In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
df=pd.read_csv('tae.data',names=['speaker', 'instructor', 'course', 'semester', 'class
df.head()
```

Out[2]:

	speaker	instructor	course	semester	class_size	attribute
0	1	23	3	1	19	3
1	2	15	3	1	17	3
2	1	23	3	2	49	3
3	1	5	2	2	33	3
4	2	7	11	2	55	3

In [3]:

```
df.isna().sum()
```

Out[3]:

```
speaker       0
instructor    0
course        0
semester      0
class_size    0
attribute     0
dtype: int64
```

In [4]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 151 entries, 0 to 150
Data columns (total 6 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   speaker     151 non-null    int64
 1   instructor  151 non-null    int64
 2   course      151 non-null    int64
 3   semester    151 non-null    int64
 4   class_size  151 non-null    int64
 5   attribute   151 non-null    int64
dtypes: int64(6)
memory usage: 7.2 KB
```

In [5]:

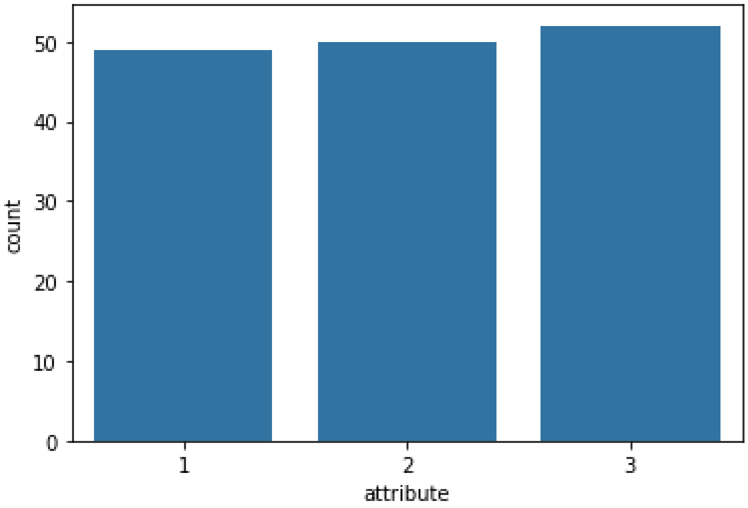
```
df.describe()
```

Out[5]:

	speaker	instructor	course	semester	class_size	attribute
count	151.000000	151.000000	151.000000	151.000000	151.000000	151.000000
mean	1.807947	13.642384	8.105960	1.847682	27.867550	2.019868
std	0.395225	6.825779	7.023914	0.360525	12.893758	0.820327
min	1.000000	1.000000	1.000000	1.000000	3.000000	1.000000
25%	2.000000	8.000000	3.000000	2.000000	19.000000	1.000000
50%	2.000000	13.000000	4.000000	2.000000	27.000000	2.000000
75%	2.000000	20.000000	15.000000	2.000000	37.000000	3.000000
max	2.000000	25.000000	26.000000	2.000000	66.000000	3.000000

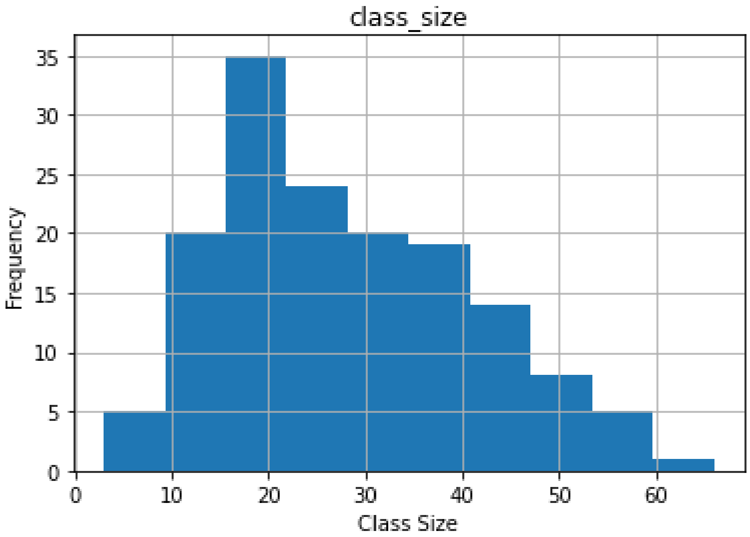
In [6]:

```
df_performance = df.groupby('attribute')[['speaker']].count().reset_index().rename(co
sns.barplot(x='attribute', y='count', data=df_performance, color='tab:blue')
plt.show()
```

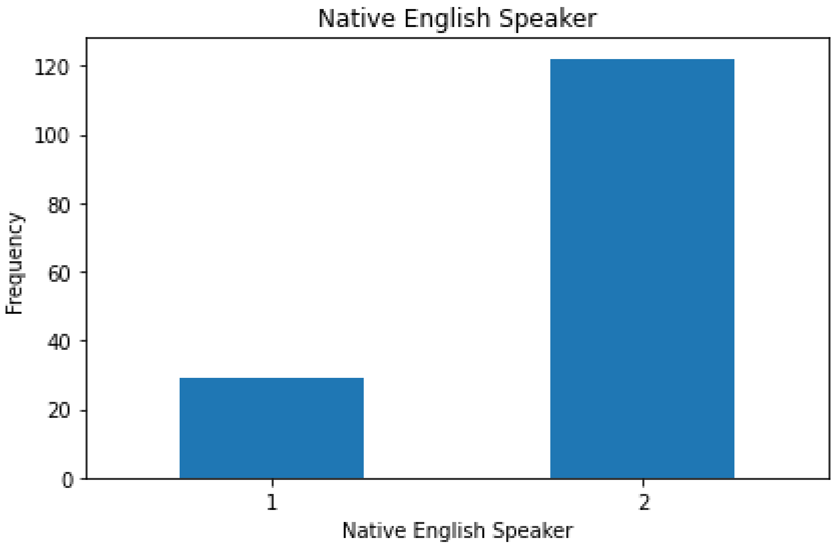


In [7]:

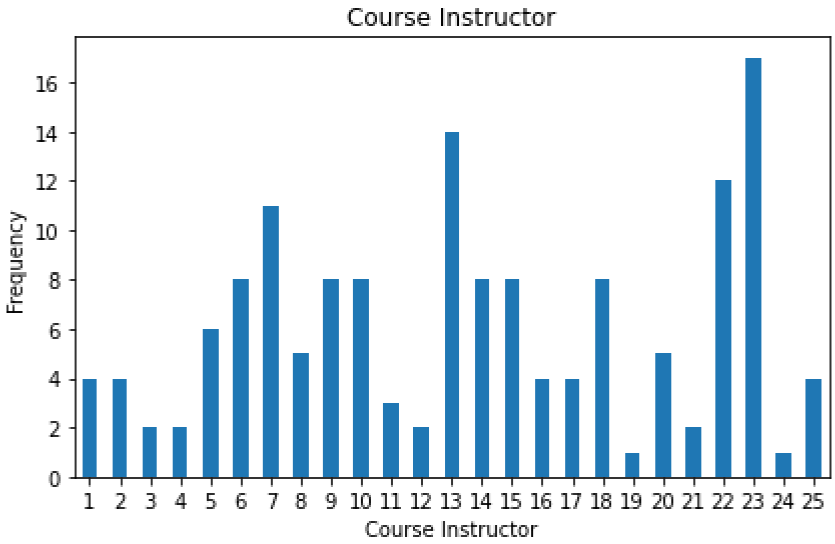
```
numerical_columns = ['class_size']

for column in numerical_columns:
    df[column].hist()
    plt.title(column)
    plt.xlabel('Class Size')
    plt.ylabel('Frequency')
    plt.show()
```



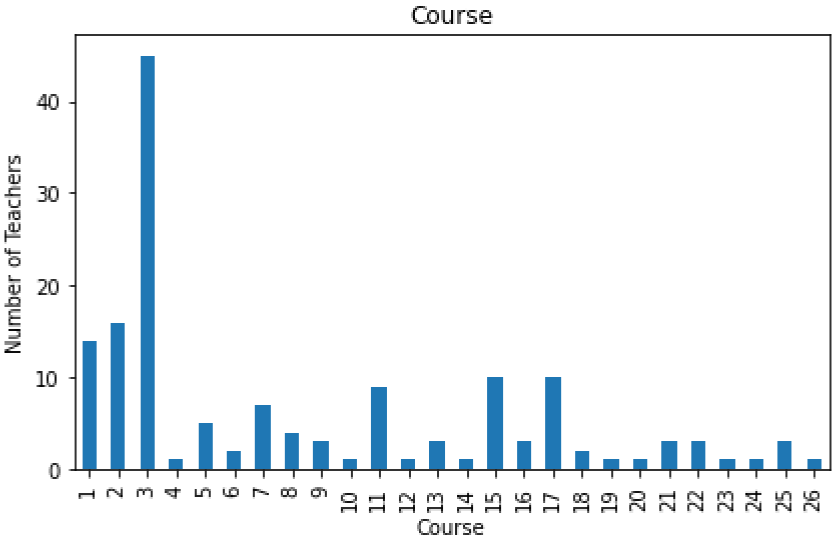
In [8]:
```
instructor_counts = df['speaker'].value_counts().sort_index()

instructor_counts.plot(kind='bar')
plt.title('Native English Speaker')
plt.xlabel('Native English Speaker')
plt.ylabel('Frequency')
plt.xticks(rotation=0)
plt.tight_layout()
plt.show()
```



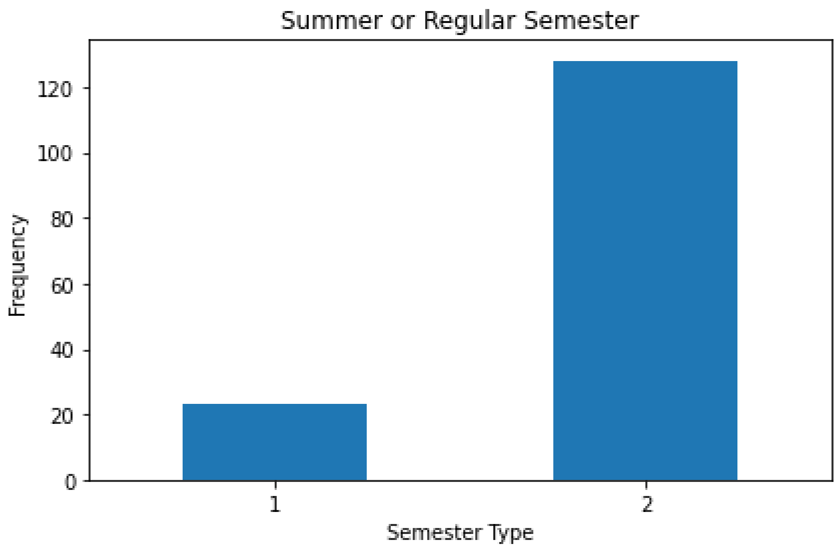
In [9]:
```
instructor_counts = df['instructor'].value_counts().sort_index()

instructor_counts.plot(kind='bar')
plt.title('Course Instructor')
plt.xlabel('Course Instructor')
plt.ylabel('Frequency')
plt.xticks(rotation=0)
plt.tight_layout()
plt.show()
```



In [10]:
```
course_counts = df['course'].value_counts().sort_index()
course_counts.plot(kind='bar')
plt.title('Course')
plt.xlabel('Course')
plt.ylabel('Number of Teachers')
plt.xticks(rotation=90)
plt.tight_layout()
plt.show()
```

