INTRODUCTION TO MACHINE LEARNING

Import Library

In [1]:
```
import numpy as np
import pandas as pd
```

Supervised Learning

Import Data

In [2]:
```
dataset = pd.read_csv(r"D:\SEMESTER 4\IS411 Data Modelling\LAB\Bahan Modul 7\winequality-red.csv", delimiter=';')
dataset.head(5)
```

Out[2]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8	5
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8	5
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8	6
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5

In [3]:
```
print(dataset.groupby('quality').size())
dataset.info()
```

```
quality
3     10
4     53
5    681
6    638
7    199
8     18
dtype: int64
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   fixed acidity         1599 non-null   float64
 1   volatile acidity      1599 non-null   float64
 2   citric acid           1599 non-null   float64
 3   residual sugar        1599 non-null   float64
 4   chlorides             1599 non-null   float64
 5   free sulfur dioxide   1599 non-null   float64
 6   total sulfur dioxide  1599 non-null   float64
 7   density               1599 non-null   float64
 8   pH                    1599 non-null   float64
 9   sulphates             1599 non-null   float64
 10  alcohol               1599 non-null   float64
 11  quality               1599 non-null   int64  
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

In [4]:
```
#memisahkan kolum independent variable dengan dependent variable

redwine = dataset.copy()
Y = redwine['quality']
X = redwine.drop(columns = 'quality')
```

In [5]:
```
#membagi data menjadi 2 bagian, untuk training dan testing dengan bantuan library
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.2, random_state=0)
```

Logistic Regression

In [6]:
```
from sklearn.linear_model import LogisticRegression

logreg = LogisticRegression()
logreg.fit(X_train, y_train)
print('Accuracy of Logistic regression classifier on training set: {:.2f}'.format(logreg.score(X_train, y_train)))
print('Accuracy of Logistic regression classifier on test set: {:.2f}'.format(logreg.score(X_test, y_test)))
```

```
Accuracy of Logistic regression classifier on training set: 0.58
Accuracy of Logistic regression classifier on test set: 0.62
```

```
C:\Users\Darren\anaconda3\lib\site-packages\sklearn\linear_model\_logistic.py:814: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

Decision Tree

In [7]:
```
from sklearn.tree import DecisionTreeClassifier

clf = DecisionTreeClassifier()
clf.fit(X_train, y_train)
print('Accuracy of Decision Tree Classifier on training set: {:.2f}'.format(clf.score(X_train, y_train)))
print('Accuracy of Decision Tree Classifier on test set: {:.2f}'.format(clf.score(X_test, y_test)))
```

```
Accuracy of Decision Tree Classifier on training set: 1.00
Accuracy of Decision Tree Classifier on test set: 0.69
```

KNN

In [8]:
```
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier()
knn.fit(X_train, y_train)
print('Accuracy of K-NN classifier on training set: {:.2f}'.format(knn.score(X_train, y_train)))
print('Accuracy of K-NN classifier on test set: {:.2f}'.format(knn.score(X_test, y_test)))
```

```
Accuracy of K-NN classifier on training set: 0.66
Accuracy of K-NN classifier on test set: 0.48
```

Naive Bayes

In [9]:
```
from sklearn.naive_bayes import GaussianNB

gnb = GaussianNB()
gnb.fit(X_train, y_train)
print('Accuracy of GNB classifier on training set: {:.2f}'.format(gnb.score(X_train, y_train)))
print('Accuracy of GNB classifier on test set: {:.2f}'.format(gnb.score(X_train, y_train)))
```

```
Accuracy of GNB classifier on training set: 0.55
Accuracy of GNB classifier on test set: 0.55
```

Challenge

In [10]:
```
#Cobalah hilangkan data dengan kualitas 3,4,7, dan 8 sehingga data hanya memiliki 2 output kategori, dan
#bagaimana hasil prediksinya? Manakah prediksi data yang lebih baik? (Boleh pilih gunakan salah satu algoritma).

df_filtered = dataset[~dataset['quality'].isin([3, 4, 7, 8])]
```

In [11]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
```

In [12]:
```
X = df_filtered.drop('quality', axis=1)
y = df_filtered['quality']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

In [13]:
```
rf = RandomForestClassifier(n_estimators=100, random_state=42)

rf.fit(X_train, y_train)

y_pred = rf.predict(X_test)

accuracy = accuracy_score(y_test, y_pred)
print("Accuracy: {:.2f}%".format(accuracy * 100))
```

```
Accuracy: 76.89%
```

Unsupervised learning

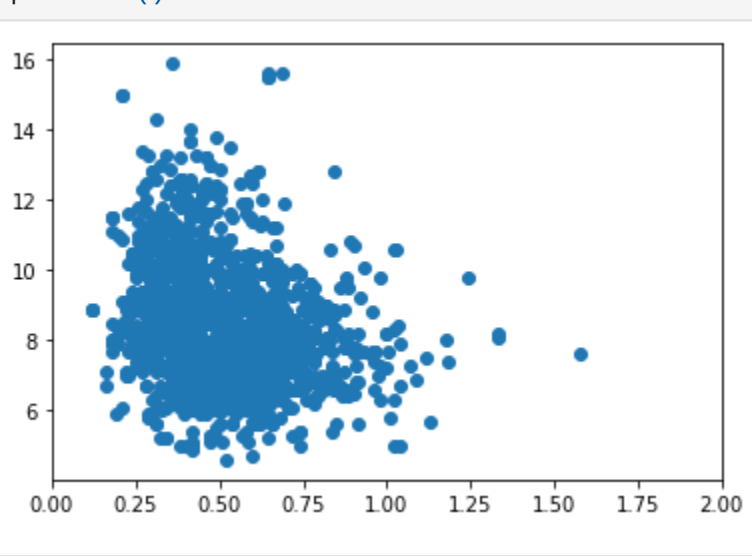
In [14]:
```
winecluster = dataset.copy()
winecluster = winecluster.drop(columns='quality')
winecluster
```

Out[14]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol
0	7.4	0.700	0.00	1.9	0.076	11.0	34.0	0.99780	3.51	0.56	9.4
1	7.8	0.880	0.00	2.6	0.098	25.0	67.0	0.99680	3.20	0.68	9.8
2	7.8	0.760	0.04	2.3	0.092	15.0	54.0	0.99700	3.26	0.65	9.8
3	11.2	0.280	0.56	1.9	0.075	17.0	60.0	0.99800	3.16	0.58	9.8
4	7.4	0.700	0.00	1.9	0.076	11.0	34.0	0.99780	3.51	0.56	9.4
...	...	...	...	...	...	...	...	...	...	...	...
1594	6.2	0.600	0.08	2.0	0.090	32.0	44.0	0.99490	3.45	0.58	10.5
1595	5.9	0.550	0.10	2.2	0.062	39.0	51.0	0.99512	3.52	0.76	11.2
1596	6.3	0.510	0.13	2.3	0.076	29.0	40.0	0.99574	3.42	0.75	11.0
1597	5.9	0.645	0.12	2.0	0.075	32.0	44.0	0.99547	3.57	0.71	10.2
1598	6.0	0.310	0.47	3.6	0.067	18.0	42.0	0.99549	3.39	0.66	11.0

1599 rows × 11 columns

In [15]:
```
#menggunakan grafik
import matplotlib.pyplot as plt

plt.scatter(winecluster['volatile acidity'], winecluster['fixed acidity'])
plt.xlim(0,2)
plt.show()
```

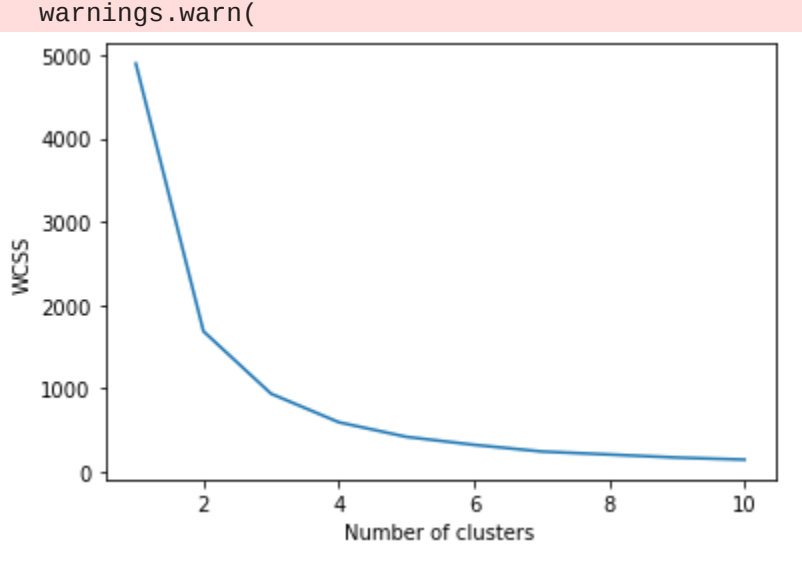


In [16]:
```
x = dataset.iloc[:,0:2]
x.info()

from sklearn.cluster import KMeans
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 2 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   fixed acidity     1599 non-null   float64
 1   volatile acidity  1599 non-null   float64
dtypes: float64(2)
memory usage: 25.1 KB
```

In [17]:
```
wcss = []
for i in range(1,11):
    kmeans = KMeans(n_clusters = i, init='k-means++', random_state = 42)
    kmeans.fit(x)
    wcss.append(kmeans.inertia_)

plt.plot(range(1,11), wcss)
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
```

```
C:\Users\Darren\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=7.
  warnings.warn(
```

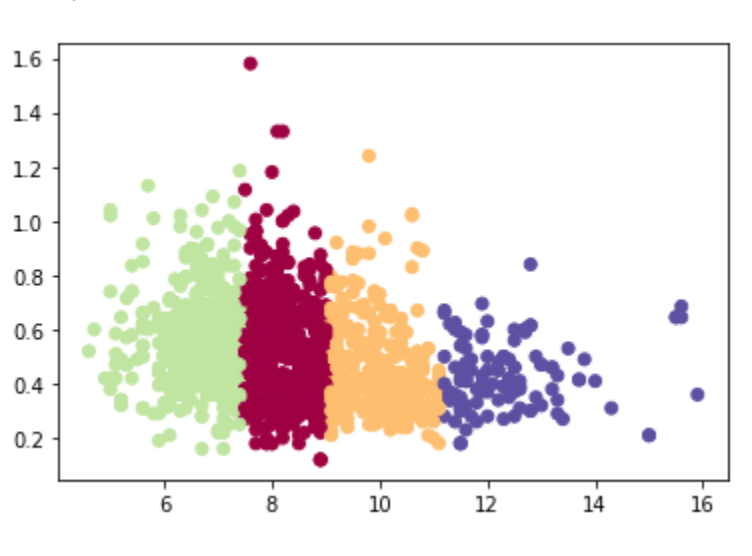


In [18]:
```
kmeans = KMeans(4)
kmeans.fit(x)

identified_clusters = kmeans.fit_predict(x)
identified_clusters
```

Out[18]:
```
array([2, 0, 0, ..., 2, 2, 2])
```

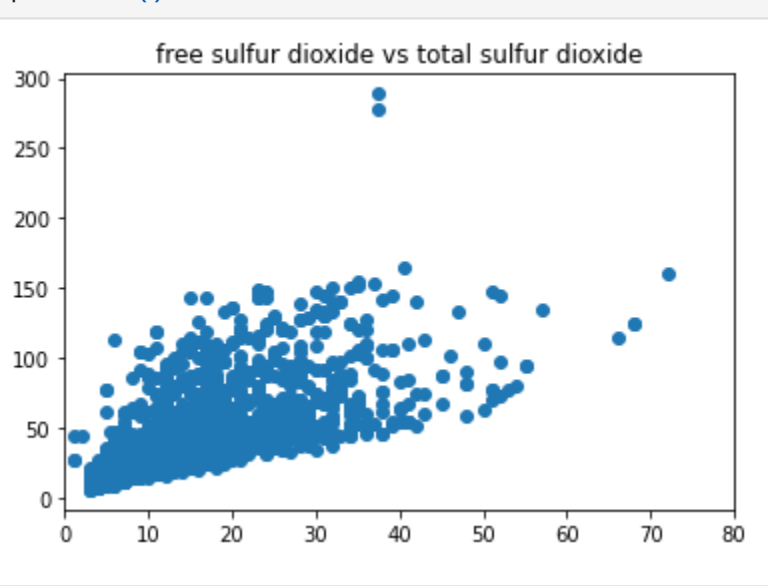
In [19]:
```
wine_clusters = winecluster.copy()
wine_clusters['Clusters'] = identified_clusters
plt.scatter(winecluster['fixed acidity'], winecluster['volatile acidity'], c=wine_clusters['Clusters'],cmap='Spectral')
```

Out[19]:
```
<matplotlib.collections.PathCollection at 0x17fa05a1550>
```



Challenge

In [20]:
```
#Coba lakukan clustering berdasarkan pada kolom free sulfur dioxide dan
#total sulfur dioxide, dan tampilkan hasilnya. Apakah nilai K-nya sama dengan clustering sebelumnya?

import matplotlib.pyplot as plt

plt.scatter(winecluster['free sulfur dioxide'], winecluster['total sulfur dioxide'])
plt.xlim(0,80)
plt.title('free sulfur dioxide vs total sulfur dioxide')
plt.show()
```



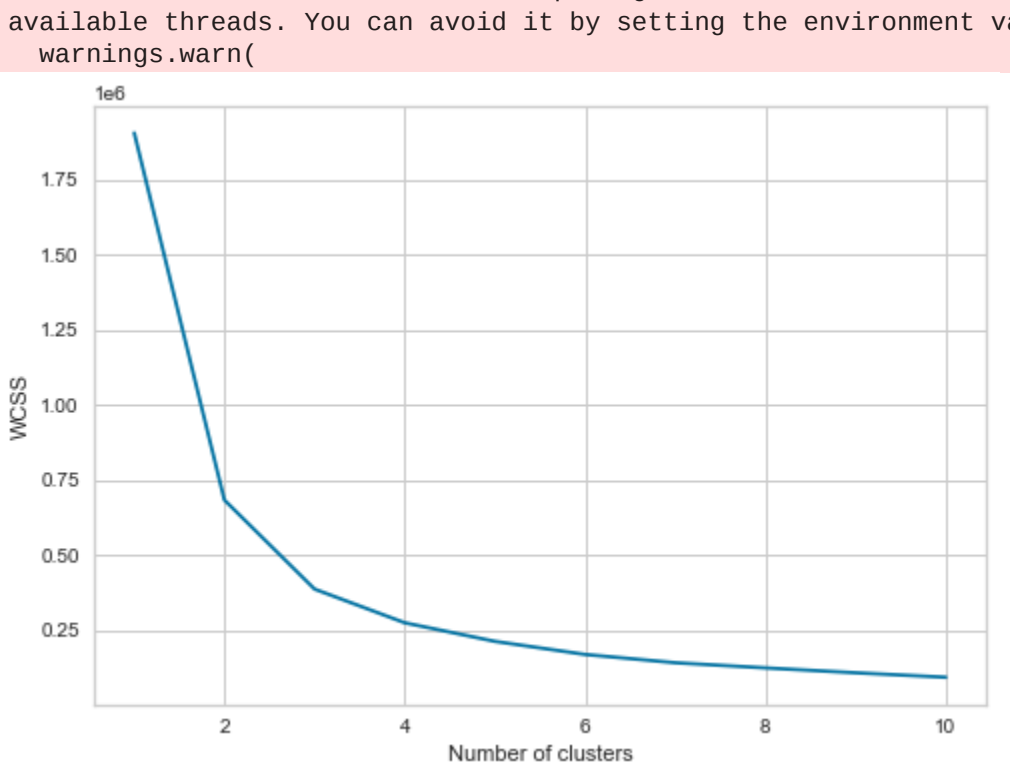
In [21]:
```
x2 = dataset.iloc[:,5:7]
x2.info()

from sklearn.cluster import KMeans
```

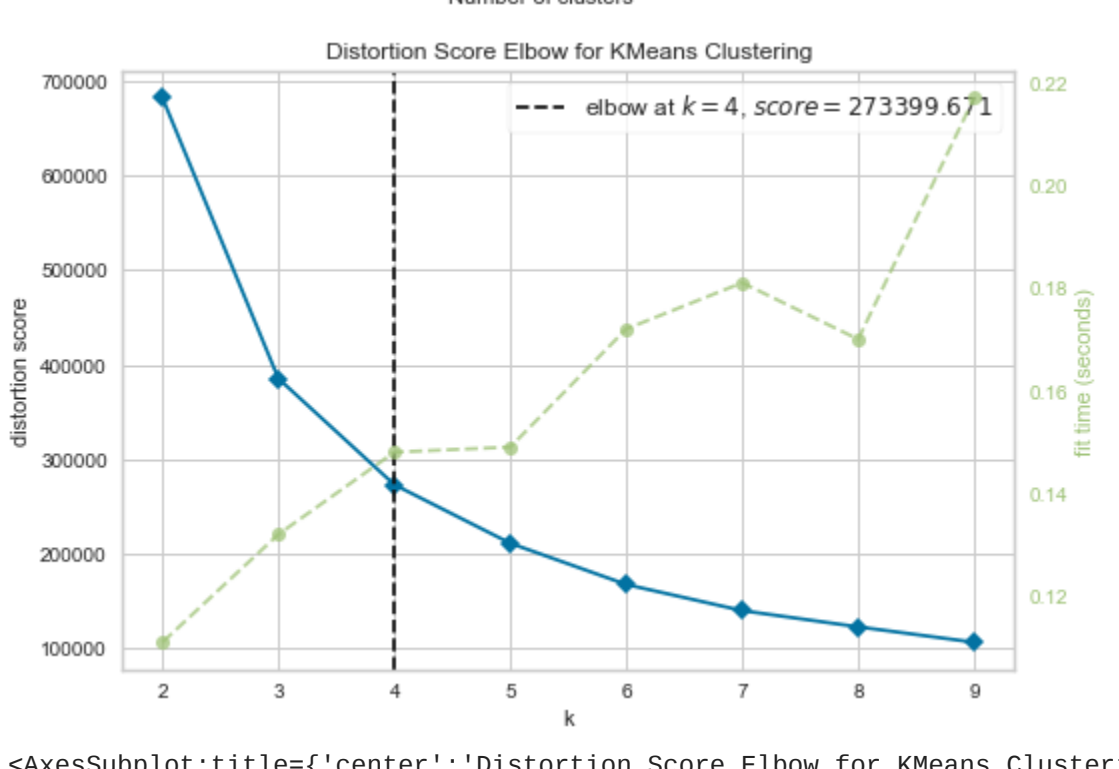
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 2 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   free sulfur dioxide   1599 non-null   float64
 1   total sulfur dioxide  1599 non-null   float64
dtypes: float64(2)
memory usage: 25.1 KB
```

In [22]:
```
#!pip install yellowbrick
```

In [23]:
```
from yellowbrick.cluster import KElbowVisualizer

wcss2 = []
for i in range(1,11):
    kmeans2 = KMeans(n_clusters = i, init='k-means++', random_state = 42)
    kmeans2.fit(x2)
    wcss2.append(kmeans2.inertia_)

visualizer = KElbowVisualizer(kmeans2, k=(2,10))


plt.plot(range(1,11), wcss2)
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
visualizer.fit(x2)
visualizer.show()
```

```
C:\Users\Darren\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=7.
  warnings.warn(
```





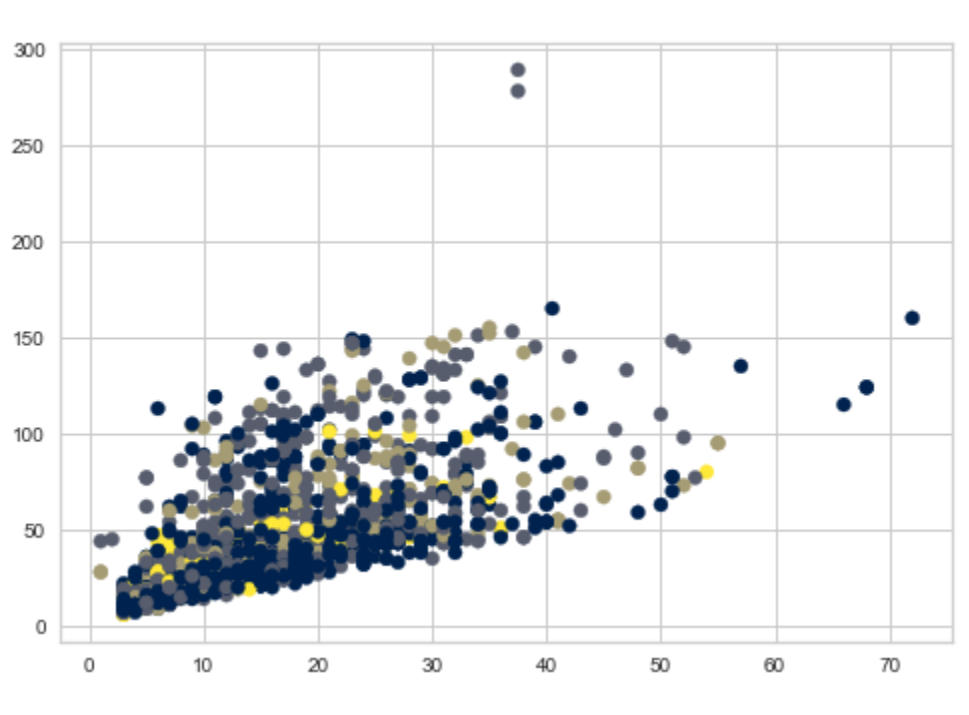
Out[23]:
```
<AxesSubplot:title={'center':'Distortion Score Elbow for KMeans Clustering'}, xlabel='k', ylabel='distortion score'>
```

In [24]:
```
kmeans2 = KMeans(4)
kmeans2.fit(x2)

identified_clusters2 = kmeans2.fit_predict(x)
identified_clusters2
```

Out[24]:
```
array([1, 1, 1, ..., 0, 0, 0])
```

In [25]:
```
wine_clusters2 = winecluster.copy()
wine_clusters2['Clusters'] = identified_clusters2
plt.scatter(winecluster['free sulfur dioxide'], winecluster['total sulfur dioxide'], c=wine_clusters2['Clusters'],cmap='cividis')
```

Out[25]:
```
<matplotlib.collections.PathCollection at 0x17fa0549070>
```



White Data wine

In [26]:
```
#Cobalah lakukan clustering pada data whitewine dan bandingkan hasilnya.
datasetwhiteclus = pd.read_csv(r"D:\SEMESTER 4\IS411 Data Modelling\LAB\Bahan Modul 7\winequality-white.csv")
datasetwhiteclus.head(5)
```

Out[26]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	7.0	0.27	0.36	20.7	0.045	45.0	170.0	1.0010	3.00	0.45	8.8	6
1	6.3	0.30	0.34	1.6	0.049	14.0	132.0	0.9940	3.30	0.49	9.5	6
2	8.1	0.28	0.40	6.9	0.050	30.0	97.0	0.9951	3.26	0.44	10.1	6
3	7.2	0.23	0.32	8.5	0.058	47.0	186.0	0.9956	3.19	0.40	9.9	6
4	7.2	0.23	0.32	8.5	0.058	47.0	186.0	0.9956	3.19	0.40	9.9	6

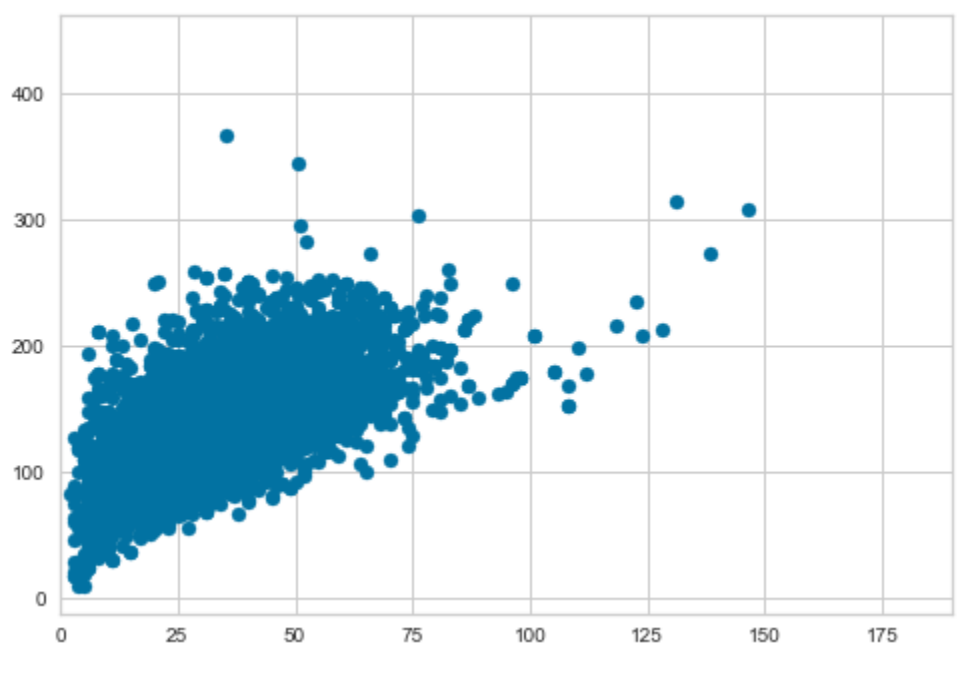
In [27]:
```
datasetwhiteclus_ = datasetwhiteclus.drop(columns='quality')
datasetwhiteclus_
```

Out[27]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol
0	7.0	0.27	0.36	20.7	0.045	45.0	170.0	1.00100	3.00	0.45	8.8
1	6.3	0.30	0.34	1.6	0.049	14.0	132.0	0.99400	3.30	0.49	9.5
2	8.1	0.28	0.40	6.9	0.050	30.0	97.0	0.99510	3.26	0.44	10.1
3	7.2	0.23	0.32	8.5	0.058	47.0	186.0	0.99560	3.19	0.40	9.9
4	7.2	0.23	0.32	8.5	0.058	47.0	186.0	0.99560	3.19	0.40	9.9
...	...	...	...	...	...	...	...	...	...	...	...
4893	6.2	0.21	0.29	1.6	0.039	24.0	92.0	0.99114	3.27	0.50	11.2
4894	6.6	0.32	0.36	8.0	0.047	57.0	168.0	0.99490	3.15	0.46	9.6
4895	6.5	0.24	0.19	1.2	0.041	30.0	111.0	0.99254	2.99	0.46	9.4
4896	5.5	0.29	0.30	1.1	0.022	20.0	110.0	0.98869	3.34	0.38	12.8
4897	6.0	0.21	0.38	0.8	0.020	22.0	98.0	0.98941	3.26	0.32	11.8

4898 rows × 11 columns

In [28]:
```
#menggunakan grafik
import matplotlib.pyplot as plt

plt.scatter(datasetwhiteclus_['free sulfur dioxide'], datasetwhiteclus['total sulfur dioxide'])
plt.xlim(0,190)
plt.show()
```

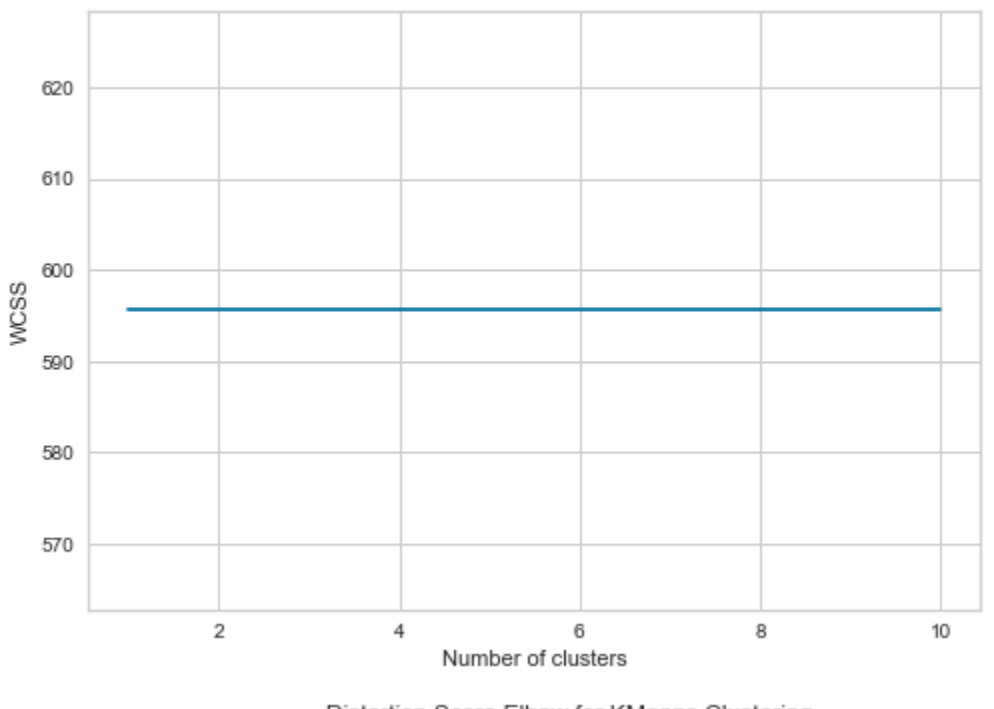


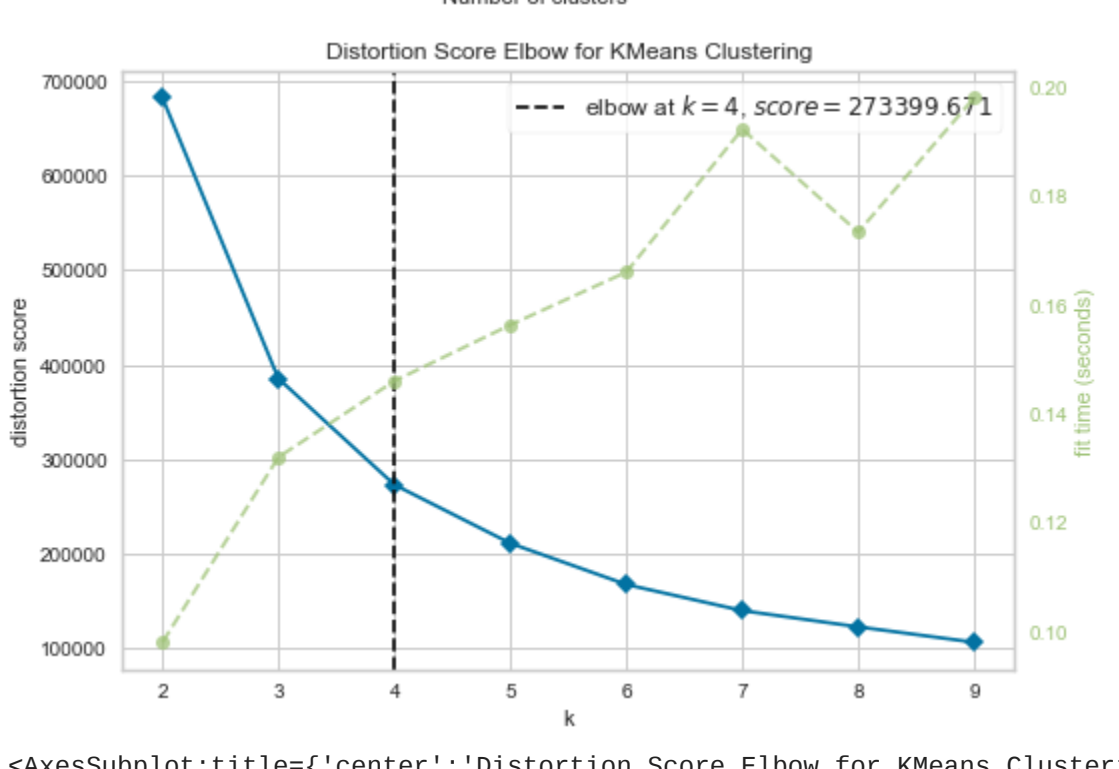
In [29]:
```
x3 = dataset.iloc[:,5:7]
x3.info()

from sklearn.cluster import KMeans
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 2 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   free sulfur dioxide   1599 non-null   float64
 1   total sulfur dioxide  1599 non-null   float64
dtypes: float64(2)
memory usage: 25.1 KB
```

In [30]:
```
from yellowbrick.cluster import KElbowVisualizer

wcss3 = []
for i in range(1,11):
    kmeans3 = KMeans(n_clusters = i, init='k-means++', random_state = 42)
    kmeans3.fit(x3)
    wcss3.append(kmeans2.inertia_)

visualizer = KElbowVisualizer(kmeans3, k=(2,10))

plt.plot(range(1,11), wcss3)
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
visualizer.fit(x3)
visualizer.show()
```

```
C:\Users\Darren\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=7.
  warnings.warn(
```





Out[30]:
```
<AxesSubplot:title={'center':'Distortion Score Elbow for KMeans Clustering'}, xlabel='k', ylabel='distortion score'>
```

In [31]:
```
kmeans3 = KMeans(4)
kmeans3.fit(x3)

identified_clusters3 = kmeans3.fit_predict(x3)
identified_clusters3
```

Out[31]:
```
array([1, 3, 0, ..., 0, 0, 0])
```

In [32]:
```
wine_clusters3 = datasetwhiteclus_.copy()
wine_clusters3['Clusters'] = identified_clusters3
plt.scatter(datasetwhiteclus_['free sulfur dioxide'], datasetwhiteclus_['total sulfur dioxide'], c=wine_clusters3['Clusters'],cmap='plasma')
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Input In [32], in <cell line: 2>()
      1 wine_clusters3 = datasetwhiteclus_.copy()
----> 2 wine_clusters3['Clusters'] = identified_clusters3
      3 plt.scatter(datasetwhiteclus_['free sulfur dioxide'], datasetwhiteclus_['total sulfur dioxide'], c=wine_clusters3['Clusters'],cmap='plasma')

File ~\anaconda3\lib\site-packages\pandas\core\frame.py:3655, in DataFrame.__setitem__(self, key, value)
   3652     self._setitem_array([key], value)
   3653 else:
   3654     # set column
-> 3655     self._set_item(key, value)

File ~\anaconda3\lib\site-packages\pandas\core\frame.py:3832, in DataFrame._set_item(self, key, value)
   3822 def _set_item(self, key, value) -> None:
   3823     """
   3824     Add series to DataFrame in specified column.
   3825 
   (...)
   3830     ensure homogeneity.
   3831     """
-> 3832     value = self._sanitize_column(value)
   3834     if (
   3835         key in self.columns
   3836         and value.ndim == 1
   3837         and not is_extension_array_dtype(value)
   3838     ):
   3839         # broadcast across multiple columns if necessary
   3840         if not self.columns.is_unique or isinstance(self.columns, MultiIndex):

File ~\anaconda3\lib\site-packages\pandas\core\frame.py:4535, in DataFrame._sanitize_column(self, value)
   4532     return _reindex_for_setitem(value, self.index)
   4534 if is_list_like(value):
-> 4535     com.require_length_match(value, self.index)
   4536 return sanitize_array(value, self.index, copy=True, allow_2d=True)

File ~\anaconda3\lib\site-packages\pandas\core\common.py:557, in require_length_match(data, index)
    553 """
    554 Check the length of data matches the length of the index.
    555 """
    556 if len(data) != len(index):
--> 557     raise ValueError(
    558         "Length of values "
    559         f"({len(data)}) "
    560         "does not match length of index "
    561         f"({len(index)})"
    562     )

ValueError: Length of values (1599) does not match length of index (4898)
```

In [ ]:
```
!jupyter nbconvert --to html "./00000054804_Christopher Darren_Week7.ipynb" --output-dir="./"
```