In [1]:
```
%load_ext autoreload
%autoreload 2

%matplotlib inline
```

In [2]:
```
import sys
import os
# add library module to PYTHONPATH
sys.path.append(f"{os.getcwd()}/../")
```

In [3]:
```
import sklearn
from sklearn.tree import DecisionTreeClassifier, DecisionTreeRegressor
from dtreeviz.models.sklearn_decision_trees import ShadowSKDTree

import graphviz
import pandas as pd
from dtreeviz.models.shadow_decision_tree import ShadowDecTree
from dtreeviz.models.sklearn_decision_trees import ShadowSKDTree
from dtreeviz import trees
from sklearn import tree
```

Classifier

In [4]:
```
random_state = 1234
dataset = pd.read_csv("../data/titanic/titanic.csv")
# Fill missing values for Age
dataset.fillna({"Age":dataset.Age.mean()}, inplace=True)
# Encode categorical variables
dataset["Sex_label"] = dataset.Sex.astype("category").cat.codes
dataset["Cabin_label"] = dataset.Cabin.astype("category").cat.codes
dataset["Embarked_label"] = dataset.Embarked.astype("category").cat.codes
features = ["Pclass", "Age", "Fare", "Sex_label", "Cabin_label", "Embarked_label"]
target = "Survived"
tree_classifier = DecisionTreeClassifier(max_depth=4, random_state=random_state)
tree_classifier.fit(dataset[features], dataset[target])
```

Out[4]:
```
DecisionTreeClassifier(max_depth=4, random_state=1234)
```

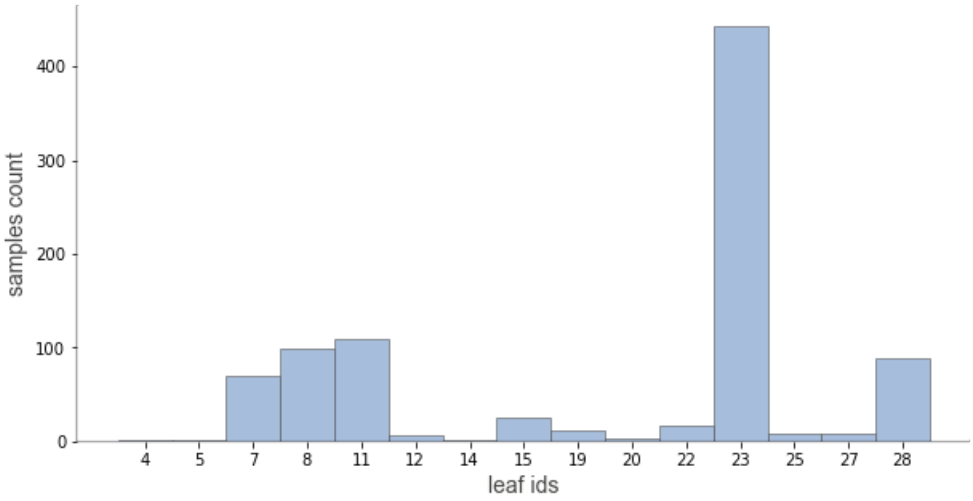
Initialize shadow tree

In [5]:
```
sk_dtree = ShadowSKDTree(tree_classifier, dataset[features], dataset[target], features, target, [0, 1])
```

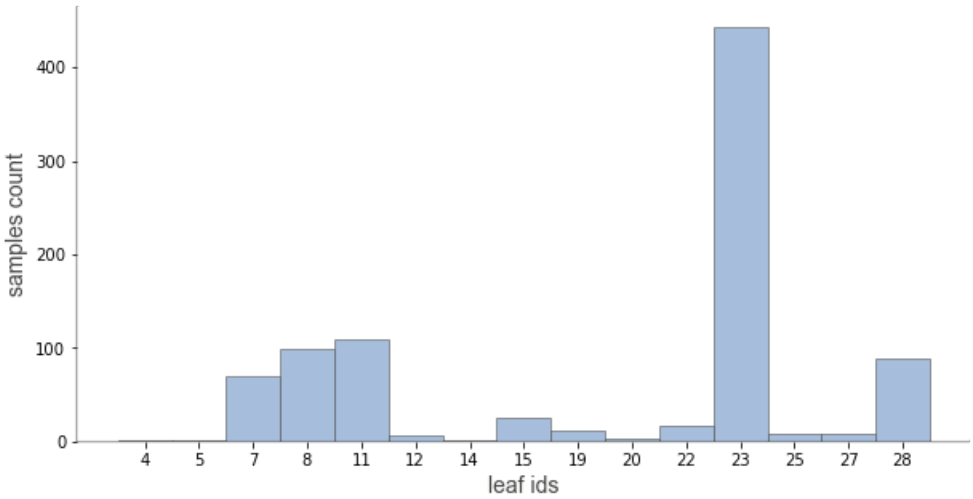
Visualizations

viz_leaf_samples

In [6]:
```
trees.viz_leaf_samples(tree_classifier, dataset[features], features)
```

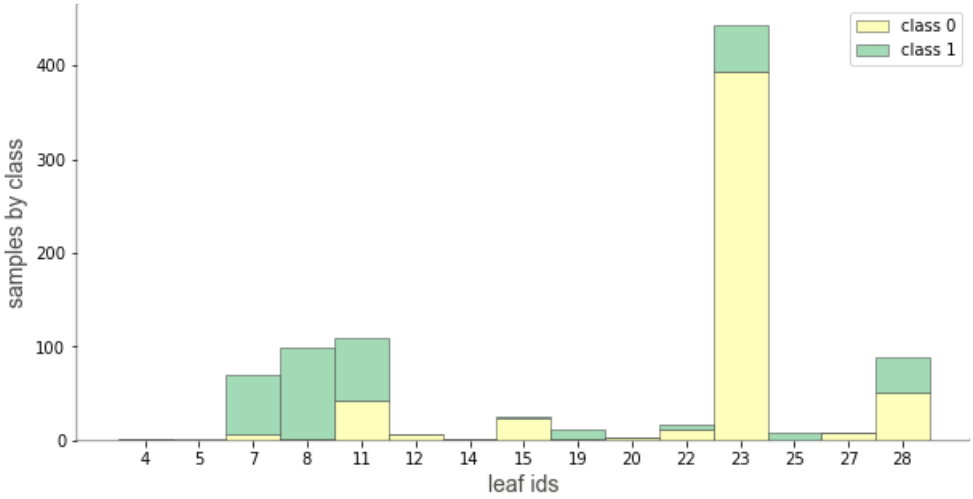


In [7]:
```
trees.viz_leaf_samples(sk_dtree)
```

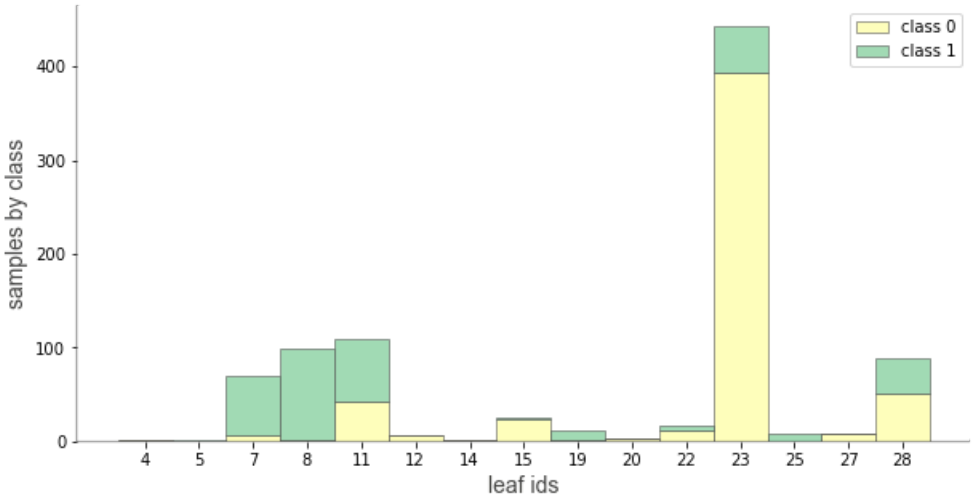


ctreeviz_leaf_samples

In [8]:
```
trees.ctreeviz_leaf_samples(tree_classifier, dataset[features], dataset[target], features)
```



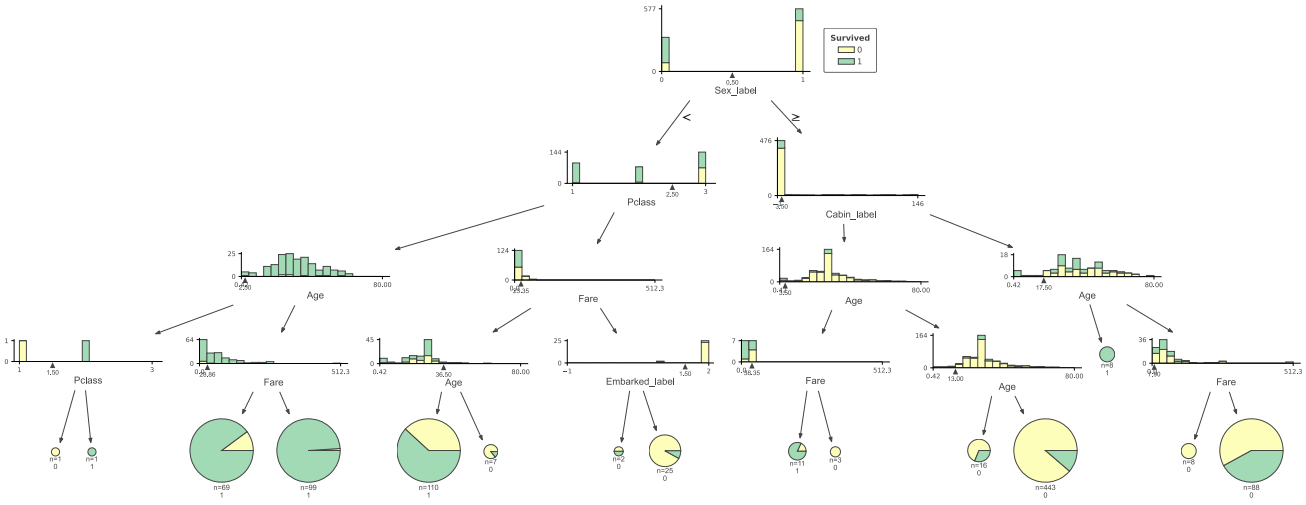
In [9]:
```
trees.ctreeviz_leaf_samples(sk_dtree)
```



dtreeviz

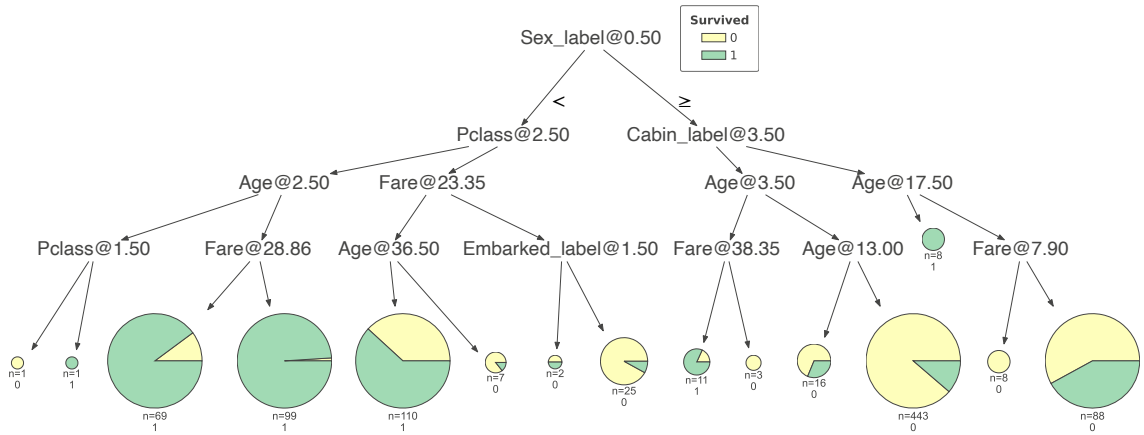
In [10]:
```
trees.dtreeviz(tree_classifier, dataset[features], dataset[target], features, target, class_names=[0, 1]
```

Out[10]:



In [11]:
```
trees.dtreeviz(sk_dtree, fancy=False)
```

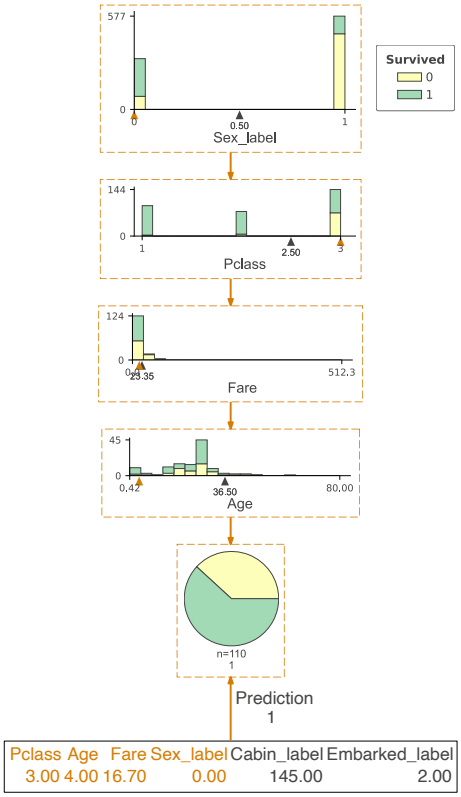
Out[11]:



show just path

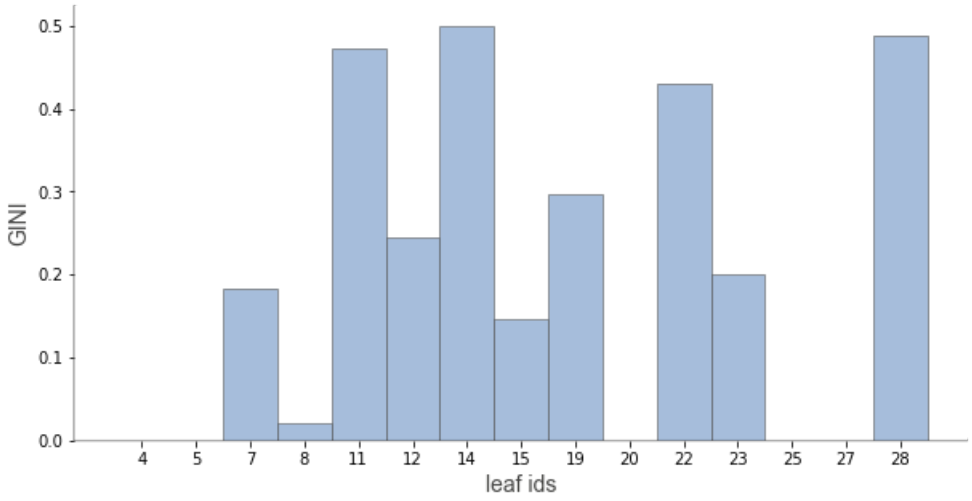
In [12]:
```
trees.dtreeviz(sk_dtree, show_just_path=True, X = dataset[features].iloc[10])
```

Out[12]:

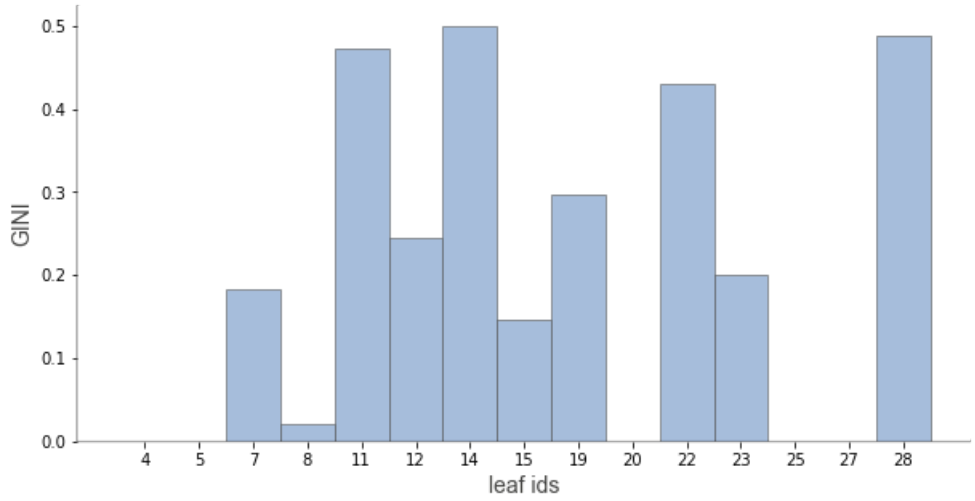


viz_leaf_criterion

In [13]:
```
trees.viz_leaf_criterion(tree_classifier)
```



In [14]:
```
trees.viz_leaf_criterion(sk_dtree)
```



describe_node_sample

In [15]:
```
trees.describe_node_sample(tree_classifier, node_id=10, x_data=dataset[features], feature_names=features
```

Out[15]:

	Pclass	Age	Fare	Sex_label	Cabin_label	Embarked_label
count	117.0	117.000000	117.000000	117.0	117.000000	117.000000
mean	3.0	23.976667	11.722829	0.0	6.196581	1.341880
std	0.0	10.534377	4.695136	0.0	31.167855	0.789614
min	3.0	0.750000	6.750000	0.0	-1.000000	0.000000
25%	3.0	18.000000	7.775000	0.0	-1.000000	1.000000
50%	3.0	27.000000	9.587500	0.0	-1.000000	2.000000
75%	3.0	29.699118	15.500000	0.0	-1.000000	2.000000
max	3.0	63.000000	23.250000	0.0	145.000000	2.000000

In [16]:
```
trees.describe_node_sample(sk_dtree, node_id=10)
```

Out[16]:

	Pclass	Age	Fare	Sex_label	Cabin_label	Embarked_label
count	117.0	117.000000	117.000000	117.0	117.000000	117.000000
mean	3.0	23.976667	11.722829	0.0	6.196581	1.341880
std	0.0	10.534377	4.695136	0.0	31.167855	0.789614
min	3.0	0.750000	6.750000	0.0	-1.000000	0.000000
25%	3.0	18.000000	7.775000	0.0	-1.000000	1.000000
50%	3.0	27.000000	9.587500	0.0	-1.000000	2.000000
75%	3.0	29.699118	15.500000	0.0	-1.000000	2.000000
max	3.0	63.000000	23.250000	0.0	145.000000	2.000000

explain_prediction_path

In [17]:
```
X = dataset[features].iloc[10]
X
```

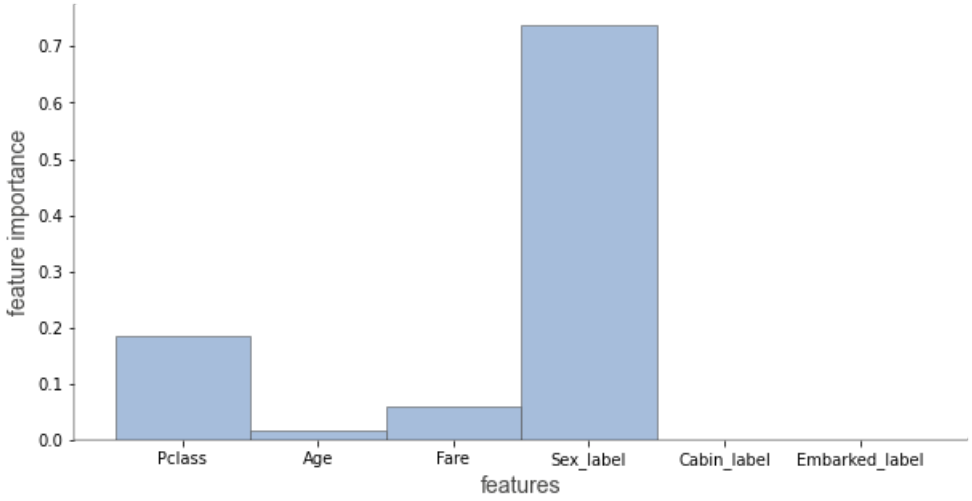
Out[17]:
```
Pclass              3.0
Age                 4.0
Fare               16.7
Sex_label           0.0
Cabin_label       145.0
Embarked_label      2.0
Name: 10, dtype: float64
```

In [18]:
```
print(trees.explain_prediction_path(tree_classifier, X, feature_names=features, explanation_type="plain_
```

```
2.5 <= Pclass
Age < 36.5
Fare < 23.35
Sex_label < 0.5
```

In [19]:
```
trees.explain_prediction_path(tree_classifier, X, feature_names=features, explanation_type="sklearn_defa
```

Out[19]: <AxesSubplot:xlabel='features', ylabel='feature importance'>



Regressor

In [20]:
```
features_reg = ["Pclass", "Fare", "Sex_label", "Cabin_label", "Embarked_label", "Survived"]
target_reg = "Age"
tree_regressor = DecisionTreeRegressor(max_depth=3, random_state=random_state, criterion="mae")
tree_regressor.fit(dataset[features_reg], dataset[target_reg])
```

Out[20]: DecisionTreeRegressor(criterion='mae', max_depth=3, random_state=1234)

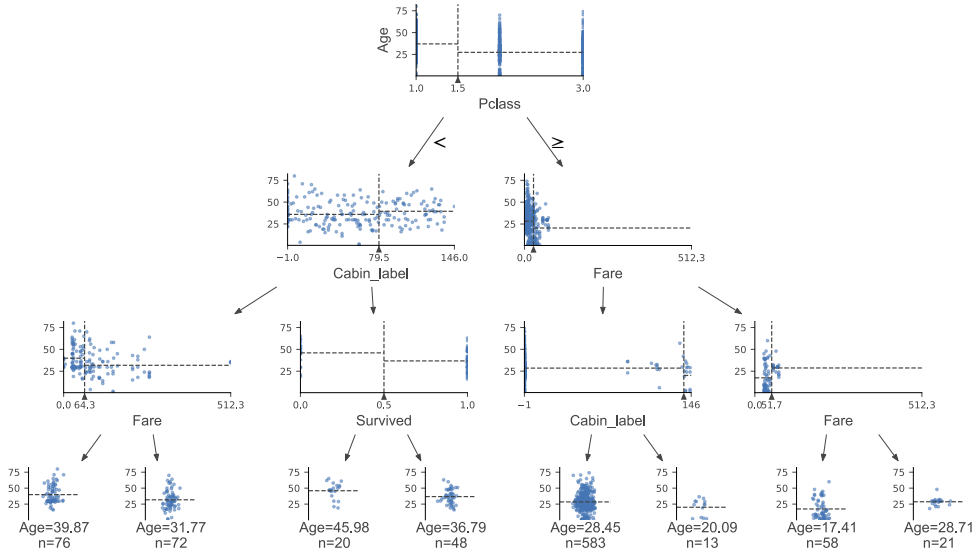
In [21]:
```
sk_dtree_reg = ShadowSKDTree(tree_regressor, dataset[features_reg], dataset[target_reg], features_reg, t
```

Visualizations

dtreeviz

In [22]:
```
trees.dtreeviz(tree_regressor, dataset[features_reg], dataset[target_reg], features_reg, target_reg)
```

Out[22]:



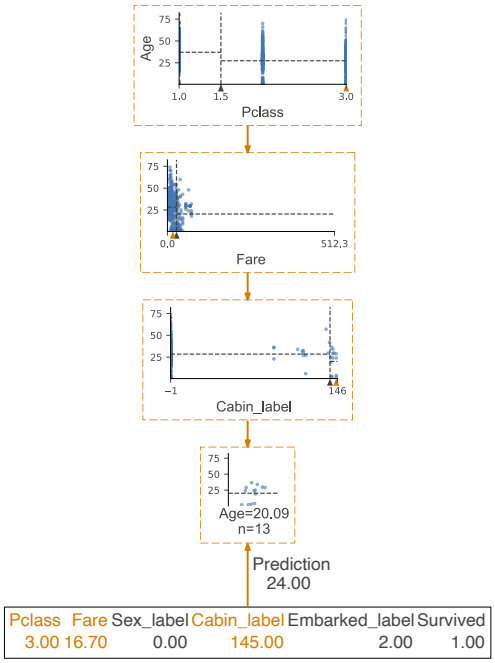
show just path

In [23]:
```
x = dataset[features_reg].iloc[10]
x
```

Out[23]:
```
Pclass              3.0
Fare               16.7
Sex_label           0.0
Cabin_label       145.0
Embarked_label      2.0
Survived            1.0
Name: 10, dtype: float64
```

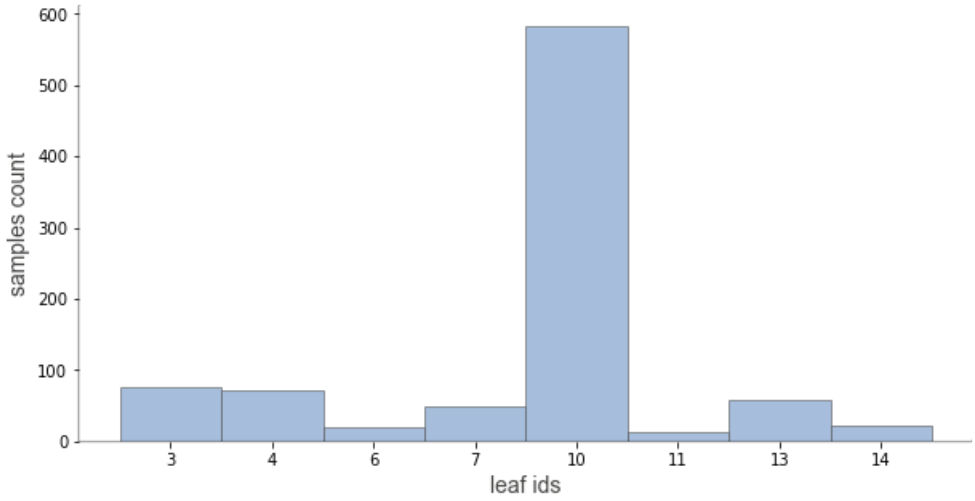
In [24]:
```
trees.dtreeviz(sk_dtree_reg, show_just_path=True, X = x)
```

Out[24]:

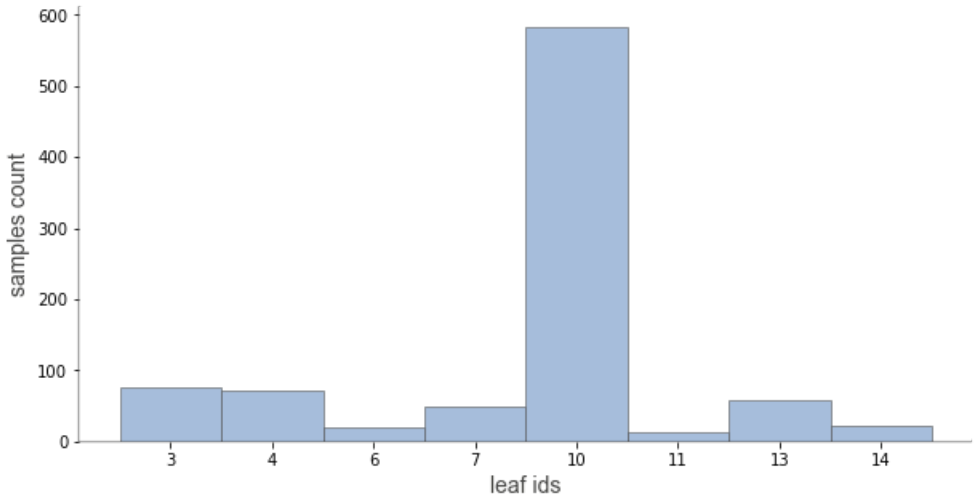


viz_leaf_samples

In [25]:
```
trees.viz_leaf_samples(tree_regressor, dataset[features_reg], features_reg)
```

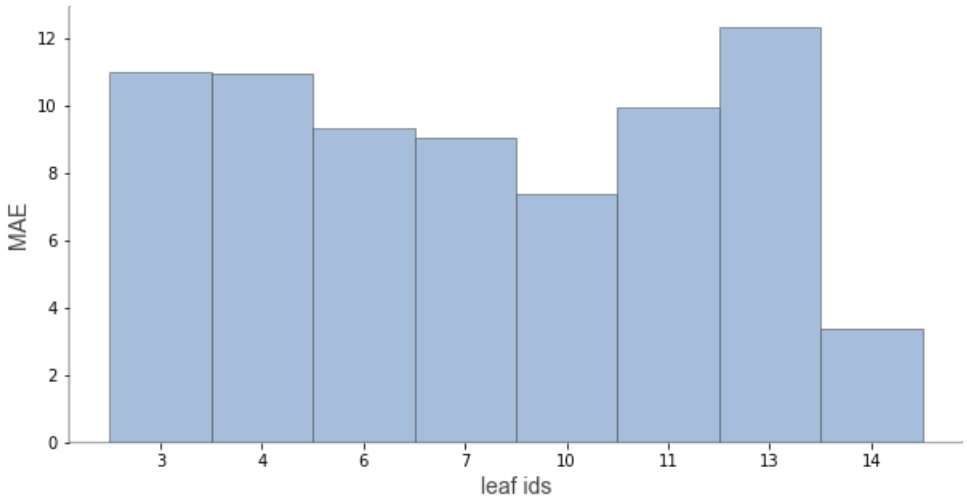


In [26]:
```
trees.viz_leaf_samples(sk_dtree_reg)
```

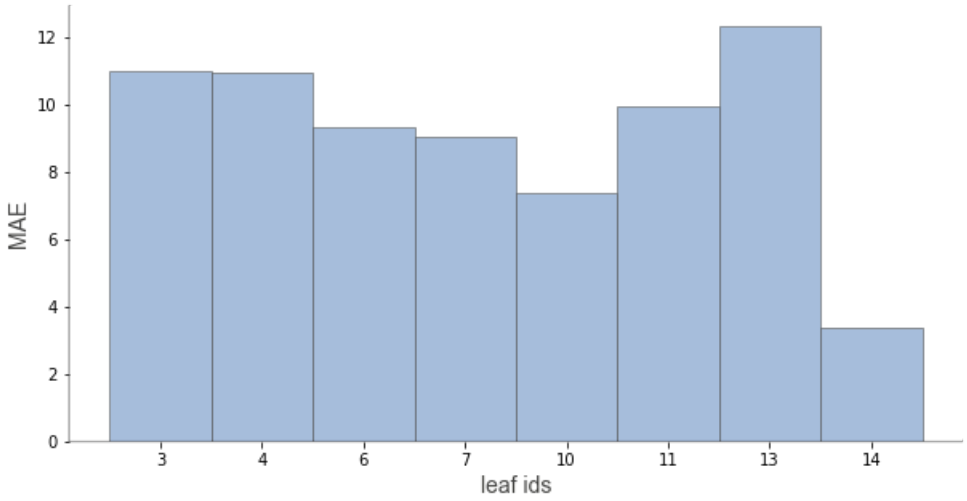


viz_leaf_criterion

In [27]:
```
trees.viz_leaf_criterion(tree_regressor)
```

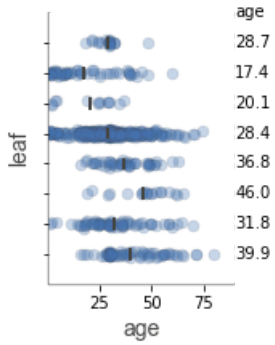


In [28]:
```
trees.viz_leaf_criterion(sk_dtree_reg)
```

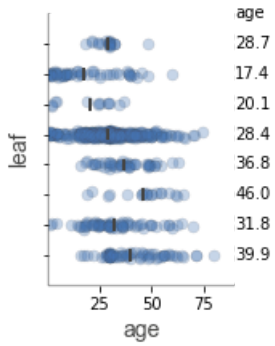


viz_leaf_target

In [29]:
```
trees.viz_leaf_target(tree_regressor, dataset[features_reg], dataset[target_reg], features_reg, target_r
```



In [30]:
```
trees.viz_leaf_target(sk_dtree_reg)
```



describe_node_sample

In [31]:
```
trees.describe_node_sample(tree_regressor, node_id=1, x_data=dataset[features], feature_names=features_r
```

Out[31]:

	Pclass	Fare	Sex_label	Cabin_label	Embarked_label	Survived
count	216.0	216.000000	216.000000	216.000000	216.000000	216.000000
mean	1.0	37.048118	84.154687	0.564815	54.773148	1.175926
std	0.0	14.046369	78.380373	0.496933	43.781906	0.996073
min	1.0	0.920000	0.000000	0.000000	-1.000000	-1.000000
25%	1.0	29.000000	30.923950	0.000000	13.750000	0.000000

	Pclass	Fare	Sex_label	Cabin_label	Embarked_label	Survived
50%	1.0	35.000000	60.287500	1.000000	53.500000	2.000000
75%	1.0	47.250000	93.500000	1.000000	91.250000	2.000000
max	1.0	80.000000	512.329200	1.000000	146.000000	2.000000

In [32]:
```
trees.describe_node_sample(sk_dtree_reg, node_id=1)
```

Out[32]:

	Pclass	Fare	Sex_label	Cabin_label	Embarked_label	Survived
count	216.0	216.000000	216.000000	216.000000	216.000000	216.000000
mean	1.0	84.154687	0.564815	54.773148	1.175926	0.629630
std	0.0	78.380373	0.496933	43.781906	0.996073	0.484026
min	1.0	0.000000	0.000000	-1.000000	-1.000000	0.000000
25%	1.0	30.923950	0.000000	13.750000	0.000000	0.000000
50%	1.0	60.287500	1.000000	53.500000	2.000000	1.000000
75%	1.0	93.500000	1.000000	91.250000	2.000000	1.000000
max	1.0	512.329200	1.000000	146.000000	2.000000	1.000000

explain_prediction_path

In [33]:
```
X_reg = dataset[features_reg].iloc[10]
X_reg
```

Out[33]:
```
Pclass              3.0
Fare               16.7
Sex_label           0.0
Cabin_label       145.0
Embarked_label      2.0
Survived            1.0
Name: 10, dtype: float64
```

In [34]:
```
print(trees.explain_prediction_path(tree_regressor, X_reg, feature_names=features_reg, explanation_type=
```

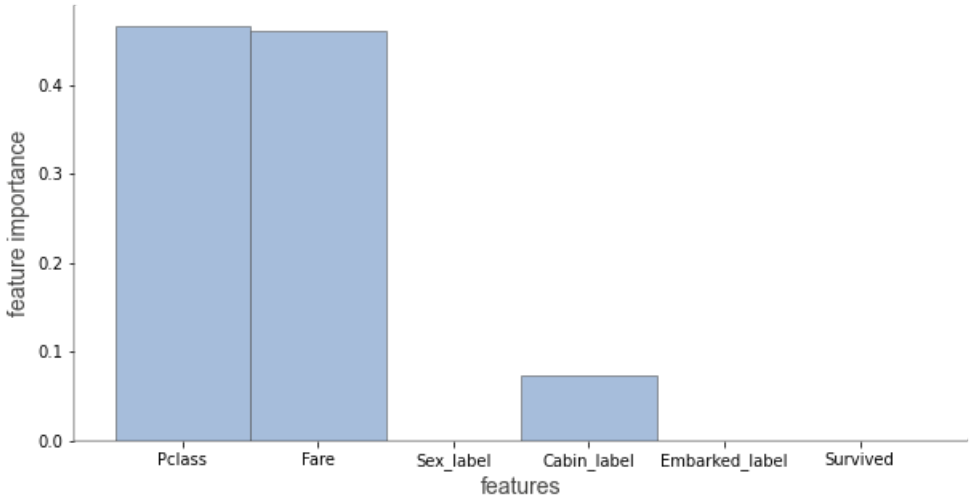
```
1.5 <= Pclass
Fare < 27.82
139.5 <= Cabin_label
```

In [35]:
```
print(trees.explain_prediction_path(sk_dtree_reg, X_reg, "plain_english"))
```

```
1.5 <= Pclass
Fare < 27.82
139.5 <= Cabin_label
```

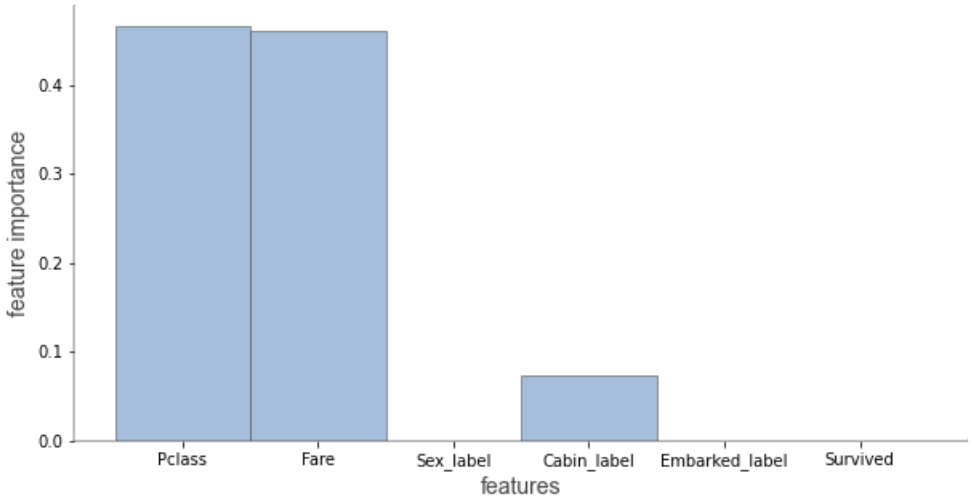
In [36]:
```
trees.explain_prediction_path(tree_regressor, X_reg, feature_names=features_reg, explanation_type="sklea
```

Out[36]:
```
<AxesSubplot:xlabel='features', ylabel='feature importance'>
```



In [37]:
```
print(trees.explain_prediction_path(sk_dtree_reg, X_reg, explanation_type="sklearn_default"))
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```



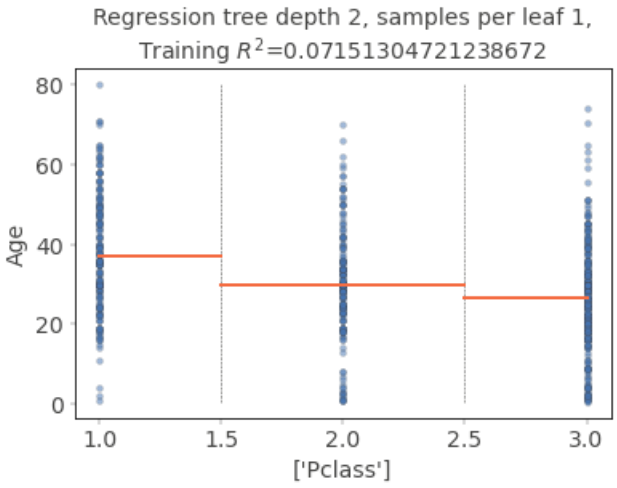
rtreeviz_univar

In [38]:
```
features_reg_univar = ["Pclass"]
target_reg = "Age"
dtr_univar = DecisionTreeRegressor(max_depth=2, random_state=random_state, criterion="mae")
dtr_univar.fit(dataset[features_reg_univar], dataset[target_reg])
```

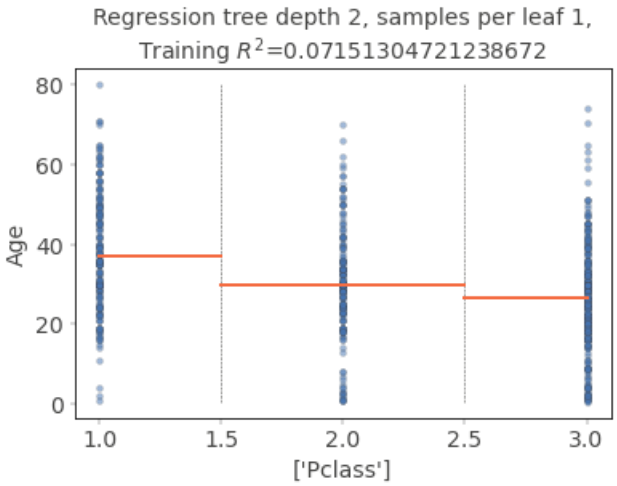
Out[38]:
```
DecisionTreeRegressor(criterion='mae', max_depth=2, random_state=1234)
```

In [39]:
```
skdtree_univar = ShadowSKDTree(dtr_univar, dataset[features_reg_univar], dataset[target_reg], features_r
```

In [40]:
```
trees.rtreeviz_univar(dtr_univar, dataset[features_reg_univar], dataset[target_reg], features_reg_univar
```



In [41]:
```
trees.rtreeviz_univar(skdtree_univar)
```



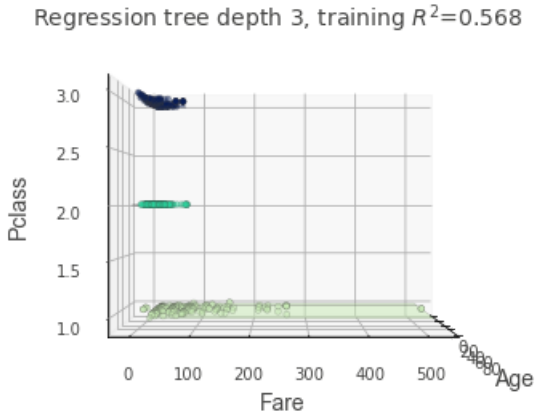
rtreeviz_bivar_3D

In [42]:
```
features_reg_bivar = ["Age", "Fare"]
target_reg = "Pclass"
dtr_bivar = DecisionTreeRegressor(max_depth=3, random_state=random_state, criterion="mae")
dtr_bivar.fit(dataset[features_reg_bivar], dataset[target_reg])
```

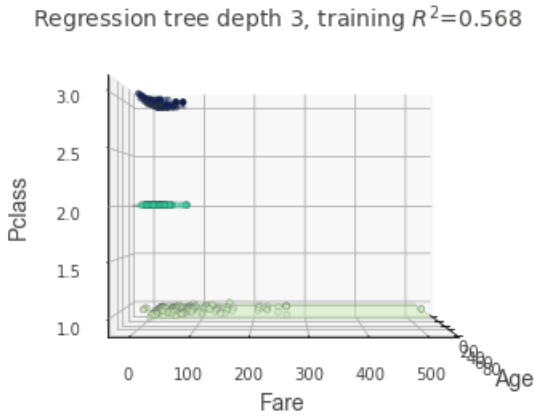
Out[42]:
```
DecisionTreeRegressor(criterion='mae', max_depth=3, random_state=1234)
```

In [43]:
```
skdtree_bivar = ShadowSKDTree(dtr_bivar, dataset[features_reg_bivar], dataset[target_reg], features_reg_
```

In [44]:
```
trees.rtreeviz_bivar_3D(dtr_bivar, dataset[features_reg_bivar], dataset[target_reg], features_reg_bivar,
```



In [45]:
```
trees.rtreeviz_bivar_3D(skdtree_bivar)
```



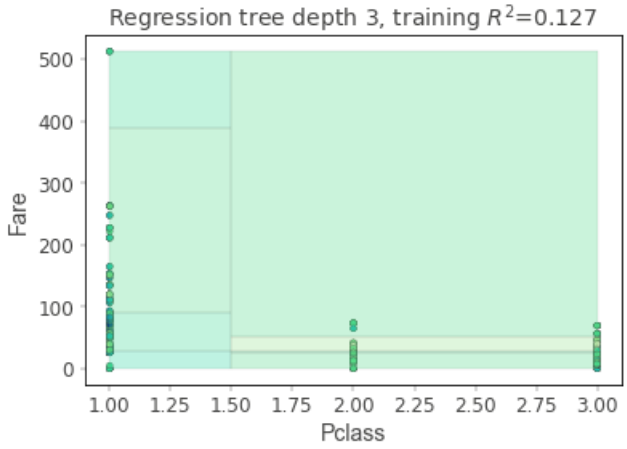
rtreeviz_bivar_heatmap

In [46]:
```
features_reg_bivar = ["Pclass", "Fare"]
target_reg = "Age"
dtr_bivar = DecisionTreeRegressor(max_depth=3, random_state=random_state, criterion="mae")
dtr_bivar.fit(dataset[features_reg_bivar], dataset[target_reg])
```

Out[46]:
```
DecisionTreeRegressor(criterion='mae', max_depth=3, random_state=1234)
```

In [47]:
```
skdtree_bivar = ShadowSKDTree(dtr_bivar, dataset[features_reg_bivar], dataset[target_reg], features_reg_
```

In [48]:
```
trees.rtreeviz_bivar_heatmap(dtr_bivar, dataset[features_reg_bivar], dataset[target_reg], features_reg_b
```



In [49]:

```
trees.rtreeviz_bivar_heatmap(skdtree_bivar)
```