In [1]:

```
import pandas as pd
```

In [2]:

```
data = pd.read_csv("ACME-HappinessSurvey2020.csv")
```

In [3]:

```
data.head()
```

Out[3]:

	Y	X1	X2	X3	X4	X5	X6
0	0	3	3	3	4	2	4
1	0	3	2	3	5	4	3
2	1	5	3	3	3	3	5
3	0	5	4	3	3	3	5
4	0	5	4	3	3	3	5

In [4]:

```
data.shape
```

Out[4]:

```
(126, 7)
```

In [5]:

```
data.Y.value_counts()
```

Out[5]:

```
1    69
0    57
Name: Y, dtype: int64
```

In [6]:

```
data.isna().sum()
```

Out[6]:

```
Y     0
X1    0
X2    0
X3    0
X4    0
X5    0
X6    0
dtype: int64
```

In [7]:

```
data.describe()
```

Out[7]:

	Y	X1	X2	X3	X4	X5	X6
count	126.000000	126.000000	126.000000	126.000000	126.000000	126.000000	126.000000
mean	0.547619	4.333333	2.531746	3.309524	3.746032	3.650794	4.253968
std	0.499714	0.800000	1.114892	1.023440	0.875776	1.147641	0.809311
min	0.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
25%	0.000000	4.000000	2.000000	3.000000	3.000000	3.000000	4.000000
50%	1.000000	5.000000	3.000000	3.000000	4.000000	4.000000	4.000000
75%	1.000000	5.000000	3.000000	4.000000	4.000000	4.000000	5.000000
max	1.000000	5.000000	5.000000	5.000000	5.000000	5.000000	5.000000

Goal is to predict if a customer is happy or not based on the answers they give to questions asked

In [8]:

```
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import StratifiedKFold, cross_validate, train_test_split, cross_val_score, KFold
from sklearn.metrics import roc_curve, auc, classification_report, confusion_matrix, precision_score, recall_score,  accuracy_score, precision_recall_curve
```

In [9]:

```
Y = data['Y']
X = data.drop('Y', axis = 1)
```

In [10]:

```
Y.shape, X.shape
```

Out[10]:

```
((126,), (126, 6))
```

In [11]:

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, train_size = 0.7, random_state = 15)
```

In [12]:

```
print("Train Data Dimensions : ", X_train.shape)
print("Test Data Dimensions : ", X_test.shape)
```

```
Train Data Dimensions :  (88, 6)
Test Data Dimensions :  (38, 6)
```

In [13]:

```
logreg = LogisticRegression()
logreg.fit(X_train,Y_train)
```

Out[13]:

```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=
True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=None, solver='lbfgs', tol=0.0001, verbo
se=0,
                   warm_start=False)
```

In [14]:

```
Y_pred = logreg.predict(X_test)
print('Accuracy of logistic regression classifier on test set: {:.2f}'.f
ormat(logreg.score(X_test, Y_test)))
```

```
Accuracy of logistic regression classifier on test set: 0.53
```

In [15]:

```
from sklearn.metrics import f1_score
f1_score(Y_test, Y_pred, average='macro')
```

Out[15]:

```
0.45192307692307687
```

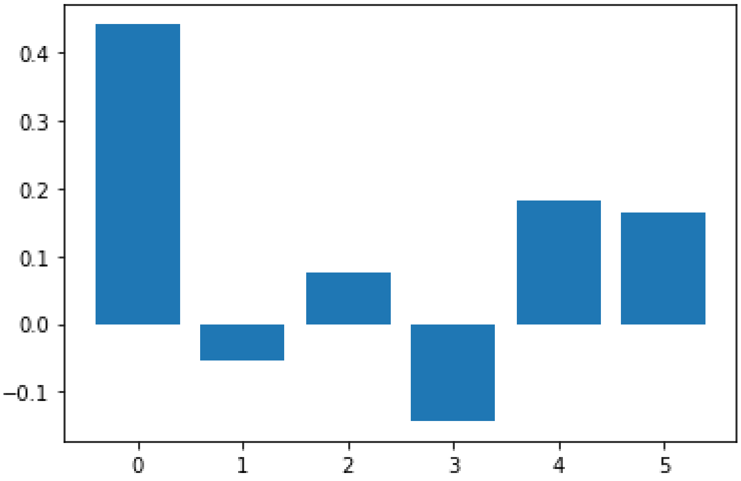
In [16]:

```
import matplotlib.pyplot as plt
```

In [17]:

```
# get importance
importance = logreg.coef_[0]
# summarize feature importance
for i,v in enumerate(importance):
    print('Feature: %0d, Score: %.5f' % (i,v))
# plot feature importance
plt.bar([x for x in range(len(importance))], importance)
plt.show()
```

```
Feature: 0, Score: 0.44203
Feature: 1, Score: -0.05557
Feature: 2, Score: 0.07554
Feature: 3, Score: -0.14277
Feature: 4, Score: 0.18195
Feature: 5, Score: 0.16456
```



Gradient boost

In [19]:

```
from sklearn.ensemble import GradientBoostingClassifier
gradient_boost = GradientBoostingClassifier(random_state=1)
gradient_boost.fit(X_train, Y_train)
Y_pred = gradient_boost.predict(X_test)
print('Accuracy of gradient boost classifier on test set: {:.2f}'.format
(gradient_boost.score(X_test, Y_test)))
```

```
Accuracy of gradient boost classifier on test set: 0.63
```

Should the data be divided into 3 sets? training, test and validation set? but dividing into 3 would reduce the data avaliable for training, training set is already small.

In [29]:

```
scores = cross_val_score(gradient_boost, X, Y, cv=10)
scores
```

Out[29]:

```
array([0.76923077, 0.53846154, 0.46153846, 0.53846154, 0.61538462,
       0.23076923, 0.83333333, 0.75      , 0.33333333, 0.5       ])
```

In [30]:

```
print("Accuracy of gradient boosting with 5-fold validation: %0.2f" % (s
cores.mean()))
```

```
Accuracy of gradient boosting with 5-fold validation: 0.56
```

cross fold validation is reducing the accuracy, why?

Random Forest

In [32]:

```
from sklearn.ensemble import RandomForestClassifier
RF = RandomForestClassifier(random_state=1)
%time RF.fit(X_train, Y_train)
Y_pred = RF.predict(X_test)
print('Accuracy of Random Forest classifier on test set: {:.2f}'.format(
RF.score(X_test, Y_test)))
```

```
CPU times: user 143 ms, sys: 2.73 ms, total: 146 ms
Wall time: 149 ms
Accuracy of Random Forest classifier on test set: 0.66
```

In [33]:

```
scores = cross_val_score(RF, X, Y, cv=10)
scores
```

Out[33]:

```
array([0.69230769, 0.38461538, 0.46153846, 0.61538462, 0.61538462,
       0.38461538, 0.66666667, 0.75      , 0.33333333, 0.5       ])
```

In [43]:

```
print("Accuracy of Randon Forest with 10-fold validation: %0.2f" % (scores.mean()))
```

```
Accuracy of Randon Forest with 10-fold validation: 0.54
```

Again, accuracy reduced with cross validation

In [36]:

```
RF.feature_importances_
```

Out[36]:

```
array([0.1511827 , 0.1772059 , 0.18402833, 0.16528549, 0.18015894,
       0.14213864])
```

In [42]:

```
print("Features sorted by their score:")
print(sorted(zip(map(lambda x: round(x, 4), RF.feature_importances_), X.columns),
             reverse=True))
```

```
Features sorted by their score:
[(0.184, 'X3'), (0.1802, 'X5'), (0.1772, 'X2'), (0.1653, 'X4'), (0.1512, 'X1'), (0.1421, 'X6')]
```