Scikit-plot Documentation

Release

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Contents

CHAPTER 1

First steps with Scikit-plot

Eager to use Scikit-plot? Let's get started! This section of the documentation will teach you the basic philosophy behind Scikit-plot by running you through a quick example.

Installation

Before anything else, make sure you've installed the latest version of Scikit-plot. Scikit-plot is on PyPi, so simply run:

```
$ pip install scikit-plot
```

to install the latest version.

Alternatively, you can clone the source repository and run:

```
$ python setup.py install
```

at the root folder.

Scikit-plot depends on Scikit-learn and Matplotlib to do its magic, so make sure you have them installed as well.

Your First Plot

For our quick example, let's show how well a Random Forest can classify the digits dataset bundled with Scikit-learn. A popular way to evaluate a classifier's performance is by viewing its confusion matrix.

Before we begin plotting, we'll need to import the following for Scikit-plot:

```
>>> import matplotlib.pyplot as plt
```

`matplotlib.pyplot` is used by Matplotlib to make plotting work like it does in MATLAB and deals with things like axes, figures, and subplots. But don't worry. Unless you're an advanced user, you won't need to understand any of

that while using Scikit-plot. All you need to remember is that we use the `matplotlib.pyplot.show()` function to show any plots generated by Scikit-plot.

Let's begin by generating our sample digits dataset:

```
>>> from sklearn.datasets import load_digits
>>> X, y = load_digits(return_X_y=True)
```

Here, `X` and `y` contain the features and labels of our classification dataset, respectively.

We'll proceed by creating an instance of a RandomForestClassifier object from Scikit-learn with some initial parameters:

```
>>> from sklearn.ensemble import RandomForestClassifier
>>> random_forest_clf = RandomForestClassifier(n_estimators=5, max_depth=5, random_
↪state=1)
```

The magic happens in the next two lines:

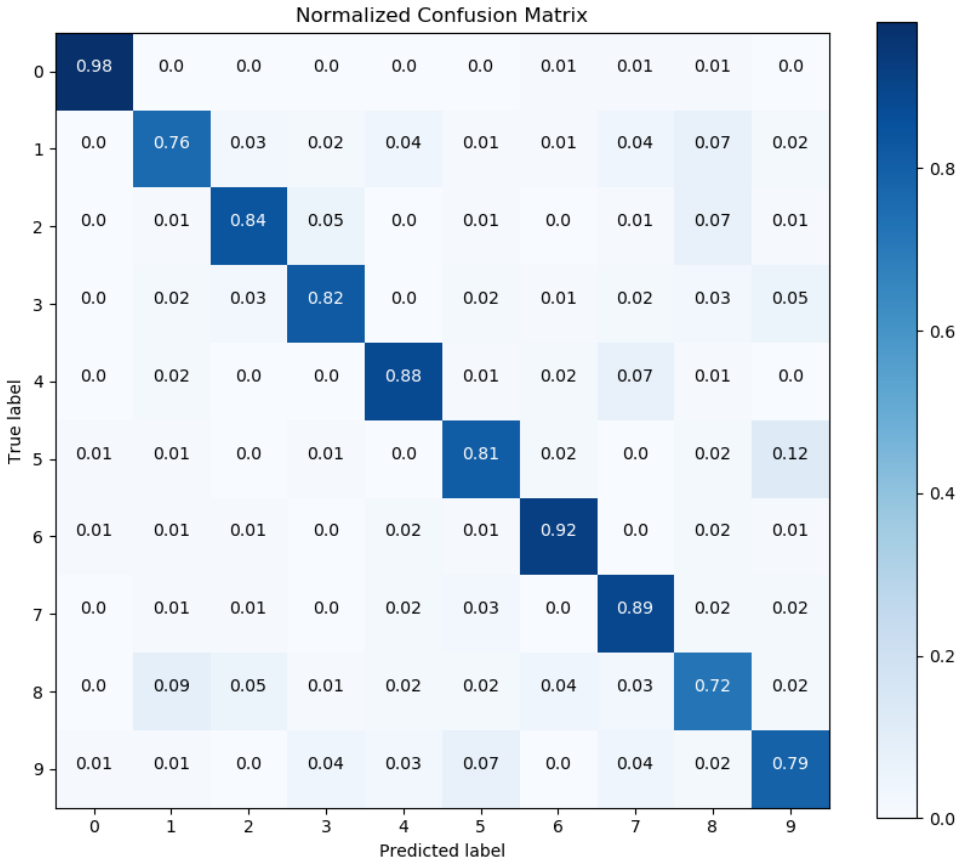
```
>>> from scikitplot import classifier_factory
>>> classifier_factory(random_forest_clf)
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
        max_depth=5, max_features='auto', max_leaf_nodes=None,
        min_impurity_split=1e-07, min_samples_leaf=1,
        min_samples_split=2, min_weight_fraction_leaf=0.0,
        n_estimators=5, n_jobs=1, oob_score=False, random_state=1,
        verbose=0, warm_start=False)
```

In detail, here's what happened. *`classifier_factory()`* is a function that modifies an instance of a scikit-learn classifier. When we passed `random_forest_clf` to *`classifier_factory()`*, it **appended** new plotting methods to the instance, while leaving everything else alone. The original variables and methods of `random_forest_clf` are kept intact. In fact, if you take any of your existing scripts, pass your classifier instances to *`classifier_factory()`* at the top and run them, you'll likely never notice a difference! (If something does break, though, we'd appreciate it if you open an issue at Scikit-plot's Github repository.)

Among the methods added to our classifier instance is the *`plot_confusion_matrix()`* method, used to generate a colored heatmap of the classifier's confusion matrix as evaluated on a dataset.

To plot and show how well our classifier does on the sample dataset, we'll run `random_forest_clf`'s new instance method *`plot_confusion_matrix()`*, passing it the features and labels of our sample dataset. We'll also pass `normalize=True` to *`plot_confusion_matrix()`* so the values displayed in our confusion matrix plot will be from the range [0, 1]. Finally, to show our plot, we'll call `plt.show()`.

```
>>> random_forest_clf.plot_confusion_matrix(X, y, normalize=True)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



And that's it! A quick glance of our confusion matrix shows that our classifier isn't doing so well with identifying the digits 1, 8, and 9. Hmm. Perhaps a bit more tweaking of our Random Forest's hyperparameters is in order.

Note

The more observant of you will notice that we didn't train our classifier at all. Exactly how was the confusion matrix generated? Well, *plot_confusion_matrix()* provides an optional parameter `do_cv`, set to **True** by default, that determines whether or not the classifier will use cross-validation to generate the confusion matrix. If **True**, the predictions generated by each iteration in the cross-validation are aggregated and used to generate the confusion matrix.

If you do not wish to do cross-validation e.g. you have separate training and testing datasets, simply set `do_cv` to **False** and make sure the classifier is already trained prior to calling *plot_confusion_matrix()*. In this case, the confusion matrix will be generated on the predictions of the trained classifier on the passed `X` and `y`.

The Functions API

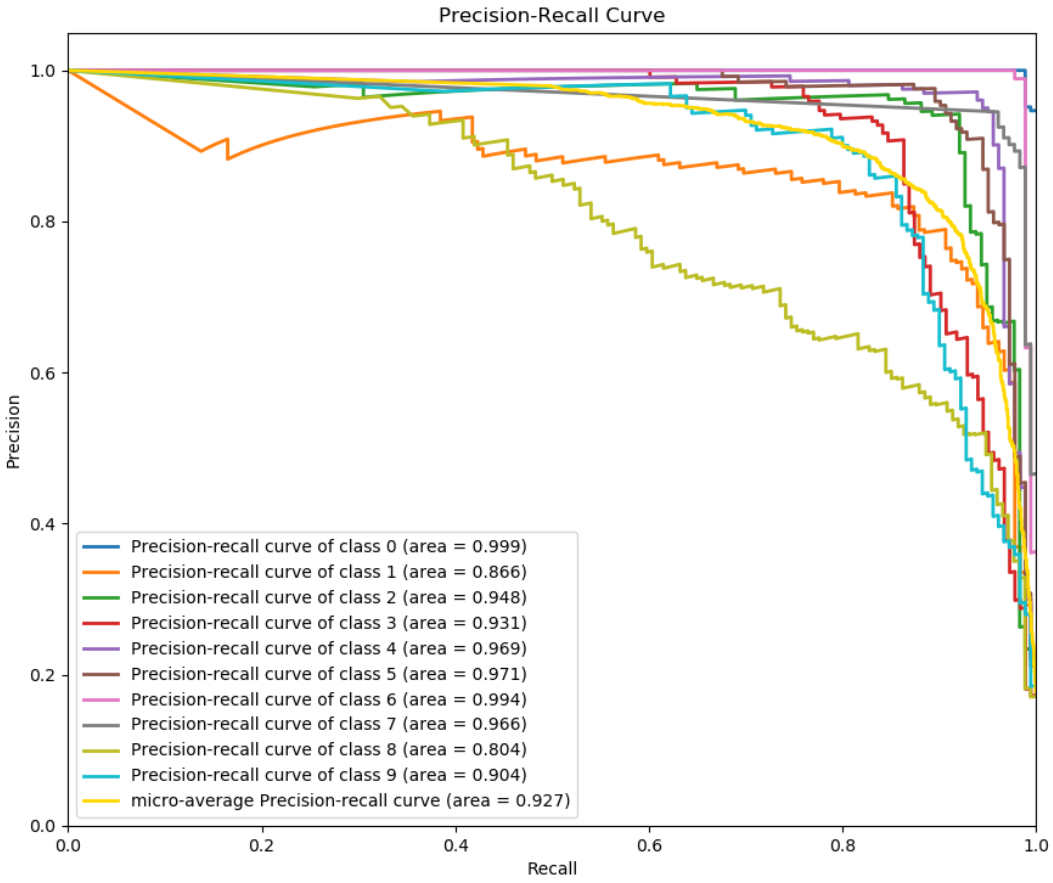
Although convenient, the Factory API may feel a little restrictive for more advanced users and users of external libraries. Thus, to offer more flexibility over your plotting, Scikit-plot also exposes a Functions API that, well, exposes

functions.

The nature of the Functions API offers compatibility with non-scikit-learn objects.

Here's a quick example to generate the precision-recall curves of a Keras classifier on a sample dataset.

```
>>> # Import what's needed for the Functions API
>>> import matplotlib.pyplot as plt
>>> import scikitplot.plotters as skplt
>>> # This is a Keras classifier. We'll generate probabilities on the test set.
>>> keras_clf.fit(X_train, y_train, batch_size=64, nb_epoch=10, verbose=2)
>>> probas = keras_clf.predict_proba(X_test, batch_size=64)
>>> # Now plot.
>>> skplt.plot_precision_recall_curve(y_test, probas)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



And again, that's it! You'll notice that in this plot, all we needed to do was pass the ground truth labels and predicted probabilities to `plot_precision_recall_curve()` to generate the precision-recall curves. This means you can use literally any classifier you want to generate the precision-recall curves, from Keras classifiers to NLTK Naive Bayes to XGBoost, as long as you pass in the predicted probabilities in the correct format.

More Plots

Want to know the other plots you can generate using Scikit-plot? Visit the *Factory API Reference* or the *Functions API Reference*.

CHAPTER 2

Factory API Reference

This document contains the plotting methods that are embedded into scikit-learn objects by the factory functions *clustering_factory()* and *classifier_factory()*.

Important Note

If you want to use stand-alone functions and not bother with the factory functions, view the *Functions API Reference* instead.

Classifier Plots

scikitplot.**classifier_factory**(*clf*)

Takes a scikit-learn classifier instance and embeds scikit-plot instance methods in it.

Parameters **clf** – Scikit-learn classifier instance

Returns The same scikit-learn classifier instance passed in **clf** with embedded scikit-plot instance methods.

Raises ValueError – If **clf** does not contain the instance methods necessary for scikit-plot instance methods.

scikitplot.classifiers.**plot_learning_curve**(*clf*, *X*, *y*, *title=u'Learning Curve'*, *cv=None*, *train_sizes=None*, *n_jobs=1*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates a plot of the train and test learning curves for a given classifier.

Parameters

- **clf** – Classifier instance that implements fit and predict methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Training vector, where n_samples is the number of samples and n_features is the number of features.

- **y** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for classification or regression; None for unsupervised learning.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Learning Curve"
- **cv** (*int, cross-validation generator, iterable, optional*) – Determines the cross-validation strategy to be used for splitting.

  Possible inputs for cv are:

  - None, to use the default 3-fold cross-validation,
  - integer, to specify the number of folds.
  - An object to be used as a cross-validation generator.
  - An iterable yielding train/test splits.

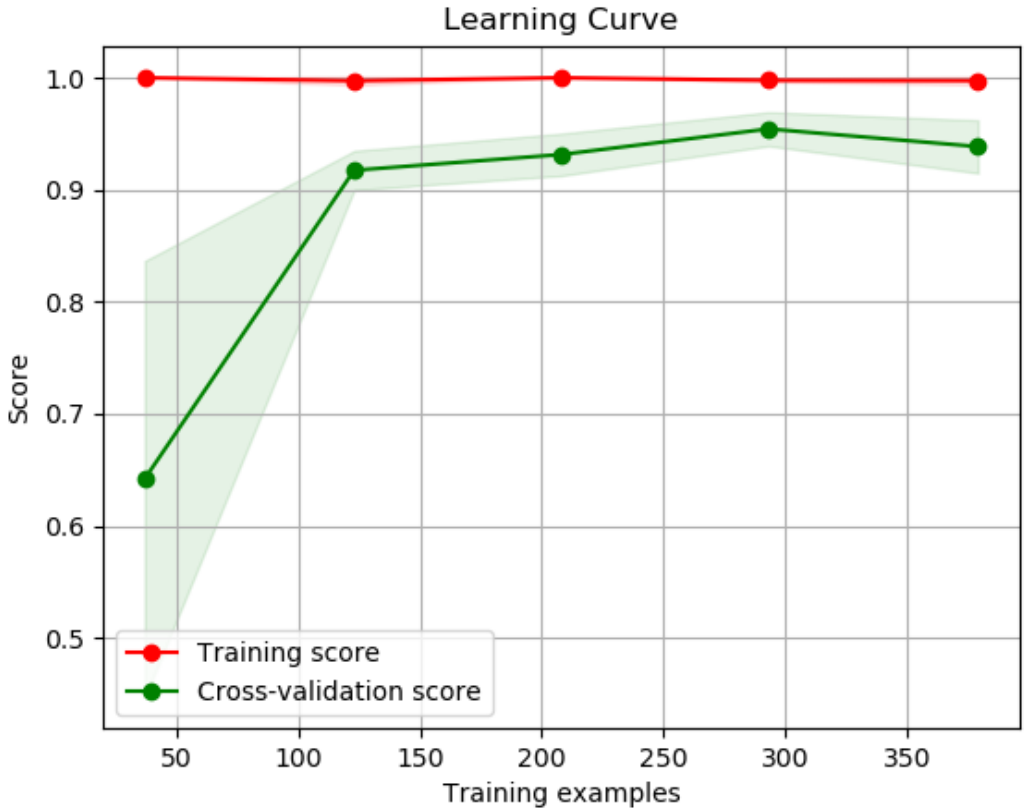
  For integer/None inputs, if `y` is binary or multiclass, `StratifiedKFold` used. If the estimator is not a classifier or if `y` is neither binary nor multiclass, `KFold` is used.
- **train_sizes** (*iterable, optional*) – Determines the training sizes used to plot the learning curve. If None, `np.linspace(.1, 1.0, 5)` is used.
- **n_jobs** (*int, optional*) – Number of jobs to run in parallel. Defaults to 1.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> rf = RandomForestClassifier()
>>> skplt.plot_learning_curve(rf, X, y)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.classifiers.**plot_confusion_matrix**(*clf*, *X*, *y*, *labels=None*, *title=None*, *normalize=False*, *do_cv=True*, *cv=None*, *shuffle=True*, *random_state=None*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the confusion matrix for a given classifier and dataset.

Parameters

- **clf** – Classifier instance that implements `fit` and `predict` methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Training vector, where n_samples is the number of samples and n_features is the number of features.
- **y** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for classification.
- **labels** (*array-like, shape (n_classes), optional*) – List of labels to index the matrix. This may be used to reorder or select a subset of labels. If none is given, those that appear at least once in `y` are used in sorted order. (new in v0.2.5)
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Confusion Matrix" if *normalize* is True. Else, defaults to "Normalized Confusion Matrix.
- **normalize** (*bool, optional*) – If True, normalizes the confusion matrix before plotting. Defaults to False.
- **do_cv** (*bool, optional*) – If True, the classifier is cross-validated on the dataset using the cross-validation strategy in *cv* to generate the confusion matrix. If False, the confusion

matrix is generated without training or cross-validating the classifier. This assumes that the classifier has already been called with its *fit* method beforehand.

- **cv** (*int, cross-validation generator, iterable, optional*) – Determines the cross-validation strategy to be used for splitting.

  Possible inputs for cv are:

  - None, to use the default 3-fold cross-validation,
  - integer, to specify the number of folds.
  - An object to be used as a cross-validation generator.
  - An iterable yielding train/test splits.

  For integer/None inputs, if `y` is binary or multiclass, `StratifiedKFold` used. If the estimator is not a classifier or if `y` is neither binary nor multiclass, `KFold` is used.

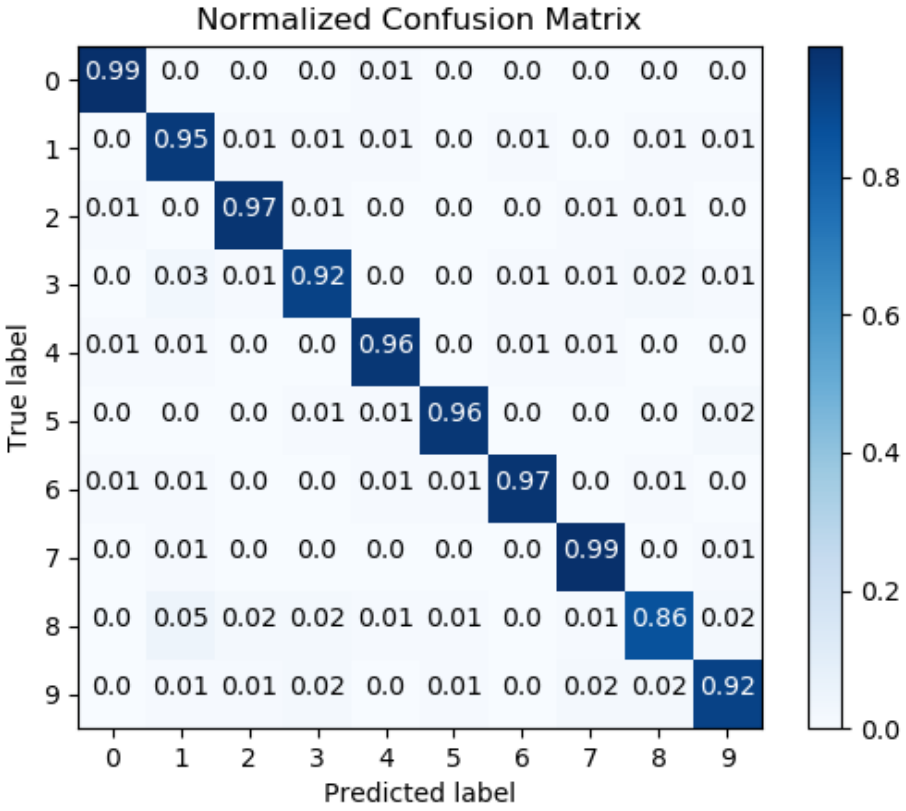
- **shuffle** (*bool, optional*) – Used when do_cv is set to True. Determines whether to shuffle the training data before splitting using cross-validation. Default set to True.
- **random_state** (int `RandomState`) – Pseudo-random number generator state used for random sampling.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> rf = classifier_factory(RandomForestClassifier())
>>> rf.plot_learning_curve(X, y, normalize=True)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.classifiers.**plot_roc_curve**(*clf*, *X*, *y*, *title=u'ROC Curves'*, *do_cv=True*, *cv=None*, *shuffle=True*, *random_state=None*, *curves=(u'micro'*, *u'macro'*, *u'each_class')*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the ROC curves for a given classifier and dataset.

Parameters

- **clf** – Classifier instance that implements "fit" and "predict_proba" methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Training vector, where n_samples is the number of samples and n_features is the number of features.
- **y** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for classification.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "ROC Curves".
- **do_cv** (*bool, optional*) – If True, the classifier is cross-validated on the dataset using the cross-validation strategy in *cv* to generate the confusion matrix. If False, the confusion matrix is generated without training or cross-validating the classifier. This assumes that the classifier has already been called with its *fit* method beforehand.
- **cv** (*int, cross-validation generator, iterable, optional*) – Determines the cross-validation strategy to be used for splitting.

  Possible inputs for cv are:

  – None, to use the default 3-fold cross-validation,

  – integer, to specify the number of folds.

  - An object to be used as a cross-validation generator.
  - An iterable yielding train/test splits.

  For integer/None inputs, if `y` is binary or multiclass, `StratifiedKFold` used. If the estimator is not a classifier or if `y` is neither binary nor multiclass, `KFold` is used.

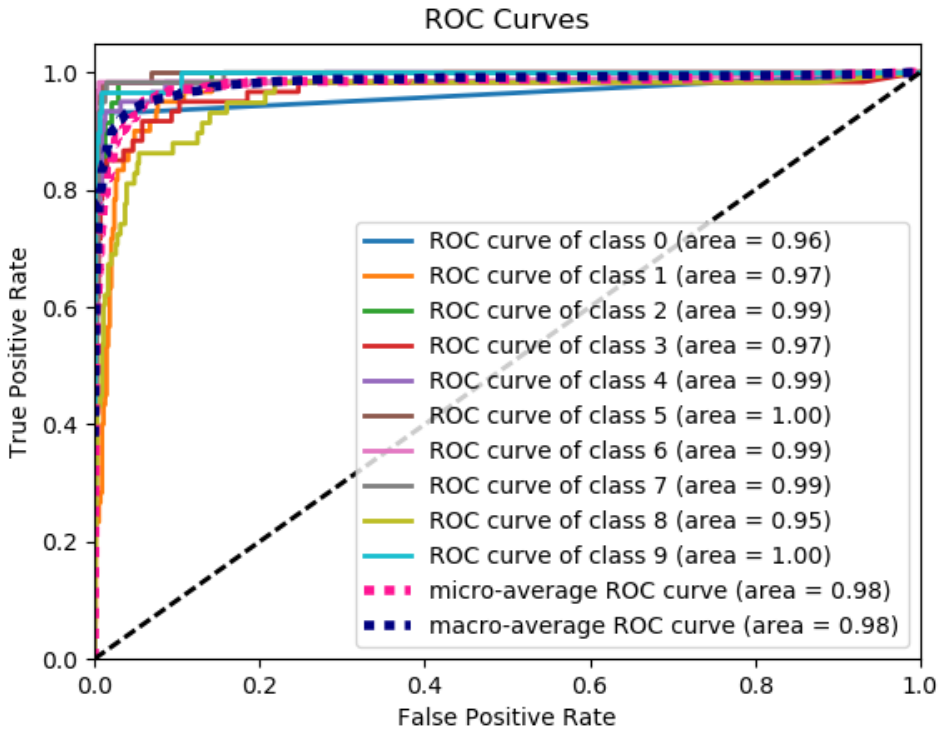
- **shuffle** (*bool, optional*) – Used when do_cv is set to True. Determines whether to shuffle the training data before splitting using cross-validation. Default set to True.
- **random_state** (int `RandomState`) – Pseudo-random number generator state used for random sampling.
- **curves** (*array-like*) – A listing of which curves should be plotted on the resulting plot. Defaults to *("micro", "macro", "each_class")* i.e. "micro" for micro-averaged curve, "macro" for macro-averaged curve
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> nb = classifier_factory(GaussianNB())
>>> nb.plot_roc_curve(X, y, random_state=1)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.classifiers.**plot_ks_statistic**(*clf*, *X*, *y*, *title=u'KS Statistic Plot'*, *do_cv=True*, *cv=None*, *shuffle=True*, *random_state=None*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the KS Statistic plot for a given classifier and dataset.

Parameters

- **clf** – Classifier instance that implements "fit" and "predict_proba" methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Training vector, where n_samples is the number of samples and n_features is the number of features.
- **y** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for classification.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "KS Statistic Plot".
- **do_cv** (*bool, optional*) – If True, the classifier is cross-validated on the dataset using the cross-validation strategy in *cv* to generate the confusion matrix. If False, the confusion matrix is generated without training or cross-validating the classifier. This assumes that the classifier has already been called with its *fit* method beforehand.
- **cv** (*int, cross-validation generator, iterable, optional*) – Determines the cross-validation strategy to be used for splitting.

  Possible inputs for cv are:

  - None, to use the default 3-fold cross-validation,
  - integer, to specify the number of folds.

- An object to be used as a cross-validation generator.
- An iterable yielding train/test splits.

For integer/None inputs, if `y` is binary or multiclass, `StratifiedKFold` used. If the estimator is not a classifier or if `y` is neither binary nor multiclass, `KFold` is used.

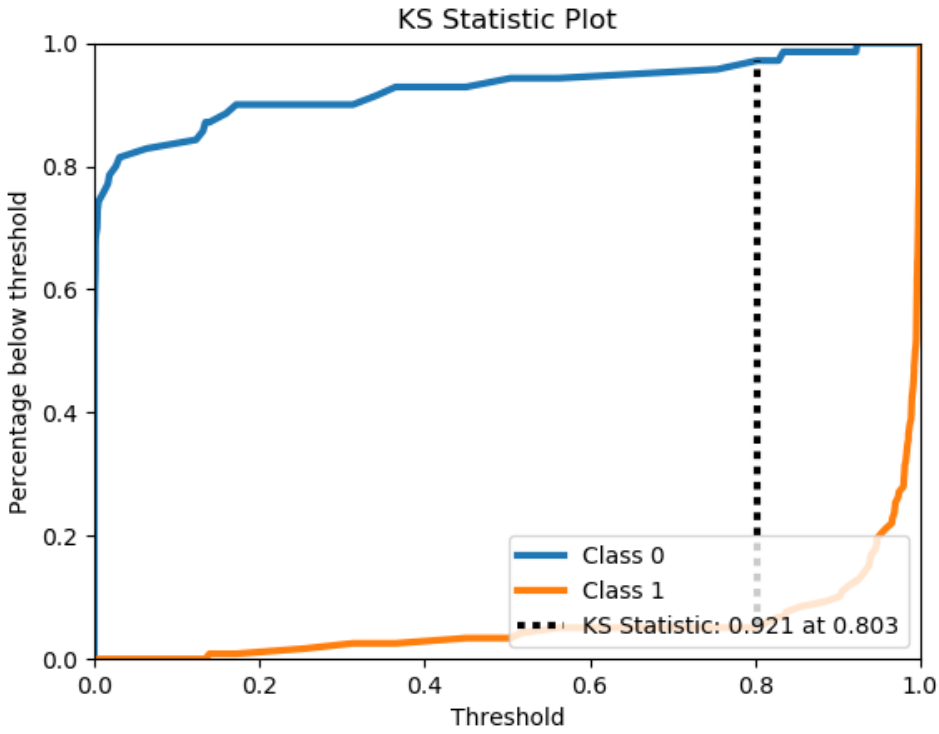
- **`shuffle`** (*`bool, optional`*) – Used when do_cv is set to True. Determines whether to shuffle the training data before splitting using cross-validation. Default set to True.
- **`random_state`** (int `RandomState`) – Pseudo-random number generator state used for random sampling.
- **`ax`** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **`figsize`** (*`2-tuple, optional`*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **`title_fontsize`** (*`string or int, optional`*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **`text_fontsize`** (*`string or int, optional`*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> lr = classifier_factory(LogisticRegression())
>>> lr.plot_ks_statistic(X, y, random_state=1)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.classifiers.**plot_precision_recall_curve**(*clf*, *X*, *y*, *title=u'Precision-Recall Curve'*, *do_cv=True*, *cv=None*, *shuffle=True*, *random_state=None*, *curves=(u'micro', u'each_class')*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the Precision-Recall curve for a given classifier and dataset.

Parameters

- **clf** – Classifier instance that implements "fit" and "predict_proba" methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Training vector, where n_samples is the number of samples and n_features is the number of features.
- **y** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for classification.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Precision-Recall Curve".
- **do_cv** (*bool, optional*) – If True, the classifier is cross-validated on the dataset using the cross-validation strategy in *cv* to generate the confusion matrix. If False, the confusion matrix is generated without training or cross-validating the classifier. This assumes that the classifier has already been called with its *fit* method beforehand.
- **cv** (*int, cross-validation generator, iterable, optional*) – Determines the cross-validation strategy to be used for splitting.

  Possible inputs for cv are:

- None, to use the default 3-fold cross-validation,
- integer, to specify the number of folds.
- An object to be used as a cross-validation generator.
- An iterable yielding train/test splits.

For integer/None inputs, if `y` is binary or multiclass, `StratifiedKFold` used. If the estimator is not a classifier or if `y` is neither binary nor multiclass, `KFold` is used.

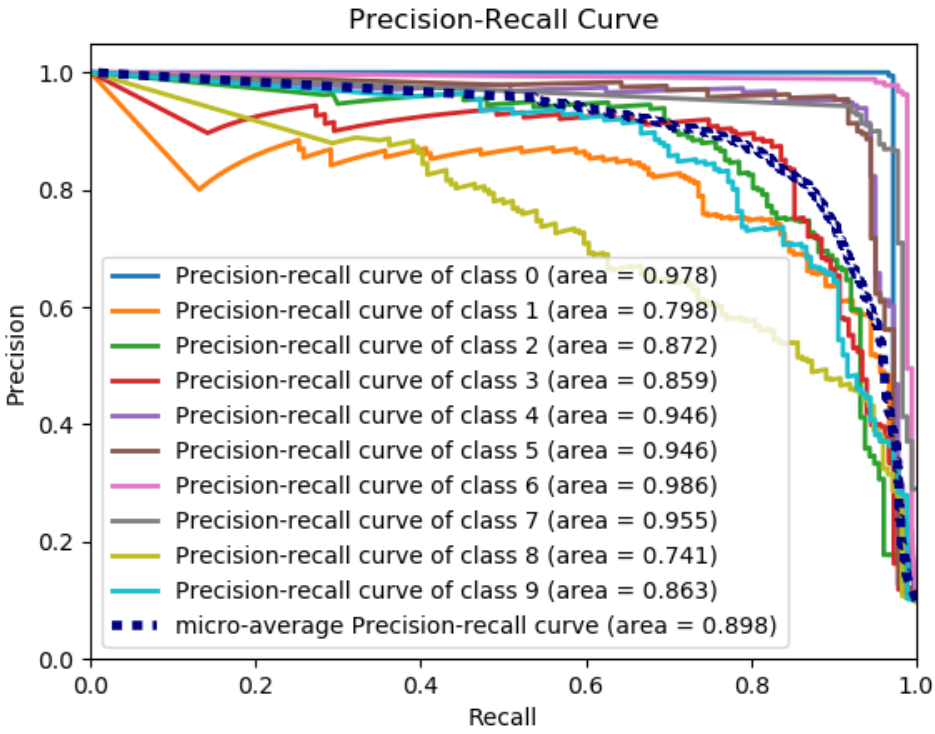
- **`shuffle`** (*`bool, optional`*) – Used when do_cv is set to True. Determines whether to shuffle the training data before splitting using cross-validation. Default set to True.
- **`random_state`** (int `RandomState`) – Pseudo-random number generator state used for random sampling.
- **`curves`** (*`array-like`*) – A listing of which curves should be plotted on the resulting plot. Defaults to *("micro", "each_class")* i.e. "micro" for micro-averaged curve
- **`ax`** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **`figsize`** (*`2-tuple, optional`*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **`title_fontsize`** (*`string or int, optional`*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **`text_fontsize`** (*`string or int, optional`*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> nb = classifier_factory(GaussianNB())
>>> nb.plot_precision_recall_curve(X, y, random_state=1)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



`scikitplot.classifiers.`**`plot_feature_importances`**(*clf*, *title=u'Feature Importance'*, *feature_names=None*, *max_num_features=20*, *order=u'descending'*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates a plot of a classifier's feature importances.

Parameters

- **`clf`** – Classifier instance that implements `fit` and `predict_proba` methods. The classifier must also have a `feature_importances_` attribute.
- **`title`** (*`string, optional`*) – Title of the generated plot. Defaults to "Feature importances".
- **`feature_names`** (None, `list` of string, optional) – Determines the feature names used to plot the feature importances. If None, feature names will be numbered.
- **`max_num_features`** (*`int`*) – Determines the maximum number of features to plot. Defaults to 20.
- **`order`** (*`'ascending', 'descending', or None, optional`*) – Determines the order in which the feature importances are plotted. Defaults to 'descending'.
- **`ax`** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **`figsize`** (*`2-tuple, optional`*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.

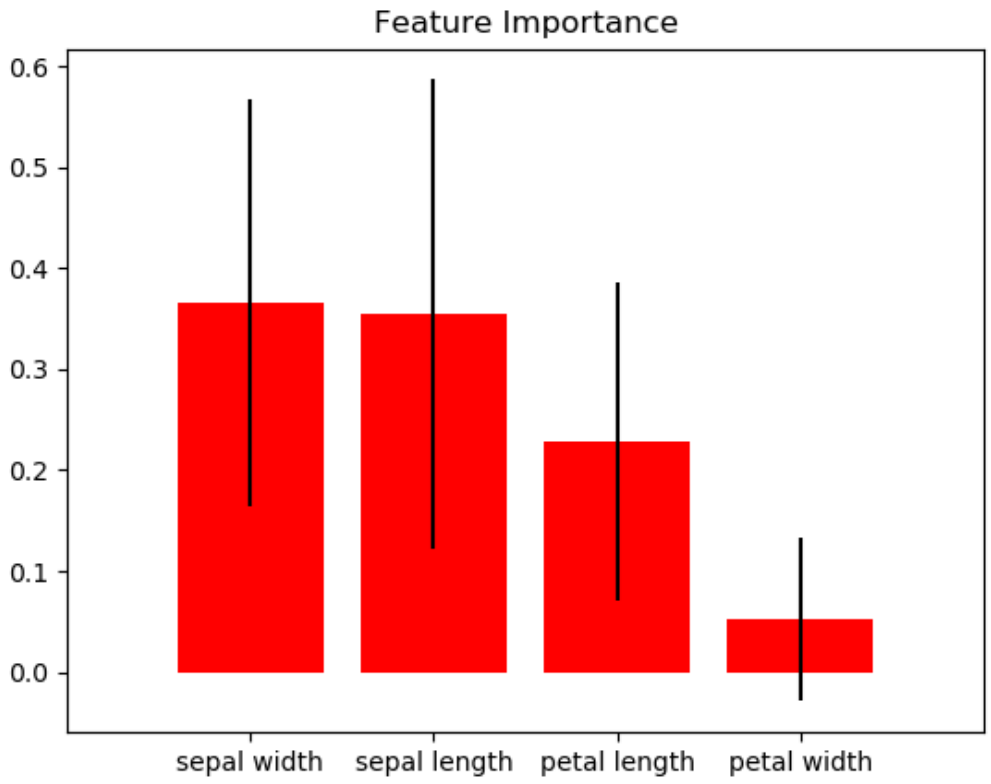
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. “small”, “medium”, “large” or integer-values. Defaults to “large”.
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. “small”, “medium”, “large” or integer-values. Defaults to “medium”.

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> rf = RandomForestClassifier()
>>> rf.fit(X, y)
>>> skplt.plot_feature_importances(rf, feature_names=['petal length', 'petal width
↪',
...                                                   'sepal length', 'sepal width
↪'])
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



Clustering Plots

scikitplot.**clustering_factory**(*clf*)

Takes a scikit-learn clusterer and embeds scikit-plot plotting methods in it.

Parameters **clf** – Scikit-learn clusterer instance

Returns The same scikit-learn clusterer instance passed in **clf** with embedded scikit-plot instance methods.

Raises ValueError – If **clf** does not contain the instance methods necessary for scikit-plot instance methods.

scikitplot.clustering.**plot_silhouette**(*clf*, *X*, *title=u'Silhouette Analysis'*, *metric=u'euclidean'*, *copy=True*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Plots silhouette analysis of clusters using fit_predict.

Parameters

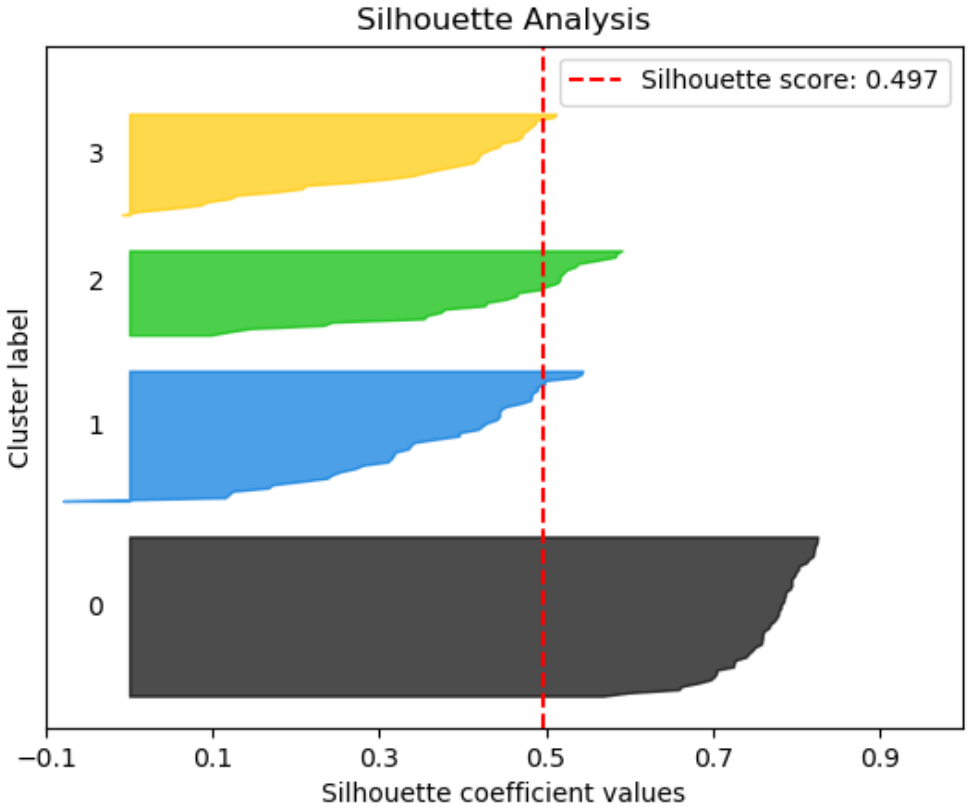
- **clf** – Clusterer instance that implements fit and fit_predict methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Data to cluster, where n_samples is the number of samples and n_features is the number of features.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Silhouette Analysis"
- **metric** (*string or callable, optional*) – The metric to use when calculating distance between instances in a feature array. If metric is a string, it must be one of the options allowed by sklearn.metrics.pairwise.pairwise_distances. If X is the distance array itself, use "precomputed" as the metric.
- **copy** (*boolean, optional*) – Determines whether fit is used on **clf** or on a copy of **clf**.
- **ax** (matplotlib.axes.Axes, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to None.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (matplotlib.axes.Axes)

Example

```
>>> import scikitplot.plotters as skplt
>>> kmeans = KMeans(n_clusters=4, random_state=1)
>>> skplt.plot_silhouette(kmeans, X)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.clustering.**plot_elbow_curve**(*clf*, *X*, *title=u'Elbow Plot'*, *cluster_ranges=None*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Plots elbow curve of different values of K for KMeans clustering.

Parameters

- **clf** – Clusterer instance that implements `fit` and `fit_predict` methods and a `score` parameter.
- **X** (*array-like, shape (n_samples, n_features)*) – Data to cluster, where n_samples is the number of samples and n_features is the number of features.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Elbow Plot"
- **cluster_ranges** (None or `list` of int, optional) – List of n_clusters for which to plot the explained variances. Defaults to `range(1, 12, 2)`.
- **copy** (*boolean, optional*) – Determines whether `fit` is used on **clf** or on a copy of **clf**.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".

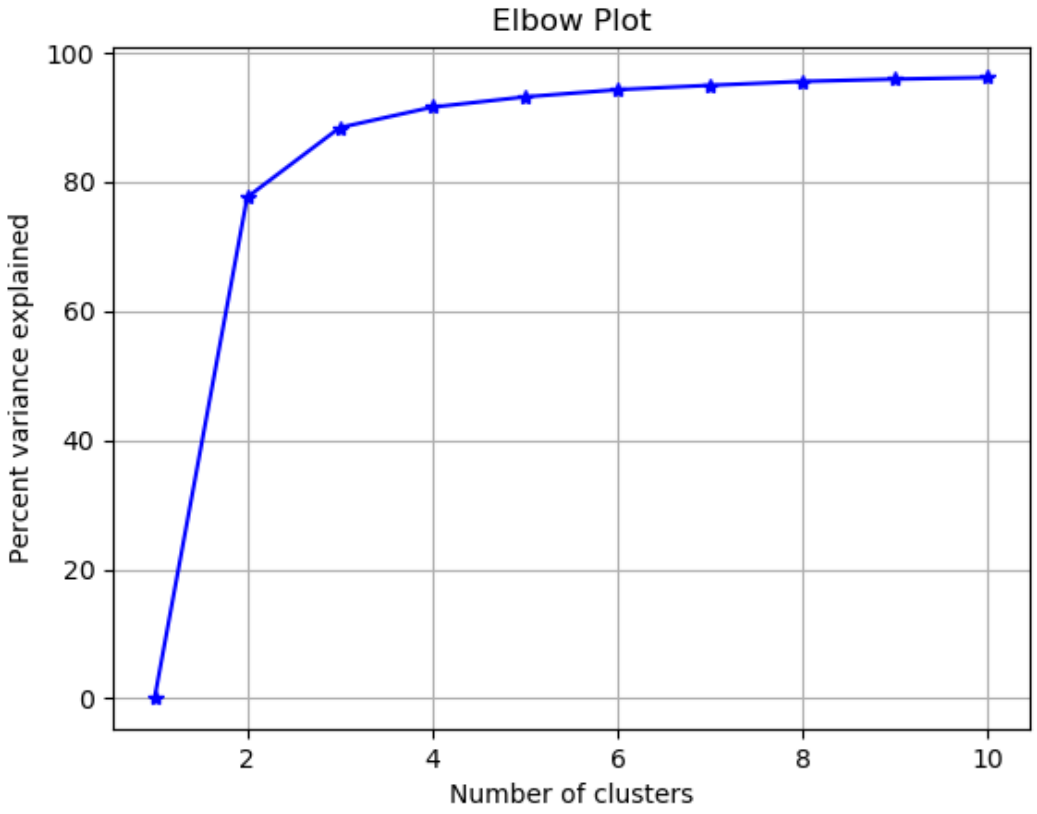
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. “small”, “medium”, “large” or integer-values. Defaults to “medium”.

Returns The axes on which the plot was drawn.

Return type ax (matplotlib.axes.Axes)

Example

```
>>> import scikitplot.plotters as skplt
>>> kmeans = KMeans(random_state=1)
>>> skplt.plot_elbow_curve(kmeans, cluster_ranges=range(1, 11))
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



CHAPTER 3

Functions API Reference

This document contains the stand-alone plotting functions for maximum flexibility. If you want to use factory functions *clustering_factory()* and *classifier_factory()*, use the *Factory API Reference* instead. This module contains a more flexible API for Scikit-plot users, exposing simple functions to generate plots.

scikitplot.plotters.**plot_learning_curve**(*clf*, *X*, *y*, *title=u'Learning Curve'*, *cv=None*, *train_sizes=None*, *n_jobs=1*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates a plot of the train and test learning curves for a given classifier.

Parameters

- **clf** – Classifier instance that implements `fit` and `predict` methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Training vector, where n_samples is the number of samples and n_features is the number of features.
- **y** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for classification or regression; None for unsupervised learning.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Learning Curve"
- **cv** (*int, cross-validation generator, iterable, optional*) – Determines the cross-validation strategy to be used for splitting.

  Possible inputs for cv are:

  - None, to use the default 3-fold cross-validation,
  - integer, to specify the number of folds.
  - An object to be used as a cross-validation generator.
  - An iterable yielding train/test splits.

  For integer/None inputs, if `y` is binary or multiclass, `StratifiedKFold` used. If the estimator is not a classifier or if `y` is neither binary nor multiclass, `KFold` is used.

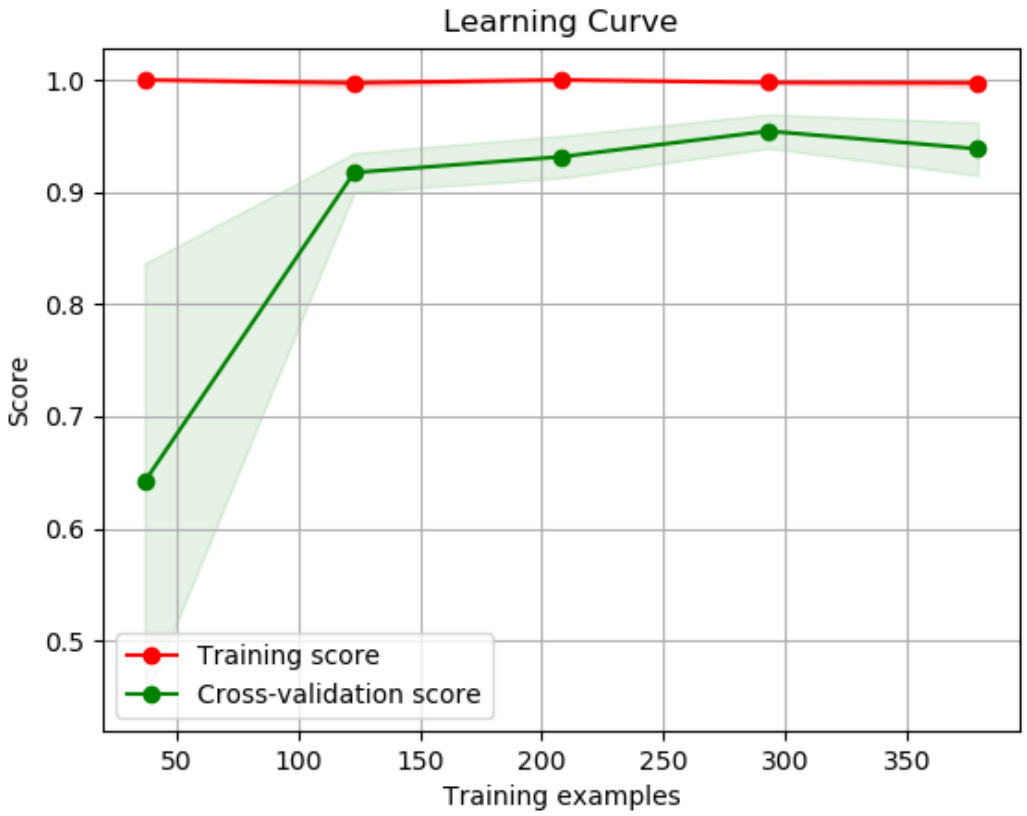
- **train_sizes** (*iterable, optional*) – Determines the training sizes used to plot the learning curve. If None, `np.linspace(.1, 1.0, 5)` is used.
- **n_jobs** (*int, optional*) – Number of jobs to run in parallel. Defaults to 1.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> rf = RandomForestClassifier()
>>> skplt.plot_learning_curve(rf, X, y)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.plotters.**plot_confusion_matrix**(*y_true*, *y_pred*, *labels=None*, *title=None*, *normalize=False*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates confusion matrix plot for a given set of ground truth labels and classifier predictions.

Parameters

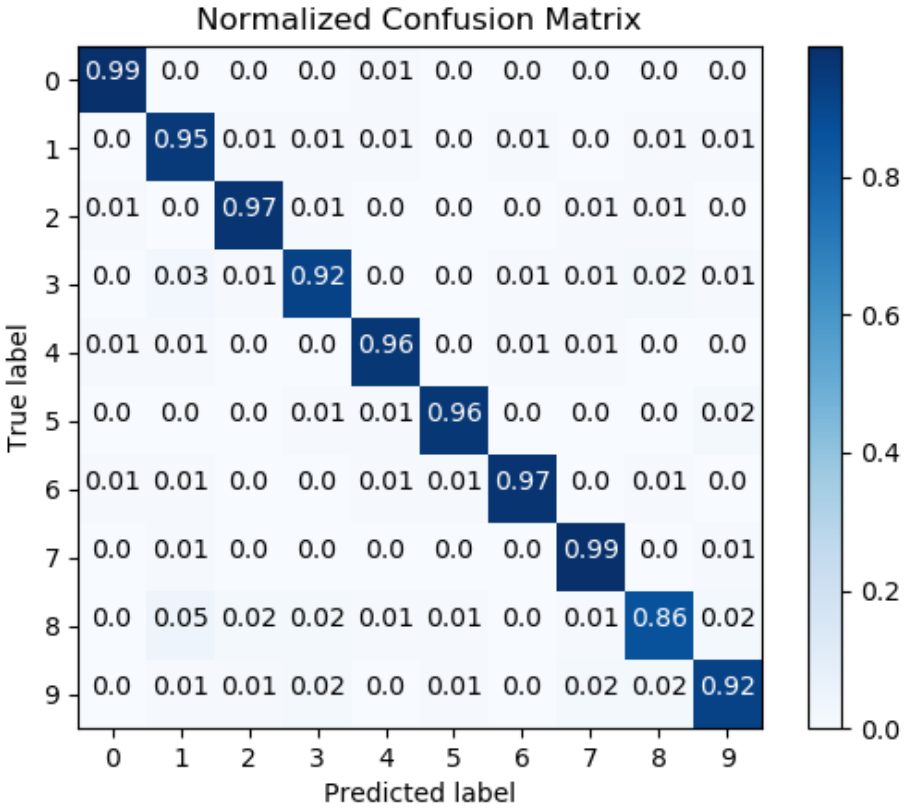
- **y_true** (*array-like, shape (n_samples)*) – Ground truth (correct) target values.
- **y_pred** (*array-like, shape (n_samples)*) – Estimated targets as returned by a classifier.
- **labels** (*array-like, shape (n_classes), optional*) – List of labels to index the matrix. This may be used to reorder or select a subset of labels. If none is given, those that appear at least once in `y_true` or `y_pred` are used in sorted order. (new in v0.2.5)
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Confusion Matrix" if *normalize* is True. Else, defaults to "Normalized Confusion Matrix.
- **normalize** (*bool, optional*) – If True, normalizes the confusion matrix before plotting. Defaults to False.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> rf = RandomForestClassifier()
>>> rf = rf.fit(X_train, y_train)
>>> y_pred = rf.predict(X_test)
>>> skplt.plot_confusion_matrix(y_test, y_pred, normalize=True)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.plotters.**plot_roc_curve**(*y_true*, *y_probas*, *title=u'ROC Curves'*, *curves=(u'micro'*, *u'macro'*, *u'each_class')*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the ROC curves for a set of ground truth labels and classifier probability predictions.

Parameters

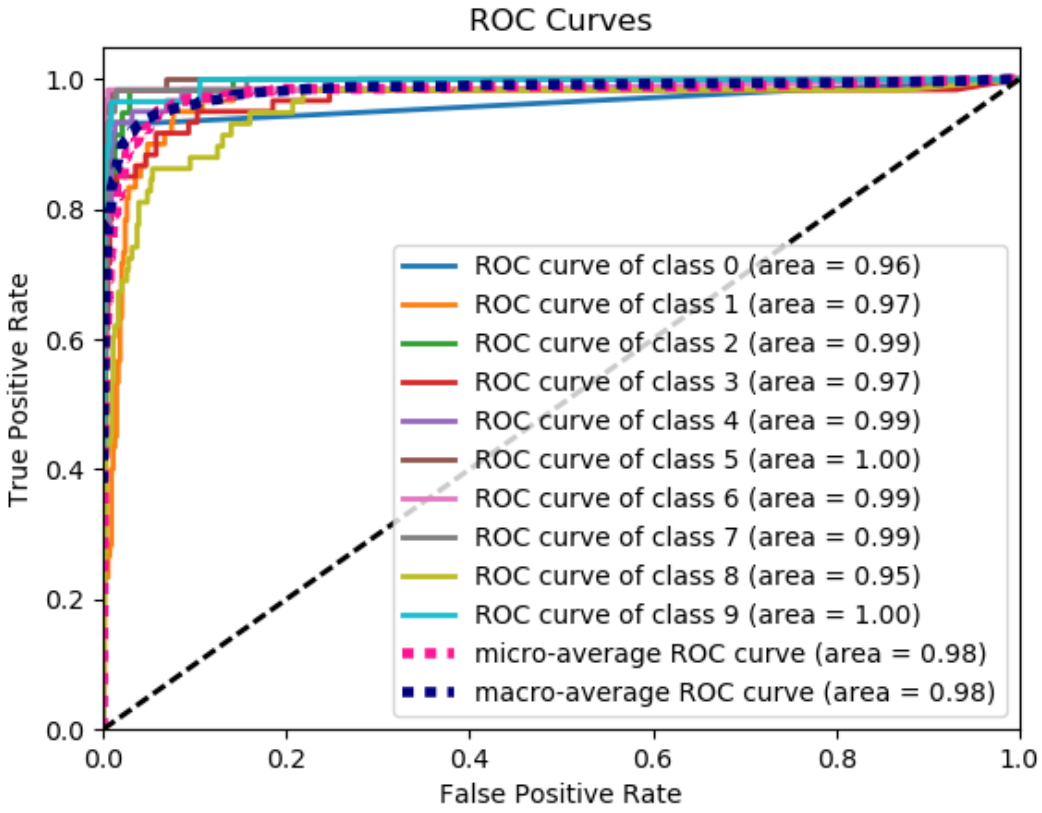
- **y_true** (*array-like, shape (n_samples)*) – Ground truth (correct) target values.
- **y_probas** (*array-like, shape (n_samples, n_classes)*) – Prediction probabilities for each class returned by a classifier.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "ROC Curves".
- **curves** (*array-like*) – A listing of which curves should be plotted on the resulting plot. Defaults to *("micro", "macro", "each_class")* i.e. "micro" for micro-averaged curve, "macro" for macro-averaged curve
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> nb = GaussianNB()
>>> nb = nb.fit(X_train, y_train)
>>> y_probas = nb.predict_proba(X_test)
>>> skplt.plot_roc_curve(y_test, y_probas)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



`scikitplot.plotters.`**`plot_ks_statistic`**(*y_true*, *y_probas*, *title=u'KS Statistic Plot'*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the KS Statistic plot for a set of ground truth labels and classifier probability predictions.

Parameters

- **`y_true`** (*`array-like, shape (n_samples)`*) – Ground truth (correct) target values.
- **`y_probas`** (*`array-like, shape (n_samples, n_classes)`*) – Prediction probabilities for each class returned by a classifier.

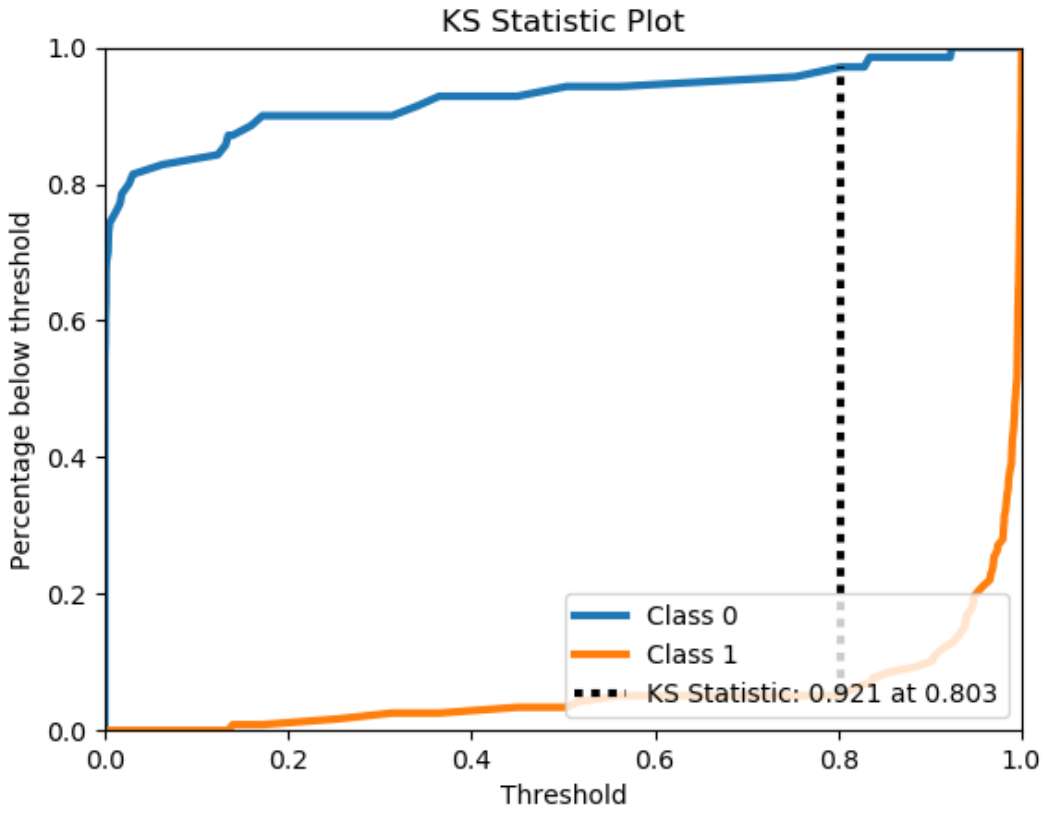
- **title** (*string, optional*) – Title of the generated plot. Defaults to "KS Statistic Plot".
- **ax** (matplotlib.axes.Axes, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to None.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (matplotlib.axes.Axes)

Example

```
>>> import scikitplot.plotters as skplt
>>> lr = LogisticRegression()
>>> lr = lr.fit(X_train, y_train)
>>> y_probas = lr.predict_proba(X_test)
>>> skplt.plot_ks_statistic(y_test, y_probas)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.plotters.**plot_precision_recall_curve**(*y_true*, *y_probas*, *title=u'Precision-Recall Curve'*, *curves=(u'micro', u'each_class')*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates the Precision Recall Curve for a set of ground truth labels and classifier probability predictions.

Parameters

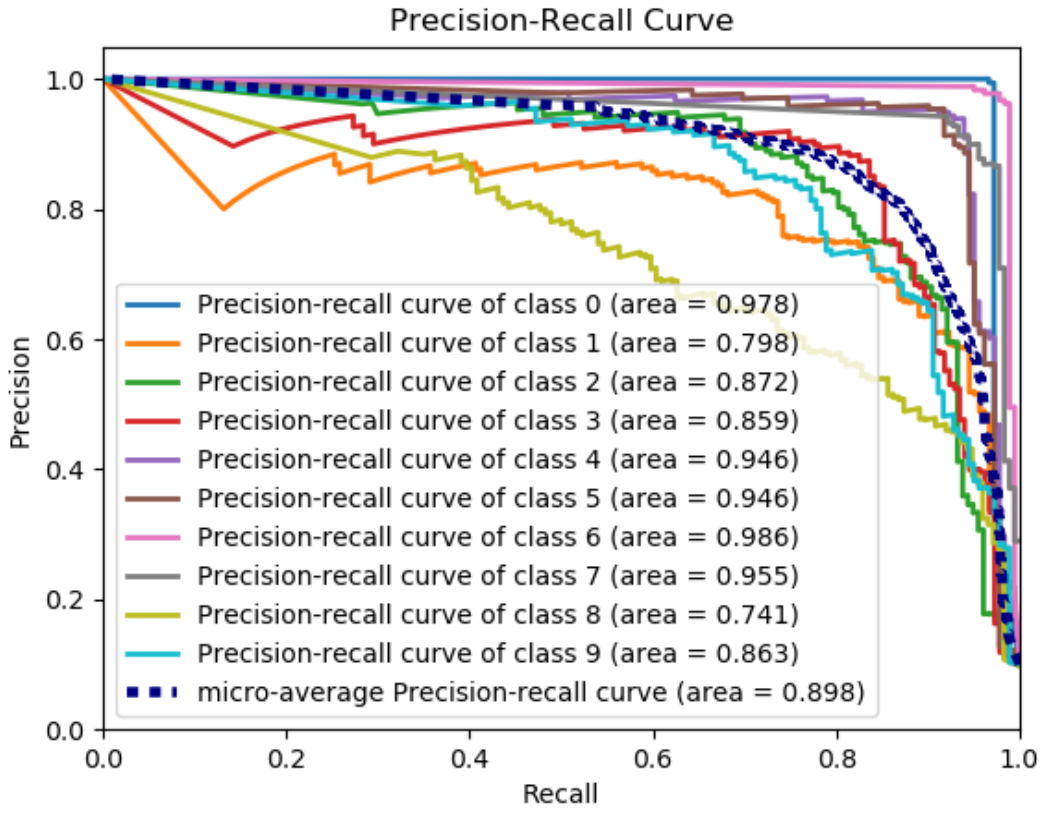
- **y_true** (*array-like, shape (n_samples)*) – Ground truth (correct) target values.
- **y_probas** (*array-like, shape (n_samples, n_classes)*) – Prediction probabilities for each class returned by a classifier.
- **curves** (*array-like*) – A listing of which curves should be plotted on the resulting plot. Defaults to *("micro", "each_class")* i.e. "micro" for micro-averaged curve
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> nb = GaussianNB()
>>> nb = nb.fit(X_train, y_train)
>>> y_probas = nb.predict_proba(X_test)
>>> skplt.plot_precision_recall_curve(y_test, y_probas)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



`scikitplot.plotters.`**`plot_feature_importances`**(*clf*, *title=u'Feature Importance'*, *feature_names=None*, *max_num_features=20*, *order=u'descending'*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Generates a plot of a classifier's feature importances.

Parameters

- **`clf`** – Classifier instance that implements `fit` and `predict_proba` methods. The classifier must also have a `feature_importances_` attribute.

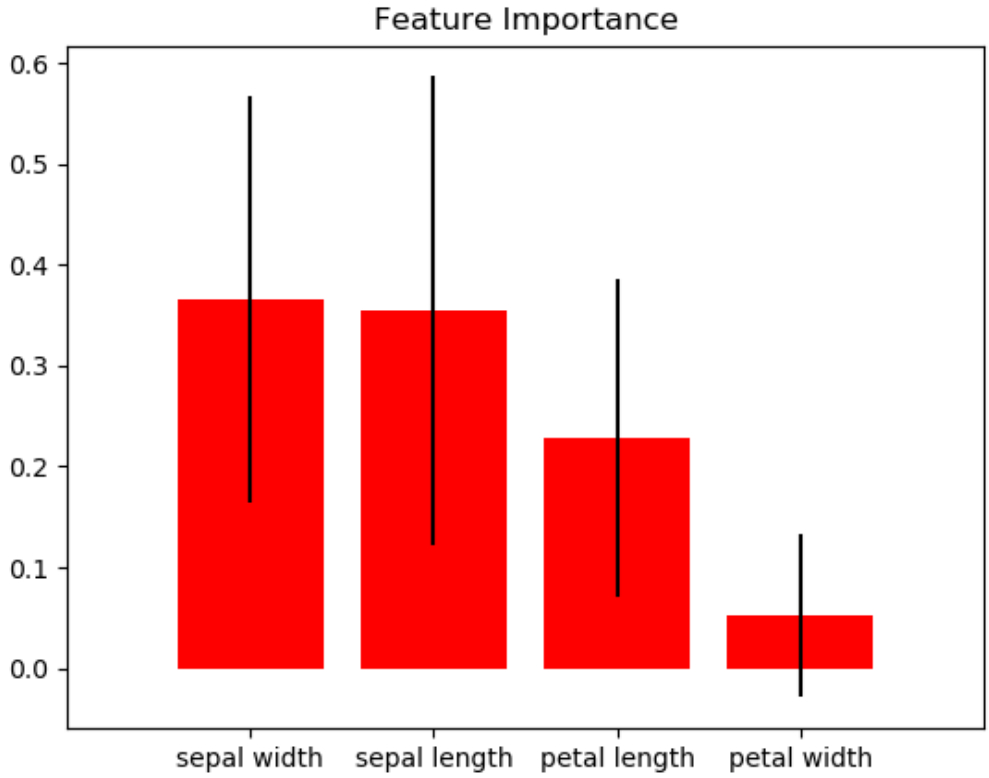
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Feature importances".
- **feature_names** (None, `list` of string, optional) – Determines the feature names used to plot the feature importances. If None, feature names will be numbered.
- **max_num_features** (*int*) – Determines the maximum number of features to plot. Defaults to 20.
- **order** (*'ascending', 'descending', or None, optional*) – Determines the order in which the feature importances are plotted. Defaults to 'descending'.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> rf = RandomForestClassifier()
>>> rf.fit(X, y)
>>> skplt.plot_feature_importances(rf, feature_names=['petal length', 'petal width
↪',
...                                                   'sepal length', 'sepal width
↪'])
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.plotters.**plot_silhouette**(*clf*, *X*, *title=u'Silhouette Analysis'*, *metric=u'euclidean'*, *copy=True*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Plots silhouette analysis of clusters using fit_predict.

Parameters

- **clf** – Clusterer instance that implements `fit` and `fit_predict` methods.
- **X** (*array-like, shape (n_samples, n_features)*) – Data to cluster, where n_samples is the number of samples and n_features is the number of features.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Silhouette Analysis"
- **metric** (*string or callable, optional*) – The metric to use when calculating distance between instances in a feature array. If metric is a string, it must be one of the options allowed by sklearn.metrics.pairwise.pairwise_distances. If X is the distance array itself, use "precomputed" as the metric.
- **copy** (*boolean, optional*) – Determines whether `fit` is used on **clf** or on a copy of **clf**.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.

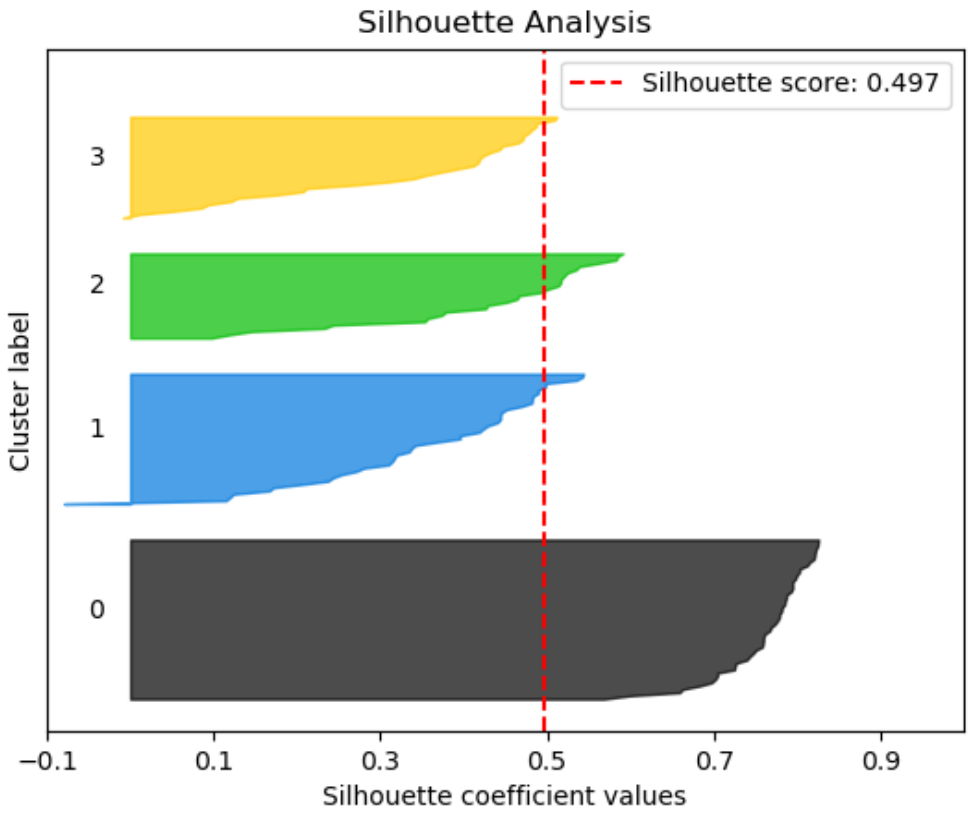
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> kmeans = KMeans(n_clusters=4, random_state=1)
>>> skplt.plot_silhouette(kmeans, X)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



`scikitplot.plotters.`**plot_elbow_curve**(*clf, X, title=u'Elbow Plot', cluster_ranges=None, ax=None, figsize=None, title_fontsize=u'large', text_fontsize=u'medium'*)

Plots elbow curve of different values of K for KMeans clustering.

Parameters

- **clf** – Clusterer instance that implements `fit` and `fit_predict` methods and a `score` parameter.

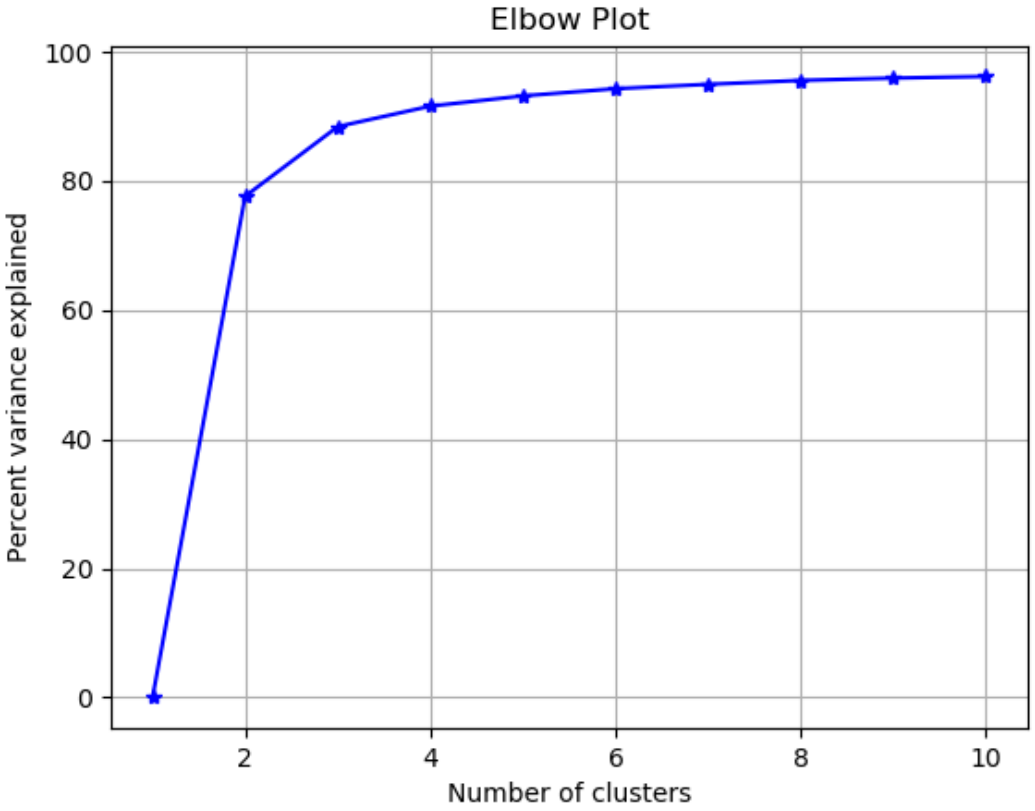
- **X** (*array-like, shape (n_samples, n_features)*) – Data to cluster, where n_samples is the number of samples and n_features is the number of features.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "Elbow Plot"
- **cluster_ranges** (None or `list` of int, optional) – List of n_clusters for which to plot the explained variances. Defaults to `range(1, 12, 2)`.
- **copy** (*boolean, optional*) – Determines whether `fit` is used on **clf** or on a copy of **clf**.
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> kmeans = KMeans(random_state=1)
>>> skplt.plot_elbow_curve(kmeans, cluster_ranges=range(1, 11))
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



scikitplot.plotters.**plot_pca_component_variance**(*clf*, *title=u'PCA Component Explained Variances'*, *target_explained_variance=0.75*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Plots PCA components' explained variance ratios. (new in v0.2.2)

Parameters

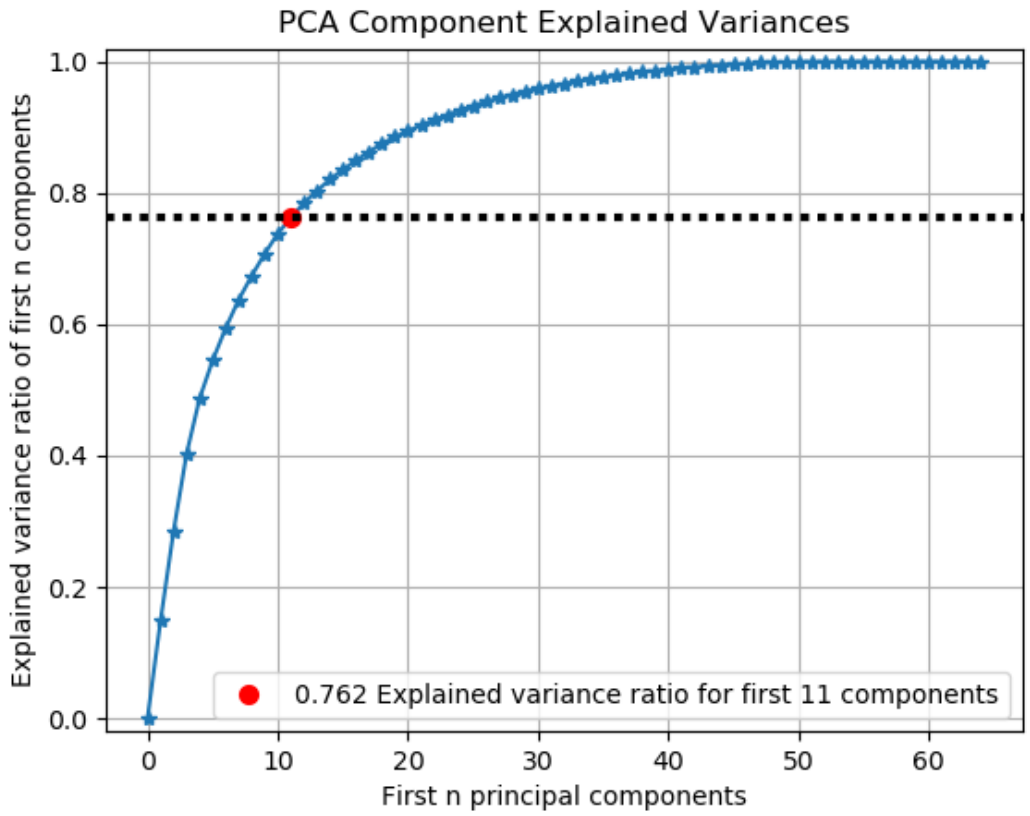
- **clf** – PCA instance that has the `explained_variance_ratio_` attribute.
- **title** (*string, optional*) – Title of the generated plot. Defaults to "PCA Component Explained Variances"
- **target_explained_variance** (*float, optional*) – Looks for the minimum number of principal components that satisfies this value and emphasizes it on the plot. Defaults to 0.75.4
- **ax** (`matplotlib.axes.Axes`, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to `None`.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (`matplotlib.axes.Axes`)

Example

```
>>> import scikitplot.plotters as skplt
>>> pca = PCA(random_state=1)
>>> pca.fit(X)
>>> skplt.plot_pca_component_variance(pca)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



`scikitplot.plotters.`**`plot_pca_2d_projection`**(*clf*, *X*, *y*, *title=u'PCA 2-D Projection'*, *ax=None*, *figsize=None*, *title_fontsize=u'large'*, *text_fontsize=u'medium'*)

Plots the 2-dimensional projection of PCA on a given dataset. (new in v0.2.2)

Parameters

- **`clf`** – PCA instance that can `transform` given data set into 2 dimensions.
- **`X`** (*array-like, shape (n_samples, n_features)*) – Feature set to project, where n_samples is the number of samples and n_features is the number of features.
- **`y`** (*array-like, shape (n_samples) or (n_samples, n_features)*) – Target relative to X for labeling.

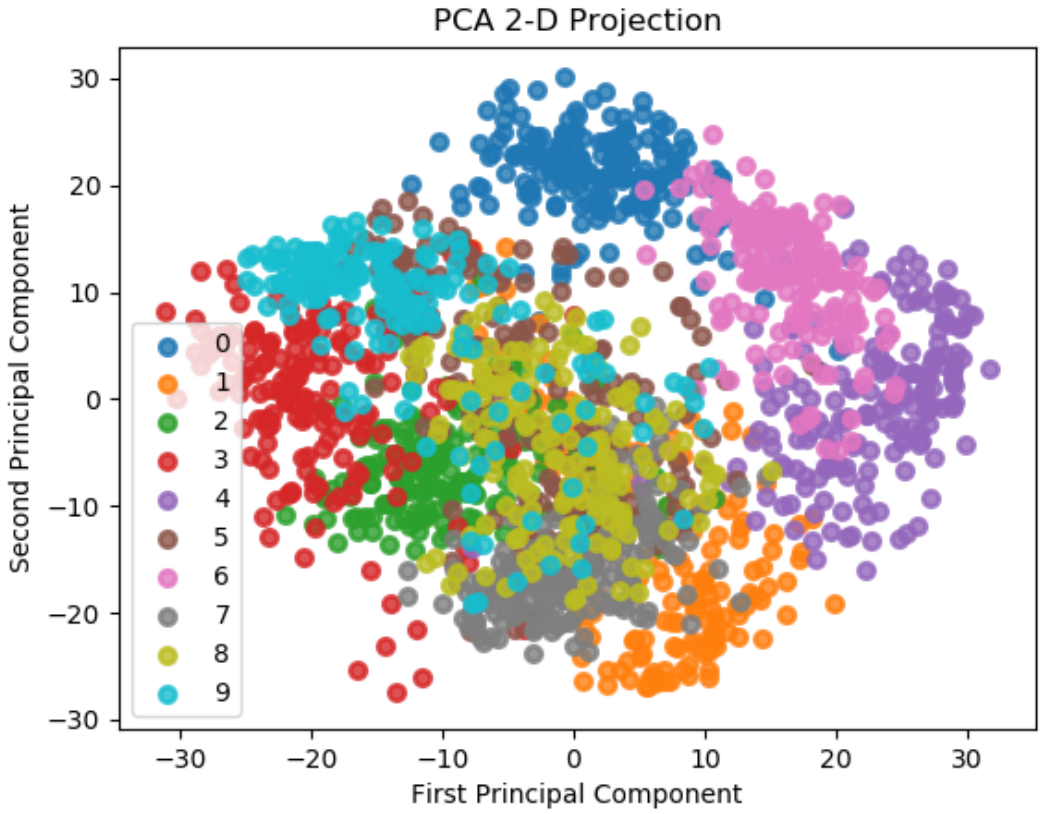
- **title** (*string, optional*) – Title of the generated plot. Defaults to "PCA 2-D Projection"
- **ax** (matplotlib.axes.Axes, optional) – The axes upon which to plot the learning curve. If None, the plot is drawn on a new set of axes.
- **figsize** (*2-tuple, optional*) – Tuple denoting figure size of the plot e.g. (6, 6). Defaults to None.
- **title_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "large".
- **text_fontsize** (*string or int, optional*) – Matplotlib-style fontsizes. Use e.g. "small", "medium", "large" or integer-values. Defaults to "medium".

Returns The axes on which the plot was drawn.

Return type ax (matplotlib.axes.Axes)

Example

```
>>> import scikitplot.plotters as skplt
>>> pca = PCA(random_state=1)
>>> pca.fit(X)
>>> skplt.plot_pca_2d_projection(pca, X, y)
<matplotlib.axes._subplots.AxesSubplot object at 0x7fe967d64490>
>>> plt.show()
```



CHAPTER 4

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