In [13]:
```
import pandas as pd
import matplotlib.pyplot as plt
import graphviz
import seaborn as sns
```

In [15]:
```
df = pd.read_csv("rainfall.csv")
```

In [17]:
```
df.head()
```

Out[17]:

	pressure	maxtemp	temparature	mintemp	dewpoint	humidity	cloud	sunshine	winc
0	1025.9	19.9	18.3	16.8	13.1	72	49	9.3	
1	1022.0	21.7	18.9	17.2	15.6	81	83	0.6	
2	1019.7	20.3	19.3	18.0	18.4	95	91	0.0	
3	1018.9	22.3	20.6	19.1	18.8	90	88	1.0	
4	1015.9	21.3	20.7	20.2	19.9	95	81	0.0	

In [19]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 366 entries, 0 to 365
Data columns (total 11 columns):
 #   Column                 Non-Null Count  Dtype  
---  ------                 --------------  -----  
 0   pressure               366 non-null    float64
 1   maxtemp                366 non-null    float64
 2   temparature            366 non-null    float64
 3   mintemp                366 non-null    float64
 4   dewpoint               366 non-null    float64
 5   humidity               366 non-null    int64  
 6   cloud                  366 non-null    int64  
 7   sunshine               366 non-null    float64
 8            winddirection  365 non-null    float64
 9   windspeed              365 non-null    float64
 10  rainfall               366 non-null    object 
dtypes: float64(8), int64(2), object(1)
memory usage: 31.6+ KB
```

In [21]:
```
df.describe()
```

Out[21]:

	pressure	maxtemp	temparature	mintemp	dewpoint	humidity	clou
count	366.000000	366.000000	366.000000	366.000000	366.000000	366.000000	366.0000
mean	1013.742623	26.191257	23.747268	21.894536	19.989071	80.177596	71.1284
std	6.414776	5.978343	5.632813	5.594153	5.997021	10.062470	21.7980
min	998.500000	7.100000	4.900000	3.100000	-0.400000	36.000000	0.0000
25%	1008.500000	21.200000	18.825000	17.125000	16.125000	75.000000	58.0000
50%	1013.000000	27.750000	25.450000	23.700000	21.950000	80.500000	80.0000
75%	1018.100000	31.200000	28.600000	26.575000	25.000000	87.000000	88.0000
max	1034.600000	36.300000	32.400000	30.000000	26.700000	98.000000	100.0000

In [23]:
```
df.isnull().sum()
```

Out[23]:
```
pressure                 0
maxtemp                  0
temparature              0
mintemp                  0
dewpoint                 0
humidity                 0
cloud                    0
sunshine                 0
         winddirection    1
windspeed                1
rainfall                 0
dtype: int64
```

In [25]:
```
df.columns = df.columns.str.strip()
```

In [27]:
```
df.isnull().sum()
```

Out[27]:
```
pressure         0
maxtemp          0
temparature      0
mintemp          0
dewpoint         0
humidity         0
cloud            0
sunshine         0
winddirection    1
windspeed        1
rainfall         0
dtype: int64
```

In [29]:
```
def wind_direction(degrees):
    if degrees >= 315 or degrees < 45:
        return 'N'
    elif 45 <= degrees < 135:
        return 'E'
```

```
    elif 135 <= degrees < 225:
        return 'S'
    else:
        return 'W'

df["wind_direct_category"] = df["winddirection"].apply(wind_direction)
df.drop(columns=["winddirection"], inplace=True)
```

In [31]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 366 entries, 0 to 365
Data columns (total 11 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   pressure              366 non-null    float64
 1   maxtemp               366 non-null    float64
 2   temparature           366 non-null    float64
 3   mintemp               366 non-null    float64
 4   dewpoint              366 non-null    float64
 5   humidity              366 non-null    int64  
 6   cloud                 366 non-null    int64  
 7   sunshine              366 non-null    float64
 8   windspeed             365 non-null    float64
 9   rainfall              366 non-null    object 
 10  wind_direct_category  366 non-null    object 
dtypes: float64(7), int64(2), object(2)
memory usage: 31.6+ KB
```

Above we changed the wind direction to 'NWSE' Values

Now we are going to change the rest of the columns to categorical as well, we will be using a qcut to give it evenly distributed values.

In [35]:
```
print(df["pressure"].describe())
```

```
count     366.000000
mean     1013.742623
std         6.414776
min       998.500000
25%      1008.500000
50%      1013.000000
75%      1018.100000
max      1034.600000
Name: pressure, dtype: float64
```

In [37]:
```
df["pressure"] = pd.qcut(df["pressure"], q=3, labels=["Low", "Medium", "High"])
```

In [39]:
```
print(df["pressure"].describe())
```

```
count     366
unique      3
top       Low
freq      124
Name: pressure, dtype: object
```

In [41]:
```
df.rename(columns={"temparature": "temperature"}, inplace=True)
```

In [43]:
```
df["maxtemp"] = pd.qcut(df["maxtemp"], q=3, labels=["Low", "Medium", "High"])
```

In [45]:
```
df["temperature"] = pd.qcut(df["temperature"], q=3, labels=["Low", "Medium", "High"
```

In [47]:
```
df["dewpoint"] = pd.qcut(df["dewpoint"], q=3, labels=["Low", "Medium", "High"])
```

In [49]:
```
df["humidity"] = pd.qcut(df["humidity"], q=3, labels=["Low", "Medium", "High"])
```

In [51]:
```
df["cloud"] = pd.qcut(df["cloud"], q=3, labels=["Low", "Medium", "High"])
```

