In [73]:
```
import pandas as pd
import numpy as np
```

In [74]:
```
# import ml classifiers
from nltk.tokenize import sent_tokenize # tokenizes sentences
from nltk.stem import PorterStemmer     # parsing/stemmer
from nltk.tag import pos_tag            # parts-of-speech tagging
from nltk.corpus import wordnet         # sentiment scores
from nltk.stem import WordNetLemmatizer # stem and context
from nltk.corpus import stopwords       # stopwords
from nltk.util import ngrams
```

In [75]:
```
df = pd.read_csv('spotify.csv').iloc[:, 1:]
df.head()
```

Out[75]:

	acousticness	artists	danceability	duration_ms	energy	explicit	
0	0.991000	['Mamie Smith']	0.598	168333	0.224	0	0cS0A1fUEUd1EW3FcF8
1	0.643000	['"Screamin Jay Hawkins"']	0.852	150200	0.517	0	0hbkKFIJm7Z05H8Zl9w
2	0.993000	['Mamie Smith']	0.647	163827	0.186	0	11m7laMUgmOKqI3oYzu
3	0.000173	['Oscar Velazquez']	0.730	422087	0.798	0	19Lc5SfJJ5O1oaxY0fp
4	0.295000	['Mixe']	0.704	165224	0.707	1	2hJjbsLCytGsnAHfdsl

5 rows × 30 columns

In [76]:
```
df.shape
```

Out[76]:
```
(174389, 30)
```

In [77]:
```
df.describe()
```

Out[77]:

	acousticness	danceability	duration_ms	energy	explicit	instrume
count	174389.000000	174389.000000	1.743890e+05	174389.000000	174389.000000	17438
mean	0.499228	0.536758	2.328100e+05	0.482721	0.068135	(
std	0.379936	0.176025	1.483958e+05	0.272685	0.251978	C
min	0.000000	0.000000	4.937000e+03	0.000000	0.000000	C
25%	0.087700	0.414000	1.661330e+05	0.249000	0.000000	C
50%	0.517000	0.548000	2.057870e+05	0.465000	0.000000	C
75%	0.895000	0.669000	2.657200e+05	0.711000	0.000000	C
max	0.996000	0.988000	5.338302e+06	1.000000	1.000000	1

8 rows × 25 columns

In [78]:

```
df.columns
```

Out[78]:

```
Index(['acousticness', 'artists', 'danceability', 'duration_ms', 'energy',
       'explicit', 'id', 'instrumentalness', 'key', 'liveness', 'loudness',
       'mode', 'name', 'popularity', 'release_date', 'speechiness', 'tempo',
       'valence', 'year_x', 'Collaboration', 'Season', 'Name Length', 'live',
       'love', 'mix', 'no', 'op', 'remast', 'version', 'year_y'],
      dtype='object')
```

In [91]:

```
# Delete some of the columns
del df['id']
del df['release_date']
del df['artists']
```

In [92]:

```
# Change some of the column names
df = df.rename(columns={'Name Length': 'name_length'})
df.head()
```

Out[92]:

	acousticness	danceability	duration_ms	energy	explicit	instrumentalness	key	liveness	l
0	0.991000	0.598	168333	0.224	0	0.000522	5	0.3790	
1	0.643000	0.852	150200	0.517	0	0.026400	5	0.0809	
2	0.993000	0.647	163827	0.186	0	0.000018	0	0.5190	
3	0.000173	0.730	422087	0.798	0	0.801000	2	0.1280	
4	0.295000	0.704	165224	0.707	1	0.000246	10	0.4020	

5 rows × 27 columns

In [81]:
```
# Get the dummy variables for season
df1 = pd.get_dummies(df[['season']])
df1.head()
```

Out[81]:

	season_Fall	season_Spring	season_Summer	season_Winter
0	0	0	0	0
1	0	0	0	1
2	0	0	0	0
3	0	0	0	1
4	1	0	0	0

In [115…
```
# Create the final dataset
spotify = df.join(df1, how='outer')
spotify.head()
```

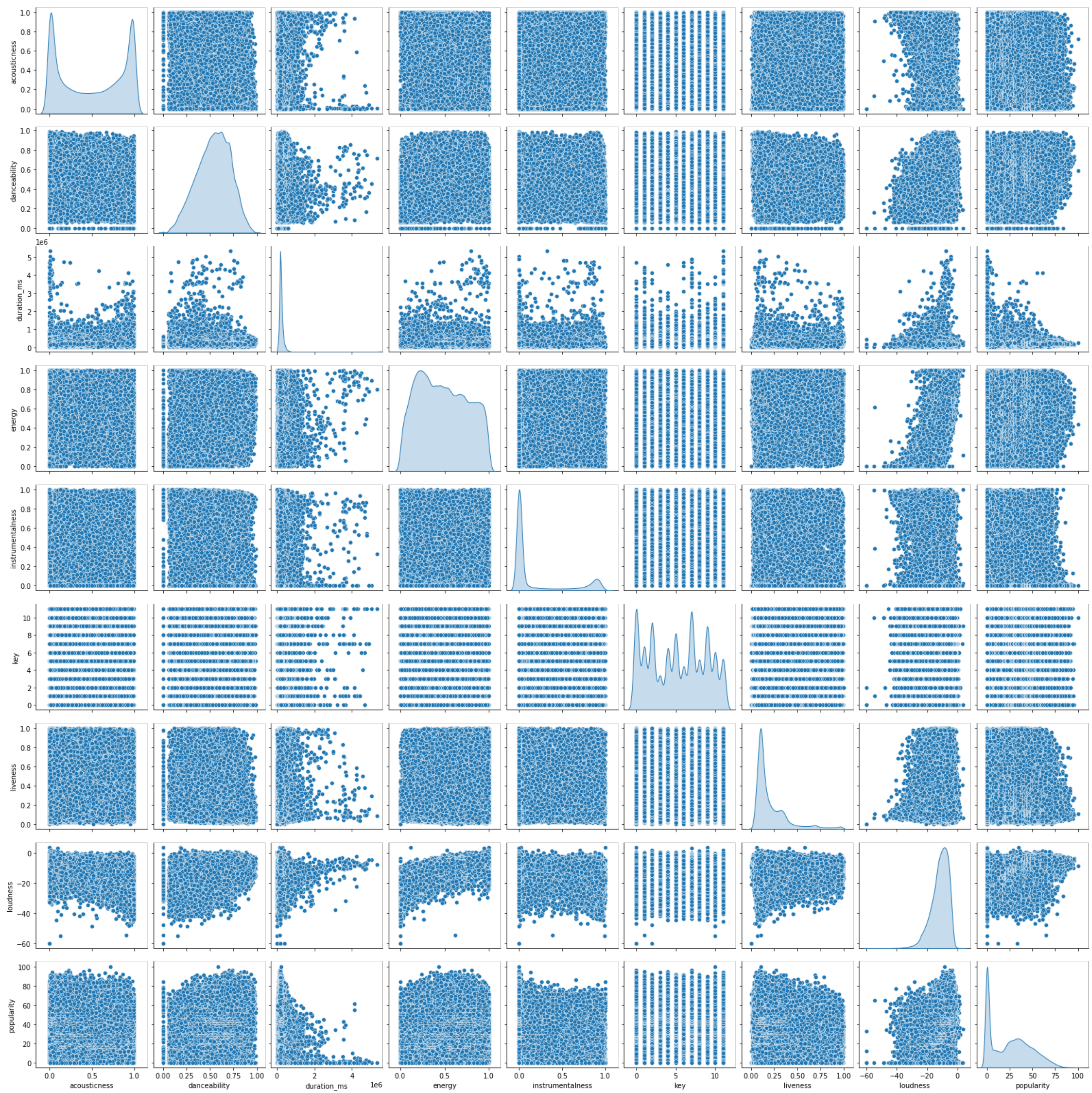
Out[115…

	acousticness	danceability	duration_ms	energy	explicit	instrumentalness	key	liveness	l
0	0.991000	0.598	168333	0.224	0	0.000522	5	0.3790	
1	0.643000	0.852	150200	0.517	0	0.026400	5	0.0809	
2	0.993000	0.647	163827	0.186	0	0.000018	0	0.5190	
3	0.000173	0.730	422087	0.798	0	0.801000	2	0.1280	
4	0.295000	0.704	165224	0.707	1	0.000246	10	0.4020	

5 rows × 31 columns

In [116…
```
# Plot scatter matrix for each pair of variables off diagonal and the histogr
# In ggplot2 in R, one can use ggscatmat, which also prints the correlation i
import seaborn as sns

cols = ['acousticness', 'danceability', 'duration_ms', 'energy',
        'instrumentalness', 'key', 'liveness', 'loudness','popularity']
sns.pairplot(spotify[cols],diag_kind='kde')
```

Out[116… <seaborn.axisgrid.PairGrid at 0x7fc7641e3700>



Building CART Model

Predict if the song is good

- A song is good if its popularity is greater than 25

In [83]:
```
from sklearn.model_selection import train_test_split
cols = ['acousticness', 'danceability', 'duration_ms', 'energy','explicit',
        'instrumentalness', 'key', 'liveness', 'loudness', 'mode', 'speechines
        'tempo', 'valence', 'year_x', 'Collaboration', 'name_length', 'live',
         'live','love', 'mix', 'no', 'op', 'remast', 'version', 'year_y',
        'Season_Fall', 'Season_Spring', 'Season_Summer', 'Season_Winter']

# re-split the dataset into training and testing data
y = spotify['popularity']
X = spotify[cols]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, ran
X_train.shape, X_test.shape
```

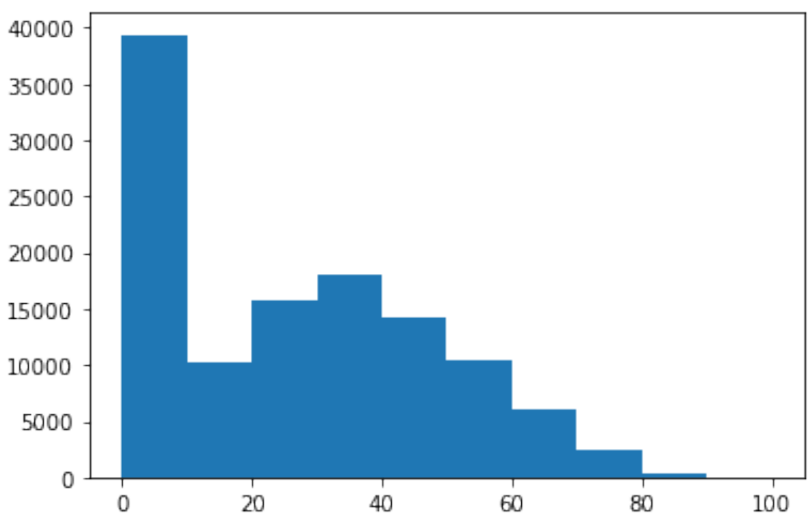
Out[83]:
```
((116840, 29), (57549, 29))
```

In [84]:
```
y_train.mean(), y_train.max(), y_train.min()
```

Out[84]:
```
(25.67584731256419, 100, 0)
```

In [85]:
```
import matplotlib.pyplot as plt
plt.hist(y_train)
```

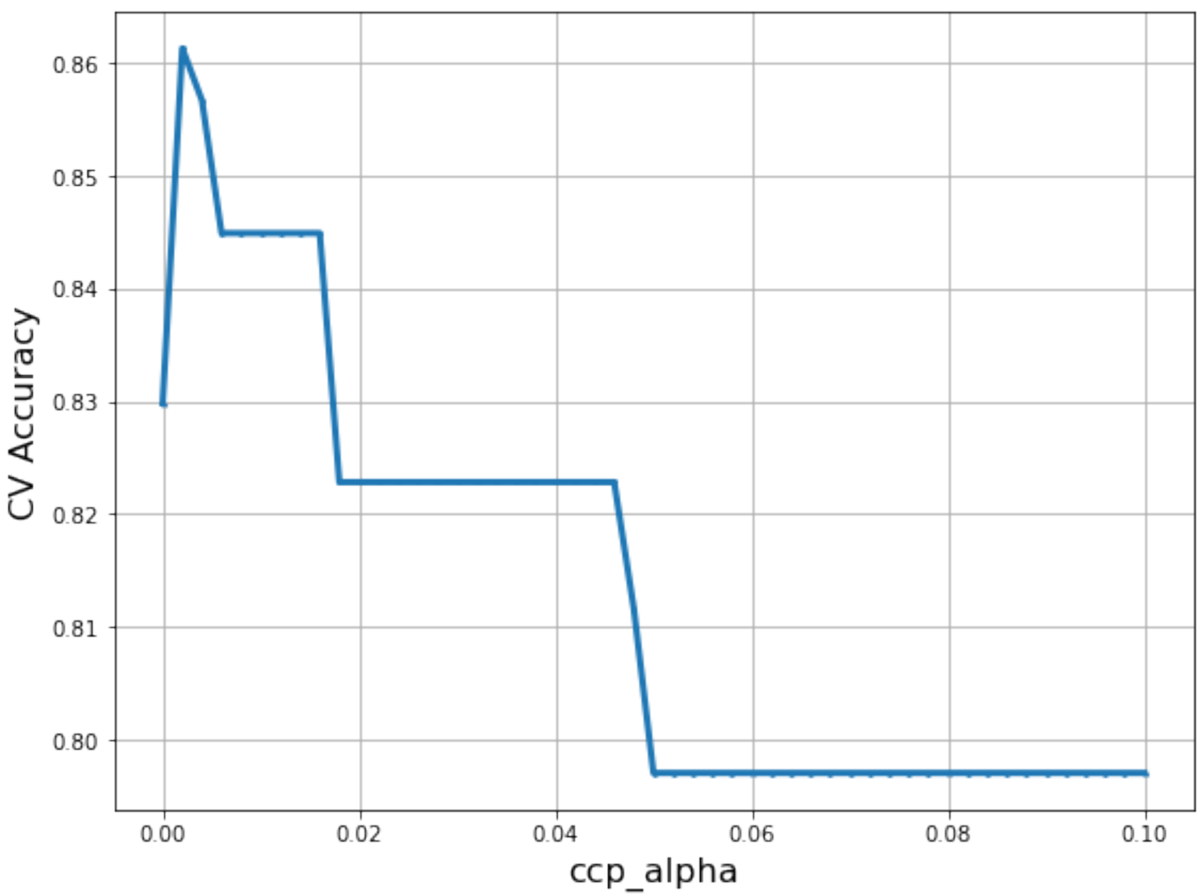
Out[85]:
```
(array([3.9388e+04, 1.0138e+04, 1.5827e+04, 1.8036e+04, 1.4227e+04,
        1.0394e+04, 6.0360e+03, 2.3960e+03, 3.7000e+02, 2.8000e+01]),
 array([  0.,  10.,  20.,  30.,  40.,  50.,  60.,  70.,  80.,  90., 100.]),
 <BarContainer object of 10 artists>)
```



In [86]:
```
# convert the popularity to be 0 or 1
# 0 if the score is less than 85, else 1
y_train=pd.Series([1 if y_train.iloc[i]>=25 else 0 for i in range(len(y_train
y_test=pd.Series([1 if y_test.iloc[i]>=25 else 0 for i in range(len(y_test))]
```

In [36]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.tree import plot_tree
from sklearn.model_selection import GridSearchCV
from sklearn.tree import DecisionTreeClassifier

grid_values = {'ccp_alpha': np.linspace(0, 0.1, 51)}

dtc = DecisionTreeClassifier(random_state=88)
dtc_cv = GridSearchCV(dtc, param_grid=grid_values, cv=5).fit(X_train, y_train
```

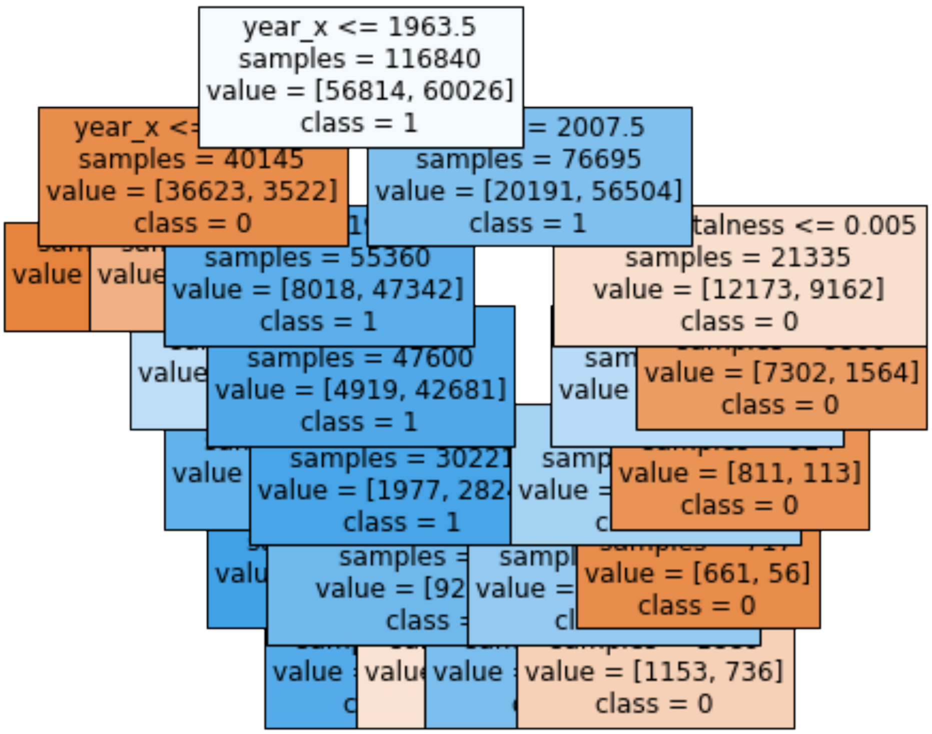
In [37]:
```
ccp_alpha = dtc_cv.cv_results_['param_ccp_alpha'].data
ACC_scores = dtc_cv.cv_results_['mean_test_score']

plt.figure(figsize=(8, 6))
plt.xlabel('ccp_alpha', fontsize=16)
plt.ylabel('CV Accuracy', fontsize=16)
plt.scatter(ccp_alpha, ACC_scores, s=3)
plt.plot(ccp_alpha, ACC_scores, linewidth=3)
plt.grid(True, which='both')

plt.tight_layout()
plt.show()

print('Best ccp_alpha', dtc_cv.best_params_)
```




```
Best ccp_alpha {'ccp_alpha': 0.002}
```

In [38]:
```
from sklearn.tree import plot_tree

print('Node count =', dtc_cv.best_estimator_.tree_.node_count)
plt.figure(figsize=(6,6))
plot_tree(dtc_cv.best_estimator_,
          feature_names=X_train.columns,
          class_names=['0','1'],
          filled=True,
          impurity=False,
          fontsize=12)
plt.show()
```

```
Node count = 23
```



In [39]:
```
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.metrics import precision_score

# Compute the performance of the training set
y_pred = dtc_cv.predict(X_train)
cm = confusion_matrix(y_train, y_pred)

print ("Confusion Matrix: \n", cm)
print ("\nAccuracy:", accuracy_score(y_train, y_pred))
print ("\nPrecision:", precision_score(y_train, y_pred))
```

```
Confusion Matrix:
 [[47044  9770]
 [ 6373 53653]]

Accuracy: 0.861836699760356

Precision: 0.8459549374832473
```

In [40]:

```
# The performance of the test set
y_pred = dtc_cv.predict(X_test)
cm = confusion_matrix(y_test, y_pred)
print ("Confusion Matrix: \n", cm)
print ("\nAccuracy:", accuracy_score(y_test, y_pred))
```

```
Confusion Matrix:
 [[23145  4872]
 [ 3228 26304]]

Accuracy: 0.8592503779388
```

Random Forest

In [109…

```
from sklearn.ensemble import RandomForestRegressor
import statsmodels.api as sm
from sklearn.model_selection import GridSearchCV
from sklearn.tree import DecisionTreeRegressor
from sklearn.model_selection import KFold

rf = RandomForestRegressor(max_features=5, min_samples_leaf=5,
                           n_estimators = 500, random_state=88, verbose=2)
rf.fit(X_train, y_train)
```

```
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worker
s.
building tree 1 of 500
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.4s remaining:    0.0
s
building tree 2 of 500
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[Parallel(n_jobs=1)]: Done 500 out of 500 | elapsed:  2.8min finished
```

Out[109…

```
RandomForestRegressor(max_features=5, min_samples_leaf=5, n_estimators=500,
                      random_state=88, verbose=2)
```

In [ ]:

In [112…

```
# Evaluate the model performance on the testing set
y_prob = rf.predict(X_test)
y_pred = pd.Series([1 if x >= 0.5 else 0 for x in y_prob])
cm = confusion_matrix(y_test, y_pred)
print ("Confusion Matrix : \n", cm)
print ("\nAccuracy:", accuracy_score(y_test, y_pred))
```

```
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent worker
s.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0
s
Confusion Matrix :
 [[23899  4118]
 [ 2527 27005]]

Accuracy: 0.8845331804201637
[Parallel(n_jobs=1)]: Done 500 out of 500 | elapsed:    9.1s finished
```

In [ ]:

In [ ]: