In [127]:
```
# data analysis and wrangling
import pandas as pd
import numpy as np
import random as rnd

# visualization
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline

# Pre processing
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split

# machine learning
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC, LinearSVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import Perceptron
from sklearn.linear_model import SGDClassifier
from sklearn.tree import DecisionTreeClassifier
```

In [2]:
```
import os
input_file = pd.ExcelFile(".\data\GPSRetention.xlsx")
GPSRetention = input_file.parse("Page1")
print('Size of GPS Retention',GPSRetention.shape)
#output to csv file so we can read it later easier
GPSRetention.to_csv(".\data\GPSRetention.csv", header=True)
```

```
Size of GPS Retention (933, 30)
```

In [118]:
```
gps_df = pd.read_csv('./data/GPSRetention.csv')
#gps_df = pd.read_csv('./data/GPSRetention.csv', dtype={'MAJOR_DESC':str})
print(gps_df.columns.values)
```

```
['Unnamed: 0' 'Fake_ID' 'STATUS_DESC' 'PROGRAM_DESC' 'MAJOR_DESC'
 'SECOND_MAJOR_DESC' 'OUTCOME_NUMBER' 'OUTCOME_AWARDED_IND'
 'CREDITS_ATTEMPTED' 'CREDITS_EARNED' 'GPA' 'CITIZENSHIP_DESC'
 'RELIGION_DESC' 'VETERAN_CATEGORY_DESC' 'GENDER' 'PRIMARY_ETHNICITY_DESC'
 'MARITAL_STATUS_DESC' 'CITY' 'COUNTY_DESC' 'STATE_PROVINCE' 'POSTAL_CODE'
 'NATION' 'PASSPORT_ISSUE_NATION_DESC' 'IMMIGRATION_STATUS'
 'NATION_OF_BIRTH_DESC' 'NATION_OF_CITIZENSHIP_DESC' 'VISA_TYPE_DESC'
 'GPS_Start_Term_' 'GPS_Last_Term_' 'Took_Non_GPS_Course_Within_Year?'
 'Retained?']
```

In [189]:
```
print(gps_df.head())
print(gps_df.tail())
```

Out[189]:

	Unnamed: 0	Fake_ID	STATUS_DESC	PROGRAM_DESC	MAJOR_DESC	SECOND_M
928	928	528709	Sought/Tracked	MS - Software Engineering	Software Engineering	NaN
929	929	560802	Sought/Tracked	MS - Software Engineering	Software Management	NaN
930	930	556401	Pending	MS - Software Engineering	Information Technology	NaN
931	931	446895	Awarded	MS - Software Engineering	Software Engineering	NaN
932	932	479389	Sought/Tracked	MS - Software Engineering	Software Management	NaN

5 rows × 31 columns

In [108]:
```
#messing with data exploring

#print(gps_df[['NATION_OF_BIRTH_DESC']].head(6))
#gps_df['IMMIGRATION_STATUS'].unique()
```

In [201]:
```
#manuallly categorical encoding

# convert string values to catogical
status_mapping = {"Awarded": 1, "Sought/Tracked": 2, "Pending": 3}
#gps_df['STATUS_DESC']= gps_df['STATUS_DESC'].map(status_mapping)


major_mapping = {"Data Science": 1, "Software Management": 2, "Software Engine
ering": 3, "Information Technology": 4, "Software Systems": 5}
#gps_df['MAJOR_DESC']= gps_df['MAJOR_DESC'].map(major_mapping)

program_mapping = {"MS - Software Engineering": 1, "MSS - Software Engineerin
g": 2, "MS-Dual Software/Business": 3}
#gps_df['PROGRAM_DESC']= gps_df['PROGRAM_DESC'].map(program_mapping)

citizenship_mapping = {"U.S. Citizen": 1, "Non-Immigrant Visa Holder": 2, "Per
manent Resident": 3, "Asylee/Refugee":4}
#gps_df['CITIZENSHIP_DESC']= gps_df['CITIZENSHIP_DESC'].map(citizenship_mappin
g)

gender_mapping = {"F": 1, "M": 2}
#gps_df['GENDER']= gps_df['GENDER'].map(gender_mapping)

#putting GPA into 4 buckets
gps_df['GPABand'] = pd.cut(gps_df['GPA'], 4)
#gps_df[['GPABand', 'Retained?']].groupby(['GPABand'], as_index=False).mean().
sort_values(by='GPABand', ascending=True)

#have a passport or not
gps_df['HAS_PASSPORT'] = np.where(gps_df['PASSPORT_ISSUE_NATION_DESC'].isnull
(), 0, 1)

#born in USA or not?
#NATION_OF_BIRTH_DESC

#has VISA?
#what does US Citizen mean?
#print(gps_df['VISA_TYPE_DESC'].unique())
gps_df['HAS_VISA'] = np.where(gps_df['VISA_TYPE_DESC'].isnull(), 0, 1)
```

```
['U.S. Citizen' 'Non-Immigrant Visa Holder' 'Permanent Resident'
 'Asylee/Refugee']
```

