In [ ]:

```
!pip install OpenBlender yfinance
```

In [2]:

```
# Import libraries
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import accuracy_score
from sklearn.metrics import roc_auc_score
from sklearn import metrics
import pandas as pd
import OpenBlender
import json

import timeit
start_time = timeit.default_timer()
import yfinance as yf #https://github.com/ranaroussi/yfinancen
%matplotlib inline

from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import roc_auc_score
from sklearn.metrics import accuracy_score
from sklearn import metrics
from sklearn import model_selection
from sklearn import linear_model
from sklearn import svm
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import AdaBoostRegressor

import timeit
#start_time = timeit.default_timer()
```

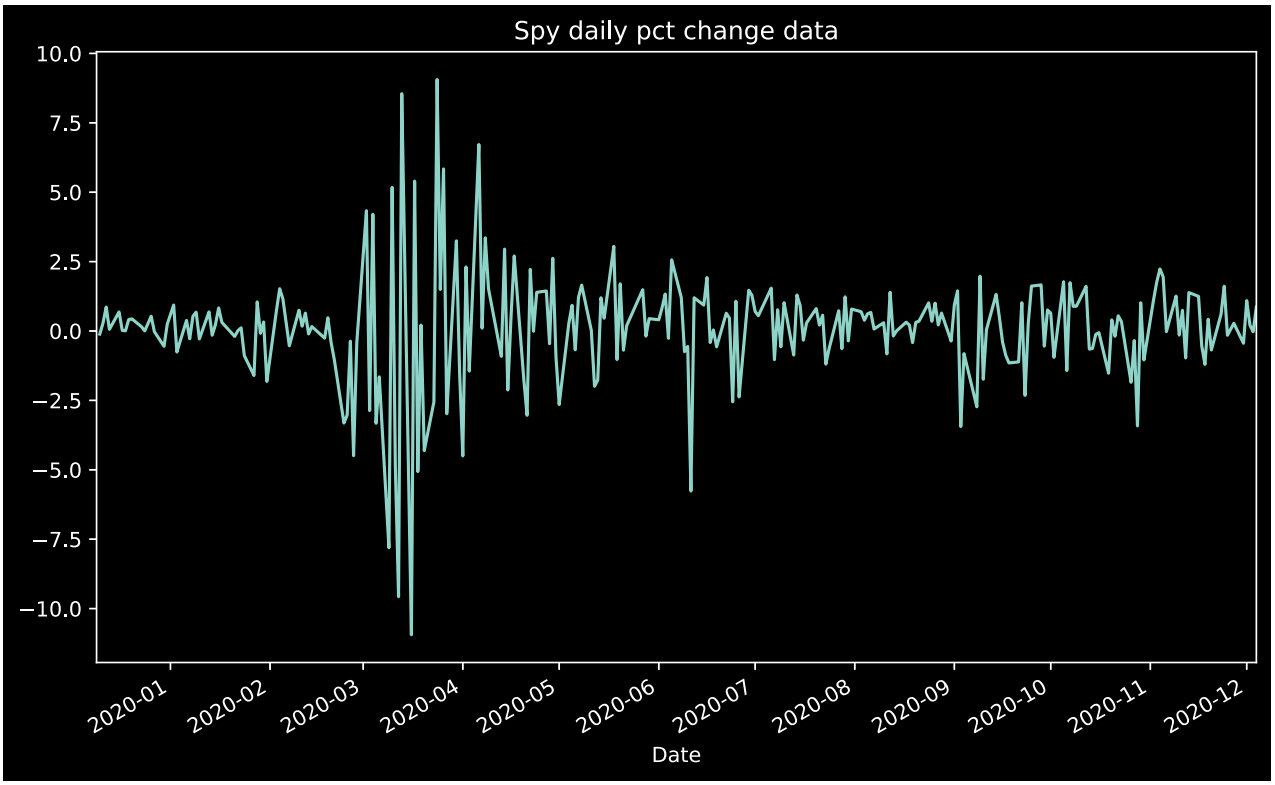
In [139…

```
plt.figure(figsize=(10,6))
price['Close'].plot()
plt.xlabel("Date")
plt.ylabel("")
plt.title("Price data")
plt.style.use('dark_background')
plt.show()
```