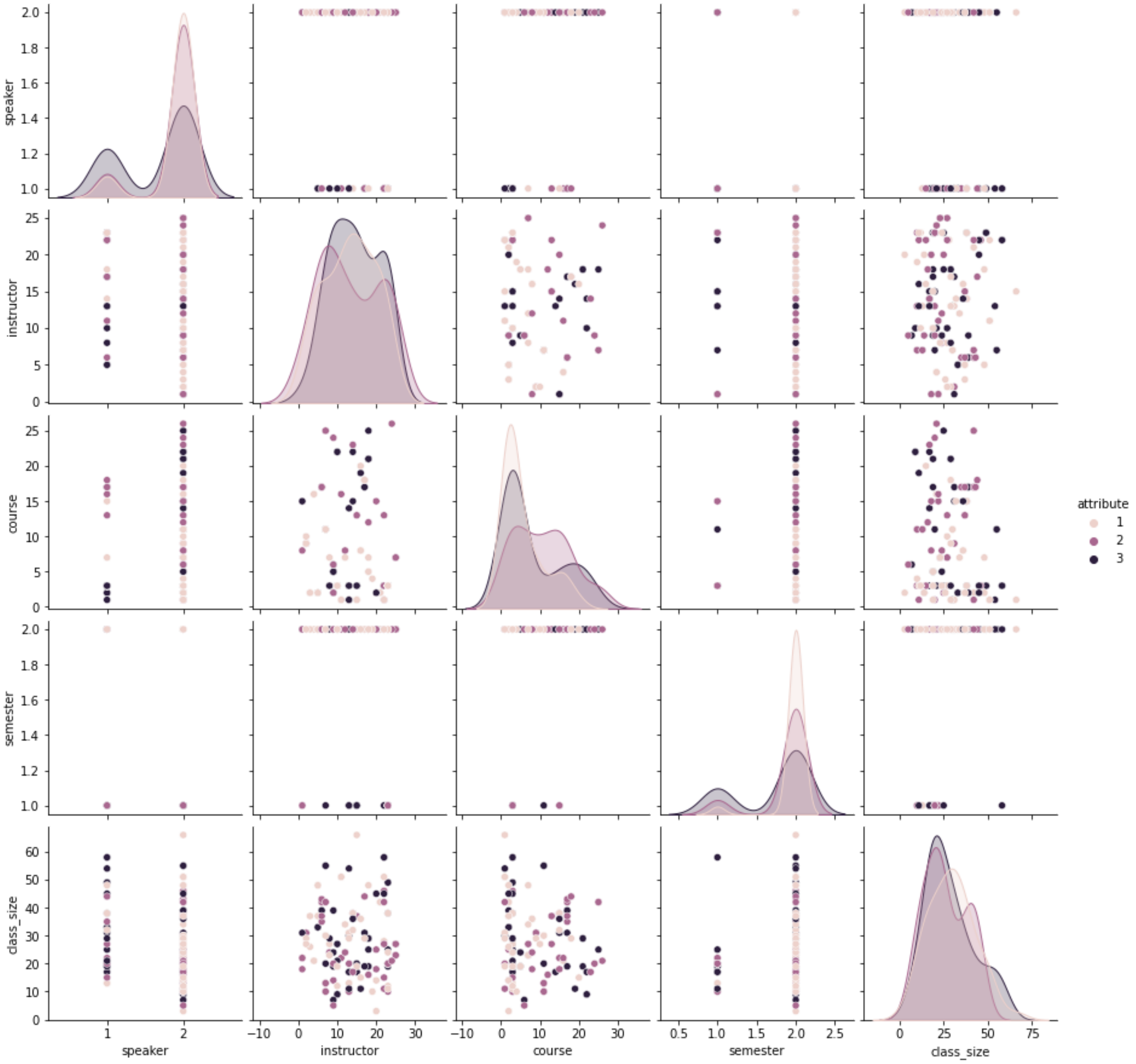


In [11]:
```
semester_counts = df['semester'].value_counts().sort_index()
semester_counts.plot(kind='bar')
plt.title('Summer or Regular Semester')
plt.xlabel('Semester Type')
plt.ylabel('Frequency')
plt.xticks(rotation=0)
plt.tight_layout()
plt.show()
```



```
In [12]: sns.pairplot(df,hue='attribute')
```

```
Out[12]: <seaborn.axisgrid.PairGrid at 0x244425aae20>
```



Task 3 – Data Modelling

In [13]:
```
x=df.drop('attribute',axis=1)
x.sample(5)
```

Out[13]:

	speaker	instructor	course	semester	class_size
46	2	10	3	2	27
17	2	22	3	2	46
57	2	13	3	1	10
62	2	1	15	1	22
45	2	9	5	2	19

In [14]:
```
y=df['attribute']
y.sample(5)
```

Out[14]:
```
26     2
115    1
83     3
17     2
107    1
Name: attribute, dtype: int64
```

Split dataset to training and testing

In [15]:
```
from sklearn.model_selection import train_test_split

from sklearn.metrics import accuracy_score,confusion_matrix
from sklearn.metrics import plot_confusion_matrix
from sklearn.metrics import classification_report

from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
```

Suite1: 50% for training and 50% for testing

In [16]:
```
x_train, x_test, y_train, y_test =train_test_split(x,y,test_size=0.5)
```

Support Vector Machine(SVM)

In [17]:
```
model=SVC()
model.fit(x_train,y_train)
```

Out[17]:
```
▾ SVC
SVC()
```

In [18]:
```
pred=model.predict(x_test)
pred
```

Out[18]:

```
array([1, 1, 1, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 1, 1, 2, 2, 2, 2, 2,
       1, 2, 2, 2, 2, 2, 1, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 1, 2, 2, 2, 1,
       2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 2, 1, 2, 2,
       1, 2, 1, 2, 2, 1, 2, 2, 2, 2], dtype=int64)
```

In [19]:

```
y_test
```

Out[19]:

```
11     3
91     3
2      3
36     1
125    3
      ..
47     3
132    2
43     3
96     2
124    3
Name: attribute, Length: 76, dtype: int64
```

Classification accuracy

In [20]:

```
accuracy_score(y_test,pred)
```

Out[20]:

```
0.42105263157894735
```

In [21]:

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

Out[21]:

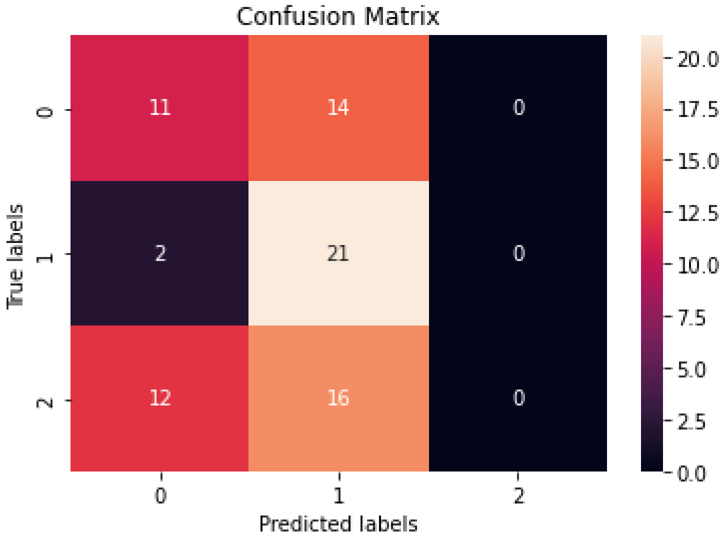
```
array([[11, 14,  0],
       [ 2, 21,  0],
       [12, 16,  0]], dtype=int64)
```

In [22]:

```
s=sns.heatmap(confusion_matrix(y_test,pred), annot = True)
s.set_title('Confusion Matrix')
s.set_xlabel('Predicted labels', fontsize=10)
s.set_ylabel('True labels', fontsize=10)
```

Out[22]:

```
Text(33.0, 0.5, 'True labels')
```



In [23]:

```
report=pd.DataFrame(classification_report(y_test,pred,output_dict=True))
report
```

```
C:\Users\user\AppData\Roaming\Python\Python39\site-packages\sklearn\metrics\_classifi
cation.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to c
ontrol this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\user\AppData\Roaming\Python\Python39\site-packages\sklearn\metrics\_classifi
cation.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to c
ontrol this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\user\AppData\Roaming\Python\Python39\site-packages\sklearn\metrics\_classifi
cation.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to c
ontrol this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

Out[23]:

	1	2	3	accuracy	macro avg	weighted avg
precision	0.44	0.411765	0.0	0.421053	0.283922	0.269350
recall	0.44	0.913043	0.0	0.421053	0.451014	0.421053
f1-score	0.44	0.567568	0.0	0.421053	0.335856	0.316501
support	25.00	23.000000	28.0	0.421053	76.000000	76.000000

Decision tree

In [24]:

```
model = DecisionTreeClassifier()
model.fit(x_train,y_train)
```

Out[24]:

```
▾ DecisionTreeClassifier
DecisionTreeClassifier()
```

In [25]:

```
pred=model.predict(x_test)
pred
```

Out[25]:

```
array([1, 2, 3, 2, 3, 2, 3, 1, 1, 2, 2, 3, 2, 2, 2, 1, 2, 3, 2, 2, 3, 2,
       1, 1, 1, 1, 1, 2, 1, 2, 3, 1, 2, 2, 3, 3, 1, 3, 3, 1, 3, 2, 3, 1,
       2, 2, 1, 2, 3, 1, 1, 3, 1, 3, 2, 3, 3, 2, 1, 3, 1, 1, 2, 3, 2, 2,
       1, 1, 3, 2, 2, 3, 1, 3, 2, 1], dtype=int64)
```

In [26]:

```
y_test
```

Out[26]:

```
11     3
91     3
2      3
36     1
125    3
      ..
47     3
132    2
43     3
96     2
124    3
Name: attribute, Length: 76, dtype: int64
```

Classification accuracy

In [27]:

```
accuracy_score(y_test,pred)
```

Out[27]:

```
0.6052631578947368
```

In [28]:

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

Out[28]:

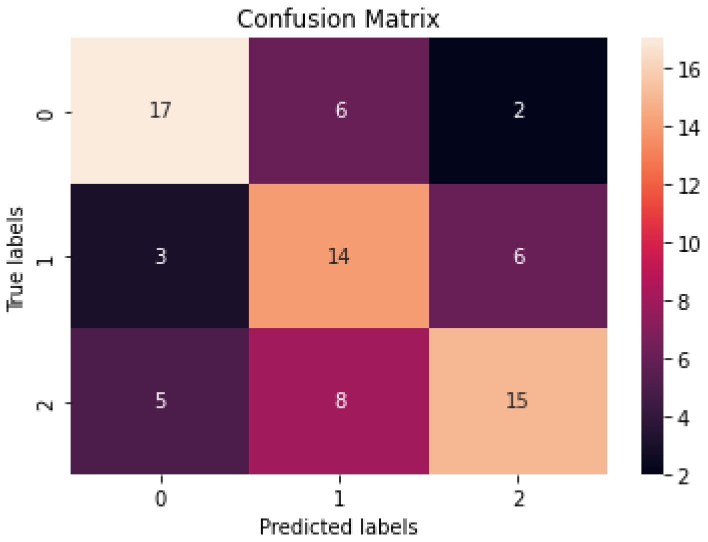
```
array([[17,  6,  2],
       [ 3, 14,  6],
       [ 5,  8, 15]], dtype=int64)
```

In [29]:

```
s=sns.heatmap(confusion_matrix(y_test,pred), annot = True)
s.set_title('Confusion Matrix')
s.set_xlabel('Predicted labels', fontsize=10)
s.set_ylabel('True labels', fontsize=10)
```

Out[29]:

```
Text(33.0, 0.5, 'True labels')
```



In [30]:

```
report=pd.DataFrame(classification_report(y_test,pred,output_dict=True))
report
```

Out[30]:

	1	2	3	accuracy	macro avg	weighted avg
precision	0.68	0.500000	0.652174	0.605263	0.610725	0.615275
recall	0.68	0.608696	0.535714	0.605263	0.608137	0.605263
f1-score	0.68	0.549020	0.588235	0.605263	0.605752	0.606553
support	25.00	23.000000	28.000000	0.605263	76.000000	76.000000

Suite2: 60% for training and 40% for testing

In [31]:

```
x_train, x_test, y_train, y_test =train_test_split(x,y,test_size=0.4)
```

Support Vector Machine(SVM)

In [32]:

```
model=SVC()
model.fit(x_train,y_train)
```

Out[32]:

```
▾ SVC
SVC()
```

In [33]:

```
pred=model.predict(x_test)
pred
```

Out[33]:

```
array([3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       1, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 1, 3, 3, 1, 1], dtype=int64)
```

In [34]:

```
y_test
```

Out[34]:

```
80     3
18     2
113    1
119    1
69     1
      ..
34     1
46     3
75     1
76     1
126    3
Name: attribute, Length: 61, dtype: int64
```

Classification accuracy

In [35]:

```
accuracy_score(y_test,pred)
```

Out[35]:

```
0.3114754098360656
```

In [36]:

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

Out[36]:

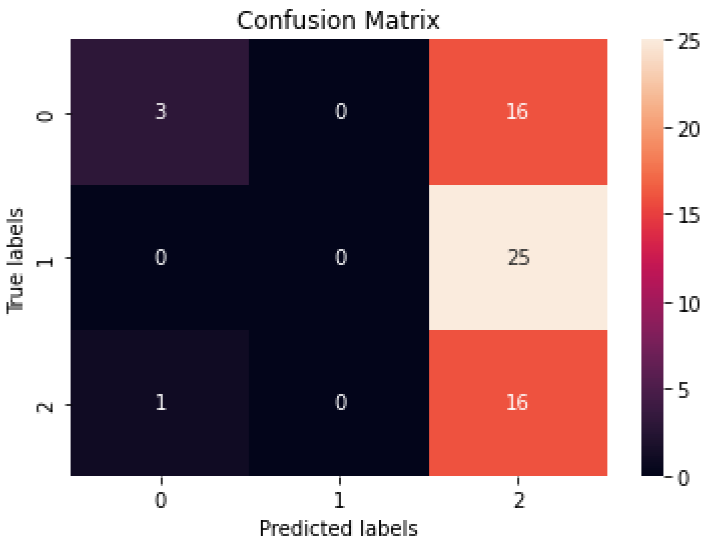
```
array([[ 3,  0, 16],
       [ 0,  0, 25],
       [ 1,  0, 16]], dtype=int64)
```

In [37]:

```
s=sns.heatmap(confusion_matrix(y_test,pred), annot = True)
s.set_title('Confusion Matrix')
s.set_xlabel('Predicted labels', fontsize=10)
s.set_ylabel('True labels', fontsize=10)
```

Out[37]:

```
Text(33.0, 0.5, 'True labels')
```



In [38]:

```
report=pd.DataFrame(classification_report(y_test,pred,output_dict=True))
report
```

```
C:\Users\user\AppData\Roaming\Python\Python39\site-packages\sklearn\metrics\_classifi
cation.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to c
ontrol this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\user\AppData\Roaming\Python\Python39\site-packages\sklearn\metrics\_classifi
cation.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to c
ontrol this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\user\AppData\Roaming\Python\Python39\site-packages\sklearn\metrics\_classifi
cation.py:1334: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to c
ontrol this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

Out[38]:

	1	2	3	accuracy	macro avg	weighted avg
precision	0.750000	0.0	0.280702	0.311475	0.343567	0.311835
recall	0.157895	0.0	0.941176	0.311475	0.366357	0.311475
f1-score	0.260870	0.0	0.432432	0.311475	0.231101	0.201768
support	19.000000	25.0	17.000000	0.311475	61.000000	61.000000

Decision tree

In [39]:

```
model = DecisionTreeClassifier()
model.fit(x_train,y_train)
```

Out[39]:

```
▾ DecisionTreeClassifier
DecisionTreeClassifier()
```

In [40]:

```
pred=model.predict(x_test)
pred
```

Out[40]:

```
array([1, 2, 1, 1, 1, 2, 3, 1, 3, 2, 2, 1, 1, 2, 1, 1, 2, 2, 1, 3, 1, 1,
       1, 3, 2, 3, 1, 3, 3, 3, 1, 3, 2, 2, 2, 3, 2, 1, 2, 3, 2, 1, 1, 2,
       1, 2, 2, 3, 3, 2, 3, 2, 1, 2, 1, 3, 1, 3, 1, 1, 3], dtype=int64)
```

In [41]:

```
y_test
```

Out[41]:

```
80     3
18     2
113    1
119    1
69     1
      ..
34     1
46     3
75     1
76     1
126    3
Name: attribute, Length: 61, dtype: int64
```

In [42]:

```
accuracy_score(y_test,pred)
```

Out[42]:

```
0.6229508196721312
```

In [43]:

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

Out[43]:

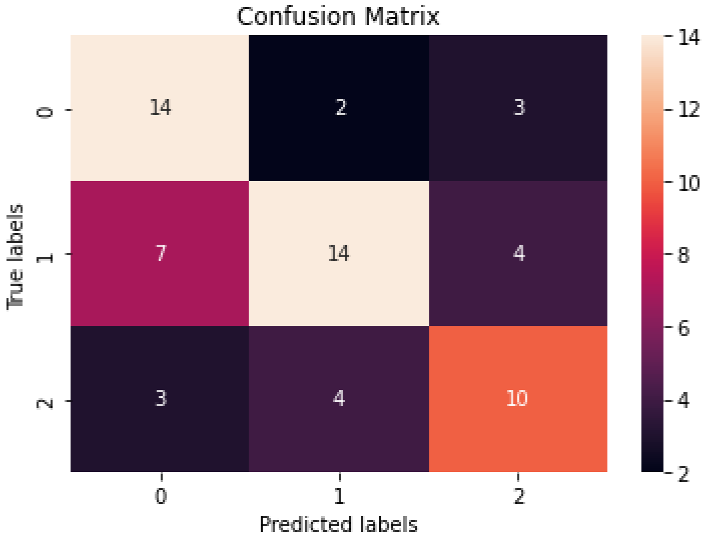
```
array([[14,  2,  3],
       [ 7, 14,  4],
       [ 3,  4, 10]], dtype=int64)
```

In [44]:

```
s=sns.heatmap(confusion_matrix(y_test,pred), annot = True)
s.set_title('Confusion Matrix')
s.set_xlabel('Predicted labels', fontsize=10)
s.set_ylabel('True labels', fontsize=10)
```

Out[44]:

```
Text(33.0, 0.5, 'True labels')
```



In [45]:

```
report=pd.DataFrame(classification_report(y_test,pred,output_dict=True))
report
```

Out[45]:

	1	2	3	accuracy	macro avg	weighted avg
precision	0.583333	0.700000	0.588235	0.622951	0.623856	0.632514
recall	0.736842	0.560000	0.588235	0.622951	0.628359	0.622951
f1-score	0.651163	0.622222	0.588235	0.622951	0.620540	0.621765
support	19.000000	25.000000	17.000000	0.622951	61.000000	61.000000

Suite3: 80% for training and 20% for testing

In [46]:

```
x_train, x_test, y_train, y_test =train_test_split(x,y,test_size=0.2)
```

Support Vector Machine(SVM)

In [47]:

```
pred=model.predict(x_test)
pred
```

Out[47]:

```
array([2, 2, 2, 1, 1, 2, 2, 2, 1, 2, 3, 3, 3, 2, 2, 3, 1, 2, 1, 2, 3, 3,
       1, 2, 2, 3, 3, 1, 3, 3, 3], dtype=int64)
```

In [48]:

```
y_test
```

Out[48]:

```
129    2
103    2
134    2
34     1
114    1
92     3
99     2
18     2
148    1
59     2
45     3
2      3
41     3
65     2
97     2
1      3
29     1
55     2
120    1
64     2
8      3
13     3
88     3
14     2
54     2
39     3
93     3
95     2
44     3
43     3
52     3
Name: attribute, dtype: int64
```

Classification accuracy

In [49]:

```
accuracy_score(y_test,pred)
```

Out[49]:

```
0.9032258064516129
```

In [50]:

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

Out[50]:

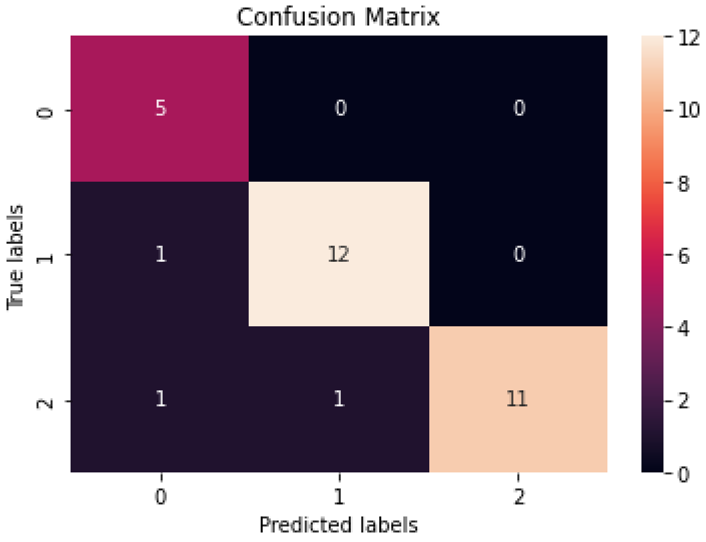
```
array([[ 5,  0,  0],
       [ 1, 12,  0],
       [ 1,  1, 11]], dtype=int64)
```

In [51]:

```
s=sns.heatmap(confusion_matrix(y_test,pred), annot = True)
s.set_title('Confusion Matrix')
s.set_xlabel('Predicted labels', fontsize=10)
s.set_ylabel('True labels', fontsize=10)
```

Out[51]:

```
Text(33.0, 0.5, 'True labels')
```



In [52]:

```
report=pd.DataFrame(classification_report(y_test,pred,output_dict=True))
report
```

Out[52]:

	1	2	3	accuracy	macro avg	weighted avg
precision	0.714286	0.923077	1.000000	0.903226	0.879121	0.921659
recall	1.000000	0.923077	0.846154	0.903226	0.923077	0.903226
f1-score	0.833333	0.923077	0.916667	0.903226	0.891026	0.905914
support	5.000000	13.000000	13.000000	0.903226	31.000000	31.000000

Decision tree

In [53]:

```
model = DecisionTreeClassifier()
model.fit(x_train,y_train)
```

Out[53]:

```
▾ DecisionTreeClassifier
DecisionTreeClassifier()
```

In [54]:

```
pred=model.predict(x_test)
pred
```

Out[54]:

```
array([2, 2, 2, 1, 2, 3, 1, 2, 2, 2, 3, 1, 1, 2, 2, 3, 1, 2, 1, 2, 3, 1,
       1, 2, 2, 3, 1, 2, 3, 3, 1], dtype=int64)
```

In [55]:

```
y_test
```

Out[55]:

```
129    2
103    2
134    2
34     1
114    1
92     3
99     2
18     2
148    1
59     2
45     3
2      3
41     3
65     2
97     2
1      3
29     1
55     2
120    1
64     2
8      3
13     3
88     3
14     2
54     2
39     3
93     3
95     2
44     3
43     3
52     3
Name: attribute, dtype: int64
```

Classification accuracy

In [56]:

```
accuracy_score(y_test,pred)
```

Out[56]:

```
0.7096774193548387
```

In [57]:

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

Out[57]:

```
array([[ 3,  2,  0],
       [ 1, 12,  0],
       [ 6,  0,  7]], dtype=int64)
```

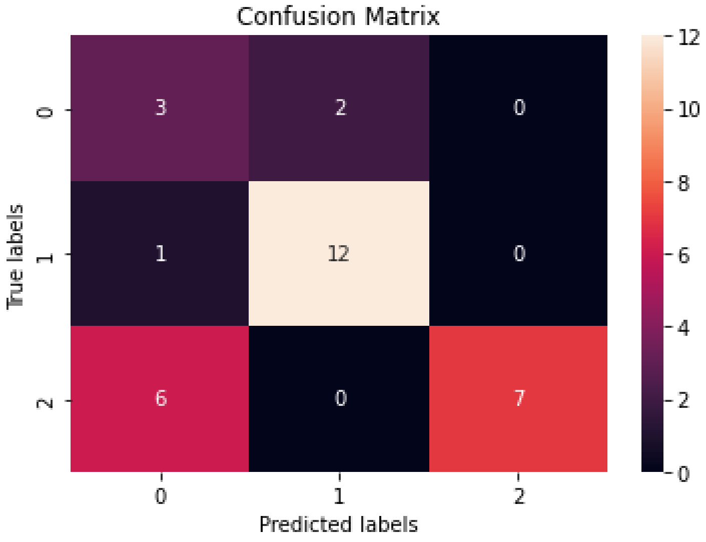
In [58]:

```
s=sns.heatmap(confusion_matrix(y_test,pred), annot = True)
s.set_title('Confusion Matrix')
```

```
s.set_xlabel('Predicted labels', fontsize=10)
s.set_ylabel('True labels', fontsize=10)
```

Out[58]:

```
Text(33.0, 0.5, 'True labels')
```



In [59]:

```
report=pd.DataFrame(classification_report(y_test,pred,output_dict=True))
report
```

Out[59]:

	1	2	3	accuracy	macro avg	weighted avg
precision	0.3	0.857143	1.000000	0.709677	0.719048	0.827189
recall	0.6	0.923077	0.538462	0.709677	0.687179	0.709677
f1-score	0.4	0.888889	0.700000	0.709677	0.662963	0.730824
support	5.0	13.000000	13.000000	0.709677	31.000000	31.000000

In [ ]: