In [1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
sns.set_theme(color_codes=True)
```

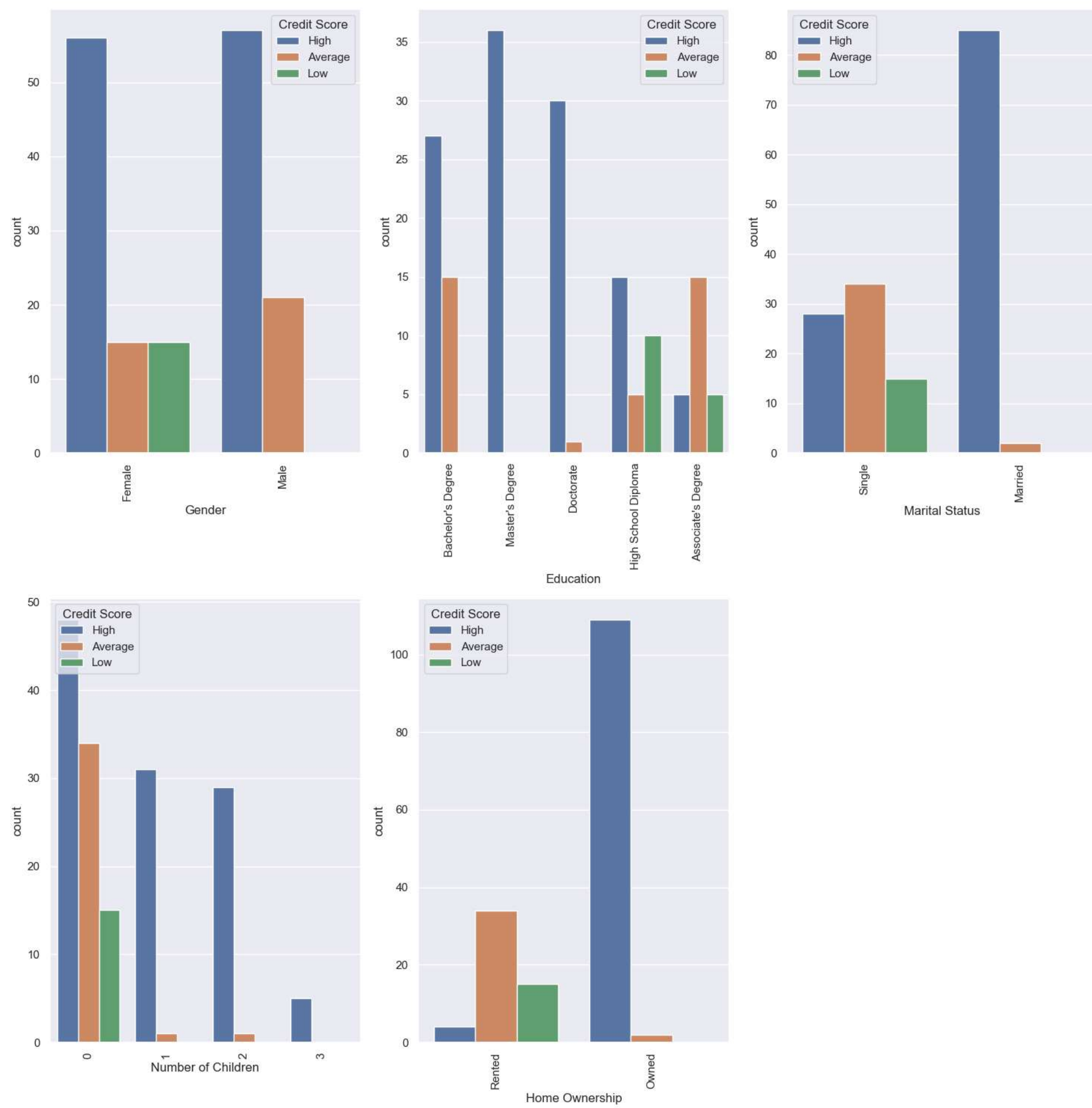
In [2]:
```
df = pd.read_csv('Credit Score Classification Dataset.csv')
df.head()
```

Out[2]:

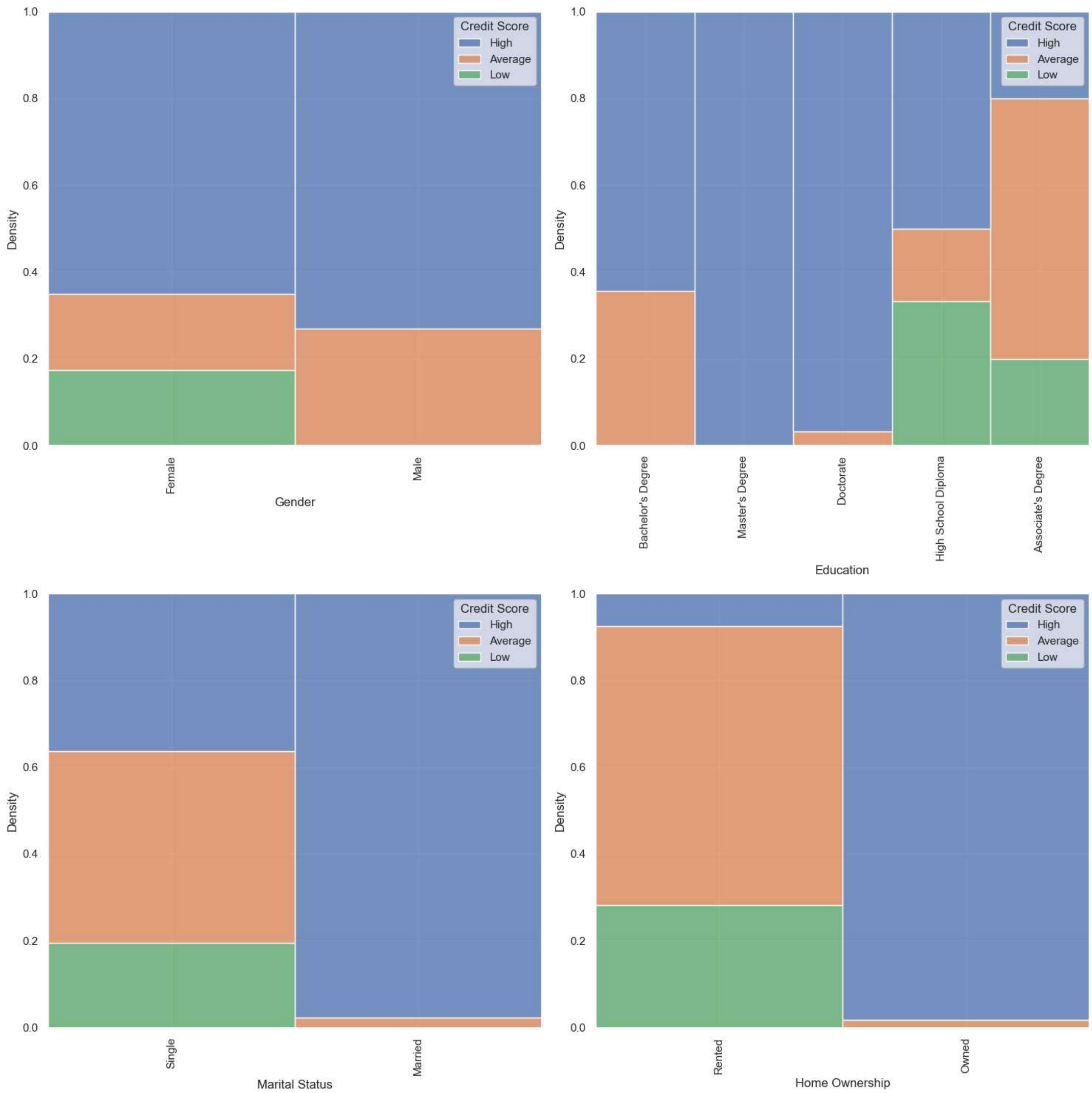
	Age	Gender	Income	Education	Marital Status	Number of Children	Home Ownership	Credit Score
0	25	Female	50000	Bachelor's Degree	Single	0	Rented	High
1	30	Male	100000	Master's Degree	Married	2	Owned	High
2	35	Female	75000	Doctorate	Married	1	Owned	High
3	40	Male	125000	High School Diploma	Single	0	Owned	High
4	45	Female	100000	Bachelor's Degree	Married	3	Owned	High

Exploratory Data Analysis

In [3]:
```python
# list of categorical variables to plot
cat_vars = ['Gender', 'Education', 'Marital Status', 'Number of Children', 'Home Ownership']

# create figure with subplots
fig, axs = plt.subplots(nrows=2, ncols=3, figsize=(15, 15))
axs = axs.flatten()

# create barplot for each categorical variable
for i, var in enumerate(cat_vars):
    sns.countplot(x=var, hue='Credit Score', data=df, ax=axs[i])
    axs[i].set_xticklabels(axs[i].get_xticklabels(), rotation=90)

# adjust spacing between subplots
fig.tight_layout()

# remove the sixth subplot
fig.delaxes(axs[5])

# show plot
plt.show()
```

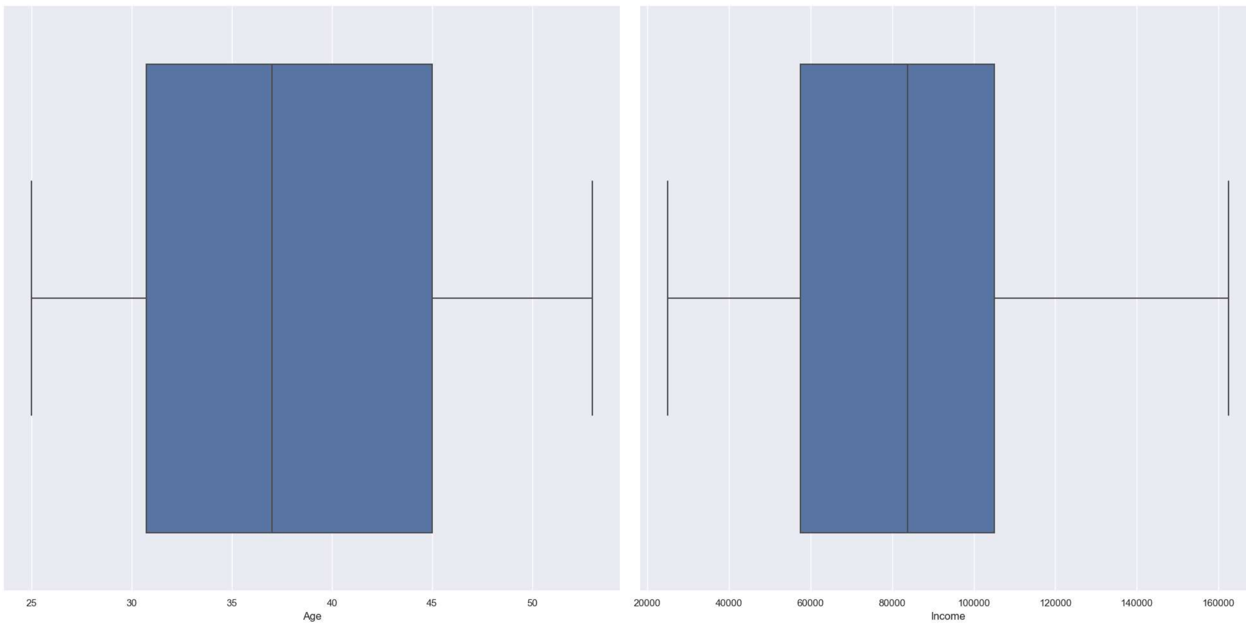


In [4]:
```
import warnings
warnings.filterwarnings("ignore")
# get list of categorical variables
cat_vars = ['Gender', 'Education', 'Marital Status', 'Home Ownership']

# create figure with subplots
fig, axs = plt.subplots(nrows=2, ncols=2, figsize=(15, 15))
axs = axs.flatten()

# create histplot for each categorical variable
for i, var in enumerate(cat_vars):
    sns.histplot(x=var, hue='Credit Score', data=df, ax=axs[i], multiple="fill", kde=False, elemen
    axs[i].set_xticklabels(df[var].unique(), rotation=90)
    axs[i].set_xlabel(var)

# adjust spacing between subplots
fig.tight_layout()

# show plot
plt.show()
```

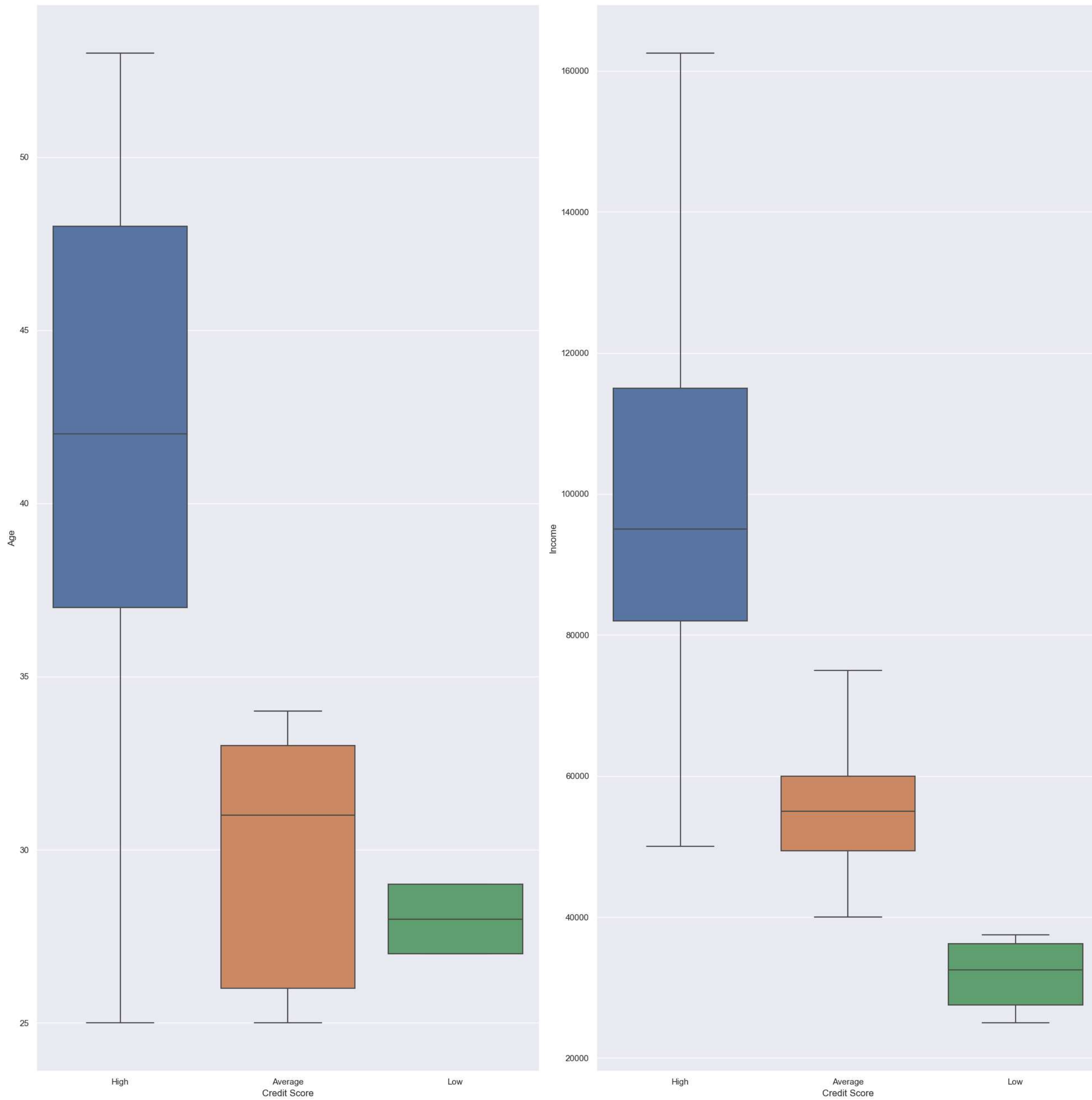


In [5]:
```
cat_vars = ['Gender', 'Education', 'Marital Status', 'Number of Children', 'Home Ownership']

# create a figure and axes
fig, axs = plt.subplots(nrows=2, ncols=3, figsize=(15, 15))

# create a pie chart for each categorical variable
for i, var in enumerate(cat_vars):
    if i < len(axs.flat):
        # count the number of occurrences for each category
        cat_counts = df[var].value_counts()

        # create a pie chart
        axs.flat[i].pie(cat_counts, labels=cat_counts.index, autopct='%1.1f%%', startangle=90)

        # set a title for each subplot
        axs.flat[i].set_title(f'{var} Distribution')

# adjust spacing between subplots
fig.tight_layout()
fig.delaxes(axs[1][2])
# show the plot
plt.show()
```

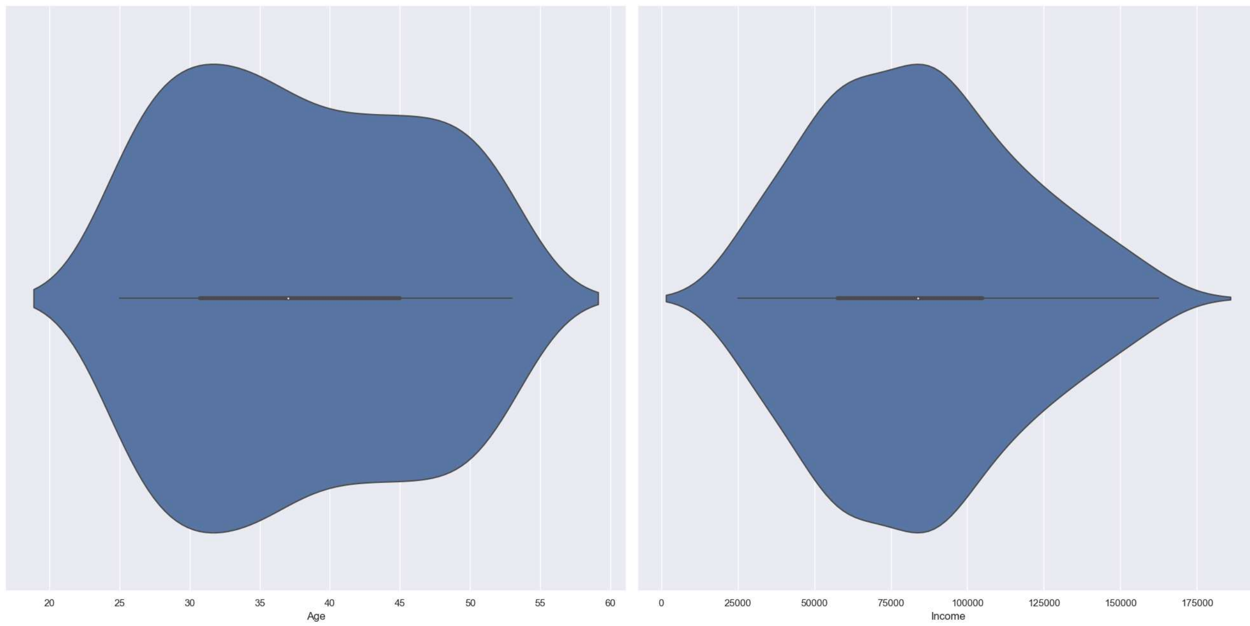
In [6]:
```
num_vars = ['Age', 'Income']

fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(20, 10))
axs = axs.flatten()

for i, var in enumerate(num_vars):
    sns.boxplot(x=var, data=df, ax=axs[i])

fig.tight_layout()

plt.show()
```



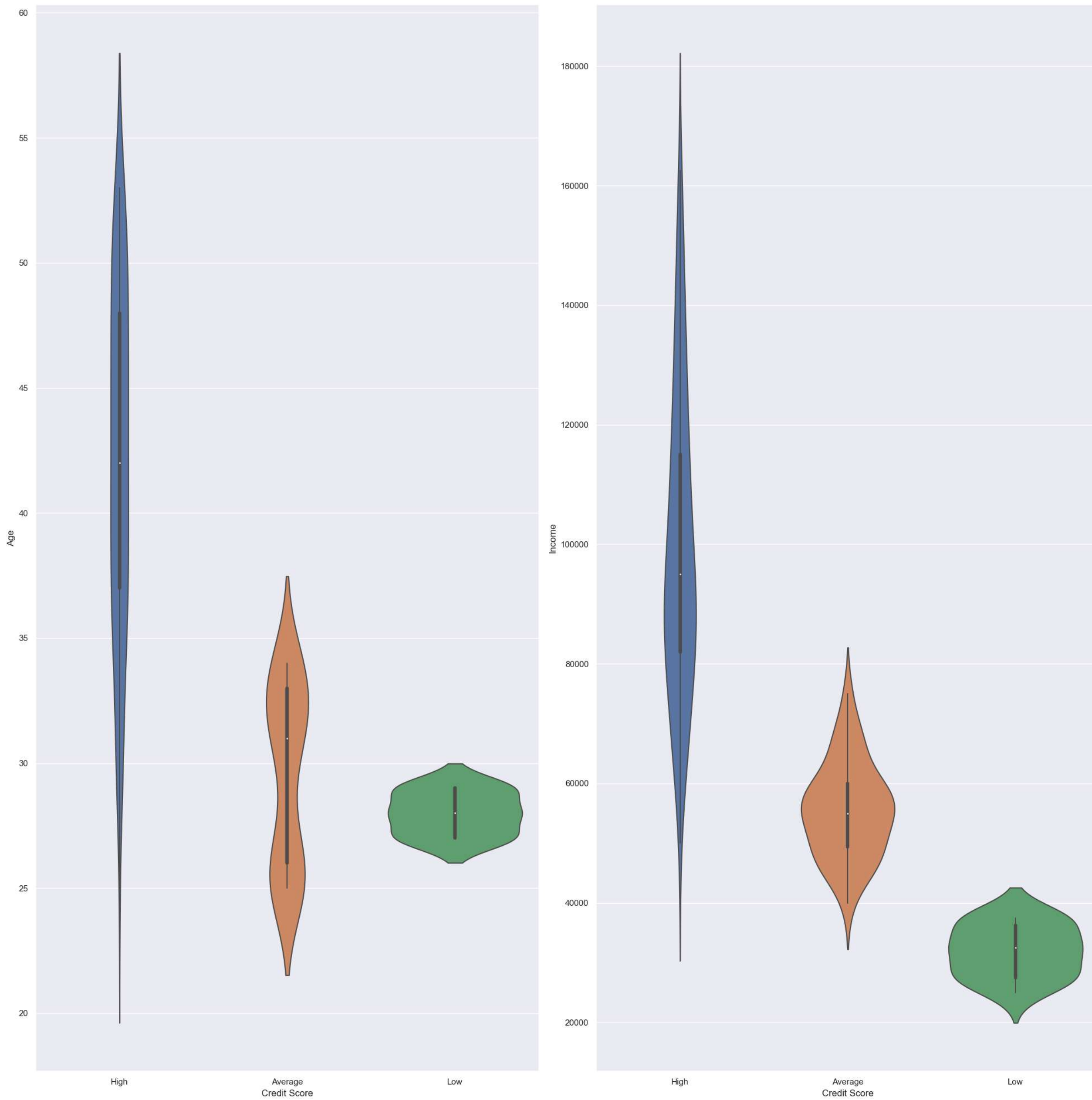
In [8]:
```
num_vars = ['Age', 'Income']

fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(20, 20))
axs = axs.flatten()

for i, var in enumerate(num_vars):
    sns.boxplot(y=var, x='Credit Score', data=df, ax=axs[i])

fig.tight_layout()

plt.show()
```



In [9]:
```
num_vars = ['Age', 'Income']

fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(20, 10))
axs = axs.flatten()

for i, var in enumerate(num_vars):
    sns.violinplot(x=var, data=df, ax=axs[i])

fig.tight_layout()

plt.show()
```



In [12]:
```
num_vars = ['Age', 'Income']

fig, axs = plt.subplots(nrows=1, ncols=2, figsize=(20, 20))
axs = axs.flatten()

for i, var in enumerate(num_vars):
    sns.violinplot(y=var, data=df, x='Credit Score', ax=axs[i])

fig.tight_layout()

plt.show()
```



Data Preprocessing

In [13]:
```
#Check missing value
check_missing = df.isnull().sum() * 100 / df.shape[0]
check_missing[check_missing > 0].sort_values(ascending=False)
```

Out[13]:
```
Series([], dtype: float64)
```

Label Encoding for object datatypes

In [14]:
```
# Loop over each column in the DataFrame where dtype is 'object'
for col in df.select_dtypes(include=['object']).columns:

    # Print the column name and the unique values
    print(f"{col}: {df[col].unique()}")
```

```
Gender: ['Female' 'Male']
Education: ["Bachelor's Degree" "Master's Degree" 'Doctorate' 'High School Diploma'
 "Associate's Degree"]
Marital Status: ['Single' 'Married']
Home Ownership: ['Rented' 'Owned']
Credit Score: ['High' 'Average' 'Low']
```

In [15]:
```
from sklearn import preprocessing

# Loop over each column in the DataFrame where dtype is 'object'
for col in df.select_dtypes(include=['object']).columns:

    # Initialize a LabelEncoder object
    label_encoder = preprocessing.LabelEncoder()

    # Fit the encoder to the unique values in the column
    label_encoder.fit(df[col].unique())

    # Transform the column using the encoder
    df[col] = label_encoder.transform(df[col])

    # Print the column name and the unique encoded values
    print(f"{col}: {df[col].unique()}")
```

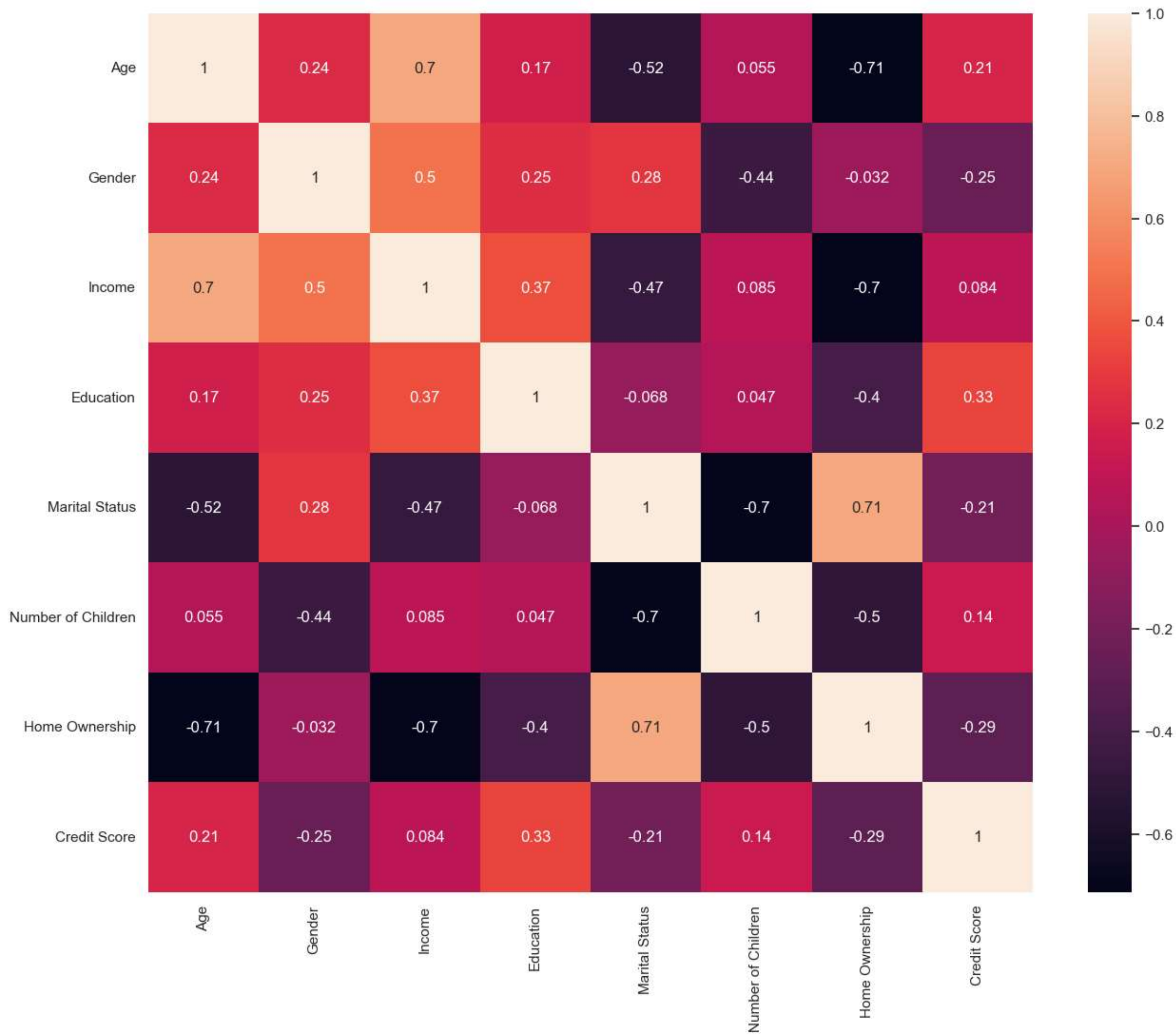
```
Gender: [0 1]
Education: [1 4 2 3 0]
Marital Status: [1 0]
Home Ownership: [1 0]
Credit Score: [1 0 2]
```

There's no outlier so we dont have to remove it

Correlation Heatmap

In [16]:
```
plt.figure(figsize=(15,12))
sns.heatmap(df.corr(), fmt='.2g', annot=True)
```

Out[16]: <AxesSubplot:>



Train Test Split

In [32]:
```
X = df.drop('Credit Score', axis=1)
y = df['Credit Score']
```

In [33]:
```
#test size 30% and train size 70%
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.3,random_state=0)
```

Decision Tree

In [34]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import GridSearchCV
dtree = DecisionTreeClassifier(class_weight='balanced')
param_grid = {
    'max_depth': [3, 4, 5, 6, 7, 8],
    'min_samples_split': [2, 3, 4],
    'min_samples_leaf': [1, 2, 3, 4],
    'random_state': [0, 42]
}

# Perform a grid search with cross-validation to find the best hyperparameters
grid_search = GridSearchCV(dtree, param_grid, cv=5)
grid_search.fit(X_train, y_train)

# Print the best hyperparameters
print(grid_search.best_params_)
```

```
{'max_depth': 3, 'min_samples_leaf': 1, 'min_samples_split': 2, 'random_state': 0}
```

In [35]:
```
from sklearn.tree import DecisionTreeClassifier
dtree = DecisionTreeClassifier(random_state=0, max_depth=3, min_samples_leaf=1, min_samples_split
dtree.fit(X_train, y_train)
```

Out[35]:
```
DecisionTreeClassifier(class_weight='balanced', max_depth=3, random_state=0)
```

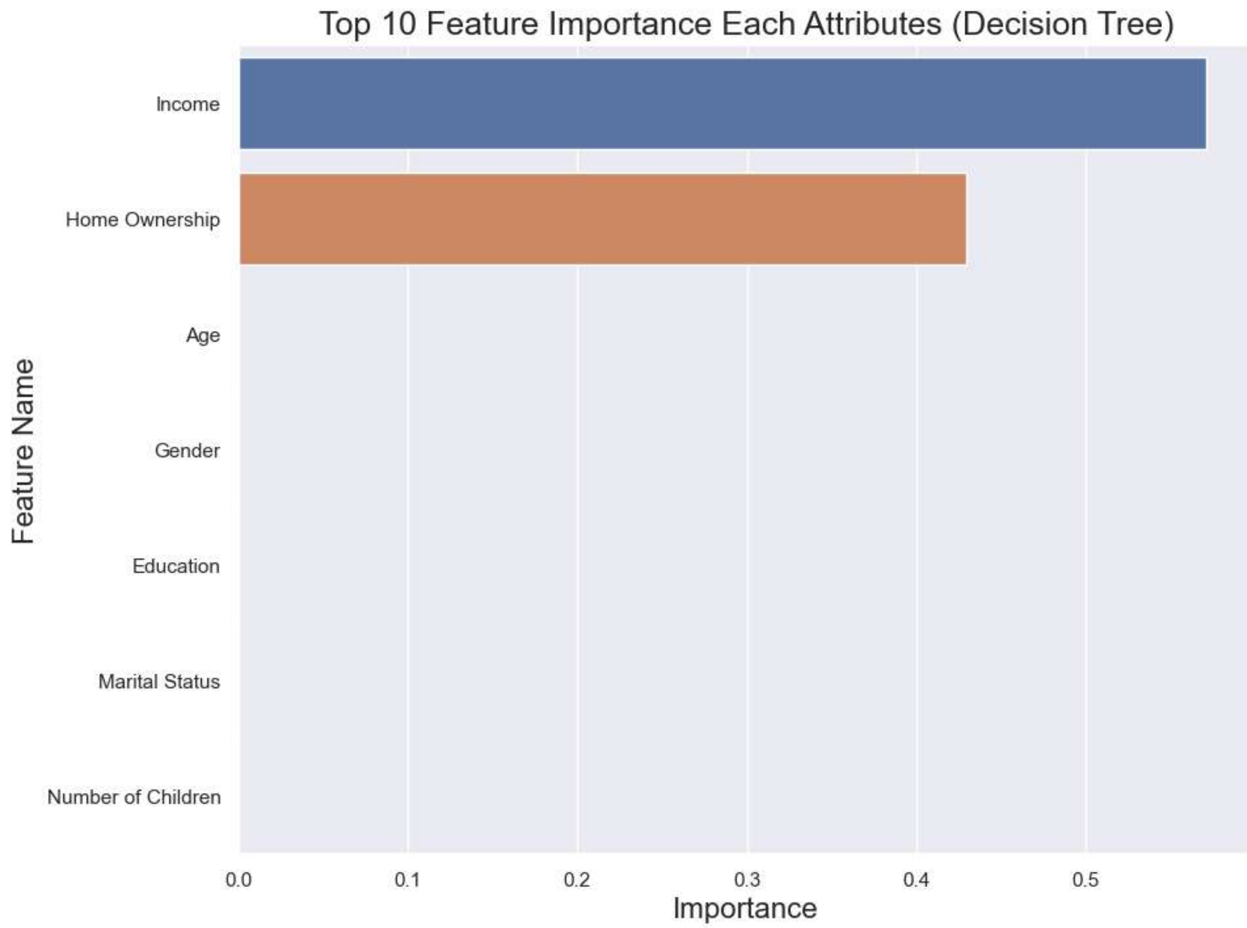
In [36]:
```
from sklearn.metrics import accuracy_score
y_pred = dtree.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

```
Accuracy Score : 96.0 %
```

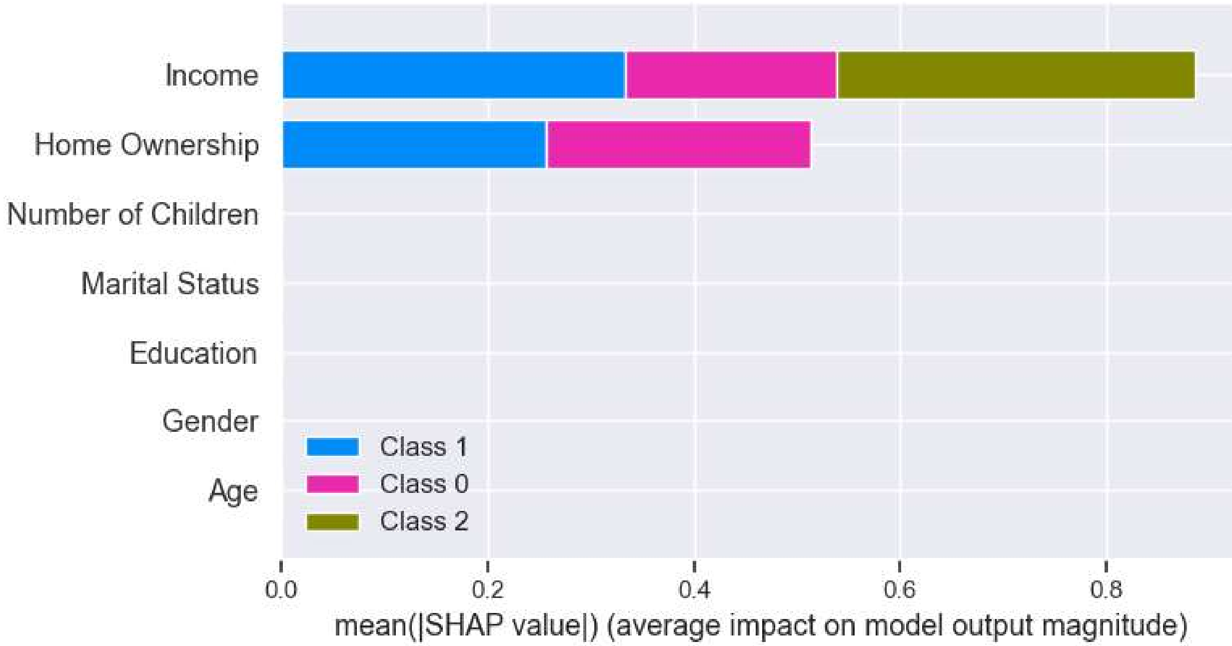
In [37]:
```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score, jaccard_scor
print('F-1 Score : ',(f1_score(y_test, y_pred, average='micro')))
print('Precision Score : ',(precision_score(y_test, y_pred, average='micro')))
print('Recall Score : ',(recall_score(y_test, y_pred, average='micro')))
print('Jaccard Score : ',(jaccard_score(y_test, y_pred, average='micro')))
```

```
F-1 Score :  0.96
Precision Score :  0.96
Recall Score :  0.96
Jaccard Score :  0.9230769230769231
```

In [38]:
```
imp_df = pd.DataFrame({
    "Feature Name": X_train.columns,
    "Importance": dtree.feature_importances_
})
fi = imp_df.sort_values(by="Importance", ascending=False)

fi2 = fi.head(10)
plt.figure(figsize=(10,8))
sns.barplot(data=fi2, x='Importance', y='Feature Name')
plt.title('Top 10 Feature Importance Each Attributes (Decision Tree)', fontsize=18)
plt.xlabel ('Importance', fontsize=16)
plt.ylabel ('Feature Name', fontsize=16)
plt.show()
```

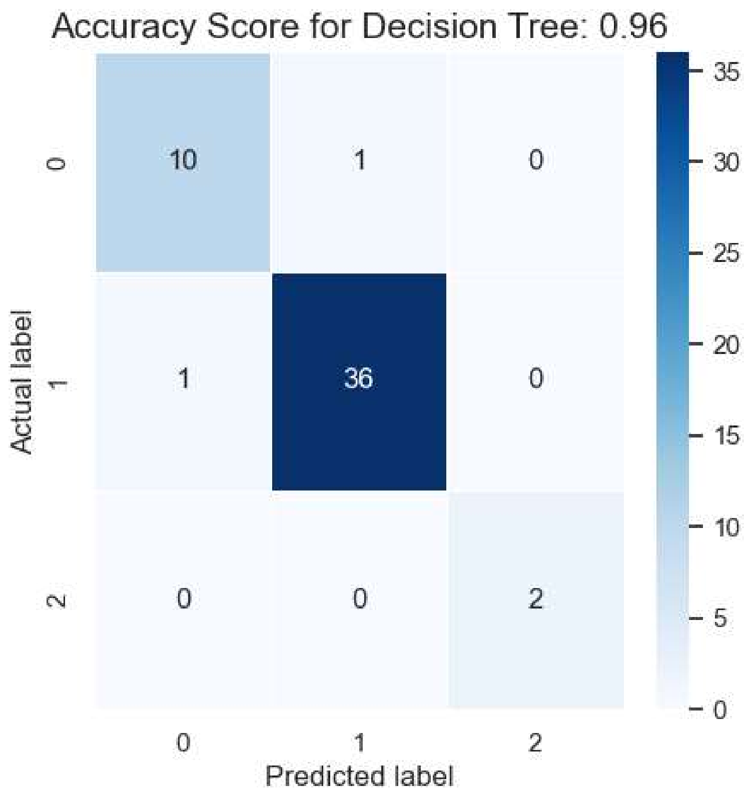


In [39]:
```
import shap
explainer = shap.TreeExplainer(dtree)
shap_values = explainer.shap_values(X_test)
shap.summary_plot(shap_values, X_test)
```



In [40]:
```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
all_sample_title = 'Accuracy Score for Decision Tree: {0}'.format(dtree.score(X_test, y_test))
plt.title(all_sample_title, size = 15)
```

Out[40]:
```
Text(0.5, 1.0, 'Accuracy Score for Decision Tree: 0.96')
```



Random Forest

In [41]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
rfc = RandomForestClassifier(class_weight='balanced')
param_grid = {
    'n_estimators': [100, 200],
    'max_depth': [None, 5, 10],
    'max_features': ['sqrt', 'log2', None],
    'random_state': [0, 42]
}

# Perform a grid search with cross-validation to find the best hyperparameters
grid_search = GridSearchCV(rfc, param_grid, cv=5)
grid_search.fit(X_train, y_train)

# Print the best hyperparameters
print(grid_search.best_params_)
```

```
{'max_depth': None, 'max_features': None, 'n_estimators': 100, 'random_state': 0}
```

In [42]:
```
from sklearn.ensemble import RandomForestClassifier
rfc = RandomForestClassifier(random_state=0, n_estimators=100, class_weight='balanced')
rfc.fit(X_train, y_train)
```

Out[42]:
```
RandomForestClassifier(class_weight='balanced', random_state=0)
```

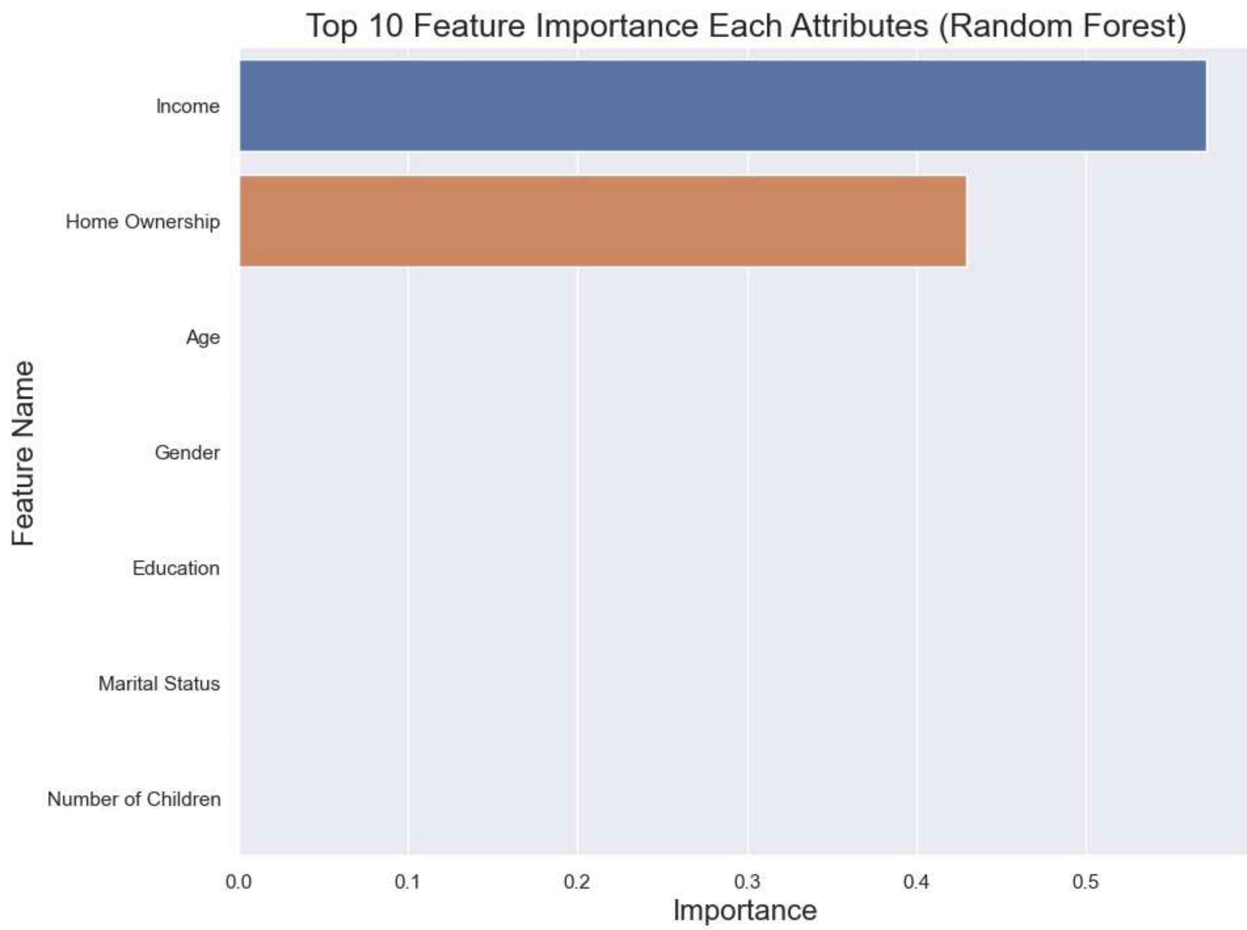
In [43]:
```
y_pred = rfc.predict(X_test)
print("Accuracy Score :", round(accuracy_score(y_test, y_pred)*100 ,2), "%")
```

```
Accuracy Score : 96.0 %
```

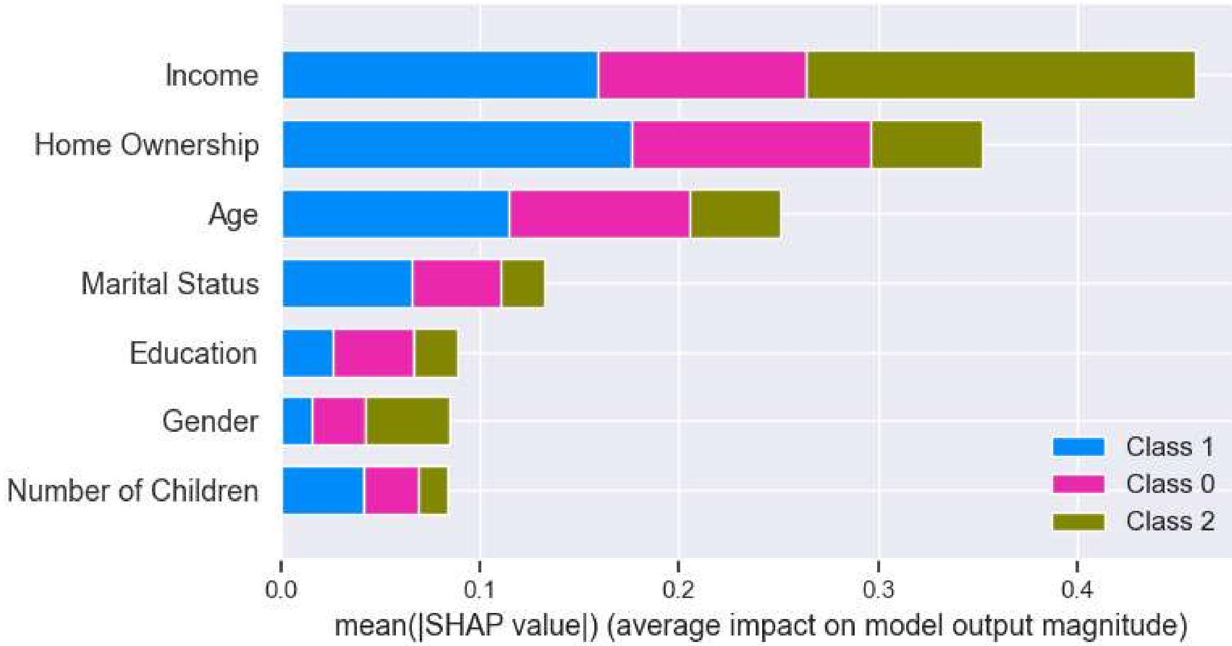
In [44]:
```
from sklearn.metrics import accuracy_score, f1_score, precision_score, recall_score, jaccard_scor
print('F-1 Score : ',(f1_score(y_test, y_pred, average='micro')))
print('Precision Score : ',(precision_score(y_test, y_pred, average='micro')))
print('Recall Score : ',(recall_score(y_test, y_pred, average='micro')))
print('Jaccard Score : ',(jaccard_score(y_test, y_pred, average='micro')))
```

```
F-1 Score :  0.96
Precision Score :  0.96
Recall Score :  0.96
Jaccard Score :  0.9230769230769231
```

In [45]:
```
imp_df = pd.DataFrame({
    "Feature Name": X_train.columns,
    "Importance": dtree.feature_importances_
})
fi = imp_df.sort_values(by="Importance", ascending=False)

fi2 = fi.head(10)
plt.figure(figsize=(10,8))
sns.barplot(data=fi2, x='Importance', y='Feature Name')
plt.title('Top 10 Feature Importance Each Attributes (Random Forest)', fontsize=18)
plt.xlabel ('Importance', fontsize=16)
plt.ylabel ('Feature Name', fontsize=16)
plt.show()
```



In [46]:
```
import shap
explainer = shap.TreeExplainer(rfc)
shap_values = explainer.shap_values(X_test)
shap.summary_plot(shap_values, X_test)
```



In [47]:
```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5,5))
sns.heatmap(data=cm,linewidths=.5, annot=True,  cmap = 'Blues')
plt.ylabel('Actual label')
plt.xlabel('Predicted label')
all_sample_title = 'Accuracy Score for Random Forest: {0}'.format(rfc.score(X_test, y_test))
plt.title(all_sample_title, size = 15)
```

Out[47]:
```
Text(0.5, 1.0, 'Accuracy Score for Random Forest: 0.96')
```