In [72]:

```
plt.figure(figsize=(10,6))
price['change_pct'].plot()
plt.xlabel("Date")
plt.ylabel("")
```

```
plt.title("Spy daily pct change data")
plt.style.use('dark_background')
plt.show()
```



In [ ]:

```
spy_price['change_pct'] = spy_price.Close.pct_change()*100.0
```

In [68]:

```
spy_price['change_pct'] = spy_price.Close.pct_change()*100.0
```

In [130…

```
#price.to_csv('spy_price.csv',index=False)
```

Using Open Blender

pre-covid period
'date_filter':{"start_date":"2019-04-08T00:00:00.000Z",
"end_date":"2019-12-09T0:00:00.000Z"},

In [4]:

```
# pre-period 4/8/19~12/9/19
# Specify the action
action = 'API_getObservationsFromDataset'
# Specify your Token
token = '5fcf78e29516296fad52cb45GfJgCsWWcabzq9TZsfnRU0TqBPK3wG'
```

```
interval = 60 * 60 * 24 # One day
parameters = {
 'token' : token,
    ##'id_dataset':'5d4ca8709516290b01c9d725', #microsoft
    'id_dataset':'5d4c39d09516290b01c8307b', #apple
    'date_filter':{"start_date":"2019-04-08T00:00:00.000Z",
                   "end_date":"2019-12-09T0:00:00.000Z"},
    'aggregate_in_time_interval' : {
              'time_interval_size' : interval,
              'output' : 'avg',
              'empty_intervals' : 'impute'
      }
}

# Pull the data into a Pandas Dataframe
df = pd.read_json(json.dumps(OpenBlender.call(action, parameters)['sample']), convert_d
df.reset_index(drop=True, inplace=True)
df['date'] = [OpenBlender.unixToDate(ts, timezone = 'GMT') for ts in df.timestamp]
#df = df.drop('timestamp', axis = 1)
#df['date'] = [OpenBlender.unixToDate(ts, timezone = 'GMT') for ts in df.timestamp]
#df = df.drop('timestamp', axis = 1)
```

```
Task ID: '5fcf79070895fafb4a9d8d4b'.
Total estimated consumption: 5867.89 processing units.
Task confirmed. Starting download..
100.0 % completed.
```

In [5]:

```
positive_filter = {'name' : 'apple',
                   'match_ngrams': ['apple', 'iphone', 'ipad',
                                    'tim cook', 'mac store','mac','silicon']}

# We need to pass the 'id_dataset', the name of the
# column (which is 'text') and an optional filter.
blend_source = {
                'id_dataset':'5e2ef74e9516294390e810a9',#Wall Street Journal Twitter
                'feature' : 'text',
                'filter_text' : positive_filter
            }
df_blend = OpenBlender.timeBlend( token = token,
                                  anchor_ts = df.timestamp,
                                  blend_source = blend_source,
```

```
                                    blend_type = 'agg_in_intervals',
                                    interval_size = 60 * 60 * 24,
                                    direction = 'time_prior',
                                    interval_output = 'list')
df_anchor = pd.concat([df, df_blend.loc[:, df_blend.columns != 'timestamp']], axis = 1)
df_anchor.head()
```

```
Task ID: '5fcf79100895fafb4a9d8d4c'.
Total estimated consumption: 9800.0 processing units.
Task confirmed. Starting download..
100%
```

Out[5]:

	change	count_agg	high	low	open	price	timestamp	date	WALL_STREE.t
0	1.776667	0	269.296667	265.903333	266.173333	269.00	1575763200	08-12-2019 00:00:00	
1	1.930000	1	271.000000	267.480000	267.480000	270.71	1575676800	07-12-2019 00:00:00	
2	1.340000	1	267.950000	265.370000	265.710000	267.84	1574899200	28-11-2019 00:00:00	
3	1.690000	1	209.360000	206.720000	208.490000	209.01	1567123200	30-08-2019 00:00:00	
4	0.670000	1	205.700000	203.320000	204.330000	205.53	1567036800	29-08-2019 00:00:00	

Creating a text vectorizer

In [6]:

```
action = 'API_createTextVectorizerPlus'
parameters = {
    'token' : token,
    'name' : 'v2 Wall Street and USA Today Vectorizer',
    'sources':[
              {'id_dataset':"5e2ef74e9516294390e810a9",
               'features' : ["text"]},
              {'id_dataset' : "5e32fd289516291e346c1726",
               'features' : ["text"]}
    ],
    'ngram_range' : {'min' : 1, 'max' : 2},
    'language' : 'en',
    'remove_stop_words' : 'on',
    'min_count_limit' : 2
}
response = OpenBlender.call(action, parameters)
response
```

Out[6]:

```
{'status': 'success',
 'num_ngrams': 4999,
 'response': 'Text Vectorizer created successfully.',
 'id_textVectorizer': '5fcf36029516296fad52c8f2'}
```

In [6]:

```
start_time = timeit.default_timer()
blend_source = {
                'id_textVectorizer':'5fcf36029516296fad52c8f2'
               }

df_blend = OpenBlender.timeBlend( token = token,
                                  anchor_ts = df_anchor.timestamp,
                                  blend_source = blend_source,
```

```
                                    blend_type = 'agg_in_intervals',
                                    interval_size = 60 * 60 * 24,
                                    direction = 'time_prior_strict') .add_prefix('VEC.')
df_anchor = pd.concat([df_anchor, df_blend.loc[:, df_blend.columns != 'timestamp']], ax
print(timeit.default_timer() - start_time)
df_anchor.head()
```

```
Task ID: '5fcf791d0895fafb4a9d8d4c'.
Total estimated consumption: 145603.2 processing units.
Task confirmed. Starting download..
100%
117.5857619999988
```

Out[6]:

	change	count_agg	high	low	open	price	timestamp	date	WALL_STREE.t
0	1.776667	0	269.296667	265.903333	266.173333	269.00	1575763200	08-12-2019 00:00:00	
1	1.930000	1	271.000000	267.480000	267.480000	270.71	1575676800	07-12-2019 00:00:00	
2	1.340000	1	267.950000	265.370000	265.710000	267.84	1574899200	28-11-2019 00:00:00	
3	1.690000	1	209.360000	206.720000	208.490000	209.01	1567123200	30-08-2019 00:00:00	
4	0.670000	1	205.700000	203.320000	204.330000	205.53	1567036800	29-08-2019 00:00:00	

5 rows × 4898 columns

In [7]:

```
df_anchor.shape
```

Out[7]:

```
(245, 4898)
```

In [8]:

```
# Where ‘change’ decreased more than 0.5%
df_anchor['negative_poc'] = [1 if log_diff < -0.005 else 0 for log_diff in df_anchor['c
# Where ‘change’ increased more than 0.5%
df_anchor['positive_poc'] = [1 if log_diff > 0.005 else 0 for log_diff in df_anchor['ch
# We need to shift our target one day so that we predict
# for what will happen 'tomorrow' with news and data from 'today'
df_anchor['target'] = df_anchor['positive_poc'].shift(-1)
df_anchor[['change', 'positive_poc', 'target']].head(3)
```

Out[8]:

	change	positive_poc	target
0	1.776667	1	1.0
1	1.930000	1	1.0

	change	positive_poc	target
2	1.340000	1	1.0

In [9]:

```
df_anchor = df_anchor[:-1] # Remove the last one with NaN
# Define target
target = 'target'
df_positive = df_anchor[1:].select_dtypes(['number'])
# Create train/test sets
X = df_positive.loc[:, df_positive.columns != target].values
y = df_positive.loc[:,[target]].values
div = int(round(len(X) * 0.7)) #prop for training set
X_train = X[:div]
y_train = y[:div]
X_test = X[div:]
y_test = y[div:]

print('Train:')
print(X_train.shape)
print(y_train.shape)
print('Test:')
print(X_test.shape)
print(y_test.shape)
```

