Predict the number of hits landed by Arse in UFC Fight Night: Dos Anjos vs. Lee¶

https://www.espn.com/mma/fightcenter/_/id/401107798/league/ufc has access to the 3 rounds of 5 minutes fight 5/18/2019 The csv file is found at: https://github.com/JanJanJan2018/FightML/blob/master/ArseErosaFightAudit.csv Predict the number of hits Arse lands based on the seconds into the round, elapsed since last action, cumulative number of hits received/landed/missed and number of hits received total for that round This data is split into a training set of 70% and a testing set of 30% based only on those instances action other than circling/standing/stepping away/toward/to the side occurs There are 224 instances of 156 training set samples of each second of action, and the remaining 68 are testing samples of each second of action. Only the first seven fields are used as feature predictor's on the hits landed by Arse feature field. Not all other fields used in this analysis.

Sci-kit learn's (sklearn) Decision Tree with max depth of 2 scored 82% as the best accuracy in prediction¶

The next best sklearn modular ML algorithms were: KNN with 79.4% accuracy Random Forest with 76.5 % accuracy logistic Regression with 78% accuracy ensemble on logistic 74%, naive bayes 55%, and random forests with 71% accuracy decision tree with 5 as max depth was 66% accuracy decision tree with 10 as max depth was 69% accuracy Note: error with the keras perceptron (logistic regression:sigmoid/relu) and multilayer perceptrons (NNs)

In [1]:

```
%%time


%matplotlib inline
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn import preprocessing
from sklearn.metrics import classification_report, f1_score, accuracy_score, confusion_matrix


# Read in the file for the dataset used in the final project due Week 8
df = pd.read_csv('ArseErosaFightAudit.csv')
```

```
Wall time: 49.2 s
```

In [2]:

```
df.head() #lists Type as the string factor names
```

Out[2]:

	Round	SecondsIntoRound	SecondsLastRoundAction	cmTotHitsR-A	cmTotHitsL-A	cmTotHitsM-A	Hits-Recvd-A	Hits-Lnd-A	Hits-Mssd-A	cm
0	1	6	6	0	0	0	0	0	0	0
1	1	19	13	0	0	0	0	0	0	0
2	1	21	2	0	0	0	0	0	0	0
3	1	24	3	1	0	0	1	0	0	0
4	1	36	12	1	0	1	0	0	1	0

In [3]:

```
df.columns
```

Out[3]:

```
Index([u'Round', u'SecondsIntoRound', u'SecondsLastRoundAction',
       u'cmTotHitsR-A', u'cmTotHitsL-A', u'cmTotHitsM-A', u'Hits-Recvd-A',
       u'Hits-Lnd-A', u'Hits-Mssd-A', u'cmTotHitsR-E', u'cmTotHitsL-E',
       u'cmTotHitsM-E', u'Hits-Recvd-E', u'Hits-Lnd-E', u'Hits-Mssd-E',
       u'Time', u'ArseFighterActionReactions',
       u'ErosaFightersActionsReactions'],
      dtype='object')
```

In [4]:

```
df.iloc[1:10,[0,1,2,3,4,5,6,8,9,10,11,12]]
```

Out[4]:

	Round	SecondsIntoRound	SecondsLastRoundAction	cmTotHitsR-A	cmTotHitsL-A	cmTotHitsM-A	Hits-Recvd-A	Hits-Mssd-A	cmTotH
1	1	19	13	0	0	0	0	0	0
2	1	21	2	0	0	0	0	0	0
3	1	24	3	1	0	0	1	0	0
4	1	36	12	1	0	1	0	1	0
5	1	39	3	2	0	1	1	0	0
6	1	46	7	2	0	2	0	1	0
7	1	49	3	2	0	2	0	0	0
8	1	51	2	2	0	2	0	0	0
9	1	57	6	2	0	3	0	1	0

In [5]:

```
df.iloc[1:5,0:7]
```

Out[5]:

	Round	SecondsIntoRound	SecondsLastRoundAction	cmTotHitsR-A	cmTotHitsL-A	cmTotHitsM-A	Hits-Recvd-A
1	1	19	13	0	0	0	0
2	1	21	2	0	0	0	0

	Round	SecondsIntoRound	SecondsLastRoundAction	cmTotHitsR-A	cmTotHitsL-A	cmTotHitsM-A	Hits-Recvd-A
3	1	24	3	1	0	0	1
4	1	36	12	1	0	1	0

In [6]:

```
df.describe()
```

Out[6]:

	Round	SecondsIntoRound	SecondsLastRoundAction	cmTotHitsR-A	cmTotHitsL-A	cmTotHitsM-A	Hits-Recvd-A	H
count	224.000000	224.000000	224.000000	224.000000	224.000000	224.000000	224.000000	2
mean	1.964286	136.888393	3.183036	4.357143	7.910714	14.459821	0.120536	0
std	0.756776	90.940532	3.481853	3.425981	5.286506	9.077059	0.326316	0
min	1.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0
25%	1.000000	58.750000	1.000000	2.000000	3.750000	7.750000	0.000000	0
50%	2.000000	124.000000	2.000000	4.000000	8.000000	14.000000	0.000000	0
75%	3.000000	223.250000	4.000000	5.000000	13.000000	21.000000	0.000000	0
max	3.000000	302.000000	20.000000	14.000000	17.000000	35.000000	1.000000	2

Lets make the target variable the 'Hits-lnd-A'-6 based on the first 6 fields:¶

Split the data into 70% Training and 30% Testing Samples¶

In [7]:

```
X = df.iloc[:,[0,1,2,3,4,5,6,8,9,10,11,12]].values # returns array of all instances ot
her than the target

y = df.iloc[:, 7] .values # returns array of all instances of the target


X_train, X_test, y_train, y_test = train_test_split(

    X, y, test_size=0.3, random_state=20)

print(X_train.shape)

print(X_test.shape)

print(y_train.shape)

print(y_test.shape)

print(X_train.shape)
```

```
(156L, 12L)
(68L, 12L)
(156L,)
```

```
(68L,)
(156L, 12L)
```

