In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from IPython import get_ipython
import warnings
warnings.filterwarnings("ignore")
```

In [2]:

```
data1 = pd.read_csv('zoo2.csv')
data2 = pd.read_csv('zoo3.csv')
```

In [3]:

```
data1.head()
```

Out[3]:

	animal_name	hair	feathers	eggs	milk	airborne	aquatic	predator	toothed	backbone	bre
0	turtle	0	0	1	0	0	1	0	0	1	
1	chameleon	0	0	1	0	0	0	0	1	1	
2	iguana	0	0	1	0	0	0	1	1	1	
3	lizard	0	0	1	0	0	0	1	1	1	
4	gecko	0	0	1	0	0	0	0	1	1	

In [4]:

```
data1.tail()
```

Out[4]:

	animal_name	hair	feathers	eggs	milk	airborne	aquatic	predator	toothed	backbone	br
38	spider	0	0	1	0	0	0	1	1	0	
39	snail	0	0	1	0	0	0	0	0	0	
40	silkworm	0	0	1	0	0	0	0	0	0	
41	jellyfish	0	0	1	0	0	1	0	0	0	
42	squid	0	0	1	0	0	1	0	0	0	

In [5]:

```
1 data2.head()
```

Out[5]:

	animal_name	hair	feathers	eggs	milk	airborne	aquatic	predator	toothed	backbone	bre
0	anta	1	0	0	1	0	0	0	1	1	
1	ariranha	1	0	0	1	0	1	1	1	1	
2	boto-cor-de-rosa	0	0	0	1	0	1	1	1	1	
3	bugio	1	0	0	1	0	0	0	1	1	
4	cachorro-vinagre	1	0	0	1	0	0	1	1	1	

In [6]:

```
1 data2.tail()
```

Out[6]:

	animal_name	hair	feathers	eggs	milk	airborne	aquatic	predator	toothed	backbone	br
65	vespa	0	0	1	0	1	0	1	0	0	
66	bicho-pau	0	0	1	0	0	0	0	0	0	
67	caracol-da-mata-atlantica	0	0	1	0	0	0	0	0	0	
68	caranguejeira	1	0	1	0	0	0	1	0	0	
69	sauva-limao	1	0	1	0	0	0	1	0	0	

In [7]:

```
1 data1.shape
```

Out[7]:

```
(43, 18)
```

In [8]:

```
1 data2.shape
```

Out[8]:

```
(70, 18)
```

In [9]:

```
1 data1.columns
```

Out[9]:

```
Index(['animal_name', 'hair', 'feathers', 'eggs', 'milk', 'airborne',
       'aquatic', 'predator', 'toothed', 'backbone', 'breathes', 'venomou
s',
       'fins', 'legs', 'tail', 'domestic', 'catsize', 'class_type'],
      dtype='object')
```

In [10]:

```
1 data2.columns
```

Out[10]:

```
Index(['animal_name', 'hair', 'feathers', 'eggs', 'milk', 'airborne',
       'aquatic', 'predator', 'toothed', 'backbone', 'breathes', 'venomou
s',
       'fins', 'legs', 'tail', 'domestic', 'catsize', 'class_type'],
      dtype='object')
```

In [11]:

```
1 data1.duplicated().sum()
```

Out[11]:

```
0
```

In [12]:

```
1 data2.duplicated().sum()
```

Out[12]:

```
0
```

In [13]:

```
1 data1.isnull().sum()
```

Out[13]:

```
animal_name    0
hair           0
feathers       0
eggs           0
milk           0
airborne       0
aquatic        0
predator       0
toothed        0
backbone       0
breathes       0
venomous       0
fins           0
legs           0
tail           0
domestic       0
catsize        0
class_type     0
dtype: int64
```

In [14]:

```
1 data2.isnull().sum()
```

Out[14]:

```
animal_name    0
hair           0
feathers       0
eggs           0
milk           0
airborne       0
aquatic        0
predator       0
toothed        0
backbone       0
breathes       0
venomous       0
fins           0
legs           0
tail           0
domestic       0
catsize        0
class_type     0
dtype: int64
```

In [15]:

```
1 data1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 43 entries, 0 to 42
Data columns (total 18 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   animal_name  43 non-null     object
 1   hair         43 non-null     int64 
 2   feathers     43 non-null     int64 
 3   eggs         43 non-null     int64 
 4   milk         43 non-null     int64 
 5   airborne     43 non-null     int64 
 6   aquatic      43 non-null     int64 
 7   predator     43 non-null     int64 
 8   toothed      43 non-null     int64 
 9   backbone     43 non-null     int64 
 10  breathes     43 non-null     int64 
 11  venomous     43 non-null     int64 
 12  fins         43 non-null     int64 
 13  legs         43 non-null     int64 
 14  tail         43 non-null     int64 
 15  domestic     43 non-null     int64 
 16  catsize      43 non-null     int64 
 17  class_type   43 non-null     int64 
dtypes: int64(17), object(1)
memory usage: 6.2+ KB
```

In [16]:

```
1 data1.describe()
```

Out[16]:

	hair	feathers	eggs	milk	airborne	aquatic	predator	toothed	backbone
count	43.000000	43.0	43.0	43.0	43.000000	43.000000	43.000000	43.000000	43.000000
mean	0.023256	0.0	1.0	0.0	0.162791	0.465116	0.302326	0.441860	0.581395
std	0.152499	0.0	0.0	0.0	0.373544	0.504685	0.464701	0.502486	0.499169
min	0.000000	0.0	1.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.000000	0.0	1.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000
50%	0.000000	0.0	1.0	0.0	0.000000	0.000000	0.000000	0.000000	1.000000
75%	0.000000	0.0	1.0	0.0	0.000000	1.000000	1.000000	1.000000	1.000000
max	1.000000	0.0	1.0	0.0	1.000000	1.000000	1.000000	1.000000	1.000000

In [17]:

```
1 data2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 70 entries, 0 to 69
Data columns (total 18 columns):
 #   Column       Non-Null Count  Dtype 
---  ------       --------------  ----- 
 0   animal_name  70 non-null     object
 1   hair         70 non-null     int64 
 2   feathers     70 non-null     int64 
 3   eggs         70 non-null     int64 
 4   milk         70 non-null     int64 
 5   airborne     70 non-null     int64 
 6   aquatic      70 non-null     int64 
 7   predator     70 non-null     int64 
 8   toothed      70 non-null     int64 
 9   backbone     70 non-null     int64 
 10  breathes     70 non-null     int64 
 11  venomous     70 non-null     int64 
 12  fins         70 non-null     int64 
 13  legs         70 non-null     int64 
 14  tail         70 non-null     int64 
 15  domestic     70 non-null     int64 
 16  catsize      70 non-null     int64 
 17  class_type   70 non-null     int64 
dtypes: int64(17), object(1)
memory usage: 10.0+ KB
```

In [18]:

```
1 data2.describe()
```

Out[18]:

	hair	feathers	eggs	milk	airborne	aquatic	predator	toothe
count	70.000000	70.000000	70.000000	70.000000	70.000000	70.000000	70.000000	70.00000
mean	0.314286	0.285714	0.728571	0.271429	0.314286	0.328571	0.442857	0.48571
std	0.467583	0.455016	0.447907	0.447907	0.467583	0.473085	0.500310	0.50340
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000
25%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000
50%	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.00000
75%	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.00000
max	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.00000

In [19]:

```
1 data1.nunique()
```

Out[19]:

```
animal_name    43
hair            2
feathers        1
eggs            1
milk            1
airborne        2
aquatic         2
predator        2
toothed         2
backbone        2
breathes        2
venomous        2
fins            2
legs            5
tail            2
domestic        2
catsize         2
class_type      5
dtype: int64
```

In [20]:

```
1 data2.nunique()
```

Out[20]:

```
animal_name    70
hair            2
feathers        2
eggs            2
milk            2
airborne        2
aquatic         2
predator        2
toothed         2
backbone        2
breathes        2
venomous        2
fins            2
legs            5
tail            2
domestic        2
catsize         2
class_type      7
dtype: int64
```

In [21]:

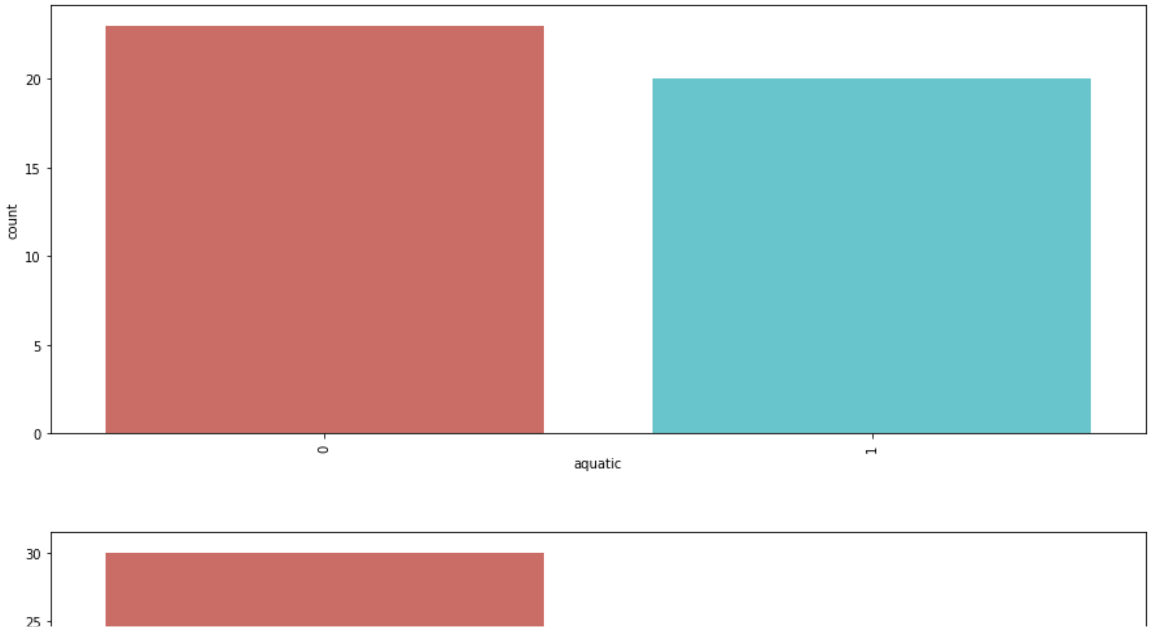
```
1 data11 = data1[['hair', 'feathers', 'eggs', 'milk', 'airborne',
2        'aquatic', 'predator', 'toothed', 'backbone', 'breathes', 'venomous',
3        'fins', 'legs', 'tail', 'domestic', 'catsize', 'class_type']]
```

In [22]:

```
data22 = data2[['hair', 'feathers', 'eggs', 'milk', 'airborne',
       'aquatic', 'predator', 'toothed', 'backbone', 'breathes', 'venomous',
       'fins', 'legs', 'tail', 'domestic', 'catsize', 'class_type']]
```

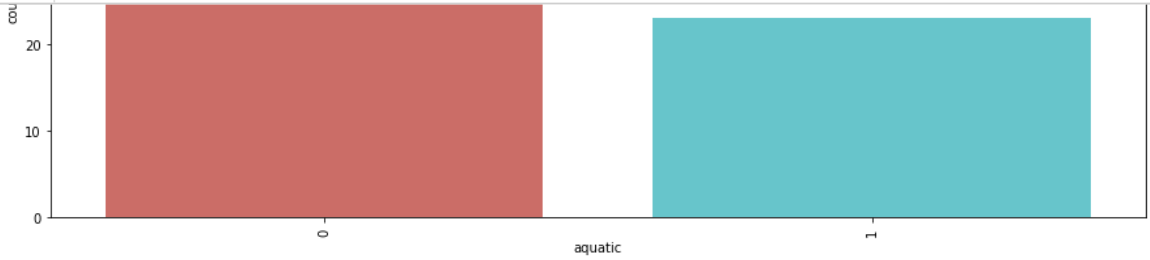
In [23]:

```
for i in data11.columns:
    plt.figure(figsize=(15,6))
    sns.countplot(data11[i], data = data11,
                  palette='hls')
    plt.xticks(rotation = 90)
    plt.show()
```



In [24]:

```
for i in data22.columns:
    plt.figure(figsize=(15,6))
    sns.countplot(data22[i], data = data22,
                  palette='hls')
    plt.xticks(rotation = 90)
    plt.show()
```

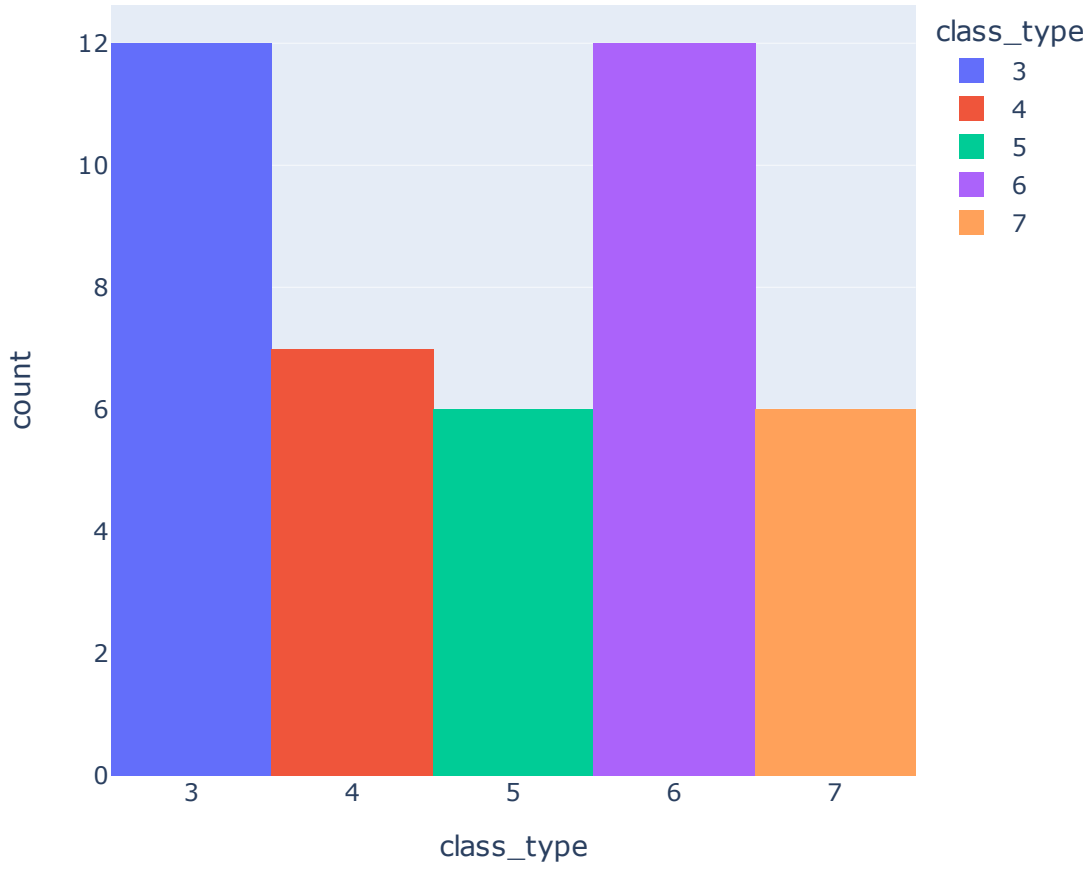


In [25]:

```
import plotly.express as px
```

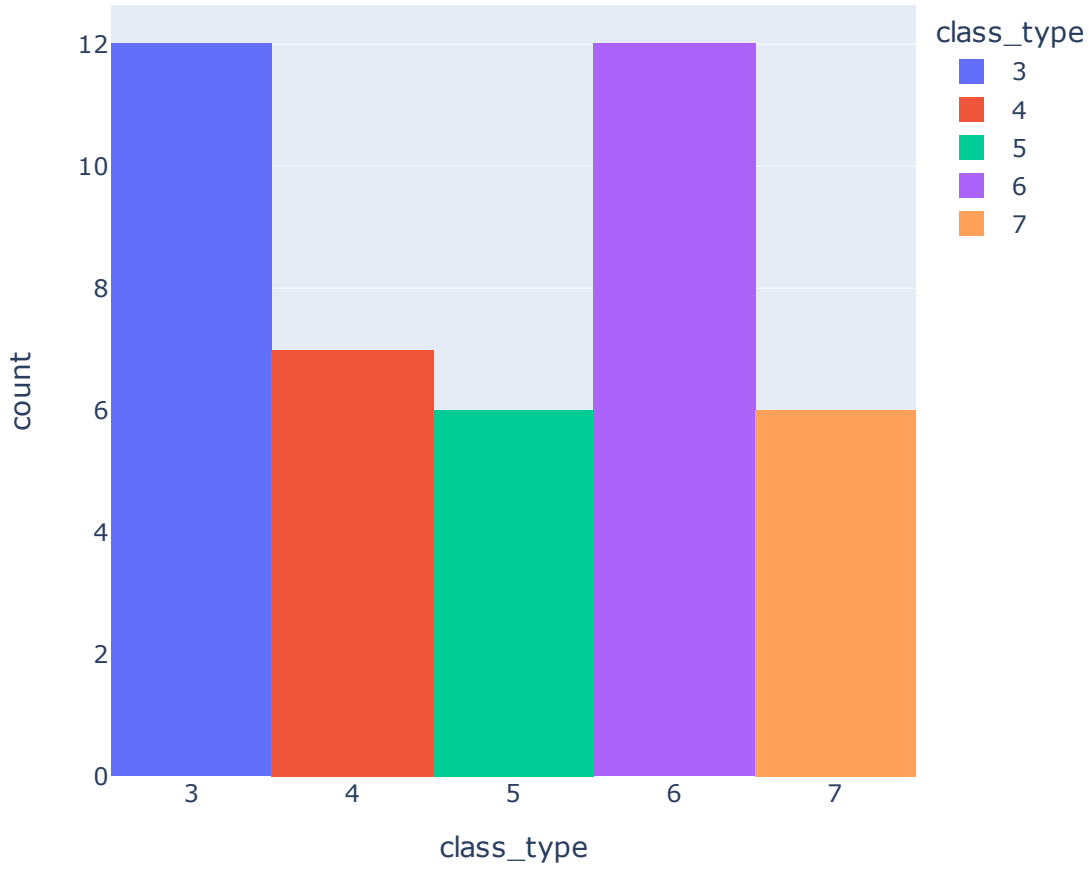
In [26]:

```
fig1 = px.histogram(data1, x = 'class_type', color = 'class_type')
fig1.show()
```



In [27]:

```
fig2 = px.histogram(data2, x = 'class_type', color = 'class_type')
fig1.show()
```



In [28]:

```
data1 = data1.drop(columns = ['animal_name','class_type'])
```

In [29]:

```
data1.head()
```

Out[29]:

	hair	feathers	eggs	milk	airborne	aquatic	predator	toothed	backbone	breathes	venomo
0	0	0	1	0	0	1	0	0	1	1	
1	0	0	1	0	0	0	0	1	1	1	
2	0	0	1	0	0	0	1	1	1	1	
3	0	0	1	0	0	0	1	1	1	1	
4	0	0	1	0	0	0	0	1	1	1	

In [30]:

```
1 X = data1.iloc[:,:]
2 print(X)
```

```
    hair  feathers  eggs  milk  airborne  aquatic  predator  toothed  \
0      0         0     1     0         0        1         0        0
1      0         0     1     0         0        0         0        1
2      0         0     1     0         0        0         1        1
3      0         0     1     0         0        0         1        1
4      0         0     1     0         0        0         0        1
5      0         0     1     0         0        0         1        1
6      0         0     1     0         0        0         1        1
7      0         0     1     0         0        0         1        1
8      0         0     1     0         0        1         1        1
9      0         0     1     0         0        1         1        1
10     0         0     1     0         0        1         1        1
11     0         0     1     0         0        0         0        1
12     0         0     1     0         0        1         0        0
13     0         0     1     0         0        1         0        0
14     0         0     1     0         0        1         0        0
15     0         0     1     0         0        1         0        0
16     0         0     1     0         0        1         1        1
17     0         0     1     0         0        1         0        0
18     0         0     1     0         0        1         0        0
19     0         0     1     0         0        1         0        1
20     0         0     1     0         0        1         0        1
21     0         0     1     0         0        1         0        1
22     0         0     1     0         0        1         0        1
23     0         0     1     0         0        1         0        1
24     0         0     1     0         0        1         0        1
25     0         0     1     0         1        0         0        0
26     0         0     1     0         1        0         1        0
27     0         0     1     0         0        0         0        0
28     0         0     1     0         0        0         0        0
29     1         0     1     0         1        0         0        0
30     0         0     1     0         1        0         1        0
31     0         0     1     0         0        0         0        0
32     0         0     1     0         0        0         1        0
33     0         0     1     0         1        0         0        0
34     0         0     1     0         0        0         0        0
35     0         0     1     0         1        0         0        0
36     0         0     1     0         1        0         0        0
37     0         0     1     0         0        1         0        0
38     0         0     1     0         0        0         1        1
39     0         0     1     0         0        0         0        0
40     0         0     1     0         0        0         0        0
41     0         0     1     0         0        1         0        0
42     0         0     1     0         0        1         0        0

    backbone  breathes  venomous  fins  legs  tail  domestic  catsize
0          1         1         0     0     4     1         1        1
1          1         1         0     0     4     1         1        0
2          1         1         0     0     4     1         1        1
3          1         1         0     0     4     1         0        0
4          1         1         0     0     4     1         1        0
5          1         1         1     0     0     1         0        1
6          1         1         0     0     0     1         0        1
7          1         1         1     0     0     1         0        1
8          1         1         0     0     4     1         0        1
```

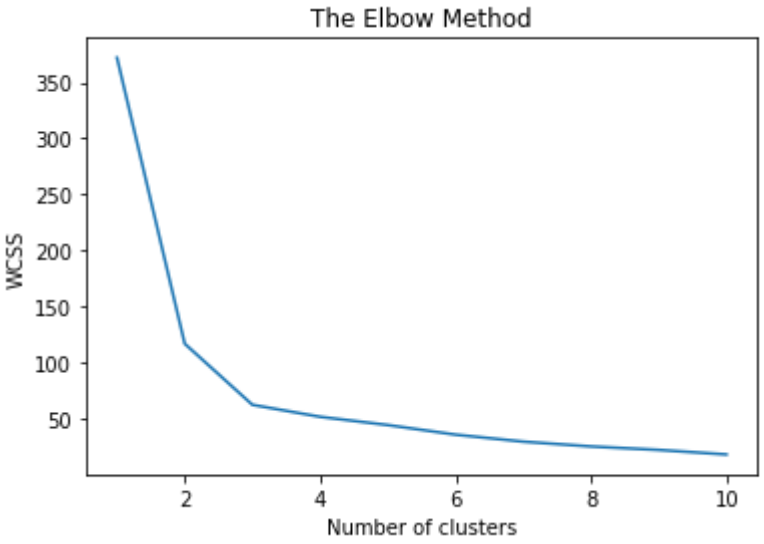
9	1	1	0	0	4	1	0	1
10	1	1	0	0	4	1	0	1
11	1	1	0	0	4	1	0	0
12	1	0	0	1	0	1	0	0
13	1	0	0	1	0	1	0	1
14	1	0	0	1	0	1	0	1
15	1	0	0	1	0	1	0	1
16	1	0	0	1	0	1	0	1
17	1	0	0	1	0	1	0	1
18	1	0	0	1	0	1	0	1
19	1	1	0	0	4	1	1	0
20	1	1	0	0	2	1	0	0
21	1	1	0	0	4	0	0	0
22	1	1	0	0	4	0	0	0
23	1	1	0	0	4	0	0	0
24	1	1	0	0	4	0	0	0
25	0	1	0	0	6	0	0	0
26	0	1	1	0	6	0	0	0
27	0	1	0	0	6	0	0	0
28	0	1	0	0	6	0	0	0
29	0	1	0	0	6	0	0	0
30	0	1	0	0	6	0	0	0
31	0	1	0	0	6	0	0	0
32	0	1	0	0	6	0	0	0
33	0	1	0	0	6	0	0	0
34	0	1	0	0	6	0	0	0
35	0	1	0	0	6	0	0	0
36	0	1	0	0	6	0	0	0
37	0	0	0	0	0	0	0	0
38	0	1	1	0	8	0	0	0
39	0	1	0	0	0	0	0	0
40	0	1	0	0	0	0	0	0
41	0	0	1	0	0	0	0	1
42	0	0	0	0	0	0	0	1

In [34]:

```
1 from sklearn.cluster import KMeans
2 from yellowbrick.cluster import KElbowVisualizer
```

In [33]:

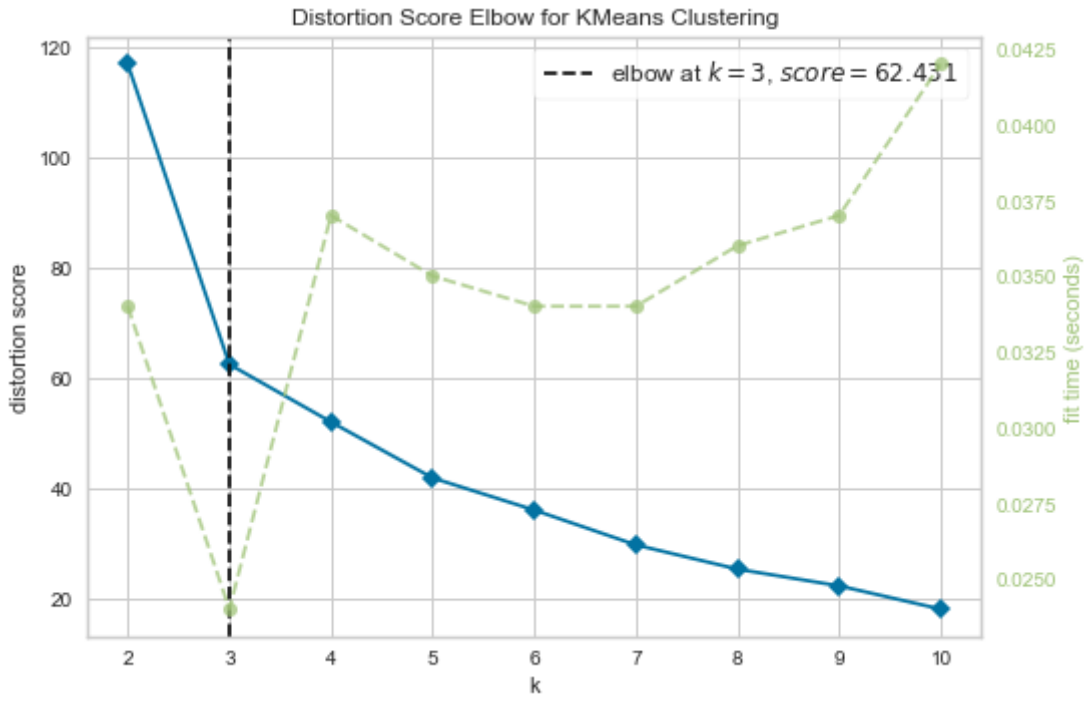
```
wcss = []
for i in range(1, 11):
    kmeans = KMeans(n_clusters = i, init = 'k-means++',
                    random_state = 42)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)
plt.plot(range(1, 11), wcss)
plt.title('The Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
```



In [35]:

```
# Quick examination of elbow method to find numbers of clusters to make.
print('Elbow Method to determine the number of clusters to be formed:')
Elbow_M = KElbowVisualizer(KMeans(), k=10)
Elbow_M.fit(X)
Elbow_M.show()
```

```
Elbow Method to determine the number of clusters to be formed:
```

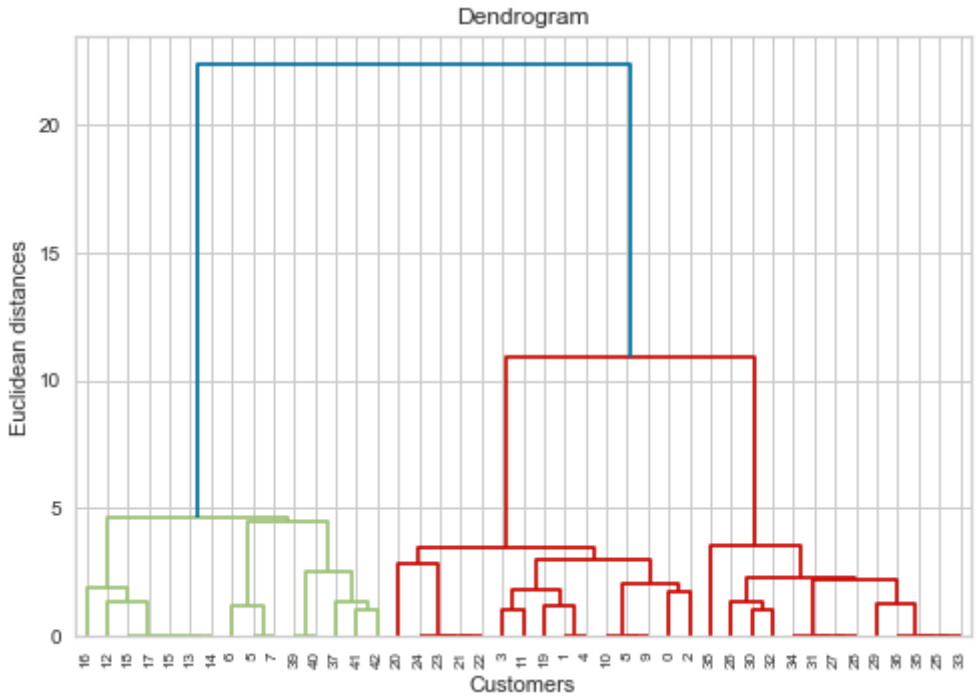


Out[35]:

```
<AxesSubplot:title={'center':'Distortion Score Elbow for KMeans Clusterin
g'}, xlabel='k', ylabel='distortion score'>
```

In [36]:

```
import scipy.cluster.hierarchy as sch
dendrogram = sch.dendrogram(sch.linkage(X, method = 'ward'))
plt.title('Dendrogram')
plt.xlabel('Customers')
plt.ylabel('Euclidean distances')
plt.show()
```

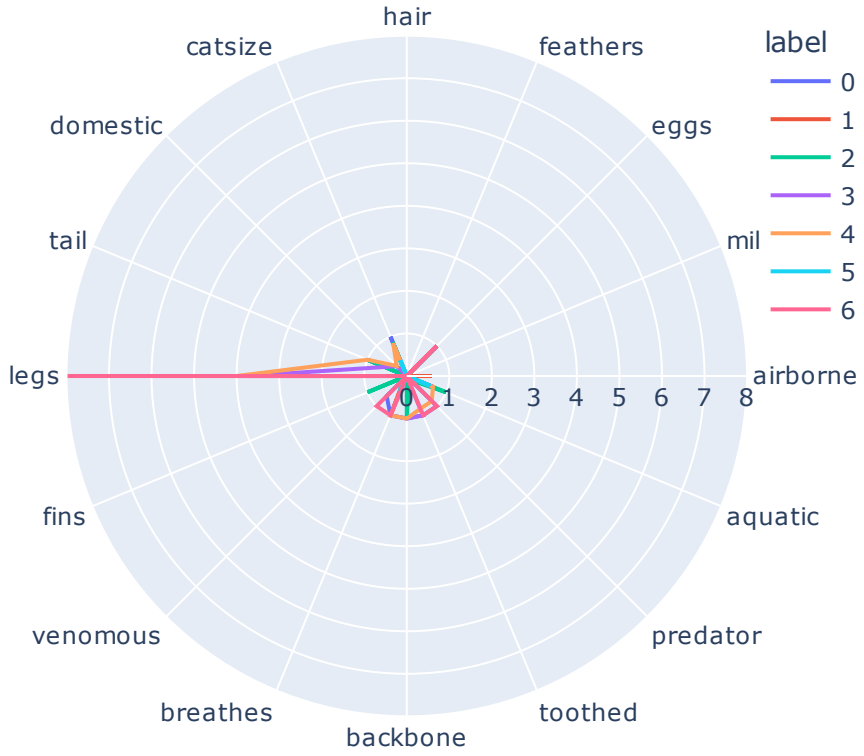


In [38]:

```
kmeans = KMeans(
        n_clusters=2, init="k-means++",
        n_init=10,
        tol=1e-04, random_state=42
    )
kmeans.fit(X)
clusters=pd.DataFrame(X,columns=data1.columns)
clusters['label']=kmeans.labels_
polar=clusters.groupby("label").mean().reset_index()
polar=pd.melt(polar,id_vars=["label"])
```

In [45]:

```
fig3 = px.line_polar(polar, r="value", theta="variable",
                     color="label", line_close=True,height=500,
                     width=500)
fig3.show()
```

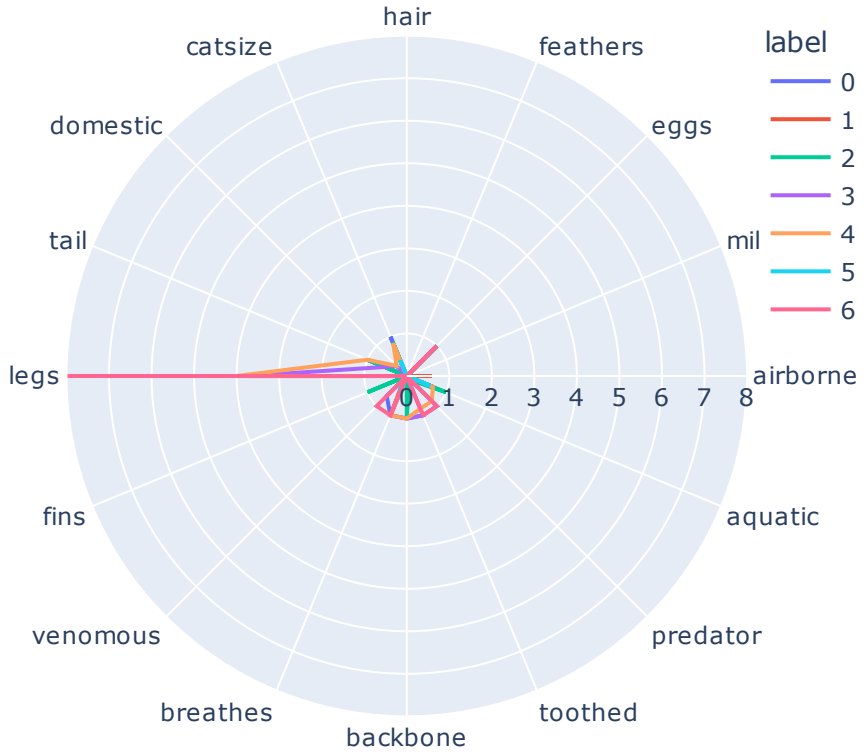


In [40]:

```
kmeans = KMeans(
        n_clusters=5, init="k-means++",
        n_init=10,
        tol=1e-04, random_state=42
    )
kmeans.fit(X)
clusters=pd.DataFrame(X,columns=data1.columns)
clusters['label']=kmeans.labels_
polar=clusters.groupby("label").mean().reset_index()
polar=pd.melt(polar,id_vars=["label"])
```

In [46]:

```
fig4 = px.line_polar(polar, r="value", theta="variable",
                     color="label", line_close=True,height=500,
                     width=500)
fig4.show()
```



In [42]:

```
kmeans = KMeans(
        n_clusters=7, init="k-means++",
        n_init=10,
        tol=1e-04, random_state=42
    )
kmeans.fit(X)
clusters=pd.DataFrame(X,columns=data1.columns)
clusters['label']=kmeans.labels_
polar=clusters.groupby("label").mean().reset_index()
polar=pd.melt(polar,id_vars=["label"])
```

In [47]:

```
fig5 = px.line_polar(polar, r="value", theta="variable",
                     color="label", line_close=True,height=500,
                     width=500)
fig5.show()
```