In [1]:
```
import pandas as pd
from matplotlib import pyplot as plt
from sklearn.metrics import classification_report
from matplotlib import pyplot as plt
import numpy as np
from sklearn.decomposition import PCA
```

In [2]:
```
dataset=pd.read_csv('breast-cancer-wisconsin.data')
dataset.shape
```

Out[2]:
```
(698, 11)
```

In [3]:
```
dataset.head()
```

Out[3]:

	1000025	5	1	1.1	1.2	2	1.3	3	1.4	1.5	2.1
0	1002945	5	4	4	5	7	10	3	2	1	2
1	1015425	3	1	1	1	2	2	3	1	1	2
2	1016277	6	8	8	1	3	4	3	7	1	2
3	1017023	4	1	1	3	2	1	3	1	1	2
4	1017122	8	10	10	8	7	10	9	7	1	4

In [4]:
```
dataset.columns = [['Id','clump_thickness','Uniformity_Cell_size','Uniformity_cell_shape','Marginal_adhesion','
```

In [5]:
```
dataset.head(10)
```

Out[5]:

	Id	clump_thickness	Uniformity_Cell_size	Uniformity_cell_shape	Marginal_adhesion	Single_e_cell_sixe	Bare_nuclei	Bland_chromatin	Nc
0	1002945	5	4	4	5	7	10	3	
1	1015425	3	1	1	1	2	2	3	
2	1016277	6	8	8	1	3	4	3	
3	1017023	4	1	1	3	2	1	3	
4	1017122	8	10	10	8	7	10	9	
5	1018099	1	1	1	1	2	10	3	
6	1018561	2	1	2	1	2	1	3	
7	1033078	2	1	1	1	2	1	1	
8	1033078	4	2	1	1	2	1	2	
9	1035283	1	1	1	1	1	1	3	

In [54]:
```
from sklearn.model_selection import train_test_split

X = np.array(dataset.iloc[:,2:5])
y = np.array(dataset['Class'])

# split into train and test
X_train, \
X_test, \
y_train, \
y_test = train_test_split(X, y, test_size=0.33, random_state=42)
```

In [55]:
```
X_test.shape
```

Out[55]:
```
(231, 3)
```

In [56]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import StandardScaler

knn = KNeighborsClassifier(n_neighbors=15)
knn.fit(X_train,y_train.ravel())
pred = knn.predict(X_test)
print("accuracy: {}".format(accuracy_score(y_test,pred)))
```

```
accuracy: 0.9523809523809523
```

In [57]:
```
classifier = KNeighborsClassifier(n_neighbors=5)
classifier.fit(X_train,y_train.ravel())
```

Out[57]:
```
KNeighborsClassifier()
```

In [58]:
```
from sklearn.model_selection import cross_val_score
neighbors = list(range(1, 20, 2))

# empty list that will hold cv scores
cv_scores = []

# perform 10-fold cross validation
for k in neighbors:
    knn = KNeighborsClassifier(n_neighbors=k)
    scores = cross_val_score(knn, X_train, y_train.ravel(), cv=2, scoring='accuracy')
    cv_scores.append(scores.mean())
print(cv_scores)
```

```
[0.9207567587395914, 0.9228751696562856, 0.9421884743773156, 0.9378966288837534, 0.9379057994937823, 0.9378966288837534, 0.9357507061369722, 0.9357598767470012, 0.9357507061369722, 0.9357507061369722]
```

In [59]:
```
y_pred = classifier.predict(X_test)
```

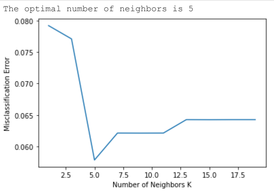
In [60]:
```
from sklearn.ensemble import RandomForestClassifier
```

In [61]:
```
# changing to misclassification error
mse = [1-x for x in cv_scores]


optimal_k = neighbors[mse.index(min(mse))]
print("The optimal number of neighbors is {}".format(optimal_k))

plt.plot(neighbors, mse)
plt.xlabel("Number of Neighbors K")
plt.ylabel("Misclassification Error")
plt.show()
```

```
The optimal number of neighbors is 5
```



In [62]:
```
from sklearn.metrics import classification_report,confusion_matrix
print(classification_report(y_test,y_pred))
print(confusion_matrix(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           2       0.98      0.95      0.97       149
           4       0.92      0.96      0.94        82

    accuracy                           0.96       231
   macro avg       0.95      0.96      0.95       231
weighted avg       0.96      0.96      0.96       231

[[142   7]
 [  3  79]]
```

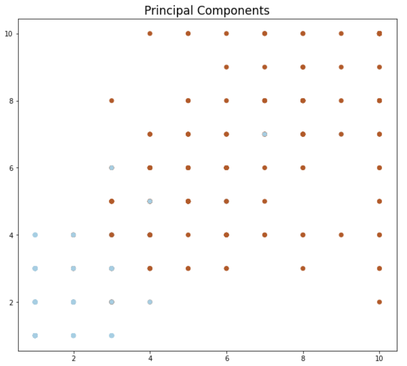
In [63]:
```
#Normalizing
sc = StandardScaler()
X_normalized = sc.fit_transform(X)
#Apply PCA
pca = PCA(n_components = 2).fit(X_normalized)
pca_X = pca.transform(X_normalized)
```

In [64]:
```
pca_X.shape
(569, 2)
```

Out[64]:
```
(569, 2)
```

In [65]:
```
import matplotlib.pyplot as plt
%matplotlib inline
plt.figure(figsize=(10,9))
plt.title("Principal Components", fontsize=17)
plt.scatter(X[:,0], X[:,1], c=y, cmap='Paired')
```

Out[65]:
```
<matplotlib.collections.PathCollection at 0x2510def8220>
```



In [66]:
```
X_train, X_test, y_train, y_test = train_test_split(pca_X, y, random_state=2)
clf = RandomForestClassifier(n_estimators=100, max_depth=4)
clf.fit(X_train, y_train.ravel())
print("Accuracy on training set {}".format(clf.score(X_train, y_train)))
y_pred = clf.predict(X_test)
print("Accuracy on test set {}".format(accuracy_score(y_test, y_pred)))
```

```
Accuracy on training set 0.9617590822179732
Accuracy on test set 0.9314285714285714
```

In [ ]:
```

```