There are 156 training samples and 68 testing samples with above split of 70-30¶

In [8]:

```
stdscaler = preprocessing.StandardScaler().fit(X_train)
X_scaled  = stdscaler.transform(X)
X_train_scaled = stdscaler.transform(X_train)
X_test_scaled  = stdscaler.transform(X_test)
```

```
C:\Users\m\Anaconda2\lib\site-packages\sklearn\utils\validation.py:595: DataConversion
Warning: Data with input dtype int64 was converted to float64 by StandardScaler.
  warnings.warn(msg, DataConversionWarning)
```

In [9]:

```
print "Training set samples: ", len(X_train)
print "Testing set samples: ", len(X_test)
```

```
Training set samples:  156
Testing set samples:  68
```

In [10]:

```
X_train_std = X_train_scaled
X_test_std = X_test_scaled
```

KNN¶

In [11]:

```
import matplotlib.pyplot as plt
from sklearn.neighbors import KNeighborsClassifier
% time
knn = KNeighborsClassifier()
knn.fit(X_train,
        y_train)
```

```
Wall time: 0 ns
```

Out[11]:

```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
           metric_params=None, n_jobs=None, n_neighbors=5, p=2,
           weights='uniform')
```

In [12]:

```
% time
y_pred = knn.predict(X_test)#_std)
```

```
Wall time: 0 ns
```

In [13]:

```
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
cm = confusion_matrix(y_test, y_pred)
print cm
print 'Accuracy: ',accuracy_score(y_test, y_pred)
```

```
[[51  5]
 [10  2]]
Accuracy:  0.7794117647058824
```

Decision Trees¶

In [14]:

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn import preprocessing, tree
from sklearn.metrics import classification_report, confusion_matrix
```

In [15]:

```
% time
dtc = tree.DecisionTreeClassifier(criterion='entropy')#, max_depth=3)
dtc.fit(X_train, y_train)
predicted = dtc.predict(X_test)


print "Decision Tree Results\nConfusion Matrix: "
print confusion_matrix(y_test,predicted)
print "\n Classifcation Report"
print classification_report(y_test,predicted)
```

```
Wall time: 0 ns
Decision Tree Results
Confusion Matrix:
```

```
[[56  0]
 [ 2 10]]

 Classifcation Report
              precision    recall  f1-score   support

           0       0.97      1.00      0.98        56
           1       1.00      0.83      0.91        12

   micro avg       0.97      0.97      0.97        68
   macro avg       0.98      0.92      0.95        68
weighted avg       0.97      0.97      0.97        68
```

Decision Tree Regression¶

In [16]:

```
#Week 7 ipynb


%matplotlib inline
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn import preprocessing
from sklearn.model_selection import train_test_split
```

In [17]:

```
import random #keep the same results when running the code, as results vary with each run of code
random.seed(100)
```

In [18]:

```
# Fit regression model
% time
regr_1 = tree.DecisionTreeRegressor(max_depth=2)
regr_2 = tree.DecisionTreeRegressor(max_depth=5)
regr_3 = tree.DecisionTreeRegressor(max_depth=10)
regr_1.fit(X_train, y_train)
regr_2.fit(X_train, y_train)
regr_3.fit(X_train, y_train)


# Predict
```

```
#X_test = np.arange(0.0, 300, 0.1)[:, np.newaxis]
y_1 = regr_1.predict(X_test)
y_2 = regr_2.predict(X_test)
y_3 = regr_3.predict(X_test)
% time
```

```
Wall time: 0 ns
Wall time: 0 ns
```

In [19]:

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn import preprocessing, tree
from sklearn.metrics import classification_report, confusion_matrix
```

In [20]:

```
print "Decision Tree Regression Prediction with Max Depth=2"
print y_1.round()
print "\nActual Testing Subset Categorical Values:"
print y_test

print "\nDecision Tree Results Max Depth=2\nConfusion Matrix: "
print confusion_matrix(y_test,y_1.round())
print "\n Classifcation Report"
print classification_report(y_test,y_1.round())

a=sum(y_1.round()==y_test)
b= len(y_test)
print 'The number of testing samples:'
print b
print 'The number of correct predictions:'
print a

print y_1.round() == y_test
print "\nAccuracy of Decision Tree with Max Depth=2"
print round(float(a)/float(b),2),"%"
```

```
Decision Tree Regression Prediction with Max Depth=2
```

```
[0. 0. 1. 1. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 1. 1. 0. 0. 1. 0. 0. 0. 0. 0. 0.
 0. 1. 0. 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Actual Testing Subset Categorical Values:
[0 0 1 1 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0
 1 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

Decision Tree Results Max Depth=2
Confusion Matrix:
[[56  0]
 [ 2 10]]

 Classifcation Report
              precision    recall  f1-score   support

           0       0.97      1.00      0.98        56
           1       1.00      0.83      0.91        12

   micro avg       0.97      0.97      0.97        68
   macro avg       0.98      0.92      0.95        68
weighted avg       0.97      0.97      0.97        68

The number of testing samples:
68
The number of correct predictions:
66
[ True  True  True  True  True  True  True  True  True  True  True  True
  True False  True  True  True  True  True  True  True  True  True  True
  True  True  True  True False  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True]

Accuracy of Decision Tree with Max Depth=2
0.97 %
```

In [21]:

```
print "Decision Tree Regression Prediction with Max Depth=5"

print y_2.round()

print "\nActual Testing Subset Categorical Values:"

print y_test


print "\nDecision Tree Results\nConfusion Matrix: "

print confusion_matrix(y_test,y_2.round())

print "\n Classifcation Report"

print classification_report(y_test,y_2.round())
```

```
Decision Tree Regression Prediction with Max Depth=5
[0. 0. 1. 1. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 1. 1. 0. 0. 1. 0. 0. 0. 0. 0. 0.
 0. 1. 0. 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Actual Testing Subset Categorical Values:
[0 0 1 1 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0
 1 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
```

```
Decision Tree Results
Confusion Matrix:
[[56  0]
 [ 2 10]]

 Classifcation Report
              precision    recall  f1-score   support

           0       0.97      1.00      0.98        56
           1       1.00      0.83      0.91        12

   micro avg       0.97      0.97      0.97        68
   macro avg       0.98      0.92      0.95        68
weighted avg       0.97      0.97      0.97        68
```

In [22]:

```
a=sum(y_2.round()==y_test)

b= len(y_test)

print 'The number of testing samples:'

print b

print 'The number of correct predictions:'

print a


print y_2.round() == y_test

print "\nAccuracy of Decision Tree with Max Depth=5"

print round(float(a)/float(b),2),"%"
```

```
The number of testing samples:
68
The number of correct predictions:
66
[ True  True  True  True  True  True  True  True  True  True  True  True
  True False  True  True  True  True  True  True  True  True  True  True
  True  True  True  True False  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True]

Accuracy of Decision Tree with Max Depth=5
0.97 %
```

Decision Tree with Max Depth = 5 and Max Depth = 10 produced similar results¶

In [23]:

```
print "Decision Tree Regression Prediction with Max Depth=10"

print y_3.round()
print "\nActual Testing Subset Categorical Values:"
print y_test


print "\nDecision Tree Results\nConfusion Matrix: "
print confusion_matrix(y_test,y_3.round())
print "\n Classifcation Report"
print classification_report(y_test,y_3.round())


a=sum(y_3.round()==y_test)
b= len(y_test)
print 'The number of testing samples:'
print b
print 'The number of correct predictions:'
print a


print y_3.round() == y_test
print "\nAccuracy of Decision Tree with Max Depth=10"
print round(float(a)/float(b),2),"%"
```

```
Decision Tree Regression Prediction with Max Depth=10
[0. 0. 1. 1. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 1. 1. 0. 0. 1. 0. 0. 0. 0. 0. 0.
 0. 1. 1. 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]

Actual Testing Subset Categorical Values:
[0 0 1 1 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0
 1 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

Decision Tree Results
Confusion Matrix:
[[55  1]
 [ 2 10]]

 Classifcation Report
              precision    recall  f1-score   support

           0       0.96      0.98      0.97        56
           1       0.91      0.83      0.87        12

   micro avg       0.96      0.96      0.96        68
   macro avg       0.94      0.91      0.92        68
weighted avg       0.96      0.96      0.96        68

The number of testing samples:
68
The number of correct predictions:
65
[ True  True  True  True  True  True  True  True  True  True  True  True
  True False  True  True  True  True  True  True  True  True  True  True
  True  True  True  True False  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True  True  True  True  True
  True  True False  True  True  True  True  True  True  True  True  True
  True  True  True  True  True  True  True  True]

Accuracy of Decision Tree with Max Depth=10
0.96 %
```

Ensemble Trees, Voting Classifier¶

logistic, random forest, and gaussian naive bayes used

In [24]:

```
from sklearn import datasets

from sklearn.model_selection import cross_val_score

from sklearn.linear_model import LogisticRegression

from sklearn.naive_bayes import GaussianNB

from sklearn.ensemble import RandomForestClassifier

from sklearn.ensemble import VotingClassifier


clf1 = LogisticRegression(random_state=1)

clf2 = RandomForestClassifier(random_state=1)

clf3 = GaussianNB()


eclf = VotingClassifier(estimators=[('lr', clf1), ('rf', clf2), ('gnb', clf3)], voting
='hard')


for clf, label in zip([clf1, clf2, clf3, eclf], ['Logistic Regression', 'Random Forest
', 'naive Bayes', 'Ensemble']):

    scores = cross_val_score(clf, X_train_std, y_train, cv=5, scoring='accuracy')

    print("Accuracy: %0.2f (+/- %0.2f) [%s]" % (scores.mean(), scores.std(), label))
```

```
C:\Users\m\Anaconda2\lib\site-packages\sklearn\model_selection\_split.py:651: Warning:
The least populated class in y has only 1 members, which is too few. The minimum numbe
r of members in any class cannot be less than n_splits=5.
  % (min_groups, self.n_splits)), Warning)
C:\Users\m\Anaconda2\lib\site-packages\sklearn\linear_model\logistic.py:433: FutureWar
ning: Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence t
his warning.
  FutureWarning)
C:\Users\m\Anaconda2\lib\site-packages\sklearn\linear_model\logistic.py:460: FutureWar
ning: Default multi_class will be changed to 'auto' in 0.22. Specify the multi_class o
ption to silence this warning.
  "this warning.", FutureWarning)
C:\Users\m\Anaconda2\lib\site-packages\sklearn\ensemble\forest.py:246: FutureWarning:
The default value of n_estimators will change from 10 in version 0.20 to 100 in 0.22.
  "10 in version 0.20 to 100 in 0.22.", FutureWarning)
Accuracy: 0.98 (+/- 0.02) [Logistic Regression]
Accuracy: 0.97 (+/- 0.02) [Random Forest]
Accuracy: 0.97 (+/- 0.02) [naive Bayes]
Accuracy: 0.98 (+/- 0.02) [Ensemble]
```

PCA then K-means UnSupervised classification¶

In [25]:

```
%matplotlib inline
import matplotlib.pyplot as plt

import pandas as pd
import numpy as np

from sklearn.metrics import classification_report, confusion_matrix
from sklearn.decomposition import PCA
from sklearn import manifold

np.random.seed = 47
```

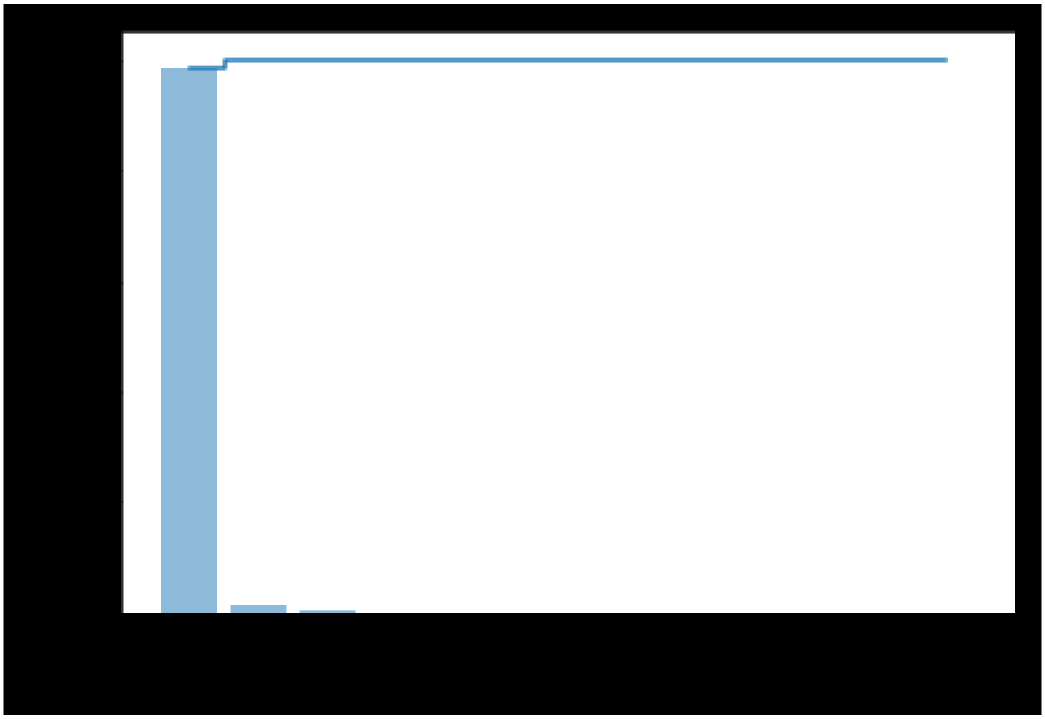
In [26]:

```
pca = PCA()
X_train_pca = pca.fit_transform(X_train)
pca.explained_variance_ratio_
print X_train_pca.shape
```

```
(156L, 12L)
```

In [27]:

```
plt.bar(range(1,len(pca.explained_variance_ratio_)+1), pca.explained_variance_ratio_,
alpha=0.5, align='center')
plt.step(range(1,len(pca.explained_variance_ratio_)+1), np.cumsum(pca.explained_varian
ce_ratio_), where='mid')
plt.ylabel('Explained variance ratio')
plt.xlabel('Principal components')
plt.show()
```



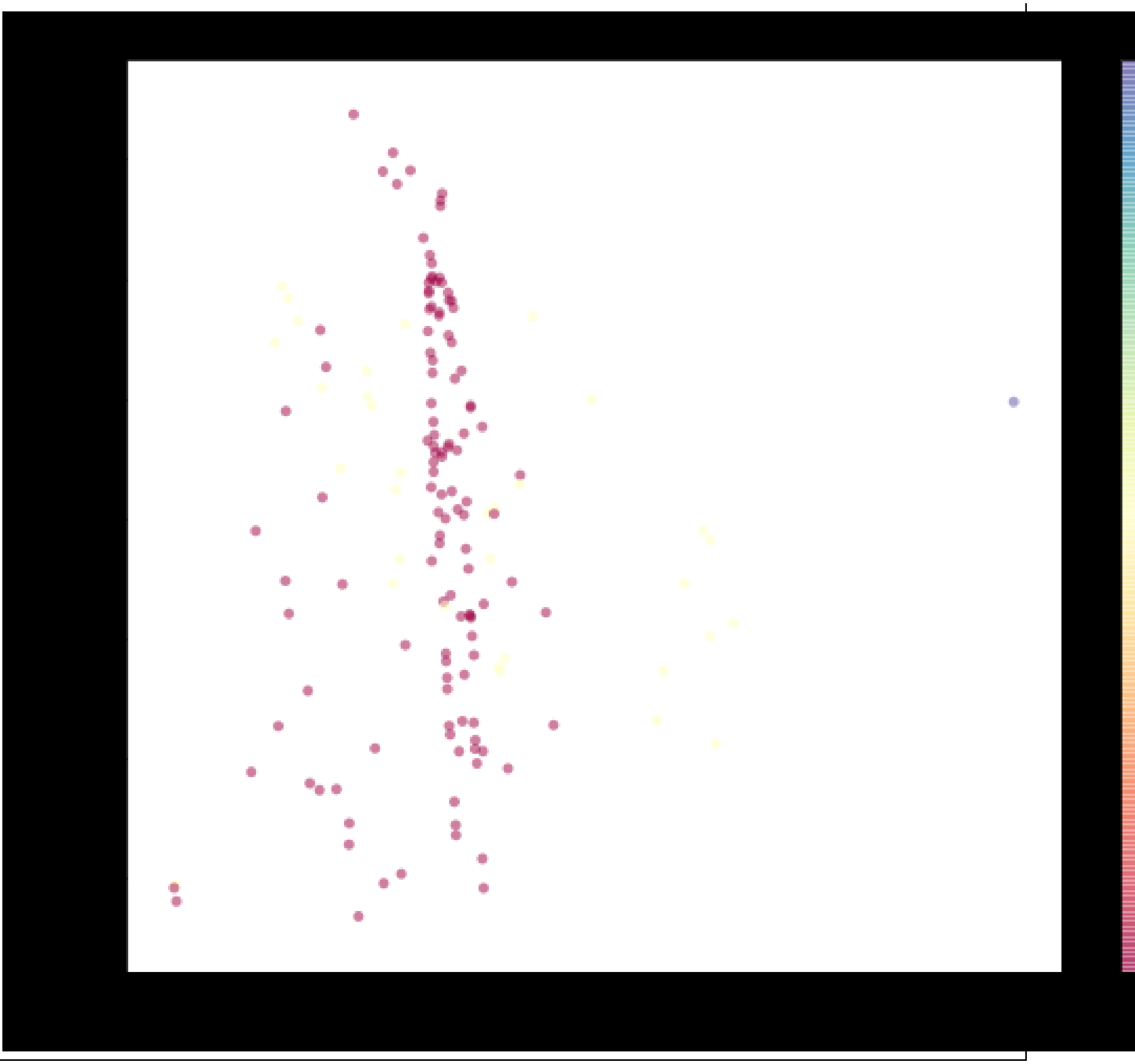
In [28]:

```
n_neighbors = 10
n_components = 2
```

In [29]:

```
% time Y2 = manifold.LocallyLinearEmbedding(n_neighbors, n_components,\
                                    eigen_solver='auto',\
                                    method='standard').fit_transform(X_train_std)
fig = plt.figure(figsize=[10,8])
axes = fig.add_subplot(1, 1, 1)#, axisbg='black')
plt.ylabel('Component 2')
plt.xlabel('Component 1')
plt.title('Training Set PCA-2 components and 10 neighbors')
plt.scatter(Y2[:, 0], Y2[:, 1], c=y_train, cmap=plt.cm.Spectral,edgecolors='none',s=25
,alpha=0.5);
cbar=plt.colorbar()
#cbar.set_ticks(list(class_mapping.values()))
#cbar.set_ticklabels(list(class_mapping.keys()))
```

```
Wall time: 62 ms
```



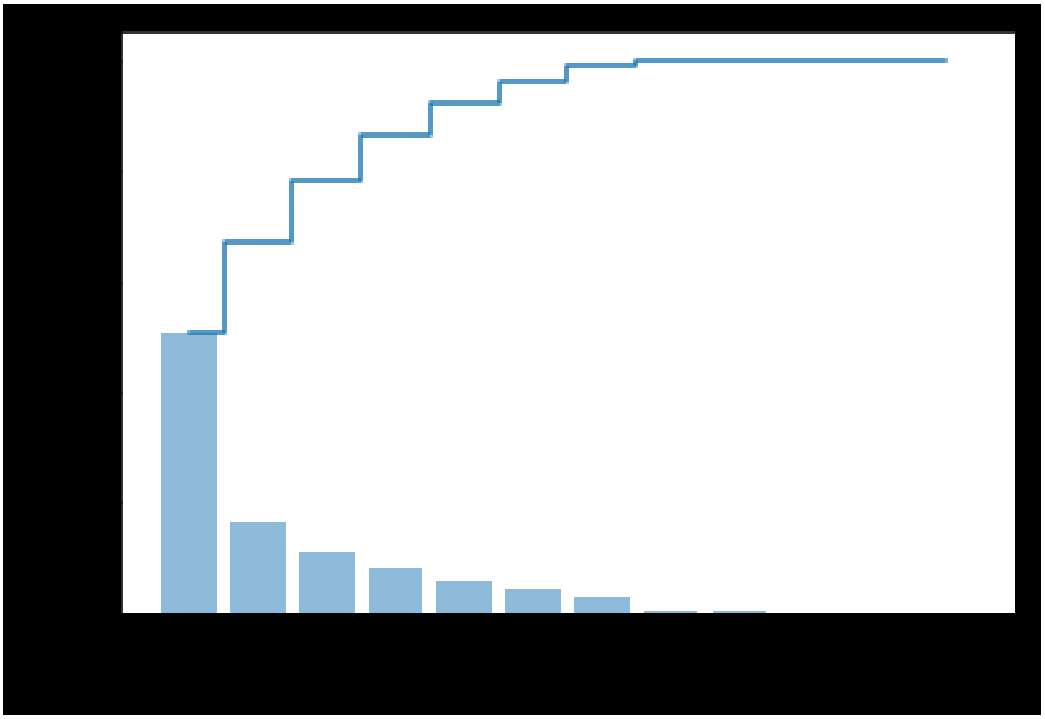
In [30]:

```
pca = PCA()
X_test_pca = pca.fit_transform(X_test_std)
pca.explained_variance_ratio_
print X_test_pca.shape
```

```
(68L, 12L)
```

In [31]:

```
plt.bar(range(1,len(pca.explained_variance_ratio_)+1), pca.explained_variance_ratio_,
alpha=0.5, align='center')

plt.step(range(1,len(pca.explained_variance_ratio_)+1), np.cumsum(pca.explained_varian
ce_ratio_), where='mid')

plt.ylabel('Explained variance ratio')

plt.xlabel('Principal components')

plt.show()
```



In [32]:

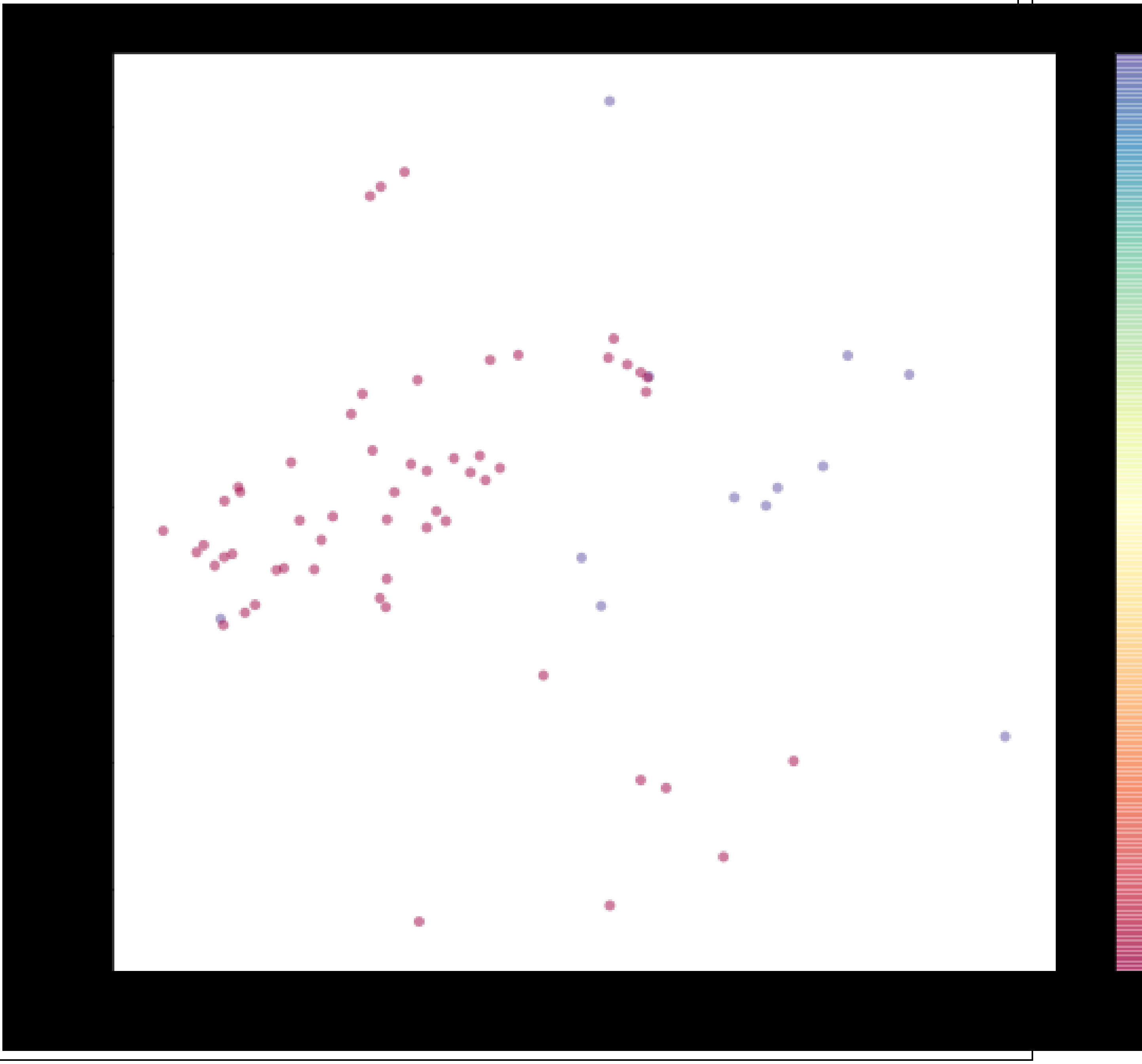
```
n_neighbors = 10

n_components = 2
```

In [33]:

```
% time Y2 = manifold.LocallyLinearEmbedding(n_neighbors, n_components,\

                                    eigen_solver='auto',\

                                    method='standard').fit_transform(X_test_std)

fig = plt.figure(figsize=[10,8])

axes = fig.add_subplot(1, 1, 1)#, axisbg='black')

plt.ylabel('Component 2')

plt.xlabel('Component 1')

plt.title('Testing Set PCA-2 components and 10 neighbors')

plt.scatter(Y2[:, 0], Y2[:, 1], c=y_test, cmap=plt.cm.Spectral,edgecolors='none',s=25,
alpha=0.5);
```

```
cbar=plt.colorbar()
#cbar.set_ticks(list(class_mapping.values()))
#cbar.set_ticklabels(list(class_mapping.keys()))
```

```
Wall time: 32 ms
```



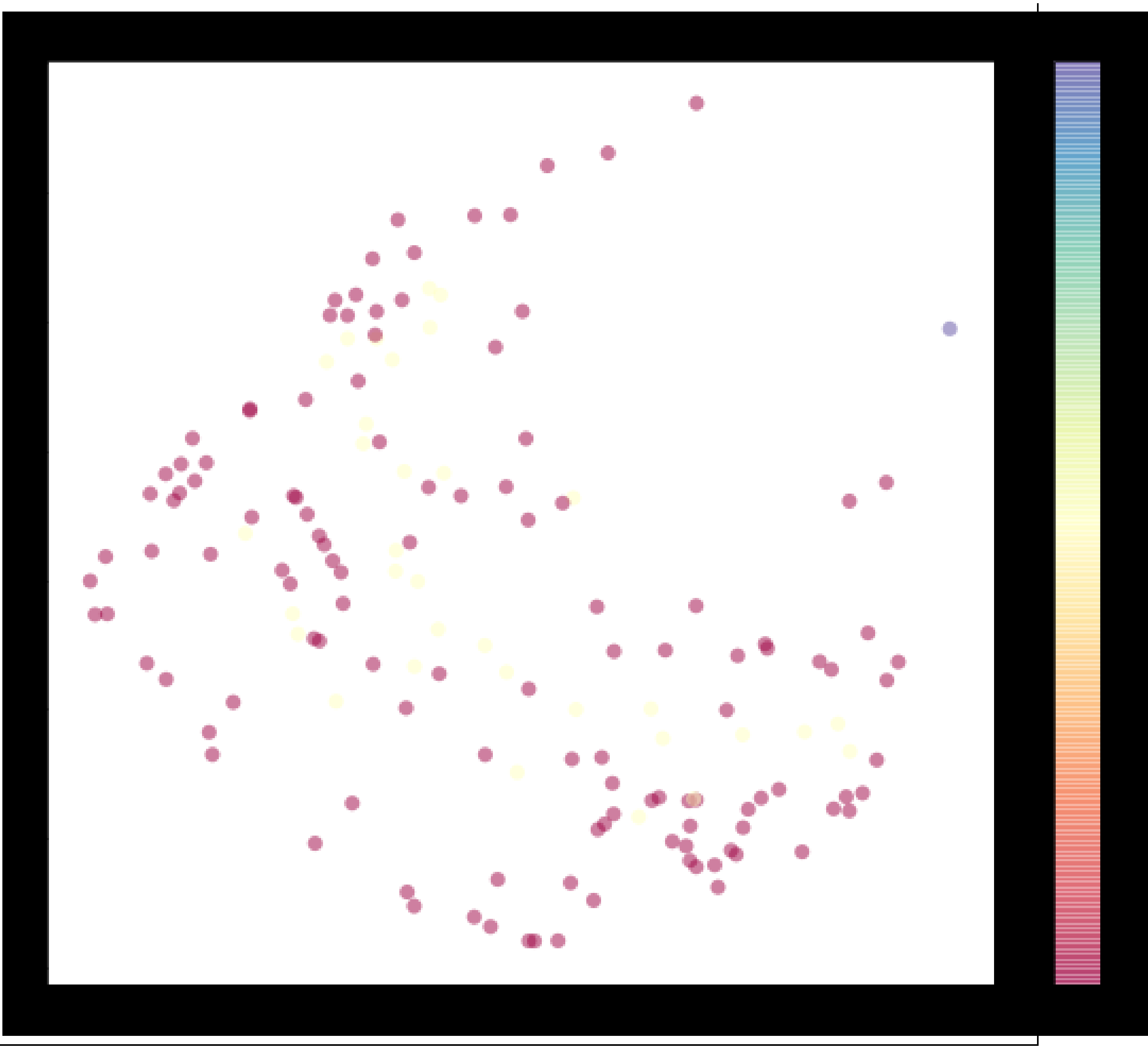
K-means¶

```
In [34]:
```

```
from sklearn.cluster import KMeans
Y = KMeans(n_clusters=2).fit_transform(X_train_std)
```

In [35]:

```
fig = plt.figure(figsize=[10,8])
axes = fig.add_subplot(1, 1, 1)#, axisbg='black')
plt.scatter(Y[:, 0], Y[:, 1], c=y_train, cmap=plt.cm.Spectral,edgecolors='none',s=50,a
lpha=0.5);
plt.title('Training Set use of K-means with K=2')
cbar=plt.colorbar()
#cbar.set_ticks(list(class_mapping.values()))
#cbar.set_ticklabels(list(class_mapping.keys()))
```



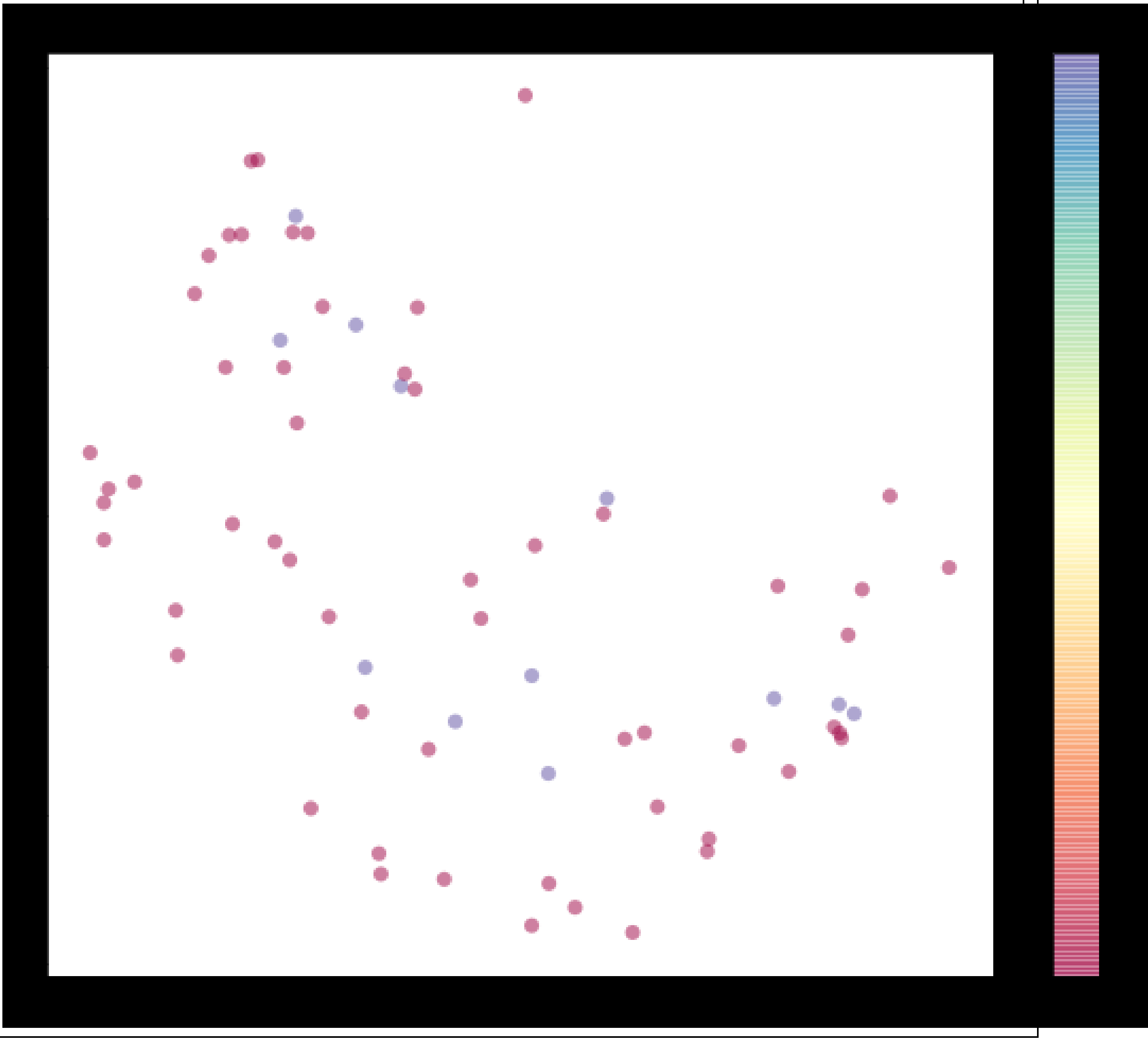
In [36]:

```
Y1 = KMeans(n_clusters=2).fit_transform(X_test_std)
```

In [37]:

```
fig = plt.figure(figsize=[10,8])

axes = fig.add_subplot(1, 1, 1)#, axisbg='black')

plt.scatter(Y1[:, 0], Y1[:, 1], c=y_test, cmap=plt.cm.Spectral,edgecolors='none',s=50,
alpha=0.5);

plt.title('Testing Set use of K-means with K=2')
```

```
cbar=plt.colorbar()
#cbar.set_ticks(list(class_mapping.values()))
#cbar.set_ticklabels(list(class_mapping.keys()))
```



Random Forests¶

In [38]:

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV


n_estimators_list = [5,10,50,100,200,300,400,1000]


rfc = RandomForestClassifier(random_state=47)

grid = GridSearchCV(estimator=rfc, param_grid=dict(n_estimators=n_estimators_list))

grid.fit(X_train_std, y_train)


print grid

# summarize the results of the grid search

print 'Grid Training Set Best Score: ',grid.best_score_

print 'Grid Training Set Best Number of Trees Estimator: ', grid.best_estimator_.n_estimators
```

```
C:\Users\m\Anaconda2\lib\site-packages\sklearn\model_selection\_split.py:2052: FutureWarning: You should specify a value for 'cv' instead of relying on the default value. The default value will change from 3 to 5 in version 0.22.
  warnings.warn(CV_WARNING, FutureWarning)
C:\Users\m\Anaconda2\lib\site-packages\sklearn\model_selection\_split.py:651: Warning: The least populated class in y has only 1 members, which is too few. The minimum number of members in any class cannot be less than n_splits=3.
  % (min_groups, self.n_splits)), Warning)
GridSearchCV(cv='warn', error_score='raise-deprecating',
       estimator=RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators='warn', n_jobs=None,
            oob_score=False, random_state=47, verbose=0, warm_start=False),
       fit_params=None, iid='warn', n_jobs=None,
       param_grid={'n_estimators': [5, 10, 50, 100, 200, 300, 400, 1000]},
       pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
       scoring=None, verbose=0)
Grid Training Set Best Score:  0.9743589743589743
Grid Training Set Best Number of Trees Estimator:  50
C:\Users\m\Anaconda2\lib\site-packages\sklearn\model_selection\_search.py:842: DeprecationWarning: The default of the `iid` parameter will change from True to False in version 0.22 and will be removed in 0.24. This will change numeric results when test-set sizes are unequal.
  DeprecationWarning)
```

In [39]:

```
from sklearn.ensemble import RandomForestClassifier

from sklearn.model_selection import GridSearchCV


n_estimators_list = [5,10,50,100,200,300,400,1000]


rfc = RandomForestClassifier(random_state=47)

grid = GridSearchCV(estimator=rfc, param_grid=dict(n_estimators=n_estimators_list))
```

```
grid.fit(X_test_std, y_test)


print grid

# summarize the results of the grid search

print 'Grid Testing Set Best Score: ',grid.best_score_

print 'Grid Testing Set Best Number of Trees Estimator: ', grid.best_estimator_.n_esti
mators
```

```
C:\Users\m\Anaconda2\lib\site-packages\sklearn\model_selection\_search.py:842: Depreca
tionWarning: The default of the `iid` parameter will change from True to False in vers
ion 0.22 and will be removed in 0.24. This will change numeric results when test-set s
izes are unequal.
  DeprecationWarning)
GridSearchCV(cv='warn', error_score='raise-deprecating',
       estimator=RandomForestClassifier(bootstrap=True, class_weight=None, criterion='
gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators='warn', n_jobs=None,
            oob_score=False, random_state=47, verbose=0, warm_start=False),
       fit_params=None, iid='warn', n_jobs=None,
       param_grid={'n_estimators': [5, 10, 50, 100, 200, 300, 400, 1000]},
       pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
       scoring=None, verbose=0)
Grid Testing Set Best Score:  0.9411764705882353
Grid Testing Set Best Number of Trees Estimator:  100
```

In [40]:

```
from sklearn.ensemble import RandomForestClassifier

from sklearn.model_selection import GridSearchCV


n_estimators_list = [5,10,50,100,200,300,400,1000]


rfc = RandomForestClassifier(random_state=47)

grid = GridSearchCV(estimator=rfc, param_grid=dict(n_estimators=n_estimators_list))

#grid.fit(X_test_std, y_test)


grid.fit(X_train_std, y_train)

print grid

print 'Grid Training Set Best Score: ',grid.best_score_

print 'Grid Training Set Best Number of Trees Estimator: ', grid.best_estimator_.n_est
imators
```

```
C:\Users\m\Anaconda2\lib\site-packages\sklearn\model_selection\_search.py:842: Depreca
tionWarning: The default of the `iid` parameter will change from True to False in vers
ion 0.22 and will be removed in 0.24. This will change numeric results when test-set s
izes are unequal.
  DeprecationWarning)
GridSearchCV(cv='warn', error_score='raise-deprecating',
       estimator=RandomForestClassifier(bootstrap=True, class_weight=None, criterion='
gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators='warn', n_jobs=None,
            oob_score=False, random_state=47, verbose=0, warm_start=False),
       fit_params=None, iid='warn', n_jobs=None,
       param_grid={'n_estimators': [5, 10, 50, 100, 200, 300, 400, 1000]},
       pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
       scoring=None, verbose=0)
Grid Training Set Best Score:  0.9743589743589743
Grid Training Set Best Number of Trees Estimator:  50
```

In [ ]: