a2_knn

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Exported from Jupyter Notebook. Please refer to report. 5dv124, Reza Firouzi (mrc20rfi), Derek Yadgaroff (mai20dyf)

import all dependencies we need for this assignment:

[1]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.datasets import *
import matplotlib.pyplot as plt
import numpy as np
```

Implement a k-NN training function and properly document the function signature:

[2]:
```
def train_knn(x_train, y_train, k):
    """
    Given training data (input and output), train a k-NN classifier.

    Input:    x/y_train - Two arrays of equal length, one with input data and
              one with the correct labels.
              k - number of neighbors considered when training the classifier.
    Returns:  The trained classifier
    """
    knn = KNeighborsClassifier(n_neighbors=k,n_jobs=-1)
    knn.fit(x_train, y_train)
    return knn
```

Implement knn evaluation function:

[3]:
```
def evaluate_knn(knn, x_train, y_train, x_test, y_test):
    """
    Given a trained classifier, its training data, and test data, calculate
    the accuracy on the training and test sets.

    Input:    knn - A trained k-nn classifier
              x/y_train - Training data
              x/y_test  - Test data

    Returns:  A tuple (train_acc, test_acc) with the resulting accuracies,
              obtained when using the classifier on the given data.
```

```
    """
    train_score = knn.score(x_train, y_train)
    test_score = knn.score(x_test, y_test)
    return (train_score, test_score)
```

Load a dataset (Iris or Breast Cancer)

[4]:
```
def load_dataset(name, features, test_size, random_state):
    """
    Loads the iris or breast cancer datasets with the given features and
    train/test ratio.

    Input:    name - Either "iris" or "breastcancer"
              features - An array with the indicies of the features to load
              test_size - How large part of the dataset to be used as test data.
                          0.33 would give a test set 33% of the total size.
    Returns:  Arrays x_train, x_test, y_train, y_test that correspond to the
              training/test sets.
    """
    # Load the dataset
    if name == "iris":
        dataset = load_iris()
    elif name == "breastcancer":
        dataset = load_breast_cancer()

    X = dataset.data[:,features]
    Y = dataset.target

    # Split the dataset into a training and a test set
    return train_test_split(X, Y, test_size=test_size,␣
↪random_state=random_state)
```

Take parameters and perform relevant machine learning tasks

[5]:
```
def train_and_evaluate(dataset_name, features, test_size, k_vals, random_state):
    """
    Controller for loading dataset with selected features, training and␣
↪evaluating the kclasifier,
    and returning their scores for specified number of k values

    Input:    dataset_name - Either "iris" or "breastcancer"
              features - An array with the indicies of the features to load
              test_size - How large part of the dataset to be used as test data.
                          0.33 would give a test set 33% of the total size.
              k_vals = Values of K to iterate over
    Returns:  Arrays train_scores and test_scores that correspond to the scores␣
↪for
```

```
            the evaluated test and train sets, the index of each element is␣
↪the value of
            k that the data was scored on.
    """

    # Load specified dataset and split into test/train
    x_train, x_test, y_train, y_test = load_dataset(dataset_name,features,␣
↪test_size, random_state)


    # Let's create some list to save the results in:
    train_scores = []
    test_scores = []

    # Using only odd values of K from 1 to k_max (which is 30), create and␣
↪train a kclasifier, evaluate the
    # score the test and train set, then append the scores to coressponding␣
↪lists
    for k in k_vals:
        knn = train_knn(x_train, y_train, k)
        knn_eval = evaluate_knn(knn, x_train, y_train, x_test, y_test)
        train_scores.append(knn_eval[0])
        test_scores.append(knn_eval[1])

    # return the lists of train and test scores for this data/parameter␣
↪configuration
    return train_scores, test_scores
```

Take in variables to plot the results

[6]:
```
def plot_dataset_results(dataset_name, features, test_size, train_scores,␣
↪test_scores, k_vals):
    """
    Takes the inputs and plots the data. The parameters are noted in the title␣
↪of the plot

    Input:    dataset_name - Either "iris" or "breastcancer"
              features - An array with the indicies of the features to load
              test_size - How large part of the dataset to be used as test data.
                          0.33 would give a test set 33% of the total size.
              train_scores, test_scores - the scores of the classifier being␣
↪evaluated
              for each corresponding k value
              k_vals = The values of k to run classifer on
    """
    # Put the parameters in the title of the plot for convenience
```

```
    plt.title('KNN results - ' + dataset_name + " - " + str(test_size) + " - "␣
↪+ str(len(features)) + " features")
    plt.xlabel('Number of Neighbors K')
    plt.ylabel('Accuracy')

    # Force the ticks on the x axis to match the values of k and not to skip␣
↪any ticks
    plt.xticks(k_vals)

    # Plot the test and training scores with labels
    plt.plot(k_vals, train_scores, label='Training score')
    plt.plot(k_vals, test_scores, label='Test score')

    # Show the figure
    plt.legend()
    plt.show()
```

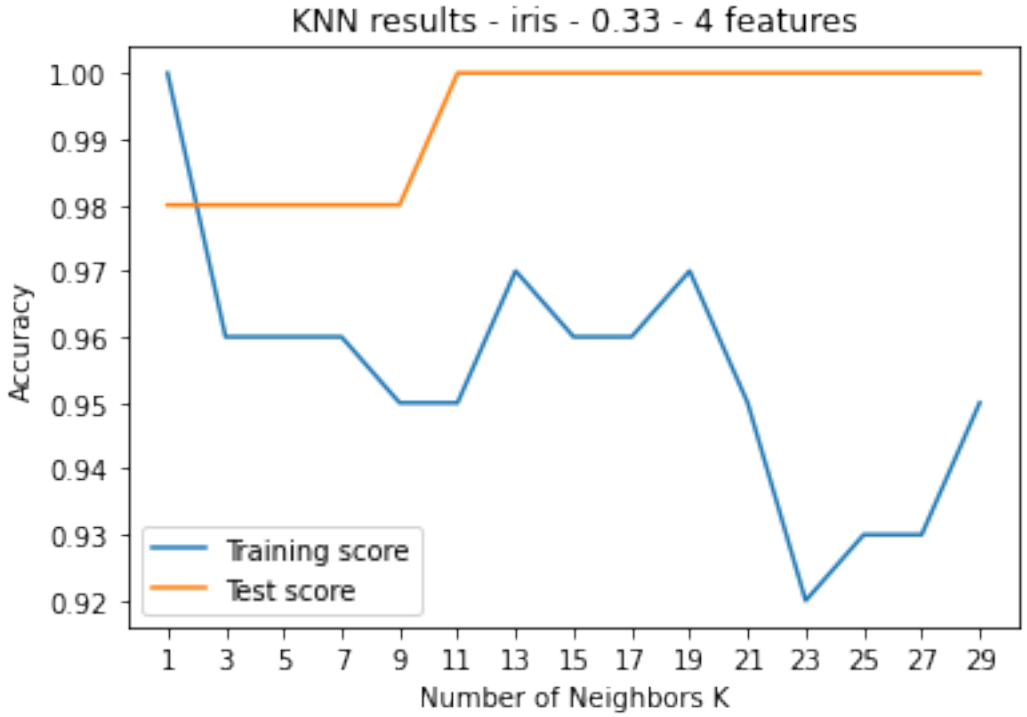
0.0.1 Setup Assignment Parameters, Train and Plot

