Decision Tree

In [ ]:
```
import pandas as pd, numpy as np, matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import LabelEncoder
import warnings
warnings.filterwarnings("ignore")
```

In [ ]:
```
file_path = "C:/Users/Owner/source/vsc_repo/machine_learn_cookbook/Logistic_Regress
hr_data = pd.read_csv(file_path, sep=",", engine="python", encoding="utf-8", encodi
hr_data.rename(columns={'Departments ': 'Departments', 'salary' : 'Salary' }, inpla
# hr_data.rename(str.title, axis='columns', inplace=True)
hr_data['Departments'] = [s.title() for s in hr_data['Departments']]
# hr_data.drop('Departments ', axis=1, inplace=True)
hr_data['Salary'] = [s.title() for s in hr_data['Salary']]
hr_data['Departments'] = hr_data['Departments'].replace(["Hr", "It","Mng", "Randd"]
```

Exploratory Data Analysis

In [ ]:
```
hr_data.head(5)
```

Out[ ]:

	Satisfaction Level	Last Evaluation	Number of Projects	Monthly Hours	Total Time at the Company	Work Accidents	Quit the Company	Promoted in Last 5 yrs
0	0.38	0.53	2	157	3	0	1	0
1	0.80	0.86	5	262	6	0	1	0
2	0.11	0.88	7	272	4	0	1	0
3	0.72	0.87	5	223	5	0	1	0
4	0.37	0.52	2	159	3	0	1	0

In [ ]:
```
hr_data.tail(5)
```

Out[ ]:

	Satisfaction Level	Last Evaluation	Number of Projects	Monthly Hours	Total Time at the Company	Work Accidents	Quit the Company	Promo in La
14994	0.40	0.57	2	151	3	0	1	
14995	0.37	0.48	2	160	3	0	1	
14996	0.37	0.53	2	143	3	0	1	
14997	0.11	0.96	6	280	4	0	1	
14998	0.37	0.52	2	158	3	0	1	

In [ ]:
```
hr_data.sample(n=5, random_state=3)
```

Out[ ]:

	Satisfaction Level	Last Evaluation	Number of Projects	Monthly Hours	Total Time at the Company	Work Accidents	Quit the Company	Promo in La
11584	0.65	0.74	4	233	4	1	0	
5034	0.47	0.51	6	190	5	0	0	
12282	0.83	0.92	5	267	6	0	1	
28	0.41	0.46	2	128	3	0	1	
9702	0.54	0.72	6	222	5	0	0	

In [ ]:
```
hr_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14999 entries, 0 to 14998
Data columns (total 11 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Satisfaction Level      14999 non-null  float64
 1   Last Evaluation         14999 non-null  float64
 2   Number of Projects      14999 non-null  int64
 3   Monthly Hours           14999 non-null  int64
 4   Total Time at the Company  14999 non-null  int64
 5   Work Accidents          14999 non-null  int64
 6   Quit the Company        14999 non-null  int64
 7   Promoted in Last 5 yrs  14999 non-null  int64
 8   Departments             14999 non-null  object
 9   Salary                  14999 non-null  object
 10  Management              14999 non-null  int64
dtypes: float64(2), int64(7), object(2)
memory usage: 1.3+ MB
```

In [ ]:
```
hr_data.dtypes
```

Out[ ]:
```
Satisfaction Level          float64
Last Evaluation             float64
Number of Projects            int64
Monthly Hours                 int64
Total Time at the Company     int64
Work Accidents                int64
Quit the Company              int64
Promoted in Last 5 yrs        int64
Departments                  object
Salary                       object
Management                    int64
dtype: object
```

In [ ]:
```
hr_data.index
```

Out[ ]:
```
RangeIndex(start=0, stop=14999, step=1)
```

In [ ]:
```
hr_data.shape
```

Out[ ]:
```
(14999, 11)
```

In [ ]:
```
hr_data.ndim
```

Out[ ]:
```
2
```

In [ ]:
```
hr_data.columns
```

Out[ ]:
```
Index(['Satisfaction Level', 'Last Evaluation', 'Number of Projects',
       'Monthly Hours', 'Total Time at the Company', 'Work Accidents',
       'Quit the Company', 'Promoted in Last 5 yrs', 'Departments', 'Salary',
       'Management'],
      dtype='object')
```

In [ ]:
```
hr_data["Departments"].unique()
```

Out[ ]:
```
array(['Sales', 'Accounting', 'HR', 'Technical', 'Support', 'Management',
       'IT', 'Product_MNG', 'Marketing', 'R&D'], dtype=object)
```

In [ ]:
```
hr_data["Salary"].unique()
```

Out[ ]:
```
array(['Low', 'Medium', 'High'], dtype=object)
```

In [ ]:
```
hr_data.describe()
```

Out[ ]:

	Satisfaction Level	Last Evaluation	Number of Projects	Monthly Hours	Total Time at the Company	Work Accidents
count	14999.000000	14999.000000	14999.000000	14999.000000	14999.000000	14999.000000
mean	0.612834	0.716102	3.803054	201.050337	3.498233	0.144610
std	0.248631	0.171169	1.232592	49.943099	1.460136	0.351719
min	0.090000	0.360000	2.000000	96.000000	2.000000	0.000000
25%	0.440000	0.560000	3.000000	156.000000	3.000000	0.000000
50%	0.640000	0.720000	4.000000	200.000000	3.000000	0.000000
75%	0.820000	0.870000	5.000000	245.000000	4.000000	0.000000
max	1.000000	1.000000	7.000000	310.000000	10.000000	1.000000

In [ ]:
```
hr_data["Quit the Company"].loc[(hr_data["Departments"] == "IT") & (hr_data["Salary
```

Out[ ]:
```
Quit the Company
0    437
1    172
Name: count, dtype: int64
```

In [ ]:
```
hr_data["Quit the Company"].loc[(hr_data["Departments"] == "IT") & (hr_data["Salary
```

Out[ ]:
```
Quit the Company
0    438
1     97
Name: count, dtype: int64
```

In [ ]:
```
hr_data["Quit the Company"].loc[(hr_data["Departments"] == "IT") & (hr_data["Salary
```

Out[ ]:
```
Quit the Company
0    79
1     4
Name: count, dtype: int64
```

Preprocessing

Preprocessing

In [ ]:
```
he = OneHotEncoder(categories="auto", drop="first", handle_unknown="error")
hr_encode = he.fit_transform(hr_data)
hr_dummies = pd.get_dummies(hr_data, prefix_sep="_", dummy_na=False, dtype=int, dro
hr_dummies.head(3)
```

Out[ ]:

	Satisfaction Level	Last Evaluation	Number of Projects	Monthly Hours	Total Time at the Company	Work Accidents	Quit the Company	Promoted in Last 5 yrs
0	0.38	0.53	2	157	3	0	1	0
1	0.80	0.86	5	262	6	0	1	0
2	0.11	0.88	7	272	4	0	1	0

In [ ]:
```
le = LabelEncoder()
hr_data["Departments_Encode"] = le.fit_transform(hr_data["Departments"])
hr_data["Salary_Encode"] = le.fit_transform(hr_data["Salary"])
hr_data.head(5)
```

Out[ ]:

	Satisfaction Level	Last Evaluation	Number of Projects	Monthly Hours	Total Time at the Company	Work Accidents	Quit the Company	Promoted in Last 5 yrs
0	0.38	0.53	2	157	3	0	1	0
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3	0.72	0.87	5	223	5	0	1	0
4	0.37	0.52	2	159	3	0	1	0

In [ ]:
```
X = hr_dummies.drop("Quit the Company",  axis=1)
y = hr_dummies["Quit the Company"]
```

In [ ]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_st
```

Decision Tree Classifier

Decision Tree Classifier

In [ ]:
```
from sklearn.model_selection import GridSearchCV
param_grid = {"criterion" : ["gini", "entropy", "log_loss"], "max_depth" : [6, 8, 1
              "random_state" : [0,42], }
grid_search = GridSearchCV(DecisionTreeClassifier(), param_grid, cv=5, scoring="acc
grid_search.fit(X_train, y_train)
print(grid_search.best_params_)


dtc = DecisionTreeClassifier(criterion="entropy", max_depth=6, max_features="auto",
dtc.fit(X_train, y_train)
y_predict = dtc.predict(X_test)
```

```
Fitting 5 folds for each of 288 candidates, totalling 1440 fits
[CV 1/5] END criterion=gini, max_depth=6, max_features=auto, min_samples_split=2, ra
ndom_state=0;, score=0.997 total time=   0.0s
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[CV 1/5] END criterion=gini, max_depth=6, max_features=log2, min_samples_split=2, ra
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[CV 5/5] END criterion=log_loss, max_depth=12, max_features=sqrt, min_samples_split=
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[CV 4/5] END criterion=log_loss, max_depth=12, max_features=sqrt, min_samples_split=
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[CV 5/5] END criterion=log_loss, max_depth=12, max_features=sqrt, min_samples_split=
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[CV 3/5] END criterion=log_loss, max_depth=12, max_features=sqrt, min_samples_split=
8, random_state=42;, score=0.998 total time=   0.0s
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[CV 5/5] END criterion=log_loss, max_depth=12, max_features=sqrt, min_samples_split=
```

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[CV 1/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
2, random_state=0;, score=0.998 total time=   0.0s
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2, random_state=0;, score=0.995 total time=   0.0s
[CV 1/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 2/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 5/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 5/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 1/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
6, random_state=0;, score=0.995 total time=   0.0s
[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
6, random_state=0;, score=0.999 total time=   0.0s
[CV 5/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
6, random_state=0;, score=0.994 total time=   0.0s
[CV 1/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
6, random_state=42;, score=0.987 total time=   0.0s
[CV 2/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
6, random_state=42;, score=0.998 total time=   0.0s
[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
```

```
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[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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[CV 5/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
6, random_state=42;, score=0.996 total time=   0.0s
[CV 1/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
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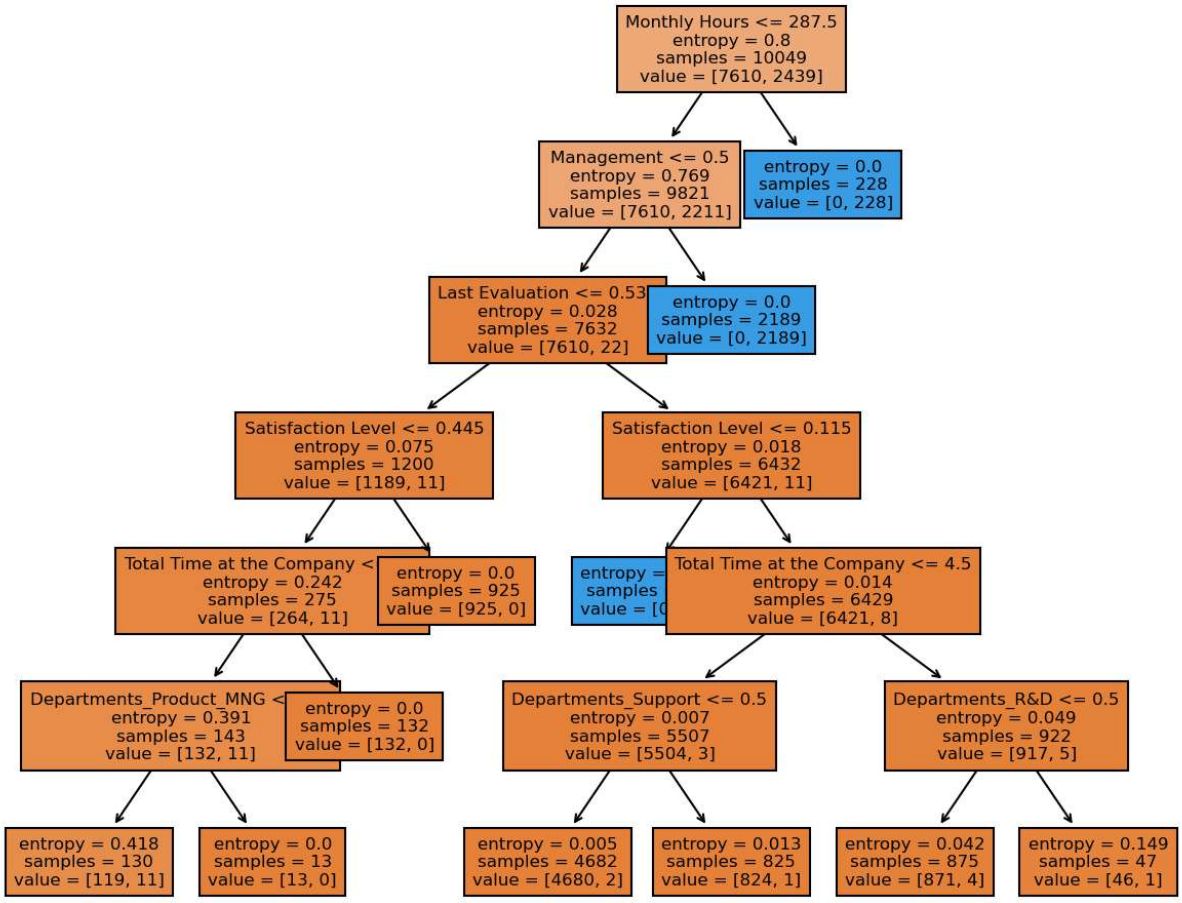
[CV 2/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=0;, score=0.999 total time=   0.0s
[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=0;, score=0.997 total time=   0.0s
[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=0;, score=0.998 total time=   0.0s
[CV 5/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=0;, score=0.995 total time=   0.0s
[CV 1/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=42;, score=0.994 total time=   0.0s
[CV 2/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=42;, score=0.998 total time=   0.0s
[CV 3/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=42;, score=0.998 total time=   0.0s
[CV 4/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=42;, score=0.996 total time=   0.0s
[CV 5/5] END criterion=log_loss, max_depth=12, max_features=log2, min_samples_split=
8, random_state=42;, score=0.996 total time=   0.0s
{'criterion': 'entropy', 'max_depth': 6, 'max_features': 'auto', 'min_samples_spli
t': 2, 'random_state': 0}
```

Visualization: Tree Plot

Visualization: Tree Plot

In [ ]:

```
classNames=["No Quit, Quit"]
plt.figure(figsize=(10,8), dpi=150)
tree.plot_tree(dtc, feature_names=X.columns, filled=True, label="all", fontsize=8,
plt.show()
```



Decision Tree for Power BI

Decision Tree for Power BI

In [ ]:

```
import pandas as pd, numpy as np, matplotlib.pyplot as plt
from sklearn import tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split

file_path = "C:/Users/Owner/source/vsc_repo/machine_learn_cookbook/Logistic_Regress
hr_data = pd.read_csv(file_path, sep=",", engine="python", encoding="utf-8", encodi
hr_data.rename(columns={'Departments ': 'Departments', 'salary' : 'Salary' }, inpla
# hr_data.rename(str.title, axis='columns', inplace=True)
hr_data['Departments'] = [s.title() for s in hr_data['Departments']]
# hr_data.drop('Departments ', axis=1, inplace=True)
hr_data['Salary'] = [s.title() for s in hr_data['Salary']]
hr_data['Departments'] = hr_data['Departments'].replace(["Hr", "It","Mng", "Randd"]

hr_dummies = pd.get_dummies(hr_data, prefix_sep="_", dummy_na=False, dtype=int, dro

X = hr_dummies.drop("Quit the Company", axis=1)
y = hr_dummies["Quit the Company"]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_st

dtc = DecisionTreeClassifier(criterion="entropy", max_depth=6, max_features="auto",
```

```
dtc.fit(X_train, y_train)
y_predict = dtc.predict(X_test)

classNames=["No Quit, Quit"]
plt.figure(figsize=(10,8), dpi=150)
tree.plot_tree(dtc, feature_names=X.columns, filled=True, label="all", fontsize=8,
plt.show()
```