In [53]:
```
df["sunshine"] = pd.qcut(df["sunshine"], q=3, labels=["Low", "Medium", "High"])
```

In [55]:
```
df["windspeed"] = pd.qcut(df["windspeed"], q=3, labels=["Low", "Medium", "High"])
```

In [57]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 366 entries, 0 to 365
Data columns (total 11 columns):
 #   Column                Non-Null Count  Dtype   
---  ------                --------------  -----   
 0   pressure              366 non-null    category
 1   maxtemp               366 non-null    category
 2   temperature           366 non-null    category
 3   mintemp               366 non-null    float64 
 4   dewpoint              366 non-null    category
 5   humidity              366 non-null    category
 6   cloud                 366 non-null    category
 7   sunshine              366 non-null    category
 8   windspeed             365 non-null    category
 9   rainfall              366 non-null    object  
 10  wind_direct_category  366 non-null    object  
dtypes: category(8), float64(1), object(2)
memory usage: 12.6+ KB
```

Two of the columns are showing as objects so we need to change it to category data types

In [60]:
```
df["wind_direct_category"] = df["wind_direct_category"].astype("category")
df["rainfall"] = df["rainfall"].astype("category")
```

In [62]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 366 entries, 0 to 365
Data columns (total 11 columns):
 #   Column                Non-Null Count  Dtype   
---  ------                --------------  -----   
 0   pressure              366 non-null    category
 1   maxtemp               366 non-null    category
 2   temperature           366 non-null    category
 3   mintemp               366 non-null    float64 
 4   dewpoint              366 non-null    category
 5   humidity              366 non-null    category
 6   cloud                 366 non-null    category
 7   sunshine              366 non-null    category
 8   windspeed             365 non-null    category
 9   rainfall              366 non-null    category
 10  wind_direct_category  366 non-null    category
dtypes: category(10), float64(1)
memory usage: 7.9 KB
```

We need to push rainfall to the end again so it acts as the target

In [65]:
```
rainfall_col = df.pop("rainfall")
df["rainfall"] = rainfall_col
```

In [67]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 366 entries, 0 to 365
Data columns (total 11 columns):
 #   Column                Non-Null Count  Dtype   
---  ------                --------------  -----   
 0   pressure              366 non-null    category
 1   maxtemp               366 non-null    category
 2   temperature           366 non-null    category
 3   mintemp               366 non-null    float64 
 4   dewpoint              366 non-null    category
 5   humidity              366 non-null    category
 6   cloud                 366 non-null    category
 7   sunshine              366 non-null    category
 8   windspeed             365 non-null    category
 9   wind_direct_category  366 non-null    category
 10  rainfall              366 non-null    category
dtypes: category(10), float64(1)
memory usage: 7.9 KB
```

Everything is converted to categorical, now I am going to start doing finishing touches to clean up the data

Dropping Duplicates

In [71]:
```
df.drop_duplicates(inplace=True)
```

Checking and handling null values

In [74]:
```
df.isnull().sum()
```

Out[74]:
```
pressure                0
maxtemp                 0
temperature             0
mintemp                 0
dewpoint                0
humidity                0
cloud                   0
sunshine                0
windspeed               1
wind_direct_category    0
rainfall                0
dtype: int64
```

In [76]:
```
df.dropna(inplace=True)
```

Decided to just drop the null value since it was only one

In [79]:
```
df.to_csv("cleaned_weather_data.csv", index=False)
```

In [122…
```
df_cleaned = pd.read_csv("cleaned_weather_data.csv")
```

In [ ]:
```

```

For some reason the mintemp and winddirection got reverted back to numeric so I am redoing those now

In [125…
```
df_cleaned["mintemp"] = pd.qcut(df_cleaned["mintemp"], q=4, labels=["Very Low", "Lo
```

In [114…
```
def categorize_wind_direction(degrees):
    if (degrees >= 0 and degrees < 90):
        return 'NE'
    elif (degrees >= 90 and degrees < 180):
        return 'SE'
    elif (degrees >= 180 and degrees < 270):
        return 'SW'
    else:
        return 'NW'

df_cleaned['wind_direct_category'] = df_cleaned['winddirection'].apply(categorize_w
df_cleaned.drop(columns=["winddirection"], inplace=True)
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
File ~\anaconda3\Lib\site-packages\pandas\core\indexes\base.py:3805, in Index.get_loc(self, key)
   3804 try:
-> 3805     return self._engine.get_loc(casted_key)
   3806 except KeyError as err:

File index.pyx:167, in pandas._libs.index.IndexEngine.get_loc()

File index.pyx:196, in pandas._libs.index.IndexEngine.get_loc()

File pandas\\_libs\\hashtable_class_helper.pxi:7081, in pandas._libs.hashtable.PyObjectHashTable.get_item()

File pandas\\_libs\\hashtable_class_helper.pxi:7089, in pandas._libs.hashtable.PyObjectHashTable.get_item()

KeyError: 'winddirection'

The above exception was the direct cause of the following exception:

KeyError                                  Traceback (most recent call last)
Cell In[114], line 11
      8     else:
      9         return 'NW'
---> 11 df_cleaned['wind_direct_category'] = df_cleaned['winddirection'].apply(categorize_wind_direction)
     12 df_cleaned.drop(columns=["winddirection"], inplace=True)

File ~\anaconda3\Lib\site-packages\pandas\core\frame.py:4102, in DataFrame.__getitem__(self, key)
   4100 if self.columns.nlevels > 1:
   4101     return self._getitem_multilevel(key)
-> 4102 indexer = self.columns.get_loc(key)
   4103 if is_integer(indexer):
   4104     indexer = [indexer]

File ~\anaconda3\Lib\site-packages\pandas\core\indexes\base.py:3812, in Index.get_loc(self, key)
   3807     if isinstance(casted_key, slice) or (
   3808         isinstance(casted_key, abc.Iterable)
   3809         and any(isinstance(x, slice) for x in casted_key)
   3810     ):
   3811         raise InvalidIndexError(key)
-> 3812     raise KeyError(key) from err
   3813 except TypeError:
   3814     # If we have a listlike key, _check_indexing_error will raise
   3815     #  InvalidIndexError. Otherwise we fall through and re-raise
   3816     #  the TypeError.
   3817     self._check_indexing_error(key)

KeyError: 'winddirection'
```

In [ ]:
```
df.head()
```

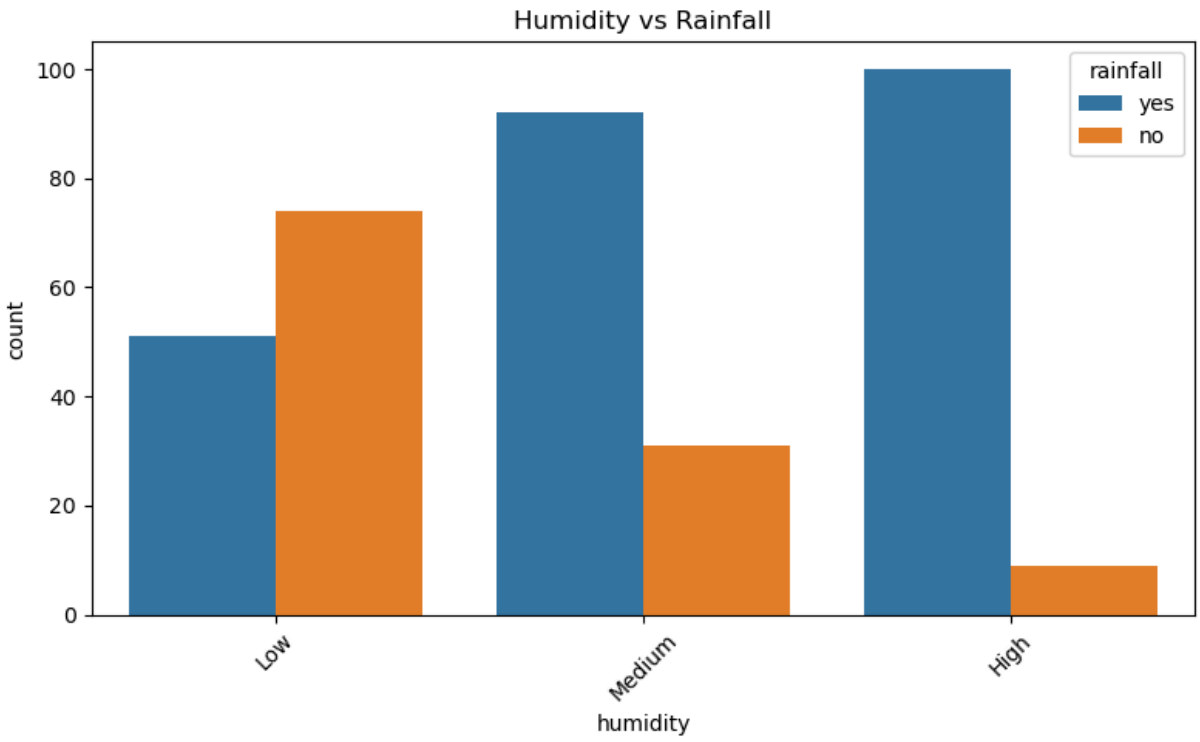
In [ ]:
```
df_cleaned.head()
```

In [128…
```
df_cleaned.to_csv("cleaned_weather_data.csv", index=False)
```

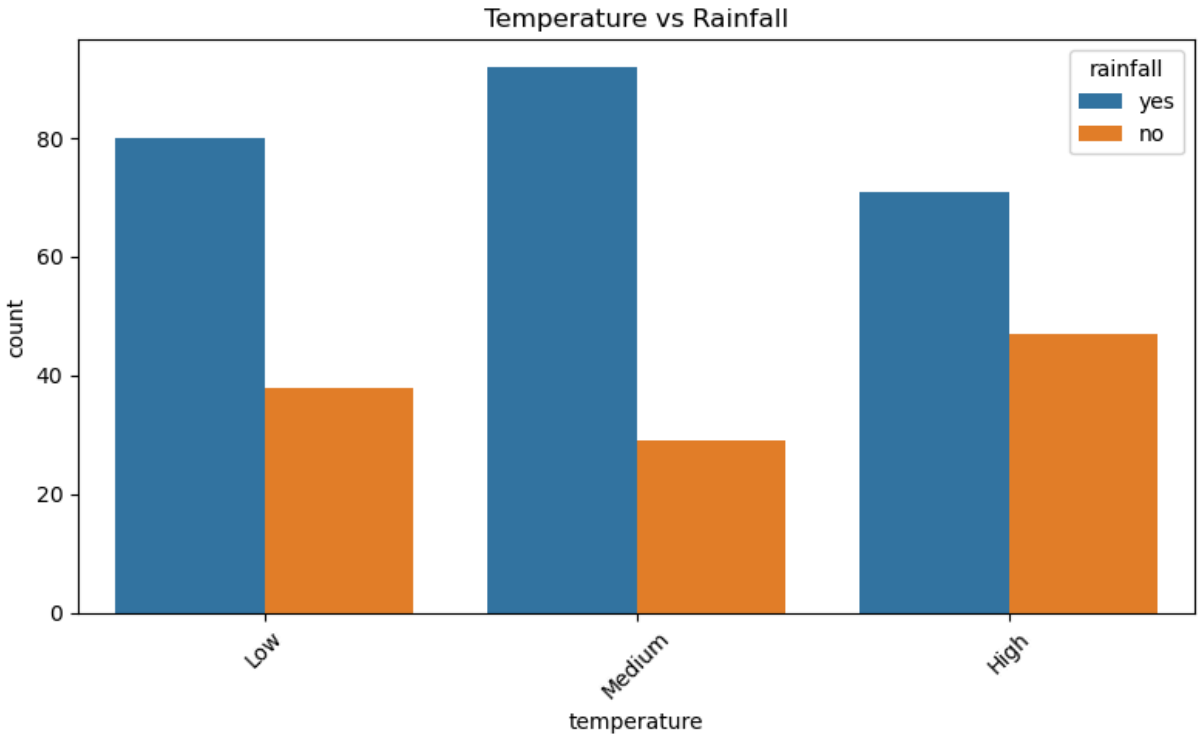
ok now everything should be categorical again

Visualizations

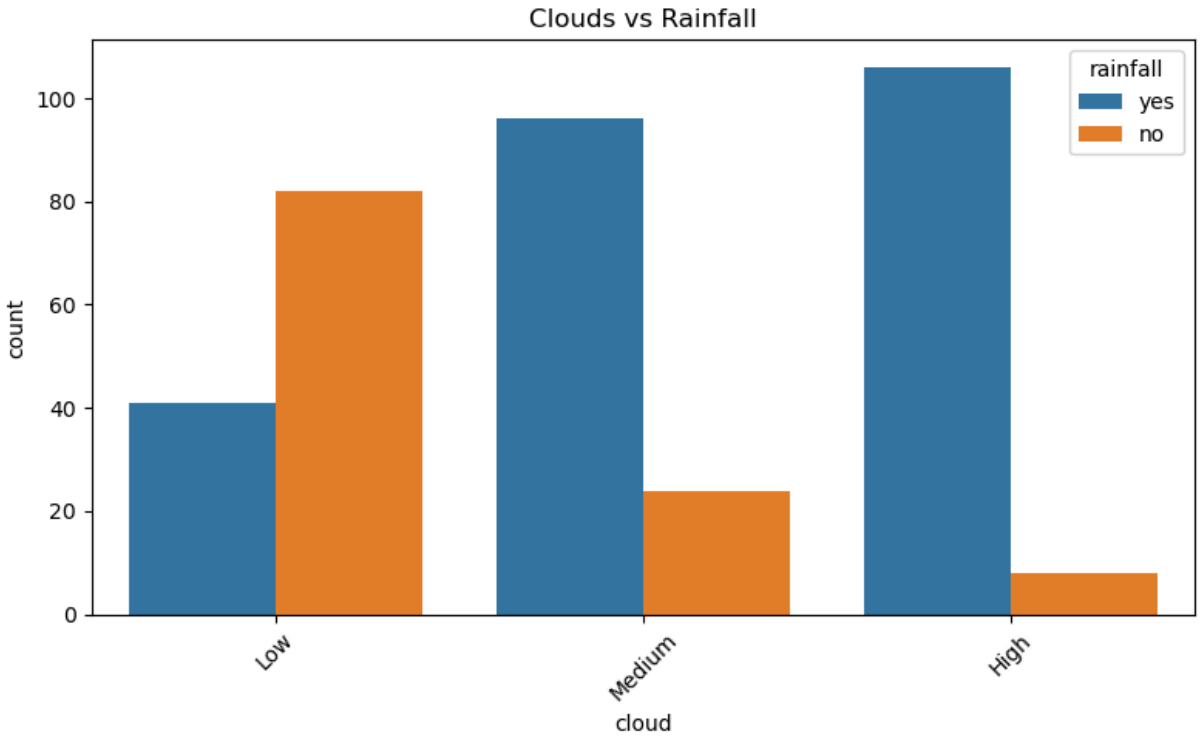
In [94]:
```
plt.figure(figsize=(8, 5))
sns.countplot(x="humidity", hue="rainfall", data=df_cleaned)
plt.title("Humidity vs Rainfall")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



In [96]:
```
plt.figure(figsize=(8, 5))
sns.countplot(x="temperature", hue="rainfall", data=df_cleaned)
plt.title("Temperature vs Rainfall")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

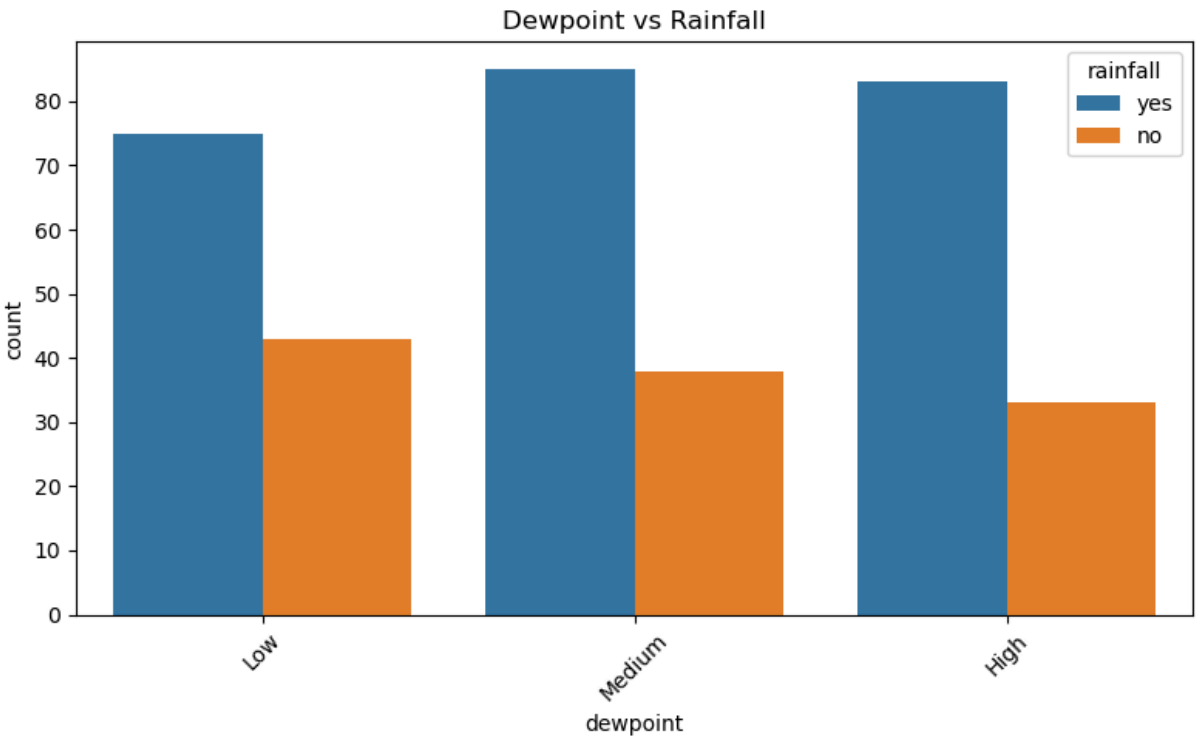


In [98]:
```
plt.figure(figsize=(8, 5))
sns.countplot(x="cloud", hue="rainfall", data=df_cleaned)
plt.title("Clouds vs Rainfall")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



In [100…
```
plt.figure(figsize=(8, 5))
sns.countplot(x="dewpoint", hue="rainfall", data=df_cleaned)
```

```
plt.title("Dewpoint vs Rainfall")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



Splitting Data And Creating the Decision Tree

In [131…

```
import pandas as pd
from sklearn.model_selection import train_test_split

# Load the cleaned data
data = pd.read_csv("cleaned_weather_data.csv")

# Separate features (X) and target (y)
X = data.drop(columns=['rainfall'])
y = data['rainfall']

# Split into train and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_sta
```

In [138…

```
import pandas as pd
import graphviz
from math import log2
from random import random
from graphviz import Source

def safe_log2(value):
    return log2(value) if value > 0 else 0

def calculate_entropy(yes_count, no_count, total_rows):
    return -(yes_count/total_rows) * safe_log2(yes_count/total_rows) - \
           (no_count/total_rows) * safe_log2(no_count/total_rows)
```

```
def calculate_category_gain(df, category_name):
    result = df.columns[-1]
    total_rows = df[result].count()
    yes_count = sum((df[result] == "y") | (df[result] == "Y"))
    no_count = sum((df[result] == "n") | (df[result] == "N"))
    entropy = calculate_entropy(yes_count, no_count, total_rows)

    values = df[category_name].unique()
    gain = entropy

    for value in values:
        vdf = df[df[category_name] == value]
        value_total = vdf[vdf.columns[0]].count()
        value_yes = sum((vdf[result] == "y") | (vdf[result] == "Y"))
        value_no = sum((vdf[result] == "n") | (vdf[result] == "N"))
        value_entropy = calculate_entropy(value_yes, value_no, value_total)
        gain -= (value_total / total_rows) * value_entropy

    return gain

def lerp(a, b, alpha):
    return tuple(int(alpha * b[i] + (1.0 - alpha) * a[i]) for i in range(3))

def rgb_to_hex(rgb):
    return '%02x%02x%02x' % rgb

def sanitize_node_name(node_name):
    """Ensure that problematic characters are handled for Graphviz."""
    return node_name.replace('%', '_percent_').replace('<', '_lt_').replace('>', '_

def add_frame_to_graph_id3(dataframe, graph, parent_name="", edge_name=""):
    node_name = ""
    color = "white"
    node_id = str(random())

    result = dataframe.columns[-1]
    total_rows = dataframe[result].count()
    yes_count = sum((dataframe[result] == "y") | (dataframe[result] == "yes"))
    no_count = sum((dataframe[result] == "n") | (dataframe[result] == "no"))
    break_on_category = ""

    if yes_count / total_rows > .8:
        node_name = f"Yes {int((yes_count/total_rows)*100)}%"
        node_id += node_name
        color = "green"
    elif no_count / total_rows > .8:
        node_name = f"No {int((no_count/total_rows)*100)}%"
        node_id += node_name
        color = "red"
    elif len(dataframe.columns[0:-1]) > 0 and total_rows > 1:
        largest_gain = -1
        for category in dataframe.columns[0:-1]:
            gain = calculate_category_gain(dataframe, category)
            if gain > largest_gain:
                largest_gain = gain
```

```
                node_name = category
                break_on_category = category
        node_id += node_name
    else:
        node_name = f"Yes: {int(100*(yes_count/total_rows))}%, No: {int(100*(no_cou
        node_id += node_name
        alpha = yes_count / total_rows
        color = f"#{rgb_to_hex(lerp((255, 0, 0), (0, 255, 0), alpha))}"

    entries = dataframe[dataframe.columns[0]].count()
    sanitized_node_name = sanitize_node_name(node_name)  # Sanitize the node name

    graph.node(node_id, f'''<
        <TABLE BORDER="1" CELLBORDER="0" CELLSPACING="0" BGCOLOR="{color}">
          <TR>
            <TD>{sanitized_node_name}</TD>
          </TR>
          <TR>
            <TD>{entries} rows</TD>
          </TR>
        </TABLE>>''')

    if edge_name:
        graph.edge(parent_name, node_id, label=str(edge_name))

    if break_on_category:
        values = dataframe[break_on_category].unique()
        for value in values:
            vdf = dataframe[dataframe[break_on_category] == value]
            rows = vdf[vdf.columns[-1]].count()
            if rows > 0:
                vdf = vdf.drop(columns=[break_on_category])
                add_frame_to_graph_id3(vdf, graph, node_id, value)

# Load your cleaned dataset
df = pd.read_csv("cleaned_weather_data.csv")

# Build the decision tree
s = graphviz.Digraph('structs', filename='structs.gv', node_attr={'shape': 'plainte
add_frame_to_graph_id3(df, s)

# Save the graph as a PNG file
s.render(filename='decision_tree', format='png', cleanup=True)
```

```
Error: decision_tree: syntax error in line 131 near '%'
```

```
---------------------------------------------------------------------------
CalledProcessError                        Traceback (most recent call last)
File ~\anaconda3\Lib\site-packages\graphviz\backend\execute.py:88, in run_check(cmd, input_lines, encoding, quiet, **kwargs)
     87 try:
---> 88     proc.check_returncode()
     89 except subprocess.CalledProcessError as e:

File ~\anaconda3\Lib\subprocess.py:502, in CompletedProcess.check_returncode(self)
    501 if self.returncode:
--> 502     raise CalledProcessError(self.returncode, self.args, self.stdout,
    503                              self.stderr)

CalledProcessError: Command '[WindowsPath('dot'), '-Kdot', '-Tpng', '-O', 'decision_tree']' returned non-zero exit status 1.

During handling of the above exception, another exception occurred:

CalledProcessError                        Traceback (most recent call last)
Cell In[138], line 111
    108 add_frame_to_graph_id3(df, s)
    110 # Save the graph as a PNG file
--> 111 s.render(filename='decision_tree', format='png', cleanup=True)

File ~\anaconda3\Lib\site-packages\graphviz\_tools.py:171, in deprecate_positional_args.<locals>.decorator.<locals>.wrapper(*args, **kwargs)
    162     wanted = ', '.join(f'{name}={value!r}'
    163                        for name, value in deprecated.items())
    164     warnings.warn(f'The signature of {func.__name__} will be reduced'
    165                   f' to {supported_number} positional args'
    166                   f' {list(supported)}: pass {wanted}'
    167                   ' as keyword arg(s)',
    168                   stacklevel=stacklevel,
    169                   category=category)
--> 171 return func(*args, **kwargs)

File ~\anaconda3\Lib\site-packages\graphviz\rendering.py:122, in Render.render(self, filename, directory, view, cleanup, format, renderer, formatter, neato_no_op, quiet, quiet_view, outfile, engine, raise_if_result_exists, overwrite_source)
    118 filepath = self.save(filename, directory=directory, skip_existing=None)
    120 args.append(filepath)
--> 122 rendered = self._render(*args, **kwargs)
    124 if cleanup:
    125     log.debug('delete %r', filepath)

File ~\anaconda3\Lib\site-packages\graphviz\_tools.py:171, in deprecate_positional_args.<locals>.decorator.<locals>.wrapper(*args, **kwargs)
    162     wanted = ', '.join(f'{name}={value!r}'
    163                        for name, value in deprecated.items())
    164     warnings.warn(f'The signature of {func.__name__} will be reduced'
    165                   f' to {supported_number} positional args'
    166                   f' {list(supported)}: pass {wanted}'
    167                   ' as keyword arg(s)',
    168                   stacklevel=stacklevel,
    169                   category=category)
--> 171 return func(*args, **kwargs)
```

```
File ~\anaconda3\Lib\site-packages\graphviz\backend\rendering.py:326, in render(engine, format, filepath, renderer, formatter, neato_no_op, quiet, outfile, raise_if_result_exists, overwrite_filepath)
    322 cmd += args
    324 assert filepath is not None, 'work around pytype false alarm'
--> 326 execute.run_check(cmd,
    327                   cwd=filepath.parent if filepath.parent.parts else None,
    328                   quiet=quiet,
    329                   capture_output=True)
    331 return os.fspath(outfile)

File ~\anaconda3\Lib\site-packages\graphviz\backend\execute.py:90, in run_check(cmd, input_lines, encoding, quiet, **kwargs)
     88     proc.check_returncode()
     89 except subprocess.CalledProcessError as e:
---> 90     raise CalledProcessError(*e.args)
     92 return proc

CalledProcessError: Command '[WindowsPath('dot'), '-Kdot', '-Tpng', '-O', 'decision_tree']' returned non-zero exit status 1. [stderr: b"Error: decision_tree: syntax error in line 131 near '%'\r\n"]
```

In [171…

```
import os
from math import log2
from random import random
import pandas as pd
import graphviz

def save_graph_as_jpg(graph, filename):
    graph.save('temp.dot')
    src = graphviz.Source.from_file('temp.dot')
    src.render(filename, format="jpg")
    os.remove('temp.dot')
    os.remove(filename)


def safe_log2(value):
    if value > 0:
        return log2(value)
    else:
        return 0


def calculate_entropy(yes_count, no_count, total_rows):
    return -(yes_count/total_rows) * safe_log2(yes_count/total_rows) - \
        (no_count/total_rows) * safe_log2(no_count/total_rows)


def calculate_category_gain(df, category_name):
    print(category_name)
    result = df.columns[-1]
    total_rows = df[result].count()
    yes_count = sum((df[result] == "y") | (df[result] == "Y"))
    no_count = sum((df[result] == "n") | (df[result] == "N"))
    entropy = calculate_entropy(yes_count, no_count, total_rows)
```

```
    values = df[category_name].unique()

    gain = entropy

    for value in values:
        vdf = df[df[category_name] == value]
        value_total = vdf[vdf.columns[0]].count()
        value_yes = sum((vdf[result] == "y") | (vdf[result] == "Y"))
        value_no = sum((vdf[result] == "n") | (vdf[result] == "N"))
        value_entropy = calculate_entropy(value_yes, value_no, value_total)
        value_gain = (value_total / total_rows) * value_entropy
        # print("{} Entropy: {}, Gain: {}".format(value, value_entropy, value_gain)
        gain -= value_gain

    # print("{} Gain: {}", category_name, gain)

    return gain


def lerp(a, b, alpha):
    c = [0, 0, 0]
    for i in range(0, len(a)-1):
        c[i] = int(alpha*b[i] + (1.0-alpha)*a[i])
    return tuple(c)


def rgb_to_hex(rgb):
    return '%02x%02x%02x' % rgb

# def rgb_to_hex(rgb):
#     return ('{:X}{:X}{:X}').format(int(rgb[0]), rgb[1], rgb[2])


def add_frame_to_graph_id3(dataframe, graph, parent_name="", edge_name=""):
    node_name = ""
    color = "white"
    node_id = str(random())

    result = dataframe.columns[-1]
    total_rows = dataframe[result].count()
    yes_count = sum((dataframe[result] == "yes") | (dataframe[result] == "Y"))
    no_count = sum((dataframe[result] == "no") | (dataframe[result] == "N"))

    break_on_category = ""

  #  print(f"""Processing data frame:
  #   {dataframe}
  #
  #   Total rows: {total_rows}
  #   Yes count: {yes_count}
  #   No count: {no_count}
  #
  #   """)

# Tweek the entropy percentage and/or number of rows
```

```
    if yes_count/total_rows > .75:
        node_name = f"Yes {int((yes_count/total_rows)*100)}%"
        node_id += node_name
        color = "green"
    elif no_count/total_rows > .75: #emperical
        node_name = f"No {int((no_count/total_rows)*100)}%"
        node_id += node_name
        color = "red"
    elif len(dataframe.columns[0:-1]) > 0 and total_rows > 10:
        largest_gain = -1
        for category in dataframe.columns[0:-1]:
            gain = calculate_category_gain(dataframe, category)
            if gain > largest_gain:
                largest_gain = gain
                node_name = category
                break_on_category = category

        # Break on category
        node_id += node_name
    else:
        node_name = "Yes: {}%, No: {}%".format(int(100*(yes_count/total_rows)), int
        node_id += "Yes-{}-percent-No-{}-percent".format(int(100*(yes_count/total_r
        alpha = yes_count/total_rows
        color = f"#{rgb_to_hex(lerp((255, 0, 0), (0, 255, 0), alpha))}"

    entries = dataframe[dataframe.columns[0]].count()
    graph.node(node_id, f'''<
        <TABLE BORDER="1" CELLBORDER="0" CELLSPACING="0" BGCOLOR="{color}">
          <TR>
            <TD>{node_name}</TD>
          </TR>
          <TR>
            <TD>{entries} rows</TD>
          </TR>
        </TABLE>>''')

    if edge_name:
        graph.edge(parent_name, node_id, label=str(edge_name))

    if break_on_category:
        # print(f"Breaking on category: {break_on_category}")
        values = df[break_on_category].unique()
        for value in values:
            vdf = dataframe[dataframe[break_on_category] == value]
            rows = vdf[vdf.columns[-1]].count()
            if rows > 0:
                # print(f"Value: {value}")
                # print(vdf)
                vdf = vdf.drop(columns=[break_on_category])
                # print(f"Dropping column: ")
                # print(vdf)
                add_frame_to_graph_id3(vdf, graph, node_id, value)



s = graphviz.Digraph('structs', filename='structs.gv',
```

```
                        node_attr={'shape': 'plaintext'})
df = pd.read_csv('cleaned_weather_data.csv')
print(df)
add_frame_to_graph_id3(df, s)
save_graph_as_jpg(s, "Rain")
```

```
    pressure maxtemp temperature   mintemp dewpoint humidity   cloud sunshine  \
0       High     Low         Low  Very Low      Low      Low     Low      High
1       High     Low         Low  Very Low      Low   Medium  Medium       Low
2       High     Low         Low       Low      Low     High    High       Low
3       High     Low         Low       Low   Medium     High    High       Low
4     Medium     Low         Low       Low   Medium     High  Medium       Low
..       ...     ...         ...       ...      ...      ...     ...       ...
352     High     Low         Low  Very Low      Low   Medium    High       Low
353     High     Low         Low  Very Low      Low      Low  Medium       Low
354     High     Low         Low  Very Low      Low      Low  Medium    Medium
355     High     Low         Low  Very Low      Low   Medium    High    Medium
356     High     Low         Low  Very Low      Low      Low     Low    Medium

    windspeed wind_direct_category rainfall
0        High                    E      yes
1         Low                    E      yes
2         Low                    N      yes
3      Medium                    E      yes
4         Low                    N      yes
..        ...                  ...      ...
352    Medium                    N      yes
353      High                    N      yes
354      High                    E      yes
355    Medium                    N      yes
356    Medium                    N       no

[357 rows x 11 columns]
pressure
maxtemp
temperature
mintemp
dewpoint
humidity
cloud
sunshine
windspeed
wind_direct_category
maxtemp
temperature
mintemp
dewpoint
humidity
cloud
sunshine
windspeed
wind_direct_category
temperature
mintemp
dewpoint
humidity
cloud
sunshine
windspeed
wind_direct_category
mintemp
dewpoint
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humidity
cloud
sunshine
windspeed
wind_direct_category
dewpoint
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temperature
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humidity
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wind_direct_category
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sunshine
windspeed
wind_direct_category
```

The Decision tree saves to the folder as Rain.jpg

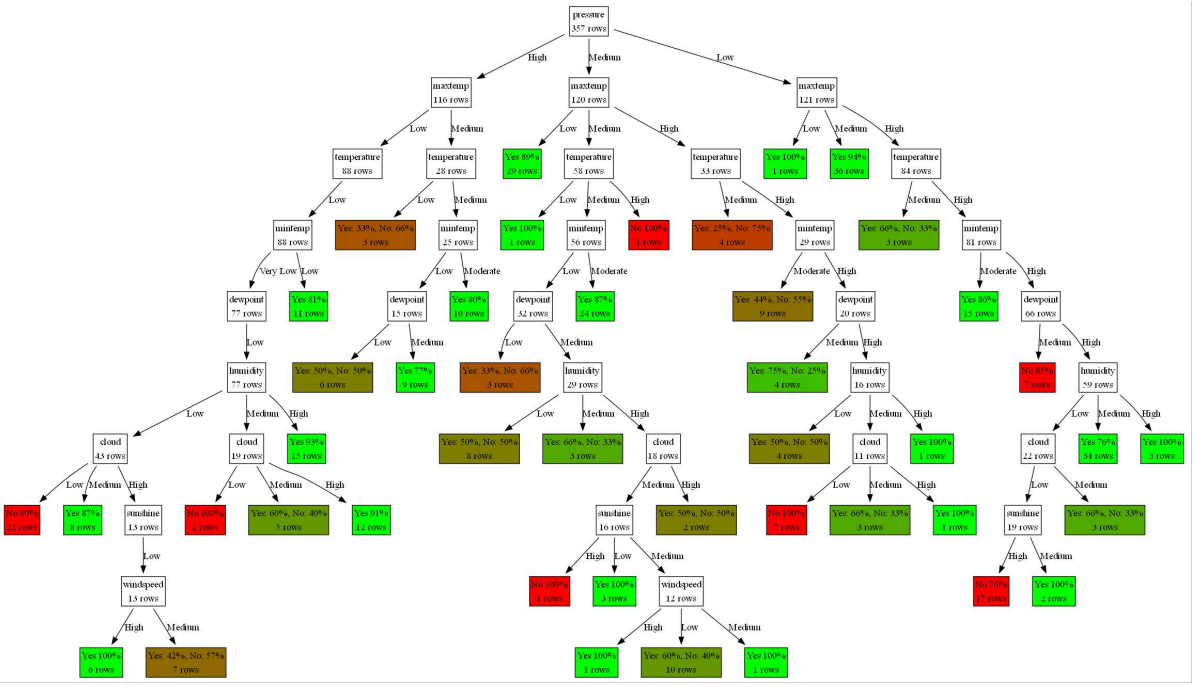
The Algorithm can be tweaked to give more accurate results, for this example I went with 70% confidence an altered the amount of rows just to make the decision tree more readable for the purposes of this project.

In [174…

```
from IPython.display import Image


Image(filename='Rain.jpg')
```

Out[174…



What I learned from this project and this dataset

Working with all numeric data and converting to categorical was challenging however using Python scripting allowed me to do it much more easily. I had to troubleshoot quite a bit with cleaning the data because everytime I stopped working on the jupyter notebook and came back I had to rerun the cells and that caused some issues that I still am not fully sure how to fix other than rerunning specific cells and saving the data to a seperate (clean) csv file.

The decision tree algorithm had to be tweaked a few times to give a concise decision tree picture. However I did learn a few things from the weather data. Firstly, Pressure seems to be a strong factor in calculating if it will rain or not. If the pressure is low, there is a higher likelihood that it will rain (this information lines up with our understanding of weather patterns). When the pressure is not high however, it appears that all of the variations of temperature data are the next factor (temp, maxtemp, mintemp). It appears that high pressure and high temps lead to no rainfall more often than not. I tweaked the algorithm to be more accurate and this general trend seemed to reign true. In conclusion, when deciding to plan an important event outdoors, you may want to make sure the atmospheric pressure is high and that the temperature is not too cold.

In [ ]: