K Nearest Neighbors(K-NN)

Import Libraries

In [12]:

```
import pandas as pd
import numpy as np

import seaborn as sns
import matplotlib.pylab as plt

%matplotlib inline
```

Get the Data

In [13]:

```
glass_data = pd.read_csv("glass.csv")
```

In [14]:

```
glass_data.head()
```

Out[14]:

	RI	Na	Mg	Al	Si	K	Ca	Ba	Fe	Type
0	1.52101	13.64	4.49	1.10	71.78	0.06	8.75	0.0	0.0	1
1	1.51761	13.89	3.60	1.36	72.73	0.48	7.83	0.0	0.0	1
2	1.51618	13.53	3.55	1.54	72.99	0.39	7.78	0.0	0.0	1
3	1.51766	13.21	3.69	1.29	72.61	0.57	8.22	0.0	0.0	1
4	1.51742	13.27	3.62	1.24	73.08	0.55	8.07	0.0	0.0	1

In [15]:

```
glass_data.describe().transpose()
```

Out[15]:

	count	mean	std	min	25%	50%	75%	max
RI	214.0	1.518365	0.003037	1.51115	1.516522	1.51768	1.519157	1.53393
Na	214.0	13.407850	0.816604	10.73000	12.907500	13.30000	13.825000	17.38000
Mg	214.0	2.684533	1.442408	0.00000	2.115000	3.48000	3.600000	4.49000
Al	214.0	1.444907	0.499270	0.29000	1.190000	1.36000	1.630000	3.50000
Si	214.0	72.650935	0.774546	69.81000	72.280000	72.79000	73.087500	75.41000
K	214.0	0.497056	0.652192	0.00000	0.122500	0.55500	0.610000	6.21000
Ca	214.0	8.956963	1.423153	5.43000	8.240000	8.60000	9.172500	16.19000
Ba	214.0	0.175047	0.497219	0.00000	0.000000	0.00000	0.000000	3.15000
Fe	214.0	0.057009	0.097439	0.00000	0.000000	0.00000	0.100000	0.51000
Type	214.0	2.780374	2.103739	1.00000	1.000000	2.00000	3.000000	7.00000

In [16]:

```
glass_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 214 entries, 0 to 213
Data columns (total 10 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   RI      214 non-null    float64
 1   Na      214 non-null    float64
 2   Mg      214 non-null    float64
 3   Al      214 non-null    float64
 4   Si      214 non-null    float64
 5   K       214 non-null    float64
 6   Ca      214 non-null    float64
 7   Ba      214 non-null    float64
 8   Fe      214 non-null    float64
 9   Type    214 non-null    int64  
dtypes: float64(9), int64(1)
memory usage: 16.8 KB
```

In [17]:

```
glass_data.isnull().sum()
```

Out[17]:

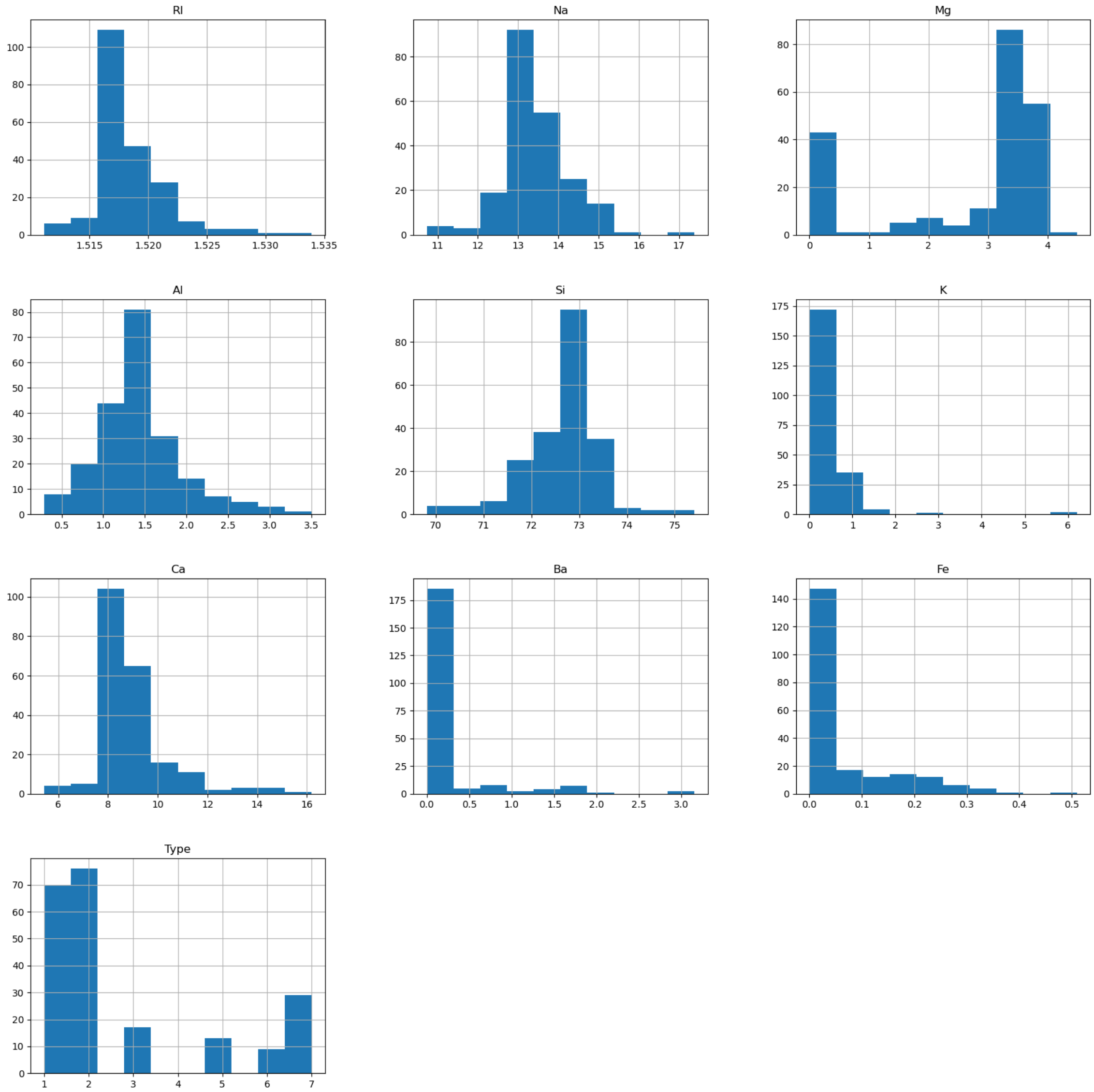
```
RI      0
Na      0
Mg      0
Al      0
Si      0
K       0
Ca      0
Ba      0
Fe      0
Type    0
dtype: int64
```

In [18]:

```python
glass_data.hist(figsize=(20,20))
```

Out[18]:

```
array([[<Axes: title={'center': 'RI'}>, <Axes: title={'center': 'Na'}>,
        <Axes: title={'center': 'Mg'}>],
       [<Axes: title={'center': 'Al'}>, <Axes: title={'center': 'Si'}>,
        <Axes: title={'center': 'K'}>],
       [<Axes: title={'center': 'Ca'}>, <Axes: title={'center': 'Ba'}>,
        <Axes: title={'center': 'Fe'}>],
       [<Axes: title={'center': 'Type'}>, <Axes: >, <Axes: >]],
      dtype=object)
```

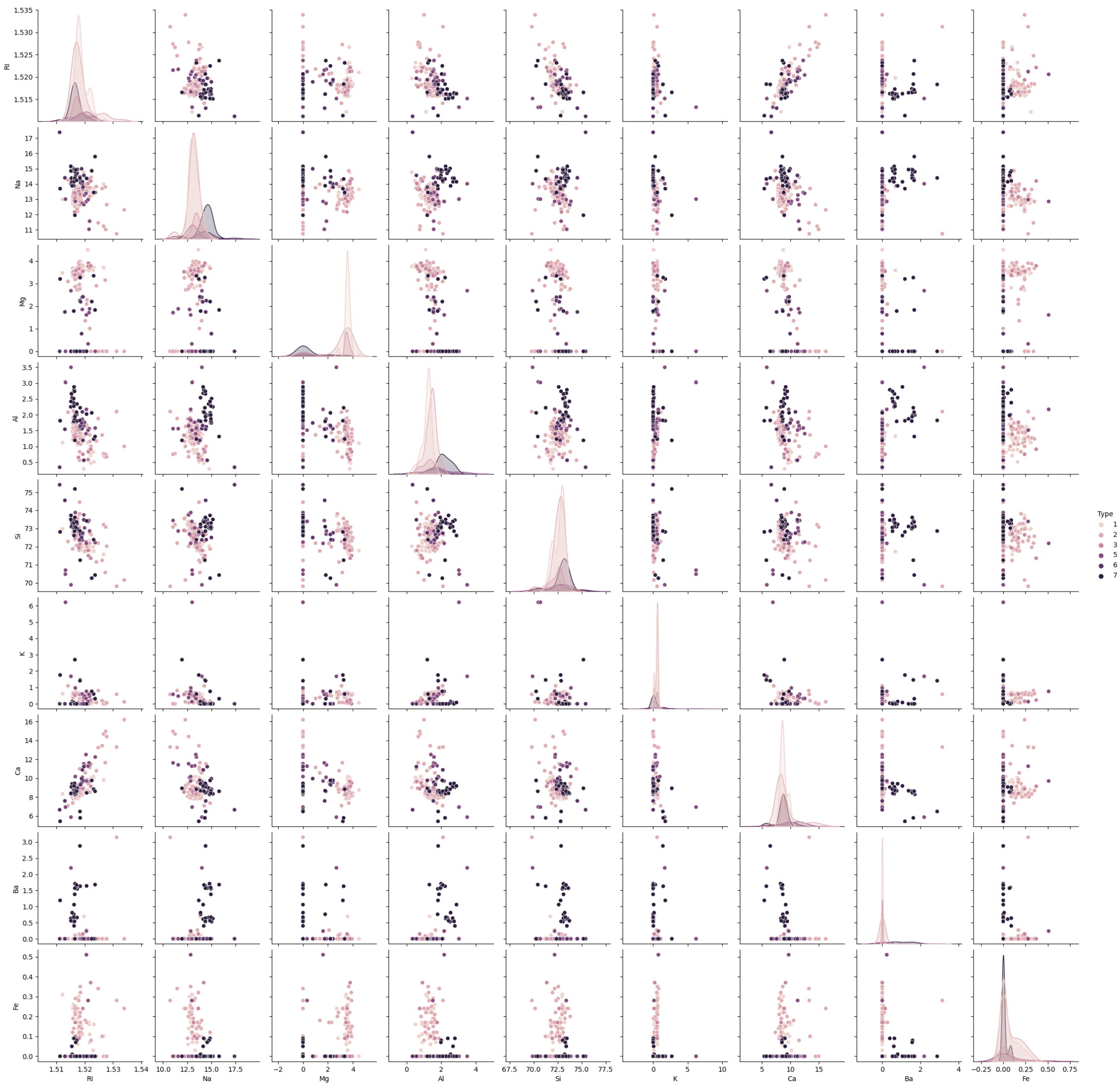


In [19]:

```
sns.pairplot(glass_data, hue='Type')
```

Out[19]:

```
<seaborn.axisgrid.PairGrid at 0x170e0cdc580>
```



standardize the variables

In [20]:

```
from sklearn.preprocessing import StandardScaler
```

In [21]:

```
scaler = StandardScaler()
```

In [22]:

```
X = pd.DataFrame(scaler.fit_transform(glass_data.drop(["Type"],axis = 1)))

y = glass_data.Type
```

In [23]:

```
X.head()
```

Out[23]:

	0	1	2	3	4	5	6	7	
0	0.872868	0.284953	1.254639	-0.692442	-1.127082	-0.671705	-0.145766	-0.352877	-0.58
1	-0.249333	0.591817	0.636168	-0.170460	0.102319	-0.026213	-0.793734	-0.352877	-0.58
2	-0.721318	0.149933	0.601422	0.190912	0.438787	-0.164533	-0.828949	-0.352877	-0.58
3	-0.232831	-0.242853	0.698710	-0.310994	-0.052974	0.112107	-0.519052	-0.352877	-0.58
4	-0.312045	-0.169205	0.650066	-0.411375	0.555256	0.081369	-0.624699	-0.352877	-0.58

Train Test Split

In [24]:

```
from sklearn.model_selection import train_test_split
```

In [25]:

```
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.30)
```

Using KNN

In [26]:

```
from sklearn.neighbors import KNeighborsClassifier
```

In [27]:

```
knn = KNeighborsClassifier(n_neighbors=1)
```

In [28]:

```
knn.fit(X_train,y_train)
```

Out[28]:

```
▾ KNeighborsClassifier
KNeighborsClassifier(n_neighbors=1)
```

In [29]:

```
pred = knn.predict(X_test)
```

Predictions and Evaluations

In [30]:

```
from sklearn.metrics import classification_report,confusion_matrix
```

In [31]:

```
print(confusion_matrix(y_test,pred))
```

```
[[20  3  1  0  0  0]
 [ 5 20  2  2  0  0]
 [ 3  0  1  0  0  0]
 [ 0  0  0  3  0  0]
 [ 0  0  0  0  1  0]
 [ 0  0  0  0  0  4]]
```

In [32]:

```
print(classification_report(y_test,pred))
```

```
              precision    recall  f1-score   support

           1       0.71      0.83      0.77        24
           2       0.87      0.69      0.77        29
           3       0.25      0.25      0.25         4
           5       0.60      1.00      0.75         3
           6       1.00      1.00      1.00         1
           7       1.00      1.00      1.00         4

    accuracy                           0.75        65
   macro avg       0.74      0.80      0.76        65
weighted avg       0.77      0.75      0.75        65
```

Choosing a K Value

In [33]:

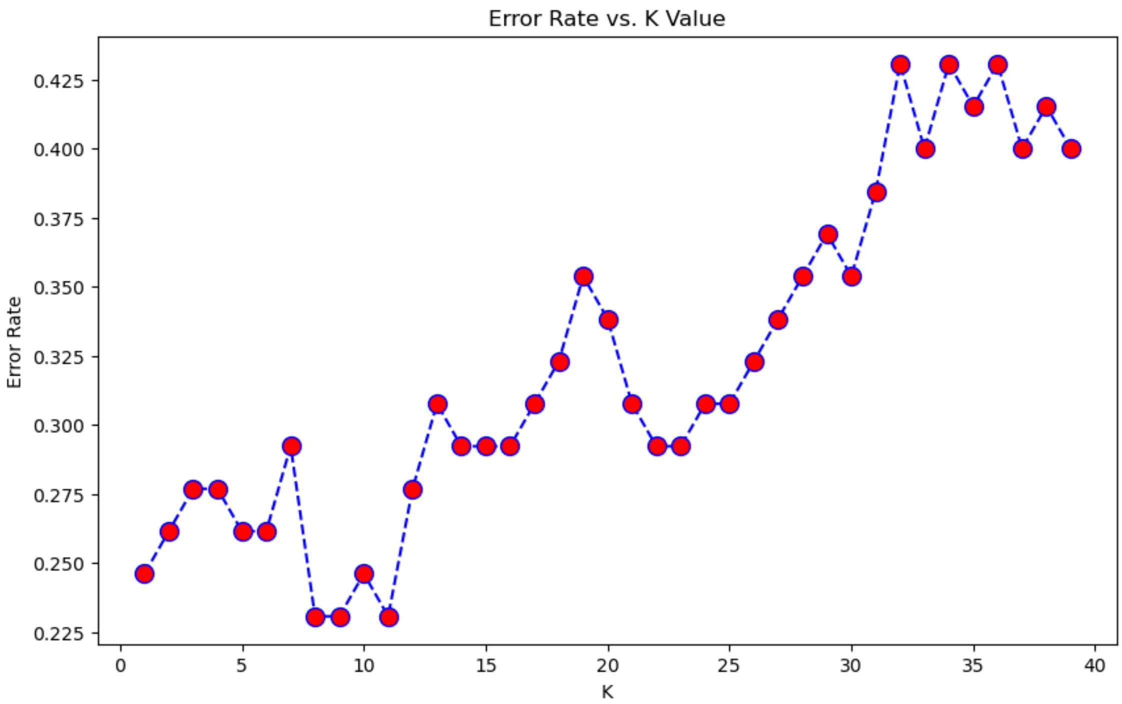
```
error_rate = []

# Will take some time
for i in range(1,40):

    knn = KNeighborsClassifier(n_neighbors=i)
    knn.fit(X_train,y_train)
    pred_i = knn.predict(X_test)
    error_rate.append(np.mean(pred_i != y_test))
```

In [34]:

```
plt.figure(figsize=(10,6))
plt.plot(range(1,40),error_rate,color='blue', linestyle='dashed', marker='o',
         markerfacecolor='red', markersize=10)
plt.title('Error Rate vs. K Value')
plt.xlabel('K')
plt.ylabel('Error Rate')
```

Out[34]:

```
Text(0, 0.5, 'Error Rate')
```



In [35]:

```
#Orginal K=1
knn = KNeighborsClassifier(n_neighbors=1)

knn.fit(X_train,y_train)
pred = knn.predict(X_test)

print('WITH k=1')
print('\n')
print(confusion_matrix(y_test,pred))
print('\n')
print(classification_report(y_test,pred))
```

```
WITH k=1


[[20  3  1  0  0  0]
 [ 5 20  2  2  0  0]
 [ 3  0  1  0  0  0]
 [ 0  0  0  3  0  0]
 [ 0  0  0  0  1  0]
 [ 0  0  0  0  0  4]]


              precision    recall  f1-score   support

           1       0.71      0.83      0.77        24
           2       0.87      0.69      0.77        29
           3       0.25      0.25      0.25         4
           5       0.60      1.00      0.75         3
           6       1.00      1.00      1.00         1
           7       1.00      1.00      1.00         4

    accuracy                           0.75        65
   macro avg       0.74      0.80      0.76        65
weighted avg       0.77      0.75      0.75        65
```

In [36]:

```
from sklearn.metrics import ConfusionMatrixDisplay
import matplotlib.pyplot as plt

conf_matrix = confusion_matrix(y_test, pred)
vis = ConfusionMatrixDisplay(confusion_matrix = conf_matrix,display_labels = [True,False
vis.plot()
plt.grid(False)
plt.show()
```

```
---------------------------------------------------------------
ValueError                        Traceback (most recent call last)
Cell In[36], line 6
      4 conf_matrix = confusion_matrix(y_test, pred)
      5 vis = ConfusionMatrixDisplay(confusion_matrix = conf_matrix,displ
ay_labels = [True,False])
----> 6 vis.plot()
      7 plt.grid(False)
      8 plt.show()

File ~\anaconda3\lib\site-packages\sklearn\metrics\_plot\confusion_matri
x.py:181, in ConfusionMatrixDisplay.plot(self, include_values, cmap, xtic
ks_rotation, values_format, ax, colorbar, im_kw, text_kw)
    179 if colorbar:
    180     fig.colorbar(self.im_, ax=ax)
--> 181 ax.set(
    182     xticks=np.arange(n_classes),
    183     yticks=np.arange(n_classes),
    184     xticklabels=display_labels,
    185     yticklabels=display_labels,
    186     ylabel="True label",
    187     xlabel="Predicted label",
    188 )
    190 ax.set_ylim((n_classes - 0.5, -0.5))
    191 plt.setp(ax.get_xticklabels(), rotation=xticks_rotation)

File ~\anaconda3\lib\site-packages\matplotlib\artist.py:147, in Artist.__
init_subclass__.<locals>.<lambda>(self, **kwargs)
    139 if not hasattr(cls.set, '_autogenerated_signature'):
    140     # Don't overwrite cls.set if the subclass or one of its paren
ts
    141     # has defined a set method set itself.
    142     # If there was no explicit definition, cls.set is inherited f
rom
    143     # the hierarchy of auto-generated set methods, which hold the
    144     # flag _autogenerated_signature.
    145     return
--> 147 cls.set = lambda self, **kwargs: Artist.set(self, **kwargs)
    148 cls.set.__name__ = "set"
    149 cls.set.__qualname__ = f"{cls.__qualname__}.set"

File ~\anaconda3\lib\site-packages\matplotlib\artist.py:1231, in Artist.s
et(self, **kwargs)
   1227 def set(self, **kwargs):
   1228     # docstring and signature are auto-generated via
   1229     # Artist._update_set_signature_and_docstring() at the end of
the
   1230     # module.
-> 1231     return self._internal_update(cbook.normalize_kwargs(kwargs, s
elf))

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internal_update(self, kwargs)
   1216 def _internal_update(self, kwargs):
   1217     """
   1218     Update artist properties without prenormalizing them, but gen
erating
   1219     errors as if calling `set`.
   1220 
   1221     The lack of prenormalization is to maintain backcompatibilit
y.
```

```
   1222     """
-> 1223     return self._update_props(
   1224         kwargs, "{cls.__name__}.set() got an unexpected keyword a
rgument "
   1225         "{prop_name!r}")

File ~\anaconda3\lib\site-packages\matplotlib\artist.py:1199, in Artist._
update_props(self, props, errfmt)
   1196             if not callable(func):
   1197                 raise AttributeError(
   1198                     errfmt.format(cls=type(self), prop_name=k))
-> 1199             ret.append(func(v))
   1200 if ret:
   1201     self.pchanged()

File ~\anaconda3\lib\site-packages\matplotlib\axes\_base.py:74, in _axis_
method_wrapper.__set_name__.<locals>.wrapper(self, *args, **kwargs)
     73 def wrapper(self, *args, **kwargs):
---> 74     return get_method(self)(*args, **kwargs)

File ~\anaconda3\lib\site-packages\matplotlib\_api\deprecation.py:297, in
rename_parameter.<locals>.wrapper(*args, **kwargs)
    292     warn_deprecated(
    293         since, message=f"The {old!r} parameter of {func.__name__}
() "
    294         f"has been renamed {new!r} since Matplotlib {since}; supp
ort "
    295         f"for the old name will be dropped %(removal)s.")
    296     kwargs[new] = kwargs.pop(old)
--> 297 return func(*args, **kwargs)

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icklabels(self, labels, minor, fontdict, **kwargs)
   1969 if isinstance(locator, mticker.FixedLocator):
   1970     # Passing [] as a list of labels is often used as a way to
   1971     # remove all tick labels, so only error for > 0 labels
   1972     if len(locator.locs) != len(labels) and len(labels) != 0:
-> 1973         raise ValueError(
   1974             "The number of FixedLocator locations"
   1975             f" ({len(locator.locs)}), usually from a call to"
   1976             " set_ticks, does not match"
   1977             f" the number of labels ({len(labels)}).")
   1978     tickd = {loc: lab for loc, lab in zip(locator.locs, labels)}
   1979     func = functools.partial(self._format_with_dict, tickd)

ValueError: The number of FixedLocator locations (6), usually from a call
to set_ticks, does not match the number of labels (2).
```

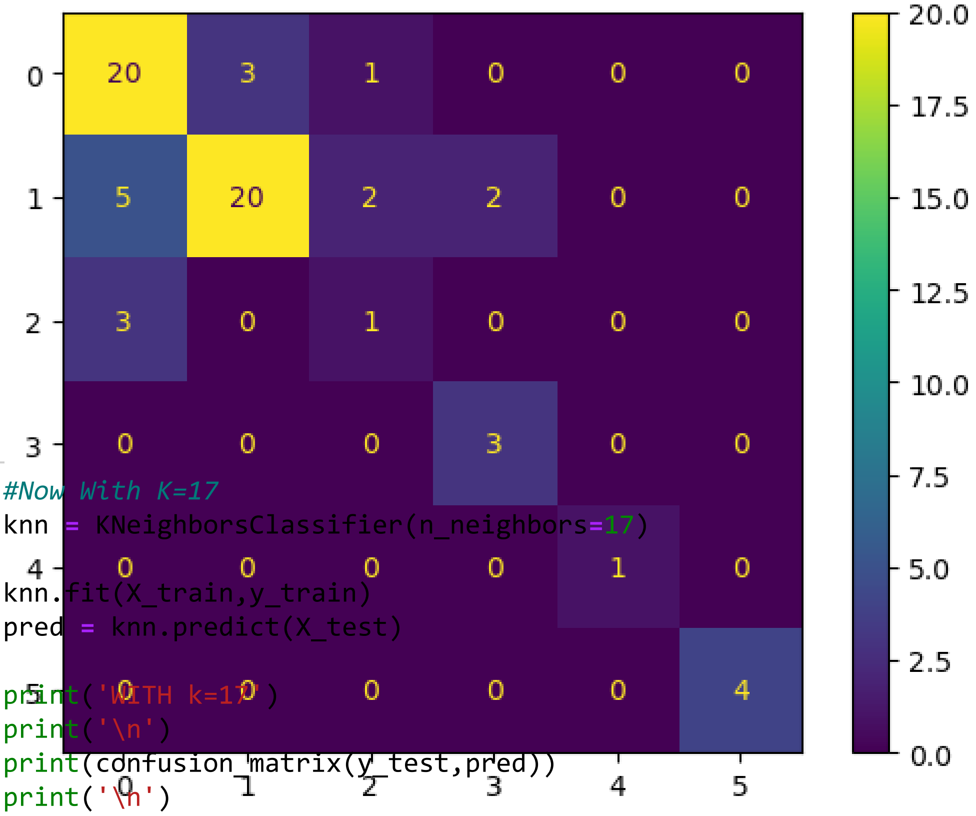


```python
#Now With K=17
knn = KNeighborsClassifier(n_neighbors=17)

knn.fit(X_train,y_train)
pred = knn.predict(X_test)

print('WITH k=17')
print('\n')
print(confusion_matrix(y_test,pred))
print('\n')
print(classification_report(y_test,pred))
```

```
WITH k=17


[[21  3  0  0  0  0]
 [ 7 20  0  0  2  0]
 [ 4  0  0  0  0  0]
 [ 1  1  0  1  0  0]
 [ 1  0  0  0  0  0]
 [ 0  1  0  0  0  3]]


              precision    recall  f1-score   support

           1       0.62      0.88      0.72        24
           2       0.80      0.69      0.74        29
           3       0.00      0.00      0.00         4
           5       1.00      0.33      0.50         3
           6       0.00      0.00      0.00         1
           7       1.00      0.75      0.86         4
```

In [38]:

```
from sklearn.metrics import ConfusionMatrixDisplay
import matplotlib.pyplot as plt

conf_matrix = confusion_matrix(y_test, pred)
vis = ConfusionMatrixDisplay(confusion_matrix = conf_matrix,display_labels = [True,False
vis.plot()
plt.grid(False)
plt.show()
```

```
---------------------------------------------------------------
ValueError                        Traceback (most recent call last)
Cell In[38], line 6
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    187     xlabel="Predicted label",
    188 )
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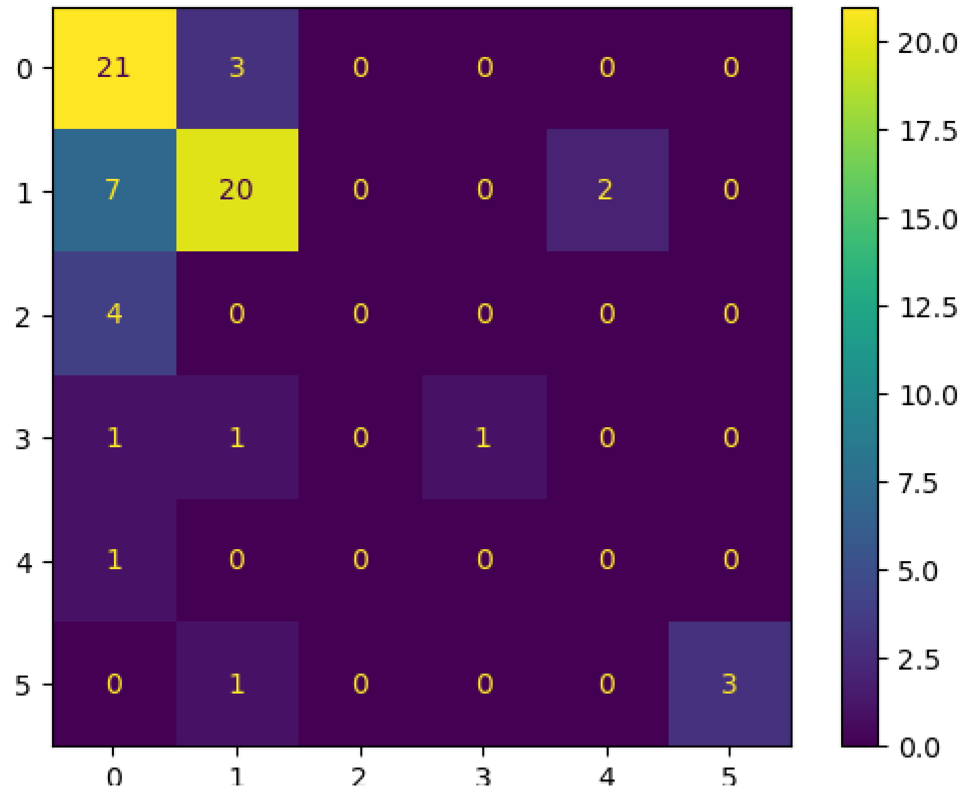
21
3
0
7
20
2
4
1
5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0