In [119]:
```
#using sk learn to create the categorical values
from sklearn.preprocessing import LabelEncoder
lb_make = LabelEncoder()
gps_df["status_code"]      = lb_make.fit_transform(gps_df["STATUS_DESC"])
gps_df["gender_code"]      = lb_make.fit_transform(gps_df["GENDER"])
gps_df["major_code"]       = lb_make.fit_transform(gps_df["MAJOR_DESC"])
gps_df["citizenship_code"] = lb_make.fit_transform(gps_df["CITIZENSHIP_DESC"])
gps_df["veteran_code"]     = lb_make.fit_transform(gps_df["VETERAN_CATEGORY_DE
SC"].astype(str))
gps_df["religion_code"]    = lb_make.fit_transform(gps_df["RELIGION_DESC"])
gps_df["marital_code"]     = lb_make.fit_transform(gps_df["MARITAL_STATUS_DES
C"])
gps_df["primary_ethnicity_code"]     = lb_make.fit_transform(gps_df["PRIMARY_E
THNICITY_DESC"])
gps_df["state_code"]     = lb_make.fit_transform(gps_df["STATE_PROVINCE"])
gps_df["immigration_code"] = lb_make.fit_transform(gps_df["IMMIGRATION_STATUS"
].astype(str))
gps_df["nation_code"] = lb_make.fit_transform(gps_df["NATION"])



#making a gpa bucket before creating the code
gps_df['gpa_bucket'] = pd.cut(gps_df['GPA'], 4) #having 5 gave no value
gps_df["gpa_code"]   = lb_make.fit_transform(gps_df["gpa_bucket"])
#gps_df[['gpa_bucket', 'Retained?']].groupby(['gpa_bucket'], as_index=False).m
ean().sort_values(by='gpa_bucket', ascending=True)

#making flag columns
gps_df['has_passport'] = np.where(gps_df['PASSPORT_ISSUE_NATION_DESC'].isnull
(), 0, 1)
gps_df['has_visa']     = np.where(gps_df['VISA_TYPE_DESC'].isnull(), 0, 1)

#gps_df[["VETERAN_CATEGORY_DESC","veteran_code"]].head(11)


#Re-name possible y values
gps_df.rename(columns = {'Retained?':'retained'}, inplace = True)

#note sure what to do with these columns
#'GPS_Start_Term_' 'GPS_Last_Term_' 'Took_Non_GPS_Course_Within_Year?'
```

In [121]:
```
#drop columns we dont want
gps_df = gps_df.drop(['Fake_ID','CREDITS_EARNED','GPA','STATUS_DESC','PROGRAM_
DESC','MAJOR_DESC',
                      'SECOND_MAJOR_DESC','OUTCOME_NUMBER','OUTCOME_AWARDED_IN
D','CREDITS_ATTEMPTED',
                       'CREDITS_EARNED','GPA','CITIZENSHIP_DESC','RELIGION_DES
C','VETERAN_CATEGORY_DESC',
                       'GENDER','PRIMARY_ETHNICITY_DESC','MARITAL_STATUS_DESC',
'CITY','COUNTY_DESC',
                       'STATE_PROVINCE','POSTAL_CODE','NATION','PASSPORT_ISSUE_
NATION_DESC','IMMIGRATION_STATUS',
                       'NATION_OF_BIRTH_DESC','NATION_OF_CITIZENSHIP_DESC','VIS
A_TYPE_DESC',
                       #created columns
                       'gpa_bucket','Unnamed: 0',
                       #no sure on these yet
                       'GPS_Start_Term_','GPS_Last_Term_','Took_Non_GPS_Course_
Within_Year?'
                     ], axis=1)
```

In [122]:
```
#output the head of data
gps_df.head()
```

Out[122]:

	retained	status_code	gender_code	major_code	citizenship_code	veteran_code	reli
0	1	0	0	3	3	2	3
1	0	2	1	0	3	2	3
2	0	2	1	2	1	2	3
3	1	0	0	1	1	2	11
4	1	0	1	0	3	2	16

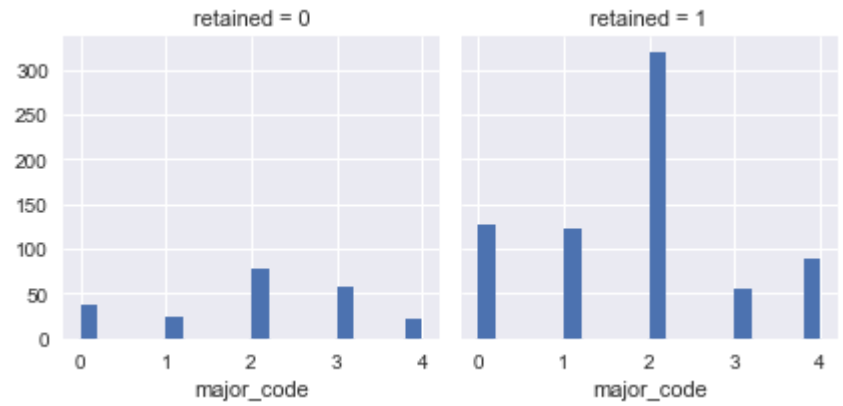
In [123]:
```
#output describe of each column
gps_df.describe()
```

Out[123]:

	retained	status_code	gender_code	major_code	citizenship_code	veteran_cc
count	933.000000	933.000000	933.000000	933.000000	933.000000	933.000000
mean	0.764202	0.810289	0.675241	1.854234	2.182208	1.996785
std	0.424725	0.946771	0.468536	1.200937	0.937434	0.073174
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	1.000000	0.000000	0.000000	1.000000	1.000000	2.000000
50%	1.000000	0.000000	1.000000	2.000000	3.000000	2.000000
75%	1.000000	2.000000	1.000000	2.000000	3.000000	2.000000
max	1.000000	2.000000	1.000000	4.000000	3.000000	2.000000

In [126]:
```
#look at major
g = sns.FacetGrid(gps_df, col='retained')
g.map(plt.hist, 'major_code', bins=20)
```

Out[126]: <seaborn.axisgrid.FacetGrid at 0xc173e48>



Split up data between train and test

In [130]:
```
X_train, X_test, y_train, y_test = train_test_split(gps_df.drop('retained', ax
is=1), gps_df.retained, test_size=0.33, random_state=42)

#output the size of test and train data
print(X_train.shape, y_train.shape, X_test.shape)
```

```
(625, 14) (625,) (308, 14)
```

Logistics Regression

Confidence Score (ACC %)

In [132]:
```
log_reg = LogisticRegression()
log_reg.fit(X_train, y_train)
y_pred = log_reg.predict(X_test)
acc_log = round(log_reg.score(X_train, y_train)*100, 2)
acc_log
```

Out[132]: 89.439999999999998

Column Coeffs

In [138]:
```
coeff_df = pd.DataFrame(gps_df.columns.delete(0)) #grabbing only column names
 into dataframe
coeff_df.columns = ['Feature'] #giving column a name
coeff_df["Correleation"] = pd.Series(log_reg.coef_[0]) #grabbing coeff of each
 column
coeff_df.sort_values(by='Correleation',ascending=False) #output coeff values
```

Out[138]:

	Feature	Correleation
11	gpa_code	1.038232
3	citizenship_code	0.912403
1	gender_code	0.772811
13	has_visa	0.668923
10	nation_code	0.508375
12	has_passport	0.230082
4	veteran_code	0.037509
5	religion_code	0.020563
8	state_code	-0.008753
7	primary_ethnicity_code	-0.072224
6	marital_code	-0.082219
9	immigration_code	-0.496545
2	major_code	-0.522695
0	status_code	-3.208063

Support Vector Machine

In [142]:
```
svc = SVC()
svc.fit(X_train, y_train)
y_pred = svc.predict(X_test)
acc_svc = round(svc.score(X_train, y_train)*100, 2)
acc_svc #outputting the acc score from SVM model
```

Out[142]: 91.359999999999999

K-Nearest Neighbors

In [145]:
```
knn = KNeighborsClassifier(n_neighbors = 3)
knn.fit(X_train, y_train)
y_pred = knn.predict(X_test)
acc_knn = round(knn.score(X_train, y_train)*100, 2)
acc_knn
```

Out[145]: 90.879999999999995

Guassian Naive Bays

In [148]:
```
gaussian = GaussianNB()
gaussian.fit(X_train, y_train)
y_pred = gaussian.predict(X_test)
acc_gaussian = round(gaussian.score(X_train, y_train)*100,2)
acc_gaussian
```

Out[148]: 84.480000000000004

Perceptron

In [152]:
```
perceptron = Perceptron()
perceptron.fit(X_train, y_train)
y_pred = perceptron.predict(X_test)
acc_perceptron = round(perceptron.score(X_train, y_train)*100,2)
acc_perceptron
```

Out[152]: 83.680000000000007

Linear SVC

In [154]:
```
linear_svc = LinearSVC()
linear_svc.fit(X_train, y_train)
acc_linear_svc = round(linear_svc.score(X_train, y_train)*100, 2)
acc_linear_svc
```

Out[154]: 89.920000000000002

Stochastic Gradient Descent

In [156]:
```
sgd = SGDClassifier()
sgd.fit(X_train, y_train)
y_pred = sgd.predict(X_test)
acc_sgd = round(sgd.score(X_train, y_train)*100, 2)
acc_sgd
```

Out[156]: 86.719999999999999

Decision Tree

In [158]:
```
decision_tree = DecisionTreeClassifier()
decision_tree.fit(X_train, y_train)
y_pred = decision_tree.predict(X_test)
acc_decision_tree = round(decision_tree.score(X_train, y_train)*100,2)
acc_decision_tree
```

Out[158]: 98.079999999999998

Random Forest

In [161]:
```
random_forest = RandomForestClassifier(n_estimators=100)
random_forest.fit(X_train, y_train)
y_pred = random_forest.predict(X_test)
random_forest.score(X_train, y_train)
acc_random_forest = round(random_forest.score(X_train, y_train)*100, 2)
acc_random_forest
```

Out[161]: 98.079999999999998

Model Evaluation

In [163]:
```
models = pd.DataFrame({
    'Model': ['Support Vector Machines', 'KNN', 'Logistic Regression',
              'Random Forest', 'Naive Bayes', 'Perceptron',
              'Stochastic Gradient Decent', 'Linear SVC',
              'Decision Tree'],
    'Score': [acc_svc, acc_knn, acc_log,
              acc_random_forest, acc_gaussian, acc_perceptron,
              acc_sgd, acc_linear_svc, acc_decision_tree]})
models.sort_values(by='Score', ascending=False)
```

Out[163]:

	Model	Score
3	Random Forest	98.08
8	Decision Tree	98.08
0	Support Vector Machines	91.36
1	KNN	90.88
7	Linear SVC	89.92
2	Logistic Regression	89.44
6	Stochastic Gradient Decent	86.72
4	Naive Bayes	84.48
5	Perceptron	83.68

In [ ]: