Spaceship Titanic

Use passenger data to predict who gets transported to an alternate dimension

https://www.kaggle.com/competitions/spaceship-titanic

```
%cd ~/code/kaggle/spaceship-titanic
```

```
/home/sammy/projects/data-science-sandbox/spaceship-titanic
```

```
# Import libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns; sns.set()
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.model_selection import train_test_split
```

Load and explore data

```
# Load the train and test data
data_path = 'data/'
train_data = pd.read_csv(data_path + 'train.csv')
test_data = pd.read_csv(data_path + 'test.csv')
```

```
train_data.head()
```

```
  PassengerId HomePlanet CryoSleep  Cabin  Destination   Age    VIP  \
0     0001_01     Europa     False  B/0/P  TRAPPIST-1e  39.0  False
1     0002_01      Earth     False  F/0/S  TRAPPIST-1e  24.0  False
2     0003_01     Europa     False  A/0/S  TRAPPIST-1e  58.0   True
3     0003_02     Europa     False  A/0/S  TRAPPIST-1e  33.0  False
4     0004_01      Earth     False  F/1/S  TRAPPIST-1e  16.0  False

   RoomService  FoodCourt  ShoppingMall     Spa  VRDeck               Name  \
0          0.0        0.0           0.0     0.0     0.0    Maham Ofracculy
1        109.0        9.0          25.0   549.0    44.0       Juanna Vines
2         43.0     3576.0           0.0  6715.0    49.0      Altark Susent
3          0.0     1283.0         371.0  3329.0   193.0       Solam Susent
4        303.0       70.0         151.0   565.0     2.0  Willy Santantines

   Transported
0        False
1         True
2        False
```

```
3        False
4         True
```

```
# Remove passengers with unknown outcome
X = train_data.dropna(axis=0, subset=['Transported'])
y = X.Transported
```

```
# Investigate data types and missing data
print('X dims: \t{}'.format(X.shape))
print('y dim:  \t {}'.format(y.size))
print('True rate: \t{}%'.format(round(100*y.sum()/y.size, 2)))
```

```
X dims:  (8693, 14)
y dim:    8693
True rate:  50.36%
```

```
def col_info(df, cat_features=None):
    """
    From input dataframe df,
    returns dataframe with
        rows:  features
        cols:  data type, unique count, and NaN count.
    """
    col_list = [('type', df.dtypes),
                ('unique_count', df.nunique()),
                ('NaN_count', df.isna().sum())]
    return pd.DataFrame(dict(col_list))

col_info(X)
```

	type	unique_count	NaN_count
PassengerId	object	8693	0
HomePlanet	object	3	201
CryoSleep	object	2	217
Cabin	object	6560	199
Destination	object	3	182
Age	float64	80	179
VIP	object	2	203
RoomService	float64	1273	181
FoodCourt	float64	1507	183
ShoppingMall	float64	1115	208
Spa	float64	1327	183
VRDeck	float64	1306	188
Name	object	8473	200
Transported	bool	2	0

Preprocess data

```
# Replace missing numerical values with median
numerical_cols = X.select_dtypes(include=['float64']).columns
for col in numerical_cols:
    med = X[col].median()
    X[col].fillna(med, inplace=True)

# Split feature 'Cabin' -> ['CabinDeck', 'CabinNum', 'CabinSide']
X[['CabinDeck', 'CabinNum', 'CabinSide']] = X['Cabin'].str.split('/', expand=True)
X.drop('Cabin', axis=1, inplace=True)

# Convert ordinal feature values into integer values
int_cols = ['CabinDeck', 'CabinSide']
for col in int_cols:
    X[col], _ = pd.factorize(X[col], sort=True, na_sentinel=None)

# Split categorical features into indicator features
cat_cols = ['HomePlanet', 'Destination']
X = pd.get_dummies(X, prefix=['Home', 'Dest'], columns=cat_cols)

# Convert booleans
bool_cols = ['CryoSleep', 'VIP']
for col in bool_cols:
    X[col] = X[col].astype(bool)

# Select features and drop samples with missing values
features = ['CryoSleep', 'VIP',
       'Age', 'RoomService', 'FoodCourt', 'ShoppingMall', 'Spa',
       'VRDeck', 'CabinDeck', 'CabinSide',
       'Home_Earth', 'Home_Europa', 'Home_Mars',
       'Dest_55 Cancri e', 'Dest_PSO J318.5-22', 'Dest_TRAPPIST-1e']
X = X[features + ['Transported']]
X.dropna(axis=0, inplace=True)
y = X['Transported']
X.drop(['Transported'], axis=1, inplace=True);
```

```
col_info(X)
```

	type	unique_count	NaN_count
CryoSleep	bool	2	0
VIP	bool	2	0
Age	float64	80	0
RoomService	float64	1273	0
FoodCourt	float64	1507	0
ShoppingMall	float64	1115	0
Spa	float64	1327	0
VRDeck	float64	1306	0
CabinDeck	int64	9	0

```
CabinSide             int64            3          0
Home_Earth            uint8            2          0
Home_Europa           uint8            2          0
Home_Mars             uint8            2          0
Dest_55 Cancri e      uint8            2          0
Dest_PSO J318.5-22    uint8            2          0
Dest_TRAPPIST-1e      uint8            2          0
```

Train and validate model

```
# Split into validation and training data
train_X, val_X, train_y, val_y = train_test_split(X, y, random_state=0)

# Find best parameters
from sklearn.model_selection import GridSearchCV
# from sklearn.metrics import f1_score

param_grid = {'max_depth': range(8, 12),
              'n_estimators': range(40, 60, 5)}

grid = GridSearchCV(RandomForestClassifier(), param_grid,
                    scoring='f1', cv=3, verbose=1)
grid.fit(train_X, train_y);

best_params = grid.best_params_
print(best_params)
```

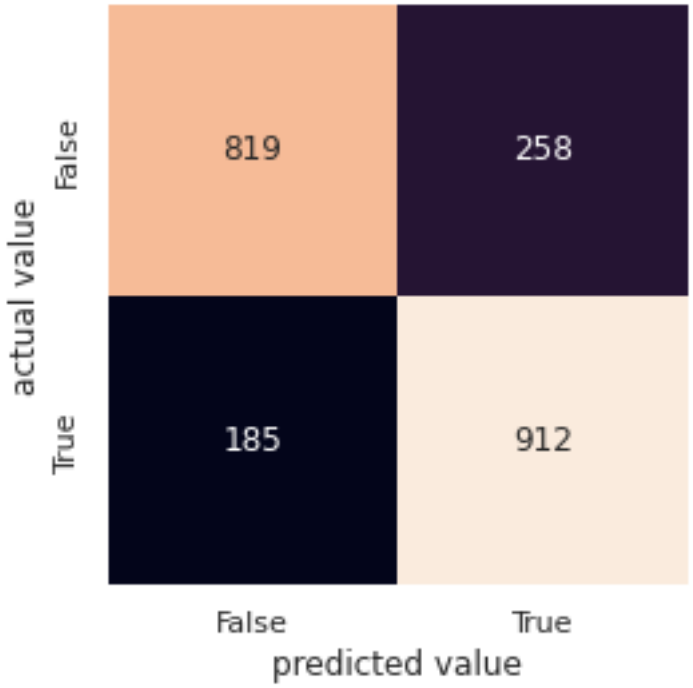
```
Fitting 3 folds for each of 16 candidates, totalling 48 fits
{'max_depth': 9, 'n_estimators': 40}
```

```
# Define a random forest classifier model and train
rf_model = RandomForestClassifier(**best_params)
rf_model.fit(train_X, train_y)

# Use model to predict boolean 'Transported'
rf_val_predictions = rf_model.predict(val_X)

# Confusion matrix
conf_mat = confusion_matrix(val_y, rf_val_predictions)

sns.heatmap(conf_mat, square=True, annot=True, fmt='d', cbar=False,
            xticklabels=['False', 'True'], yticklabels=['False', 'True'])
plt.xlabel('predicted value')
plt.ylabel('actual value');
```




```
# Classification report
print(classification_report(val_y, rf_val_predictions))
```

```
              precision    recall  f1-score   support

       False       0.82      0.76      0.79      1077
        True       0.78      0.83      0.80      1097

    accuracy                           0.80      2174
   macro avg       0.80      0.80      0.80      2174
weighted avg       0.80      0.80      0.80      2174
```

Retrain model on entire dataset

```
# Create a new Random Forest Classifier model and fit model on all data
rf_model_full = RandomForestClassifier(**best_params)
rf_model_full.fit(X, y);

# Load test data
test_data_path = 'data/'
test_X = pd.read_csv(data_path + 'test.csv')
```

```
# Replace missing numerical values with median
numerical_cols = test_X.select_dtypes(include=['float64']).columns
for col in numerical_cols:
    med = test_X[col].median()
    test_X[col].fillna(med, inplace=True)

test_X[['CabinDeck', 'CabinNum', 'CabinSide']] = test_X['Cabin'].str.split('/', expand=True)
test_X.drop('Cabin', axis=1, inplace=True)

int_cols = ['CabinDeck', 'CabinSide']
for col in int_cols:
    test_X[col], _ = pd.factorize(test_X[col], sort=True, na_sentinel=None)

cat_cols = ['HomePlanet', 'Destination']
test_X = pd.get_dummies(test_X, prefix=['Home', 'Dest'], columns=cat_cols)

bool_cols = ['CryoSleep', 'VIP']
for col in bool_cols:
    test_X[col] = test_X[col].astype(bool)

IDs = test_X['PassengerId']
features = ['CryoSleep', 'VIP',
       'Age', 'RoomService', 'FoodCourt', 'ShoppingMall', 'Spa',
       'VRDeck', 'CabinDeck', 'CabinSide',
       'Home_Earth', 'Home_Europa', 'Home_Mars',
       'Dest_55 Cancri e', 'Dest_PSO J318.5-22', 'Dest_TRAPPIST-1e']
test_X = test_X[features]

# Verify no missing data
print(test_X.notna().all().all())
```

```
True
```

Predict and export submission

```
# Predict boolean 'Transported'
test_pred = rf_model_full.predict(test_X)

# Save predictions as CSV
output = pd.DataFrame({'PassengerId': IDs,
                       'Transported': test_pred})
output.to_csv(test_data_path + 'submission.csv', index=False)
```