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ANURAG JADHAV

TASK 1 - IRIS FLOWERS CLASSIFICATION ML PROJECT

IMPORT LIBRARIES

In [10]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import holoviews as hv
import hvplot
import hvplot.pandas
import plotly.express as px
import scikitplot as skplt
import warnings
warnings.filterwarnings('ignore')
```

In [11]:
```
iris = sns.load_dataset('iris')
iris.head()
```

Out[11]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa

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In [11]:
```
iris = sns.load_dataset('iris')
iris.head()
```

Out[11]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa

Understanding Dataset

In [12]:
```
iris.ndim
```

Out[12]:
```
2
```

In [13]:
```
iris.shape
```

Out[13]:
```
(150, 5)
```

In [14]:
```
iris.columns
```

Out[14]:
```
Index(['sepal_length', 'sepal_width', 'petal_length', 'petal_width',
       'species'],
      dtype='object')
```

In [15]:
```
iris.isna().sum()
```

Out[15]:
```
sepal_length    0
```

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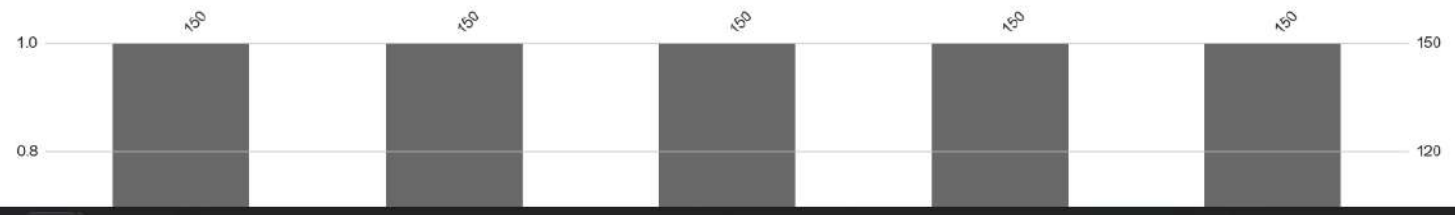
In [15]:
```
iris.isna().sum()
```

Out[15]:
```
sepal_length    0
sepal_width     0
petal_length    0
petal_width     0
species         0
dtype: int64
```

In [16]:
```
iris.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   sepal_length  150 non-null    float64
 1   sepal_width   150 non-null    float64
 2   petal_length  150 non-null    float64
 3   petal_width   150 non-null    float64
 4   species       150 non-null    object 
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
```

In [17]:
```
import missingno as msno
msno.bar(iris)
plt.show()
```



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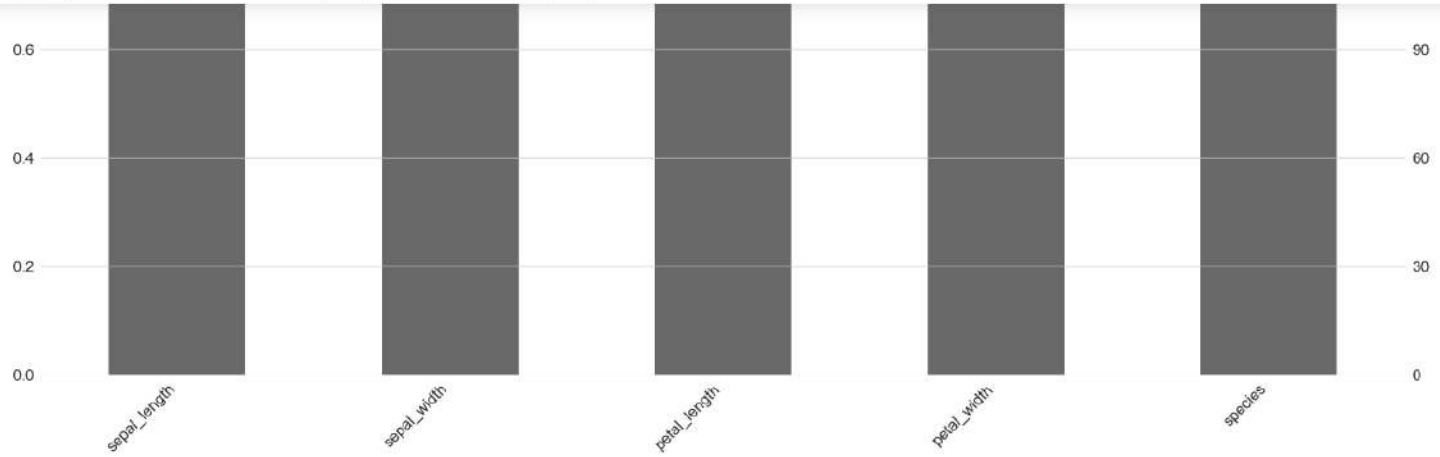

In [18]:
```
iris.species.value_counts()
```

Out[18]:
```
setosa        50
versicolor    50
virginica     50
Name: species, dtype: int64
```

In [19]:
```
iris.species.value_counts(normalize=True)
```

Out[19]:
```
setosa        0.333333
versicolor    0.333333
virginica     0.333333
Name: species, dtype: float64
```

In [20]:
```
iris.groupby('species').mean()
```

Out[20]:

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species	sepal_length	sepal_width	petal_length	petal_width
setosa	5.006	3.428	1.462	0.246
versicolor	5.936	2.770	4.260	1.326
virginica	6.588	2.974	5.552	2.026

In [21]:
```
iris.groupby('species').median()
```

Out[21]:

species	sepal_length	sepal_width	petal_length	petal_width
setosa	5.0	3.4	1.50	0.2
versicolor	5.9	2.8	4.35	1.3
virginica	6.5	3.0	5.55	2.0

In [22]:
```
iris.groupby('species').std()
```

Out[22]:

species	sepal_length	sepal_width	petal_length	petal_width
setosa	0.352490	0.379064	0.173664	0.105386
versicolor	0.516171	0.313798	0.469911	0.197753
virginica	0.635880	0.322497	0.551895	0.274650

In [23]:
```
iris.groupby('species').var()
```

Out[23]:

species	sepal_length	sepal_width	petal_length	petal_width

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setosa	0.124249	0.143690	0.030159	0.011106
versicolor	0.266433	0.098469	0.220816	0.039106
virginica	0.404343	0.104004	0.304588	0.075433

In [24]:
```
iris.describe()
```

Out[24]:

	sepal_length	sepal_width	petal_length	petal_width
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.057333	3.758000	1.199333
std	0.828066	0.435866	1.765298	0.762238
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

Visual Data Representation

TABLE

In [25]:
```
iris.hvplot.table()
```

Out[25]:

#	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa

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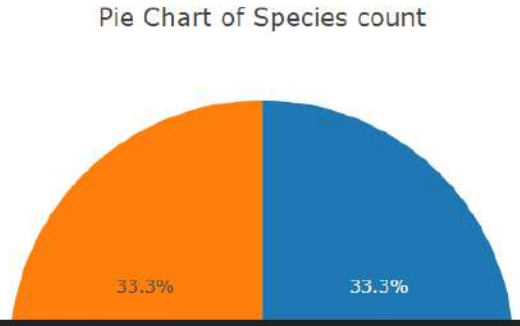
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa
5	5.4	3.9	1.7	0.4	setosa
6	4.6	3.4	1.4	0.3	setosa
7	5.0	3.4	1.5	0.2	setosa
8	4.4	2.9	1.4	0.2	setosa
9	4.9	3.1	1.5	0.1	setosa
10	5.4	3.7	1.5	0.2	setosa

Pie Plot

In [26]:
```
fig = px.pie(iris, values = iris.species.value_counts(),
             title="Pie Chart of Species count",template="none")
fig.show()
```



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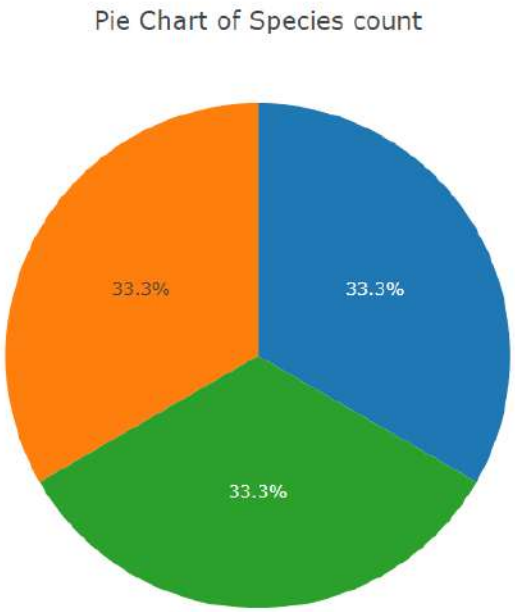
Pie Plot

In [26]:
```
fig = px.pie(iris, values = iris.species.value_counts(),
             title="Pie Chart of Species count",template="none")
fig.show()
```



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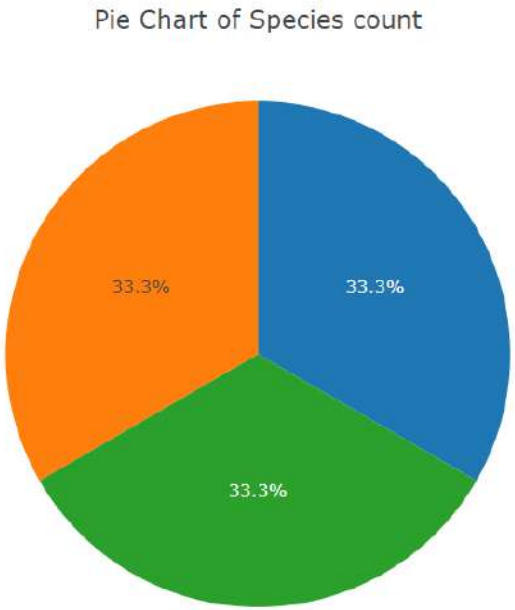
In [27]:
```
fig = px.pie(iris, values = iris.species.value_counts(),
             title="Pie Chart of Species count",template="none")
fig.show()
```



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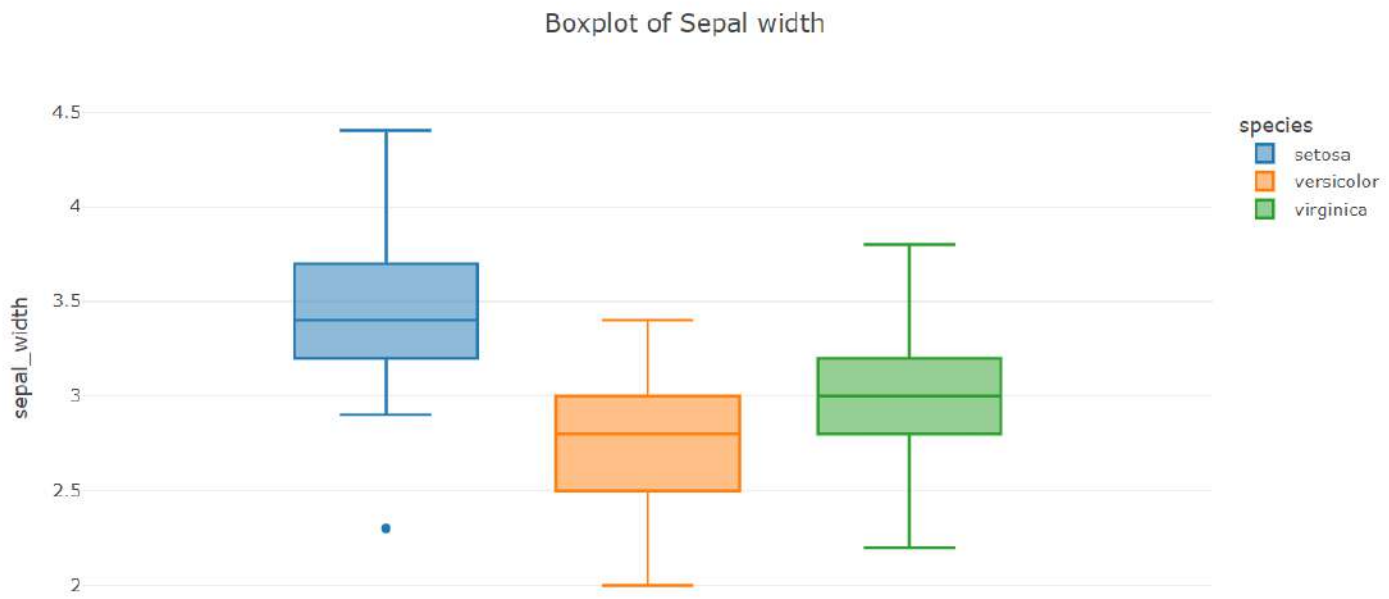
Boxplot

In [28]:
```
fig = px.box(iris, y="sepal_width",color="species",title="Boxplot of Sepal width",template="none")
fig.show()
```



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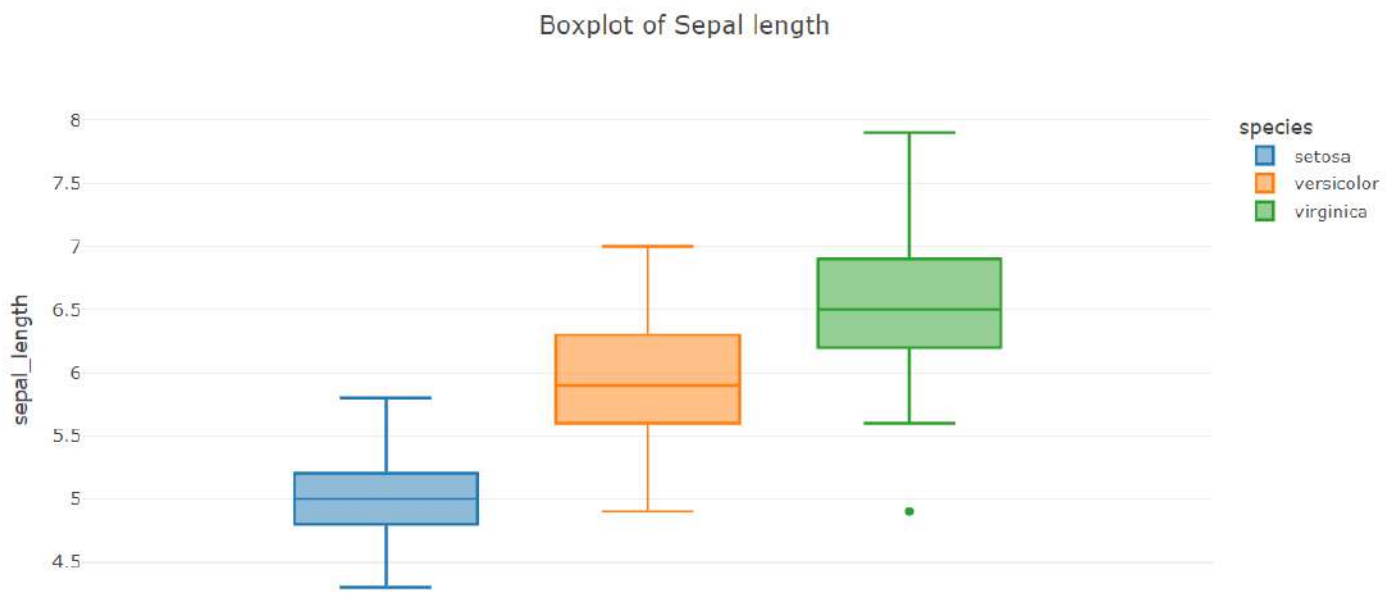
In [29]:
```
fig = px.box(iris, y="sepal_length",color="species",title="Boxplot of Sepal length",template="none")
fig.show()
```



In [30]:
```
fig = px.box(iris, y="petal_width",color="species",title="Boxplot of Petal width",template="none")
```

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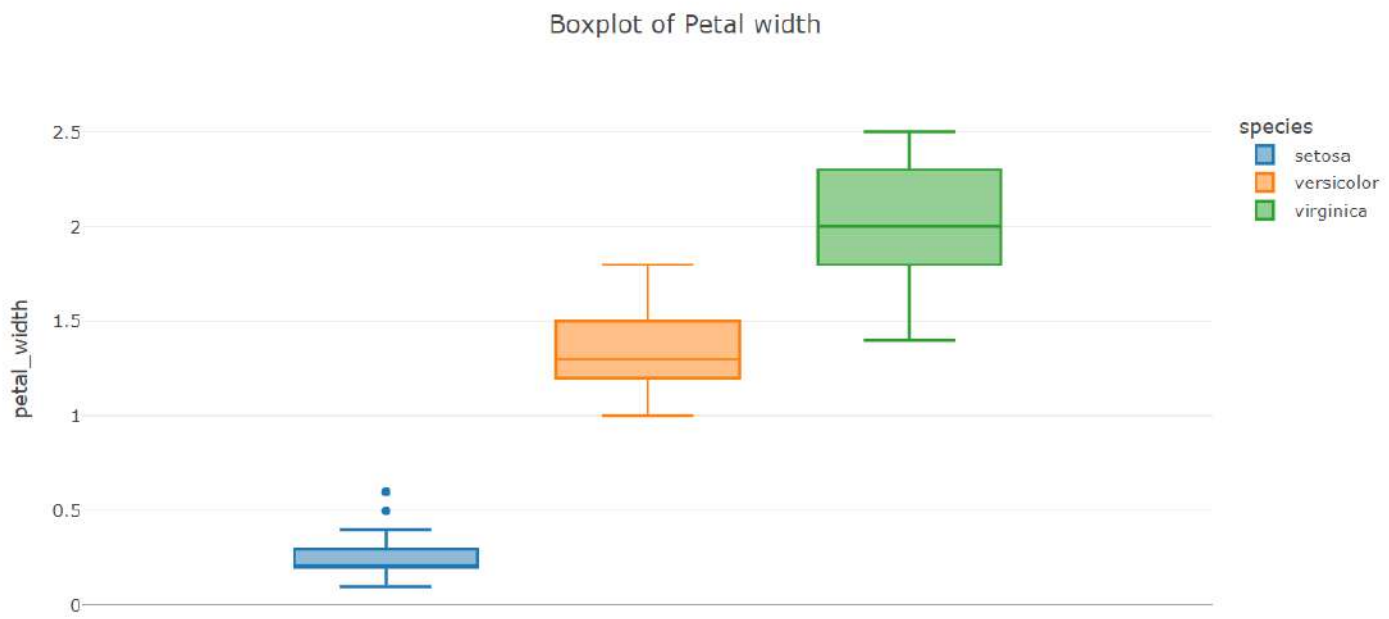
In [30]:
```
fig = px.box(iris, y="petal_width",color="species",title="Boxplot of Petal width",template="none")
fig.show()
```



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Run | Markdown

In [31]:
```
fig = px.box(iris, y="petal_length",color="species",title="Boxplot of Petal length",template="none")
fig.show()
```

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Python 3 (ipykernel)

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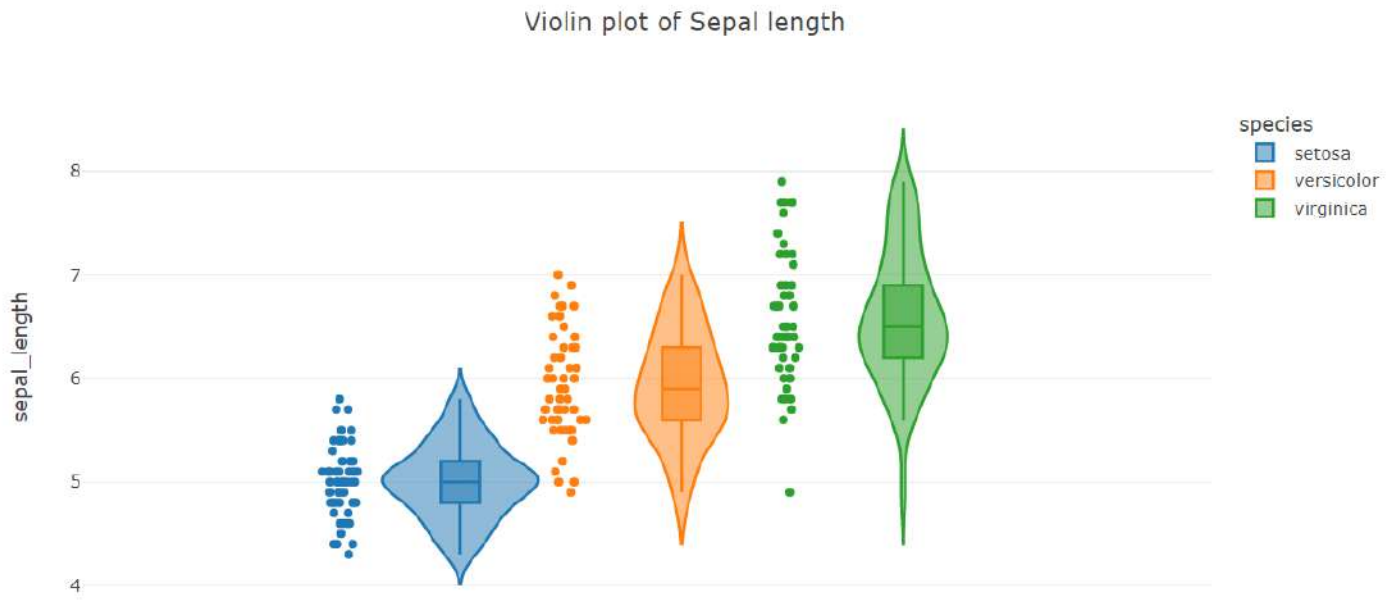
In [33]:
```
fig = px.violin(iris, y="sepal_length", box=True,points='all', color="species"
                ,title="Violin plot of Sepal length",template="none")
fig.show()
```



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Python 3 (ipykernel)

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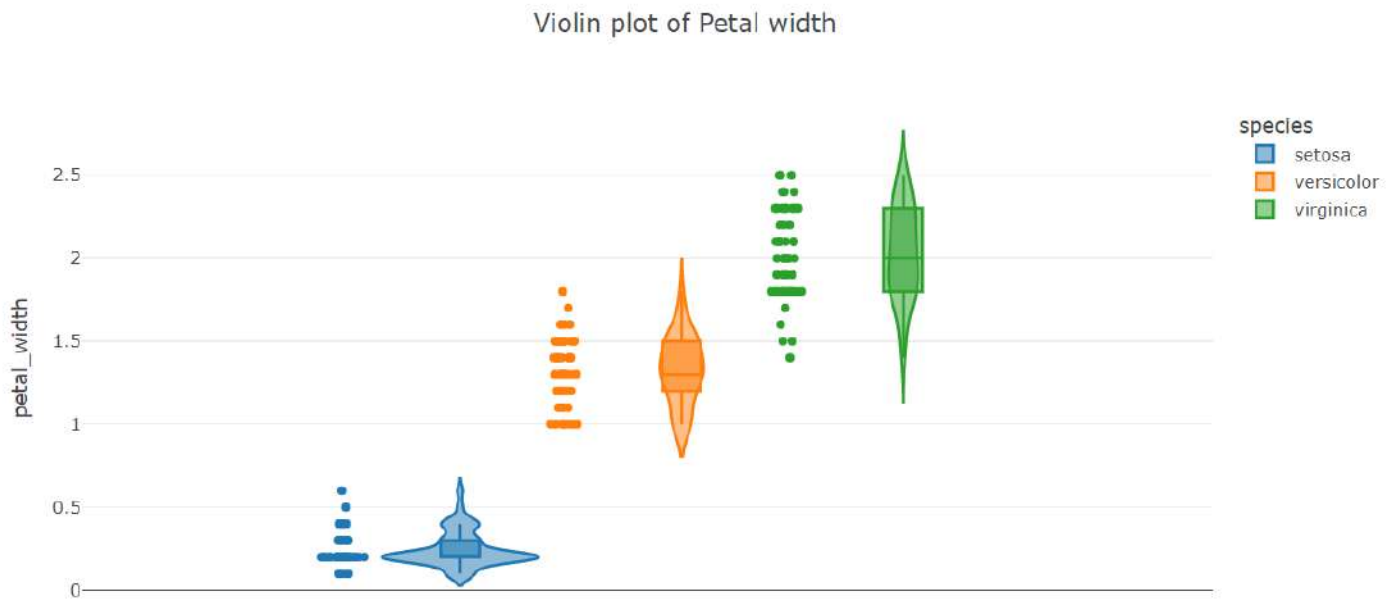
In [34]:
```
fig = px.violin(iris, y="petal_width", box=True,points='all', color="species",
                title="Violin plot of Petal width",template="none")
fig.show()
```



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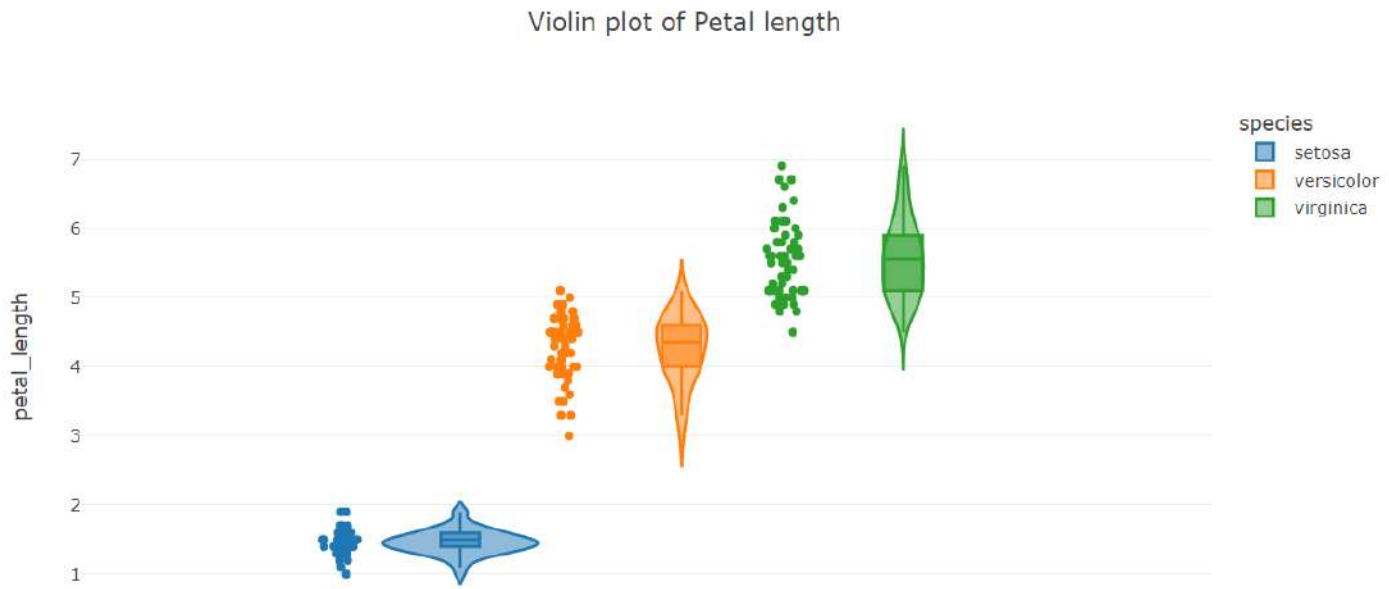
In [35]:
```
fig = px.violin(iris, y="petal_length", box=True,points='all', color="species",
                title="Violin plot of Petal length",template="none")
fig.show()
```



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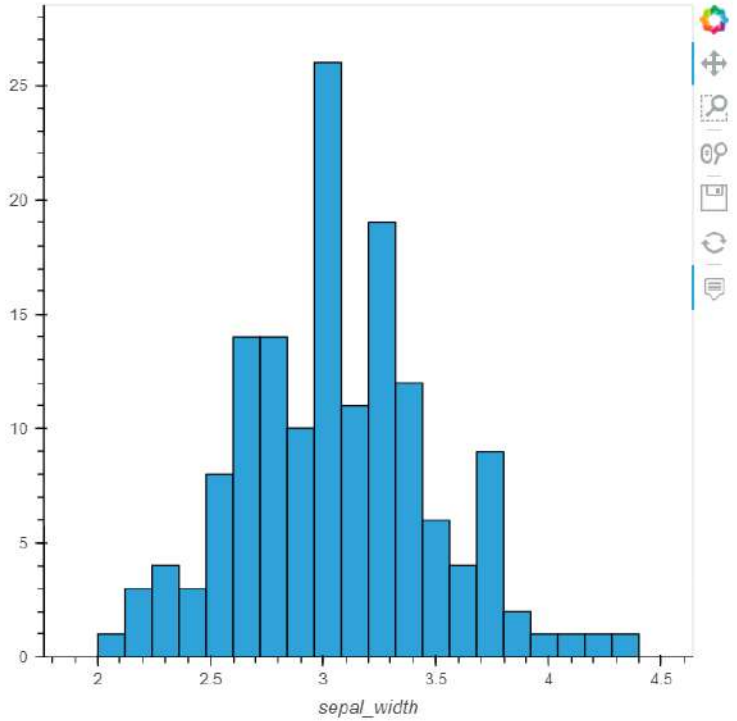
Histograms

In [36]:
```
iris.hvplot.hist("sepal_width",width=500, height=500)
```

Out[36]:



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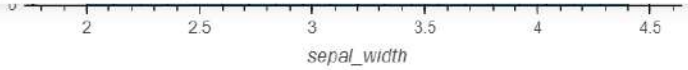
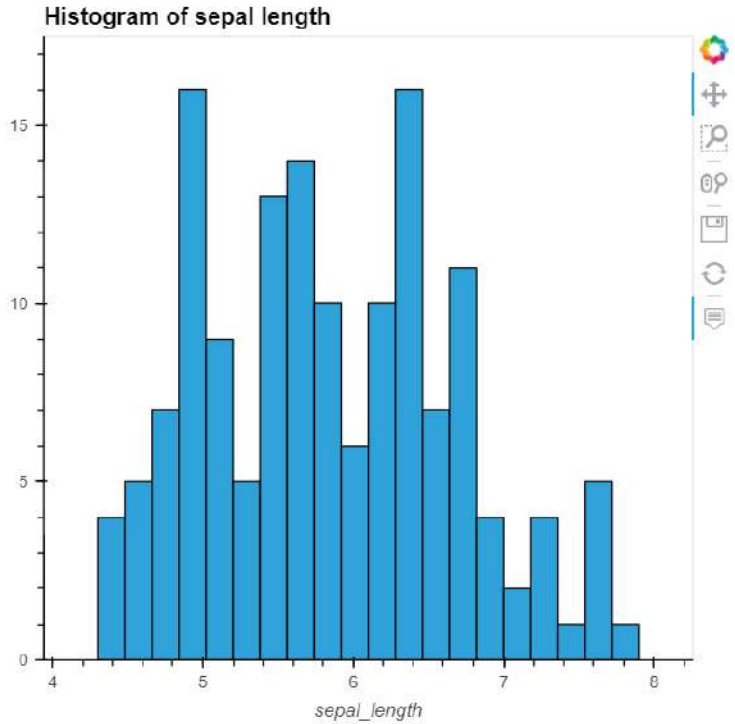


In [37]:
```
iris.hvplot.hist("sepal_length",width=500, height=500,title="Histogram of sepal length")
```

Out[37]:



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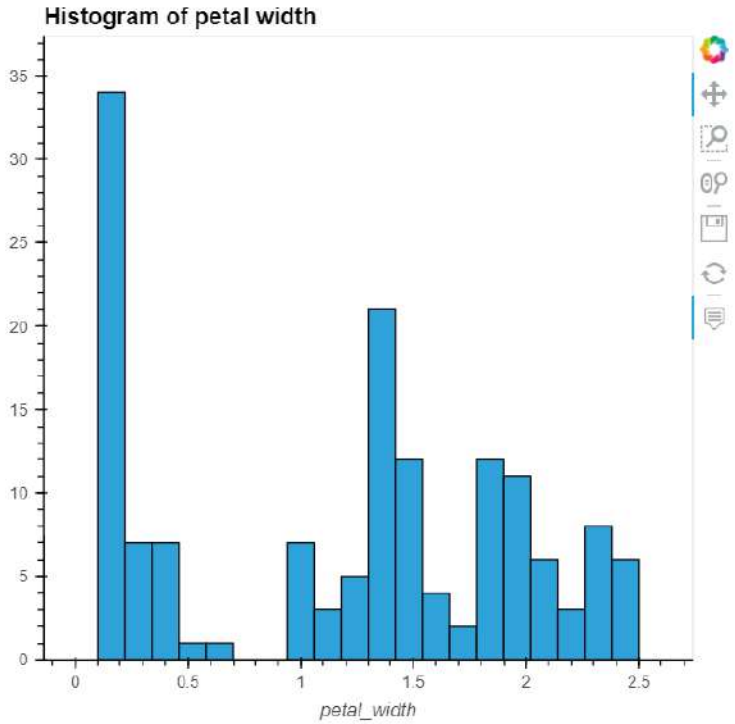
sepal_length

In [38]:
```
iris.hvplot.hist("petal_width",width=500, height=500,title="Histogram of petal width")
```

Out[38]:



In [39]:
```
iris.hvplot.kde("petal_length",width=500, height=500,title="Distribution of petal length")
```

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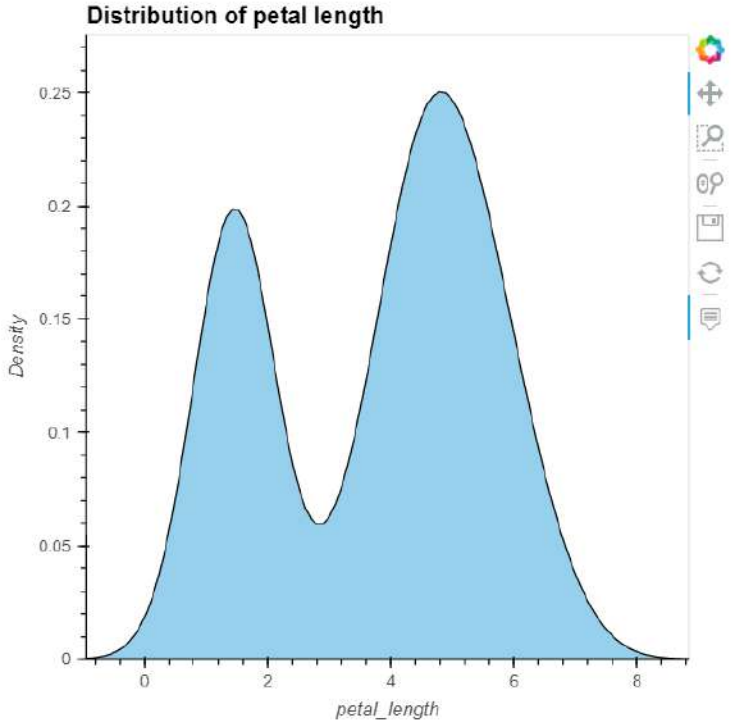
In [39]:
```
iris.hvplot.kde("petal_length",width=500, height=500,title="Distribution of petal length")
```

Out[39]:



Scatter Plots

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Python 3 (ipykernel)

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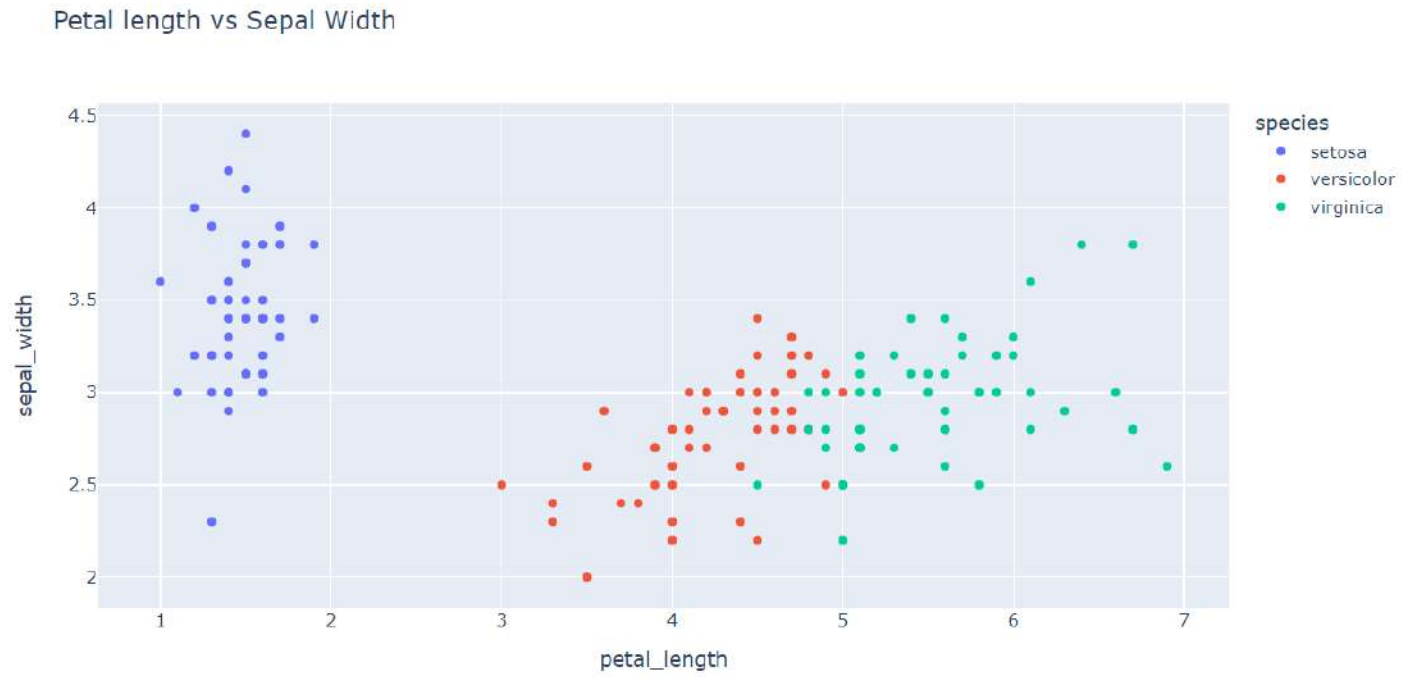
Scatter Plots

In [40]:
```
px.scatter(iris,x="petal_length", y="sepal_width", color="species",
           title="Petal length vs Sepal Width")
```



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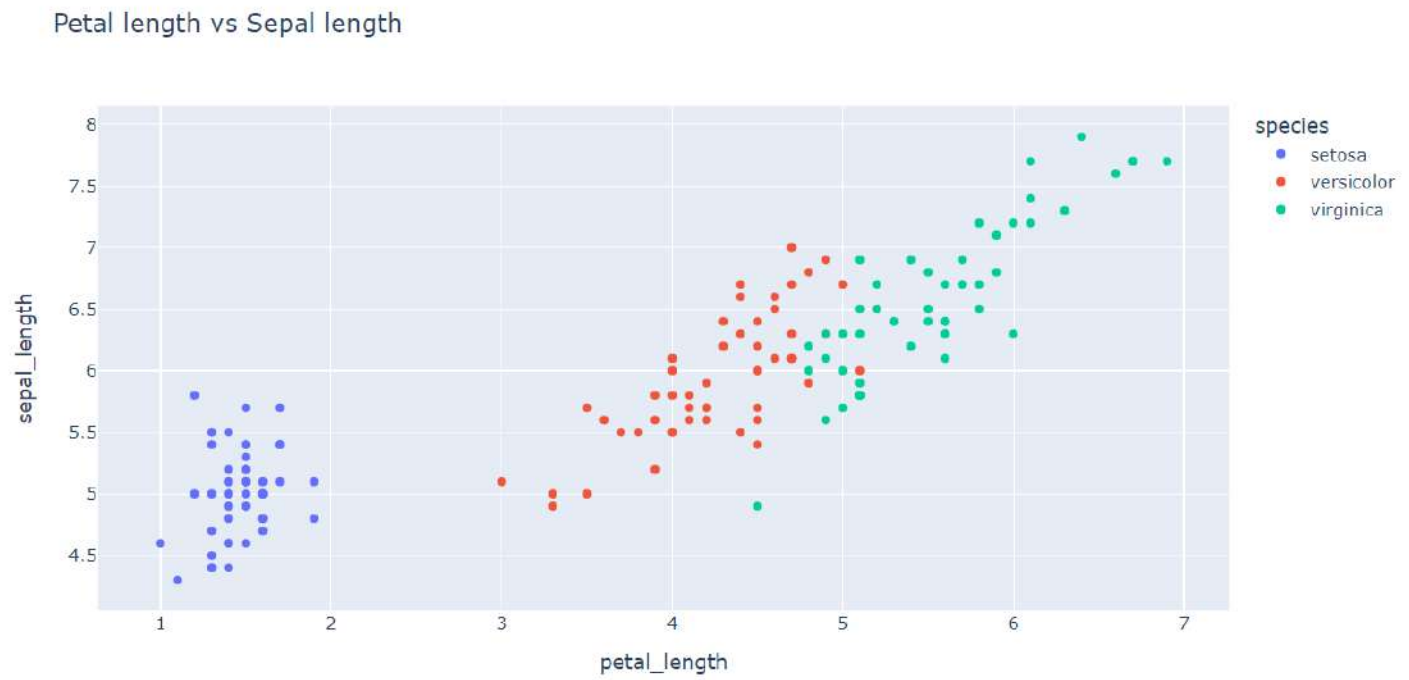
Python 3 (ipykernel)

Run Markdown

In [41]:
```
px.scatter(iris,x="petal_length", y="sepal_length", color="species",
           title="Petal length vs Sepal length")
```



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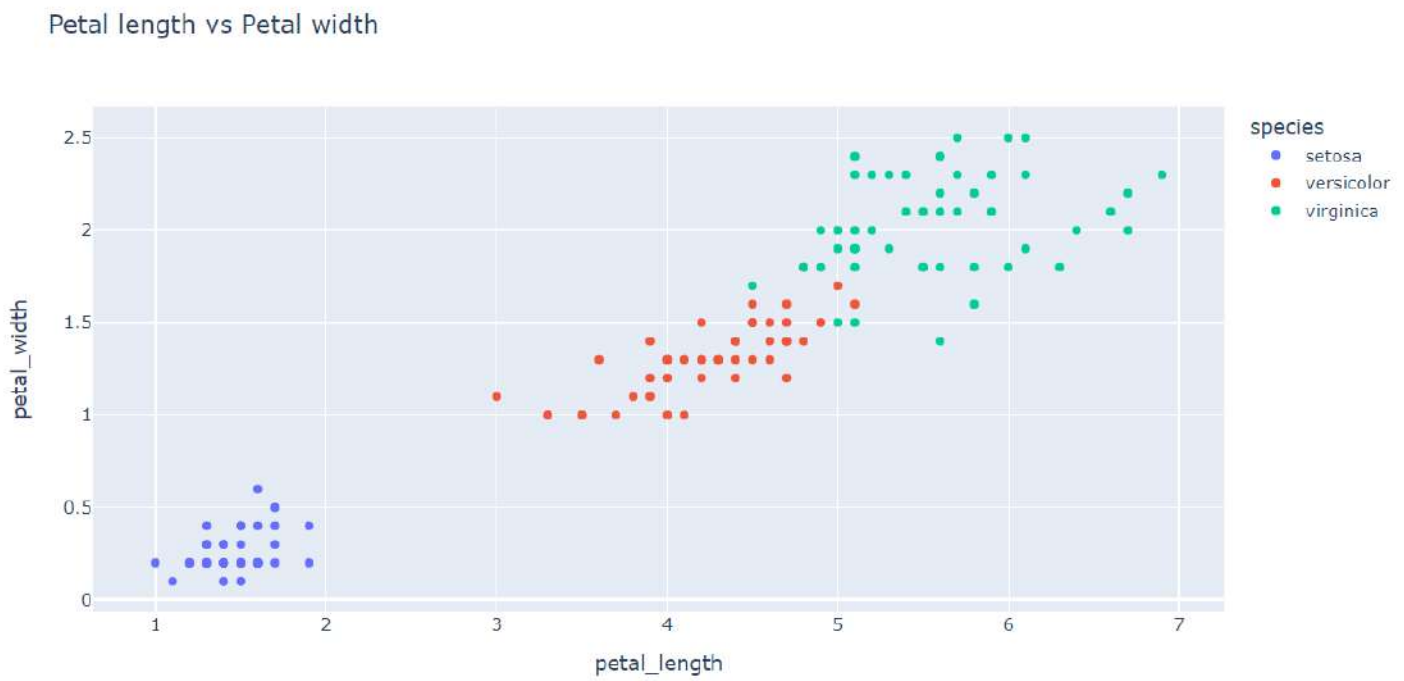
Trusted Python 3 (ipykernel)

Run Markdown

In [42]:
```
px.scatter(iris,x="petal_length", y="petal_width", color="species",
           title="Petal length vs Petal width")
```



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Python 3 (ipykernel)

Run Markdown

In [43]:
```
fig = px.scatter(iris, x="sepal_width", y="sepal_length", color="species",
                 size='petal_length', hover_data=['petal_width'])
fig.show()
```

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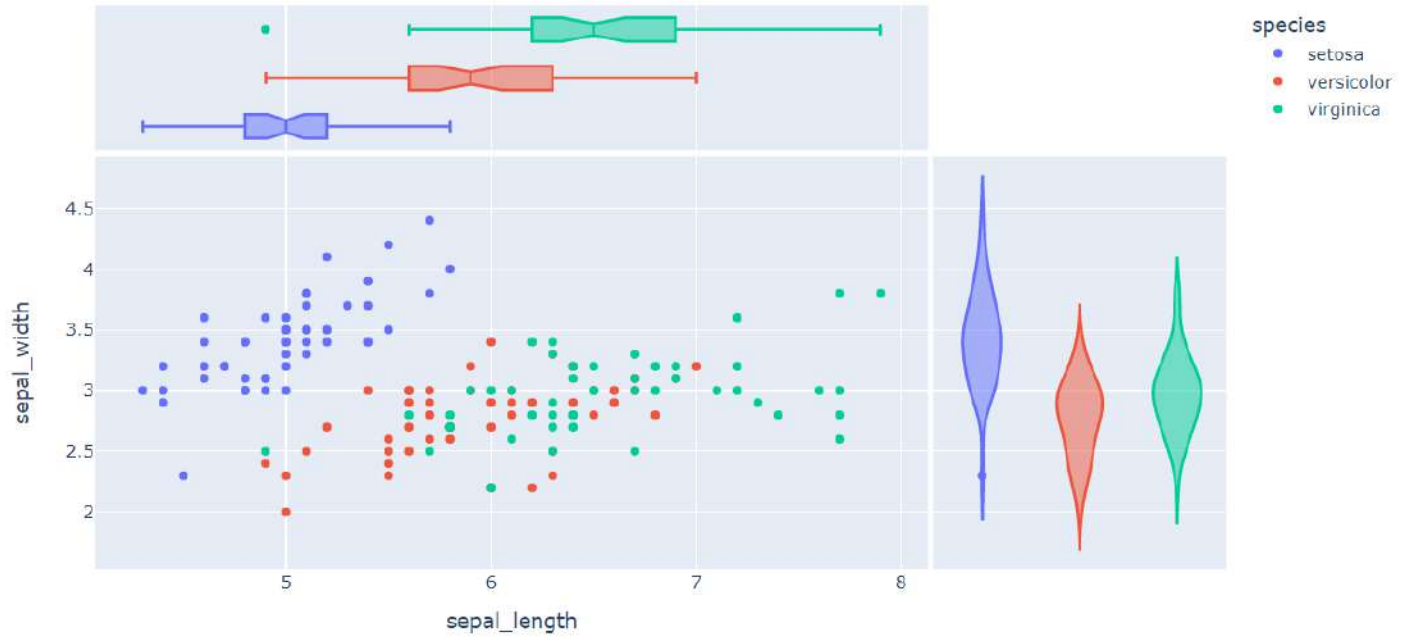
Python 3 (ipykernel)

Run Markdown

In [44]:
```
fig = px.scatter(iris, x="sepal_length", y="sepal_width", color="species",
                 marginal_x="box", marginal_y="violin")
fig.show()
```



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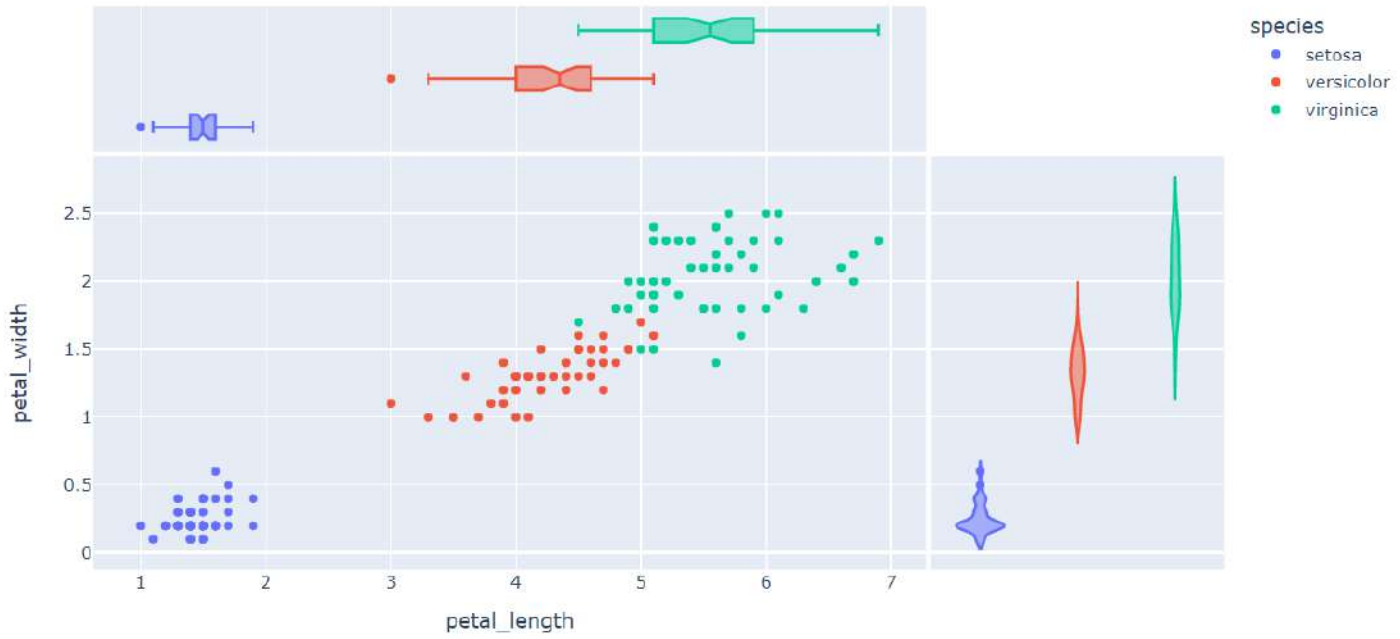
Python 3 (ipykernel)

Run Markdown

In [45]:
```
fig = px.scatter(iris, x="petal_length", y="petal_width", color="species",
                 marginal_x="box", marginal_y="violin")
fig.show()
```



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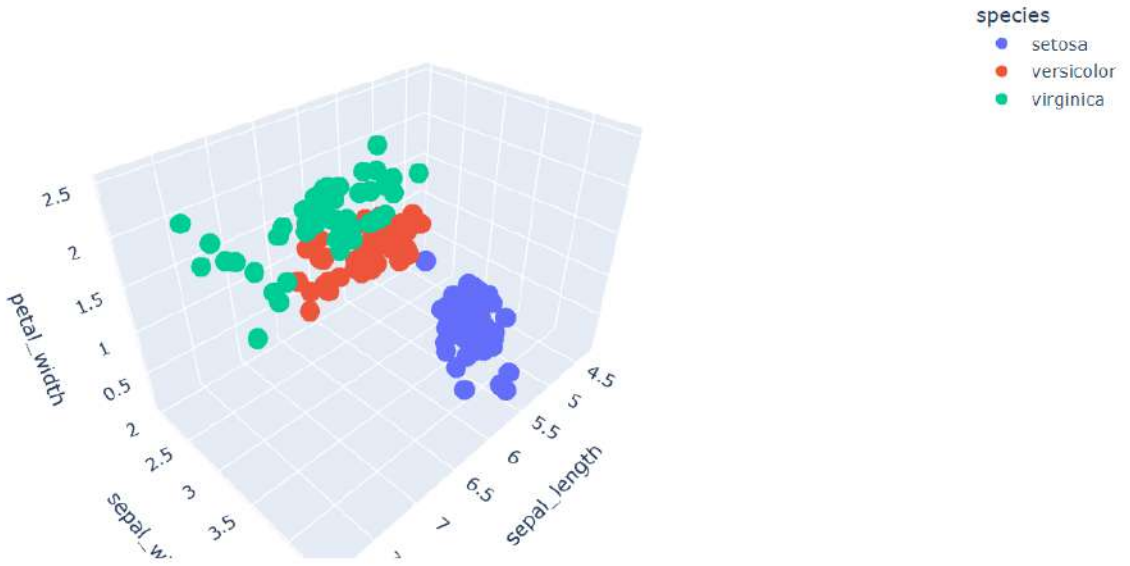
Python 3 (ipykernel)

Run

Markdown

In [46]:
```
fig = px.scatter_3d(iris, x='sepal_length', y='sepal_width', z='petal_width',
                    color='species')
fig.show()
```



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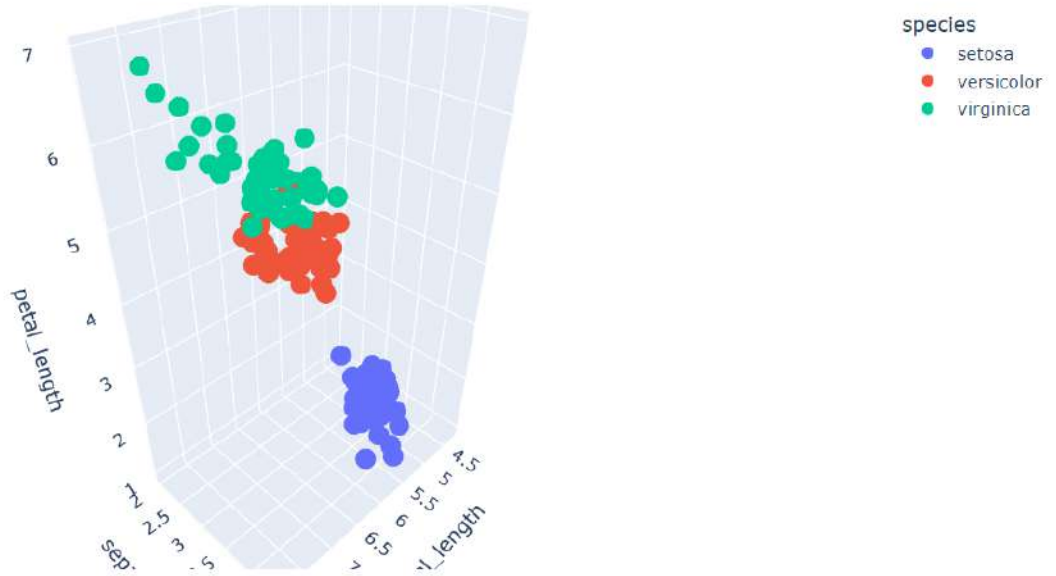
Python 3 (ipykernel)

Run Markdown

In [47]:
```
fig = px.scatter_3d(iris, x='sepal_length', y='sepal_width', z='petal_length',
                    color='species')
fig.show()
```



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Run Markdown

Correlation heatmap

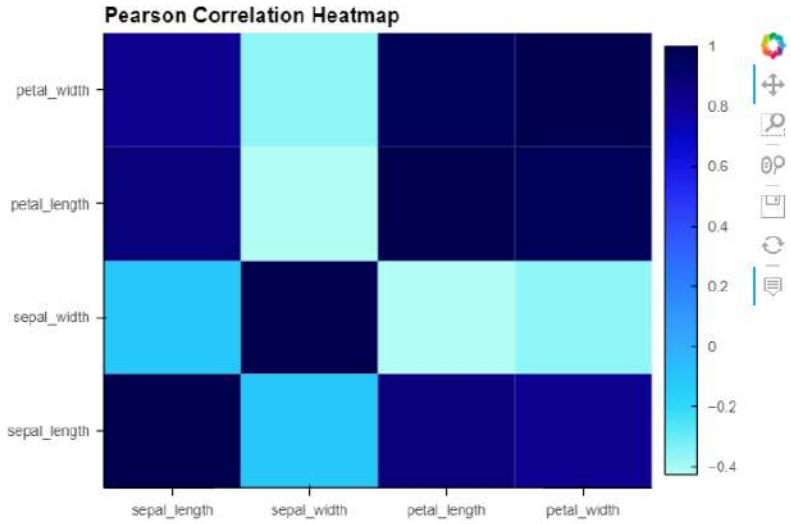
In [48]:
```
iris.corr()
```

Out[48]:

	sepal_length	sepal_width	petal_length	petal_width
sepal_length	1.000000	-0.117570	0.871754	0.817941
sepal_width	-0.117570	1.000000	-0.428440	-0.366126
petal_length	0.871754	-0.428440	1.000000	0.962865
petal_width	0.817941	-0.366126	0.962865	1.000000

In [49]:
```
iris.corr().hvplot.heatmap(height=400, width=600,
                           colorbar=True, title = "Pearson Correlation Heatmap")
```

Out[49]:



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Feature Encoding

In [50]:
```
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score
from sklearn.metrics import f1_score, recall_score, precision_score
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder, StandardScaler
from yellowbrick.target import FeatureCorrelation, BalancedBinningReference, ClassBalance
classes = ["Setosa ","Versicolour" ,"Virginica"]
```

In [51]:
```
label_encoder = LabelEncoder()
iris['species']= label_encoder.fit_transform(iris['species'])
iris['species'].unique()
```

Out[51]:
```
array([0, 1, 2])
```

In [52]:
```
iris.head()
```

Out[52]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	0
1	4.9	3.0	1.4	0.2	0
2	4.7	3.2	1.3	0.2	0
3	4.6	3.1	1.5	0.2	0
4	5.0	3.6	1.4	0.2	0

In [53]:
```
X = iris.iloc[:, :-1].values
y = iris.iloc[:, -1].values
```

In [54]:
```
X[:5]
```

Out[54]:
```
array([[5.1, 3.5, 1.4, 0.2],
       [4.9, 3. , 1.4, 0.2],
       [4.7, 3.2, 1.3, 0.2],
       [4.6, 3.1, 1.5, 0.2],
       [5. , 3.6, 1.4, 0.2]])
```

In [55]:
```
y[:5]
```

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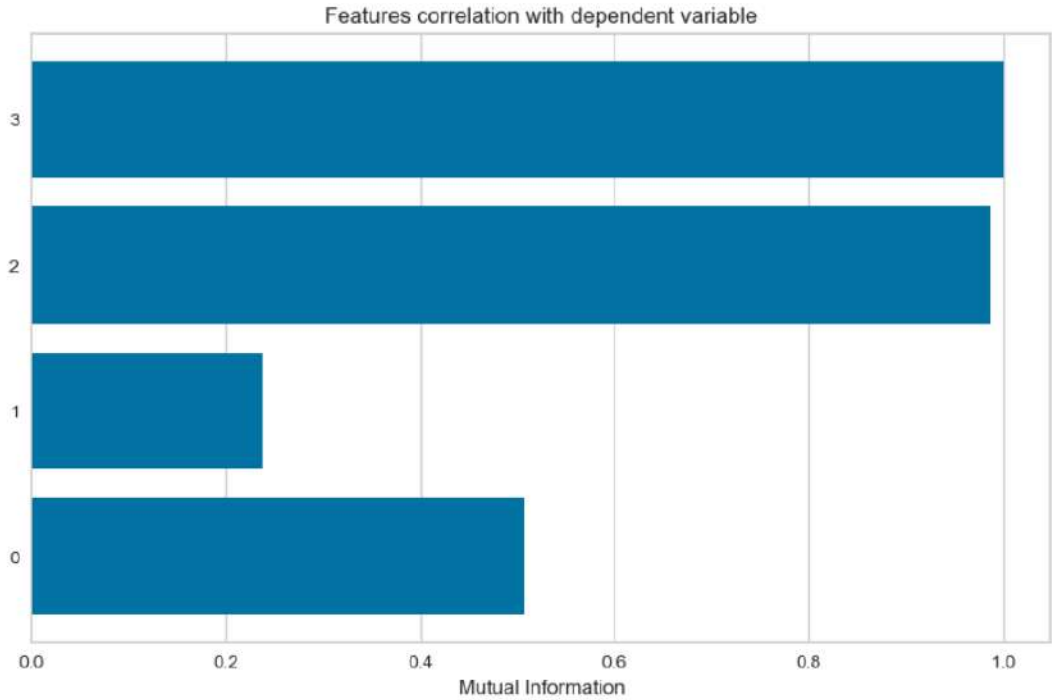
Out[55]: array([0, 0, 0, 0, 0])

In [56]:
```
plt.figure(figsize=(10,6))
visualizer = FeatureCorrelation(method='mutual_info-classification')
visualizer.fit(X, y)
visualizer.show()
plt.show()
```



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In [57]:
```
scaler = StandardScaler()
X = scaler.fit_transform(X)
print(X[:5])
```

```
[[-0.90068117  1.01900435 -1.34022653 -1.3154443 ]
 [-1.14301691 -0.13197948 -1.34022653 -1.3154443 ]
 [-1.38535265  0.32841405 -1.39706395 -1.3154443 ]
 [-1.50652052  0.09821729 -1.2833891  -1.3154443 ]
 [-1.02184904  1.24920112 -1.34022653 -1.3154443 ]]
```

In [58]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 0)
```

K-Nearest Neighbours

In [59]:
```
from sklearn.neighbors import KNeighborsClassifier
knn_clf = KNeighborsClassifier(n_neighbors=3)
knn_clf.fit(X_train, y_train)
```

Out[59]:
```
KNeighborsClassifier(n_neighbors=3)
```

In [60]:
```
y_pred = knn_clf.predict(X_test)
```

Classification Error:

In [61]:
```
print(1 - accuracy_score(y_test, y_pred))
```

```
0.033333333333333326
```

Precision Score:

In [62]:
```
print(precision_score(y_test, y_pred,average="micro"))
```

```
0.9666666666666667
```

Classification Accuracy:

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Run Markdown

In [63]:
```
print(accuracy_score(y_test, y_pred))
```

```
0.9666666666666667
```

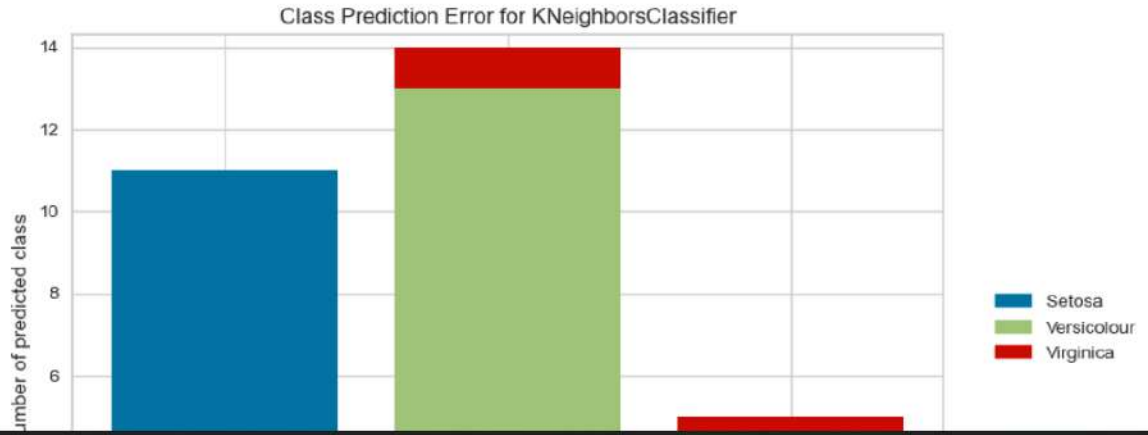
Sensitivity/True Positive Rate/Recall Score

In [64]:
```
print(recall_score(y_test, y_pred,average="micro"))
```

```
0.9666666666666667
```

Class Prediction Error

In [65]:
```
from yellowbrick.classifier import class_prediction_error
plt.figure(figsize=(10,6))
visualizer = class_prediction_error(knn_clf,X_train,y_train,X_test,y_test,classes=classes)
visualizer.show()
plt.show()
```



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Class Prediction Error

In [65]:
```
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plt.figure(figsize=(10,6))
visualizer = class_prediction_error(knn_clf,X_train,y_train,X_test,y_test,classes=classes)
visualizer.show()
plt.show()
```

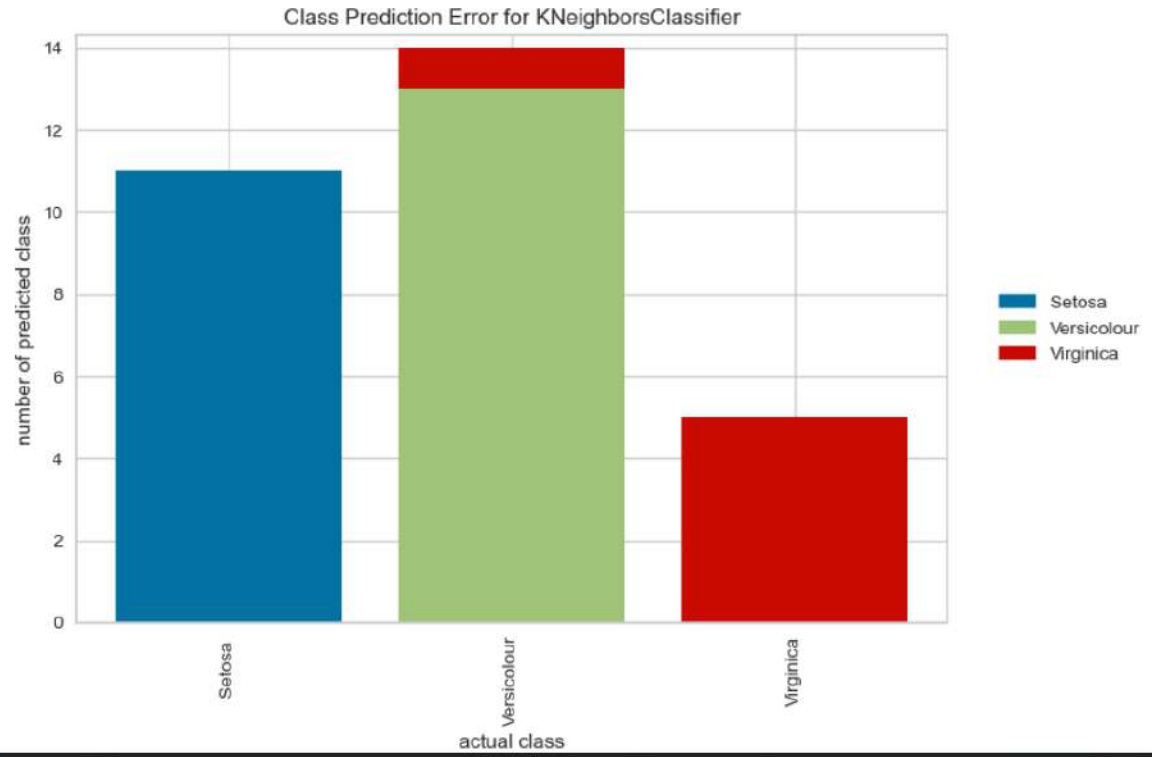

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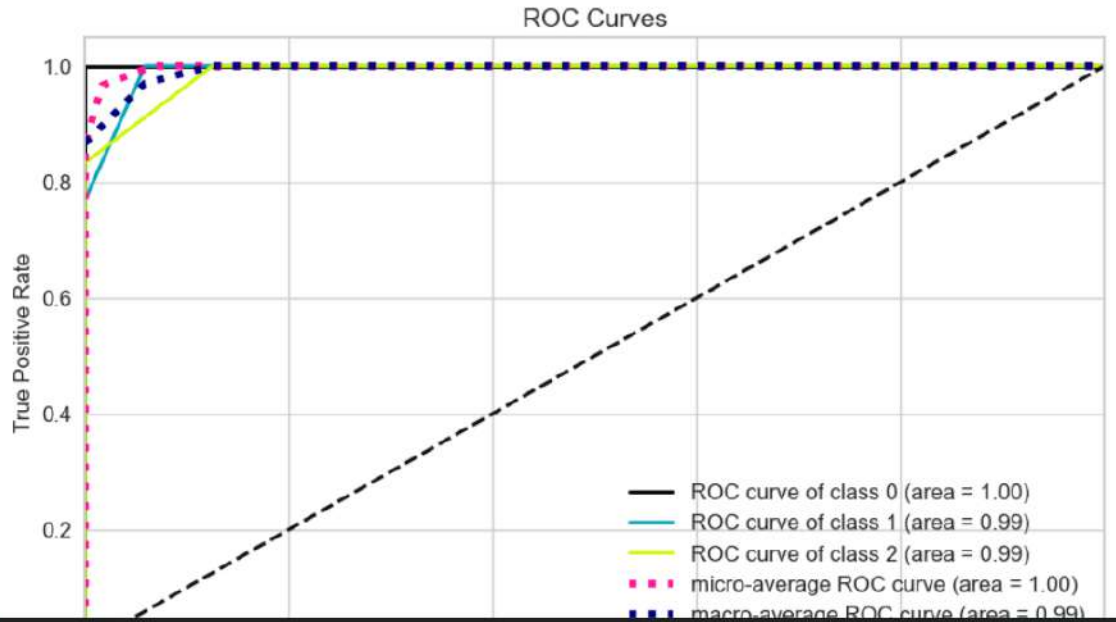
F1 Score

In [67]:
```
print( f1_score( y_test, y_pred,average="micro"))
```

```
0.9666666666666667
```

ROC Curve

In [68]:
```
y_probas = knn_clf.predict_proba(X_test)
skplt.metrics.plot_roc(y_test, y_probas,figsize=(10,6),title_fontsize=14,text_fontsize=12)
plt.show()
```



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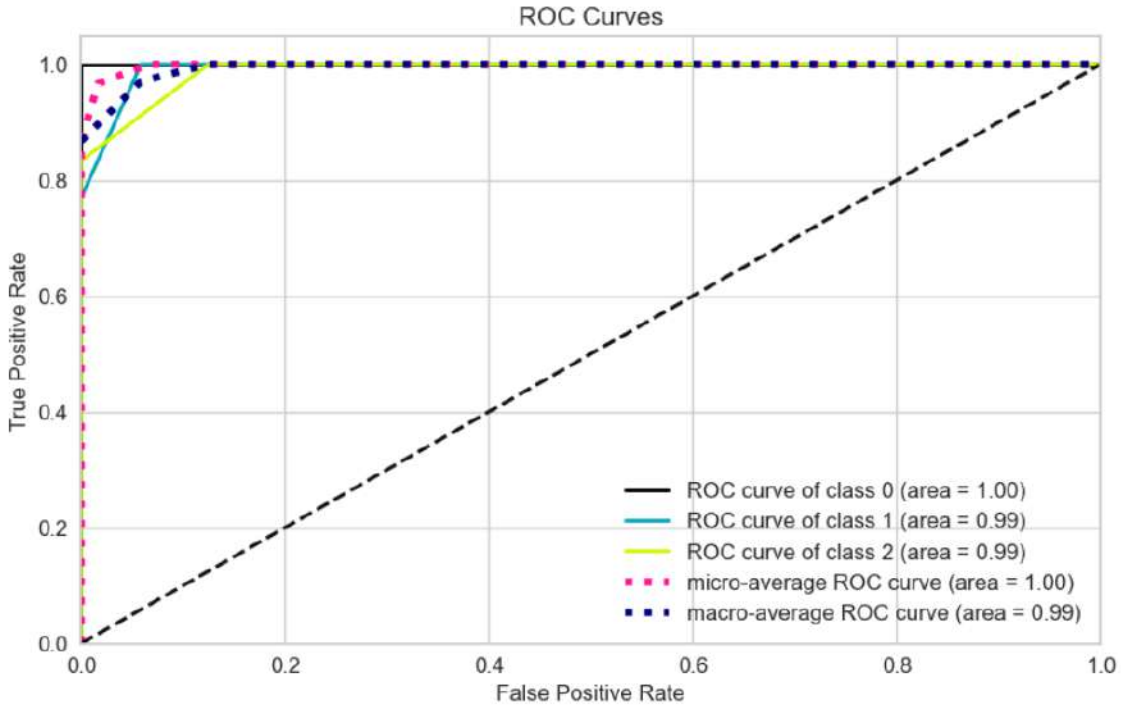
ROC Curve

In [68]:
```
y_probas = knn_clf.predict_proba(X_test)
skplt.metrics.plot_roc(y_test, y_probas,figsize=(10,6),title_fontsize=14,text_fontsize=12)
plt.show()
```



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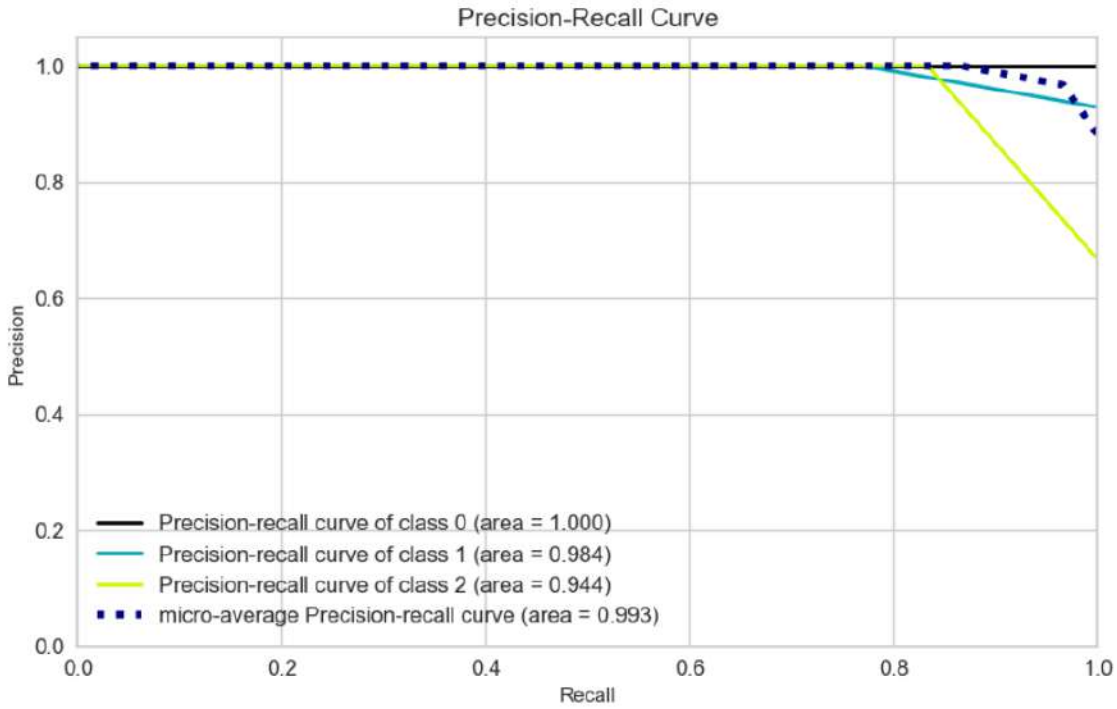
Precision Recall Curve

In [69]:
```
skplt.metrics.plot_precision_recall(y_test, y_probas,figsize=(10,6),title_fontsize=14,text_fontsize=12)
plt.show()
```



Confusion Matrix

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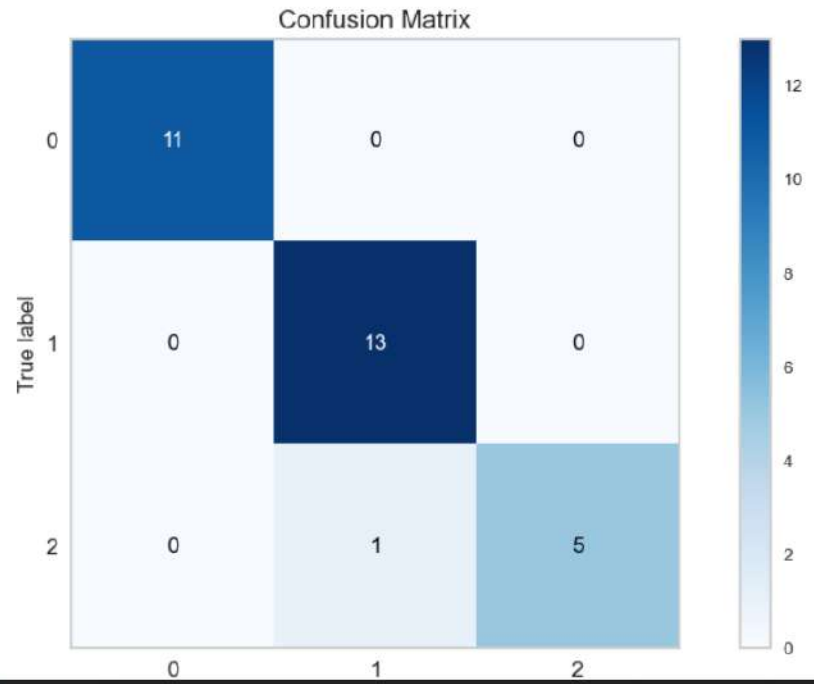
Run Code

Confusion Matrix

In [70]:
```
confusion_matrix(y_test, y_pred)
```

Out[70]:
```
array([[11,  0,  0],
       [ 0, 13,  0],
       [ 0,  1,  5]], dtype=int64)
```

In [71]:
```
skplt.metrics.plot_confusion_matrix(y_test, y_pred, figsize=(12,6),title_fontsize=14,text_fontsize=12)
plt.show()
```



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Classification Report

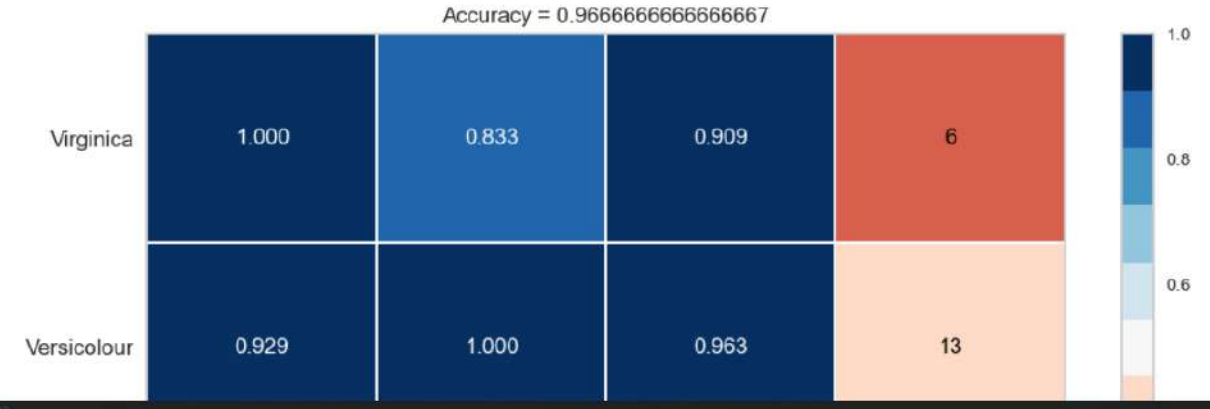
In [72]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        11
           1       0.93      1.00      0.96        13
           2       1.00      0.83      0.91         6

    accuracy                           0.97        30
   macro avg       0.98      0.94      0.96        30
weighted avg       0.97      0.97      0.97        30
```

In [73]:
```
import yellowbrick as yb
plt.figure(figsize=(10,6))
visualizer = yb.classifier.classification_report(
    knn_clf, X_train, y_train, X_test, y_test, classes=classes, support=True,cmap='RdBu',
    title = 'Accuracy = ' + str(accuracy_score(y_test,y_pred))
)
plt.show()
```



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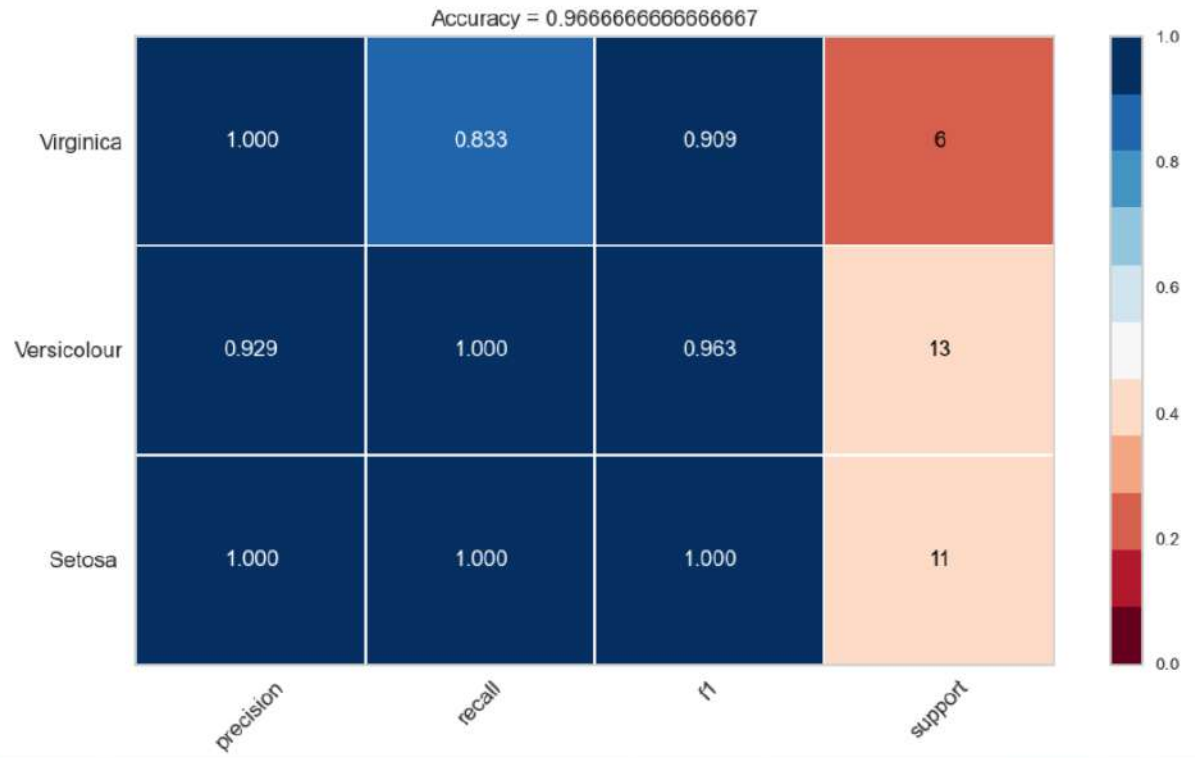
Run Code

In [73]:
```
import yellowbrick as yb
plt.figure(figsize=(10,6))
visualizer = yb.classifier.classification_report(
    knn_clf, X_train, y_train, X_test, y_test, classes=classes, support=True,cmap='RdBu',
    title = 'Accuracy = ' + str(accuracy_score(y_test,y_pred))
)
plt.show()
```



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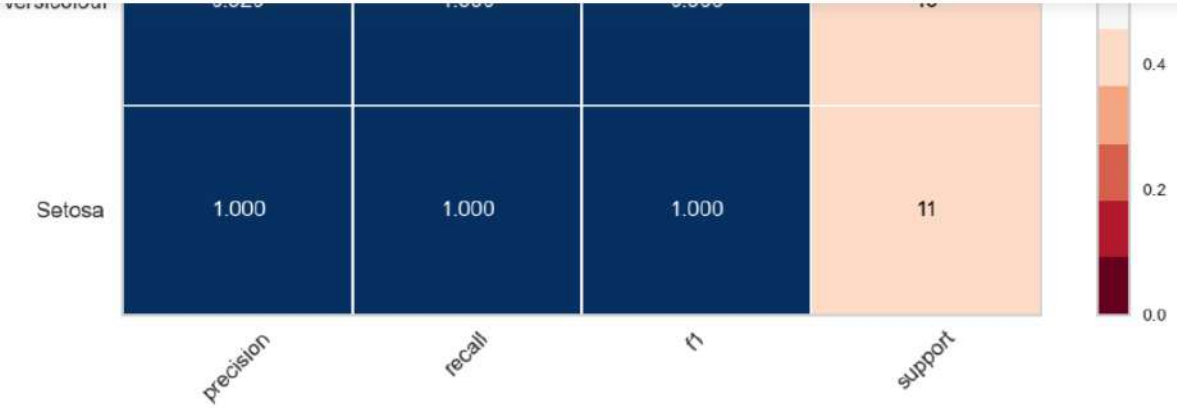

Saving ML Models

In [74]:
```
import joblib
from os import listdir
joblib.dump(knn_clf, knn_clf.__class__.__name__ + '.pkl')
for file in listdir():
    if file.endswith('.pkl'):
        print(file)
```

```
KNeighborsClassifier.pkl
```

In [ ]:

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