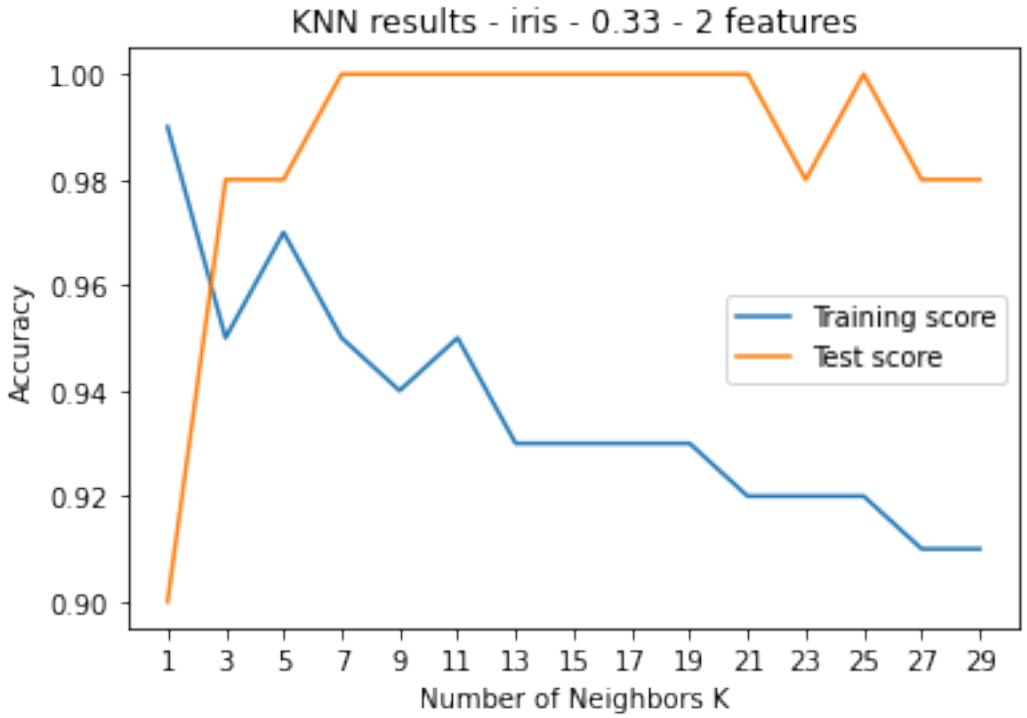
[15]:
```
# set vars
k_max=30
k_vals = np.arange(1, k_max, 2)
random_state=42
results = []
```

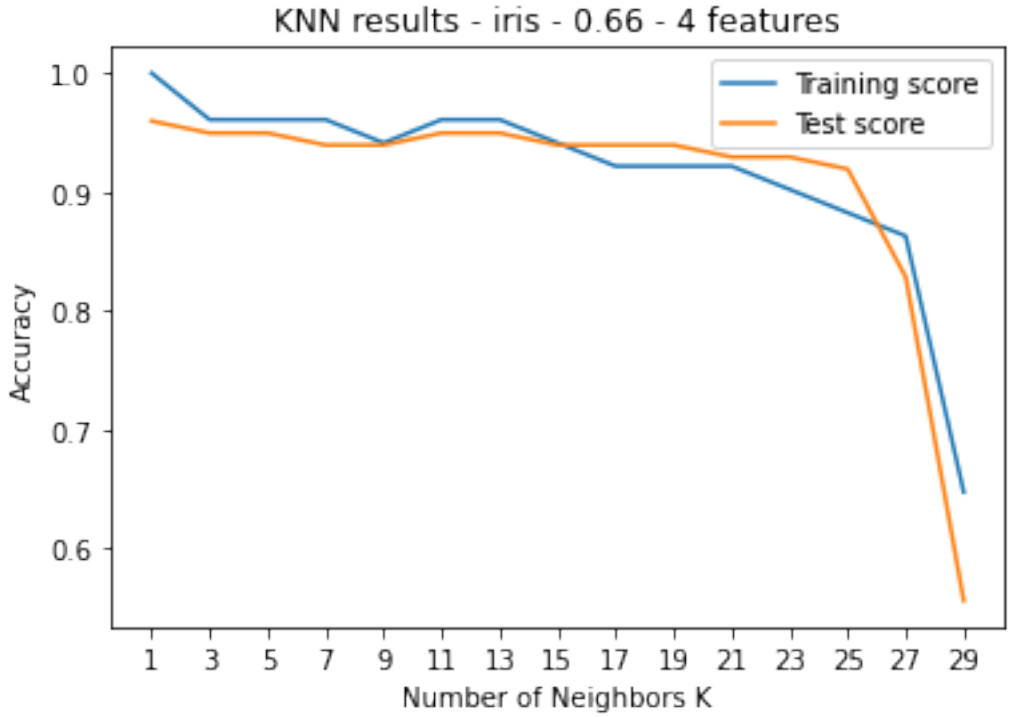
Iris

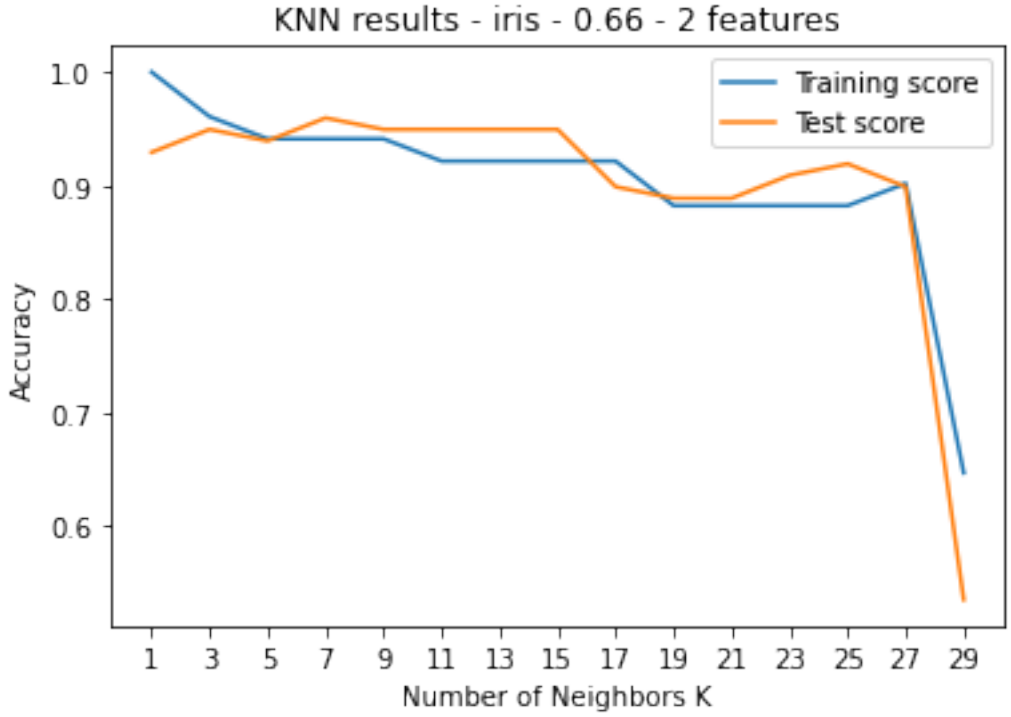
[14]:
```
# Create a list of all parameter combinations will run the classifier on
params = [("iris",[0,1,2,3], .33),
          ("iris",[0,2], .33),
          ("iris",[0,1,2,3], .66),
          ("iris",[0,2], .66)]
""",
          ("breastcancer",np.arange(30), .33),
          ("breastcancer",np.arange(10), .33),
          ("breastcancer",np.arange(30), .66),
          ("breastcancer",np.arange(10), .66)]"""



# Iterate through each parameter combination
for p in params:

    # Load data, train classifer, evaluate score
    results.append( train_and_evaluate(*p, k_vals=k_vals,␣
↪random_state=random_state))
```

```
    # Plot results
    plot_dataset_results(*p,*results[-1], k_vals=k_vals)
```



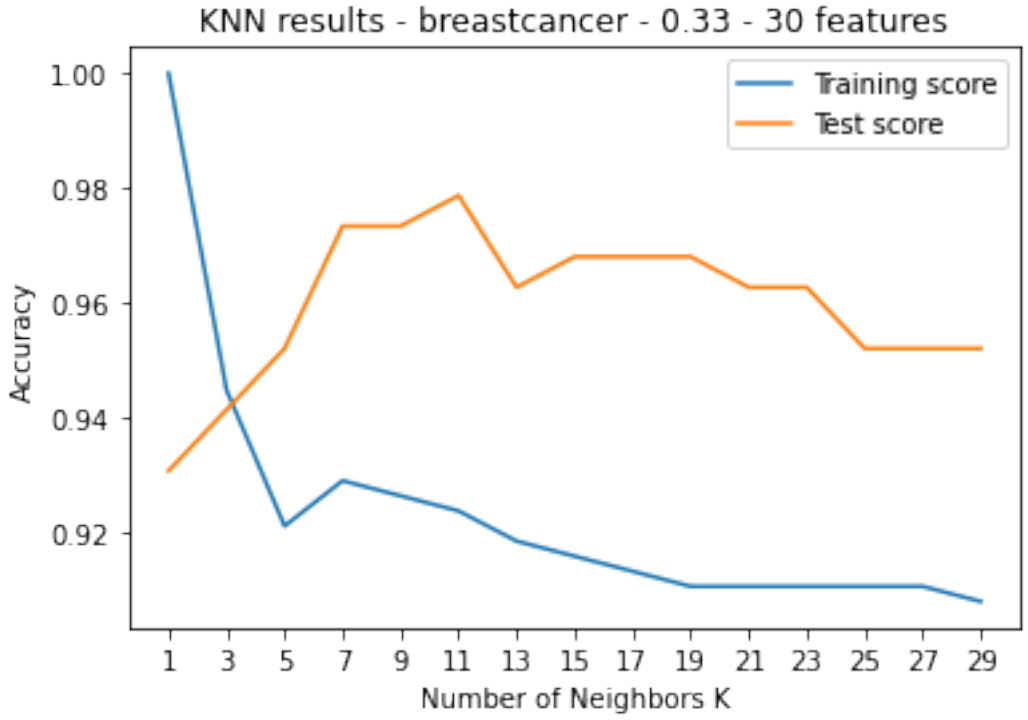


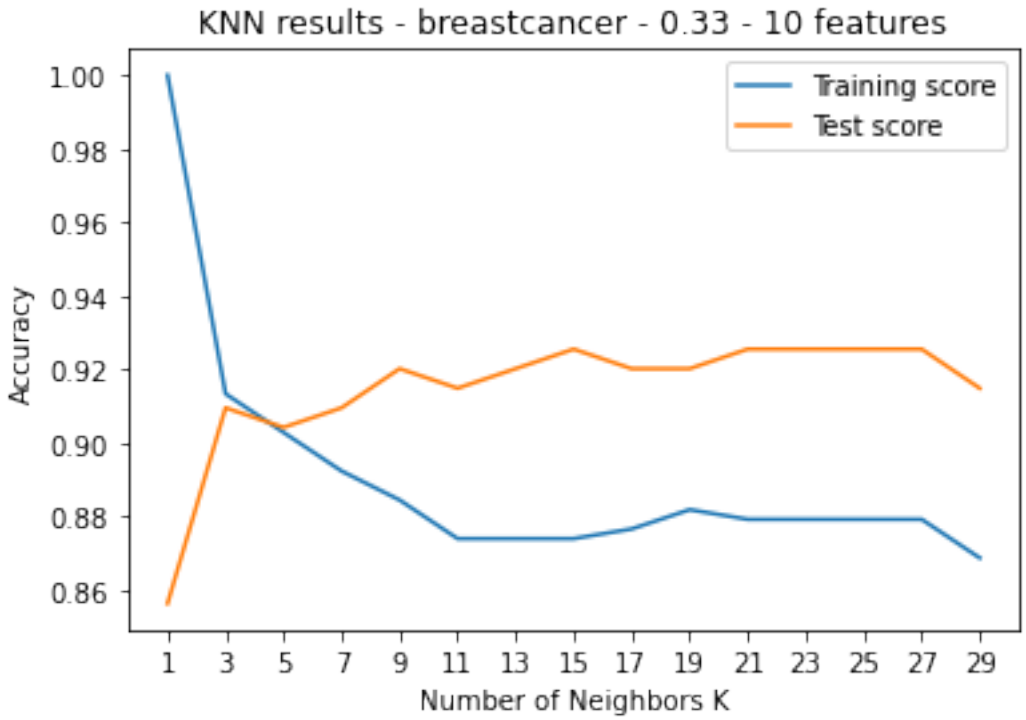

KNN results - iris - 0.66 - 4 features
Training score
Test score
Accuracy
1.0
0.9
0.8
0.7
0.6
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Number of Neighbors K

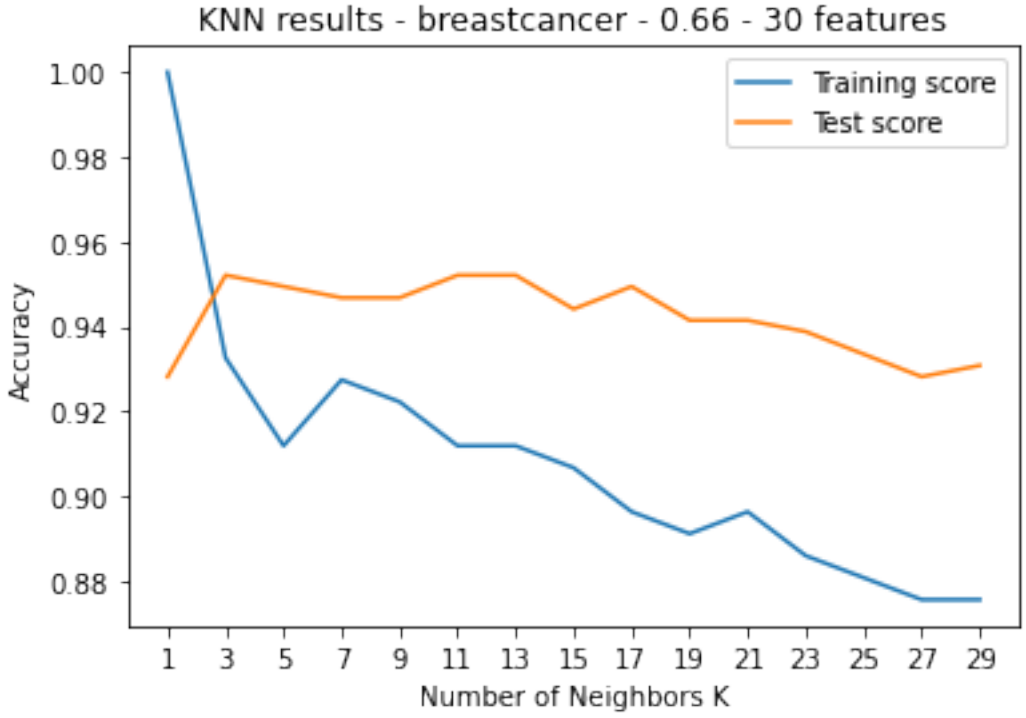

KNN results - iris - 0.66 - 2 features
Training score
Test score
Accuracy
1.0
0.9
0.8
0.7
0.6
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Number of Neighbors K

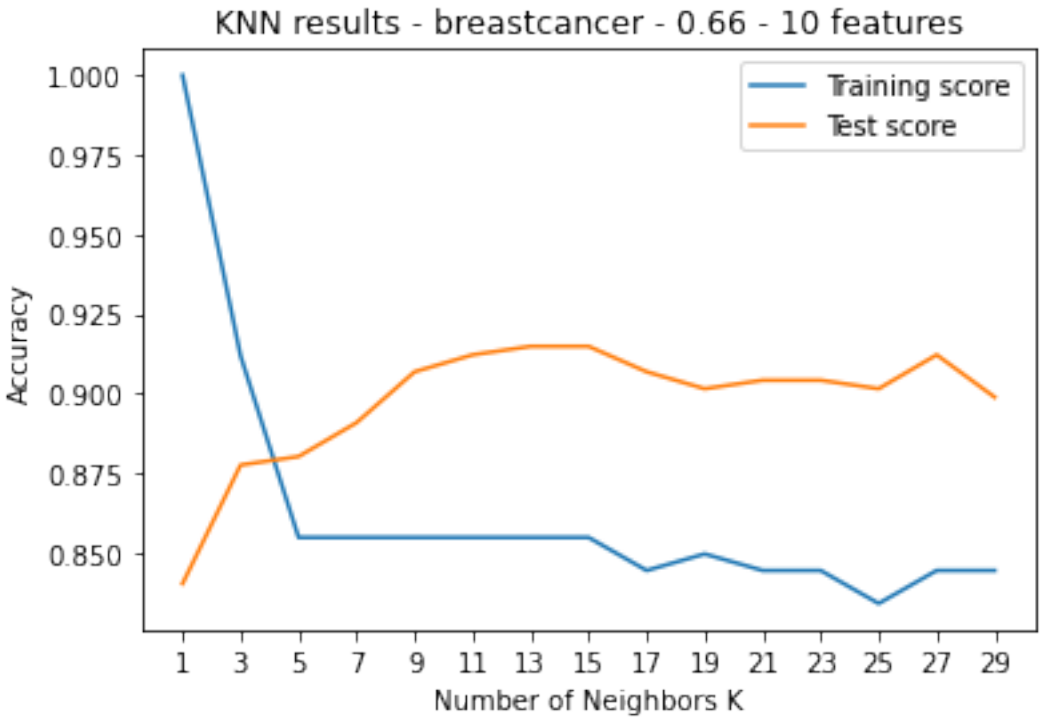
Breast Cancer

[17]:
```
# Create a list of all parameter combinations will run the classifier on
params = [("breastcancer",np.arange(30), .33),
          ("breastcancer",np.arange(10), .33),
          ("breastcancer",np.arange(30), .66),
          ("breastcancer",np.arange(10), .66)]



# Iterate through each parameter combination
for p in params:

    # Load data, train classifer, evaluate score
    results.append( train_and_evaluate(*p, k_vals=k_vals,␣
 ↪random_state=random_state))

    # Plot results
    plot_dataset_results(*p,*results[-1], k_vals=k_vals)
```




KNN results - breastcancer - 0.33 - 10 features
Training score
Test score
Accuracy
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Number of Neighbors K


KNN results - breastcancer - 0.66 - 30 features
Training score
Test score
Accuracy
1.00
0.98
0.96
0.94
0.92
0.90
0.88
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Number of Neighbors K


KNN results - breastcancer - 0.66 - 10 features
Training score
Test score
Accuracy
1.000
0.975
0.950
0.925
0.900
0.875
0.850
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
Number of Neighbors K