ill-defi
_warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-c
_warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Recall and F-score are ill-defi
_warn_prf(average, modifier, msg_start, len(result))
```