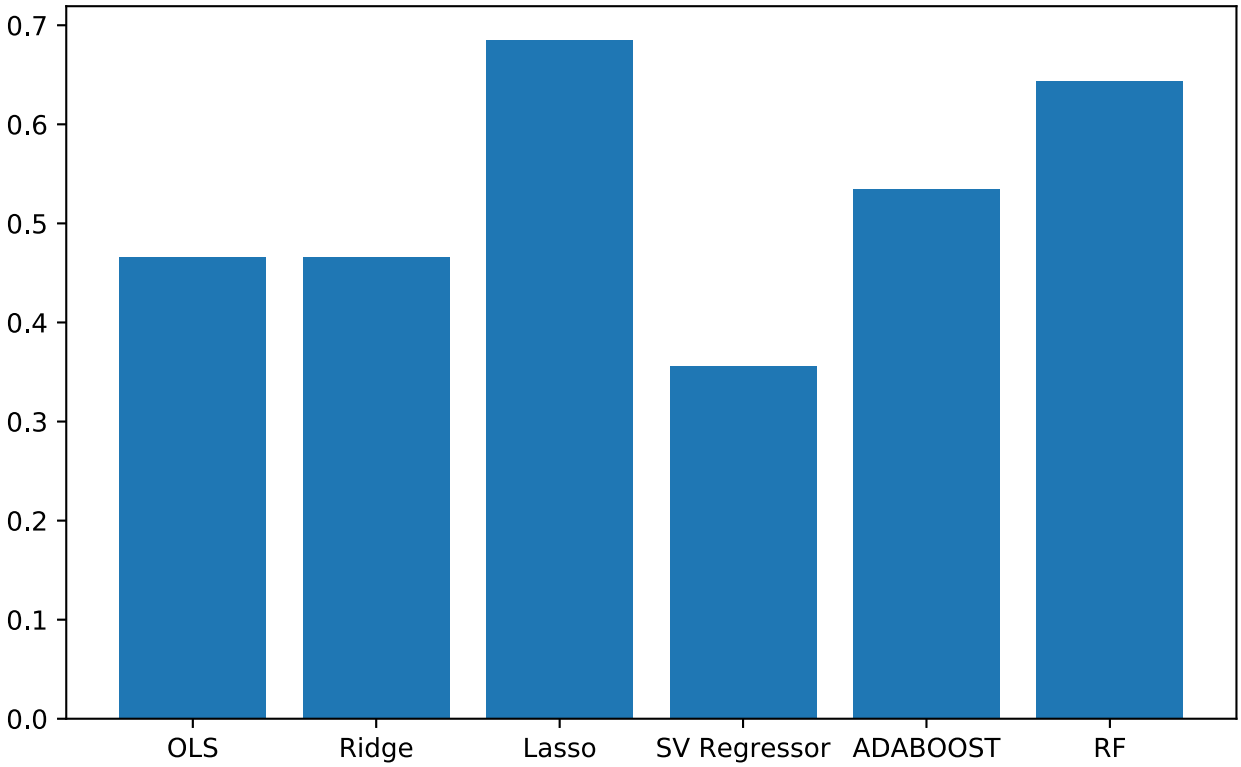
```
Train:
(170, 4897)
(170, 1)
Test:
(73, 4897)
(73, 1)
```

In [10]:

```
# Compare Algorithms
seed = 0
# prepare models
models = []
models.append(('OLS', linear_model.LinearRegression()))
models.append(('Ridge', linear_model.Ridge(alpha=0.1)))
models.append(('Lasso', linear_model.Lasso(alpha=0.1)))
models.append(('SV Regressor', svm.SVR()))
models.append(('ADABOOST', AdaBoostRegressor(DecisionTreeRegressor(max_depth=4), n_esti
models.append(('RF', RandomForestRegressor(n_estimators = 100, random_state = seed)))


# evaluate each model in turn
results = dict()

scoring = 'accuracy'
for name, model in models:
    mod = model
    mod.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    preds = [1 if val > 0.5 else 0 for val in y_pred]
    results[name] = round(accuracy_score(y_test, preds),3)


# print("AUC score:")
# print(roc_auc_score(y_test, y_pred))
```

In [11]:

```
import matplotlib.pyplot as plt
plt.figure(figsize=(8,5))
plt.bar(*zip(*results.items()))
plt.show()
```



In [12]:

```
results = []
for i in range(0, 60, 5):
    time_chunk = i/100
    print("time_chunk:" + str(time_chunk) + " starts")
    df_ml = df_positive[:int(round(df_positive.shape[0] * (time_chunk + 0.4)))]
    X = df_ml.loc[:, df_ml.columns != target].values
    y = df_ml.loc[:,[target]].values
    div = int(round(len(X) * 0.29))
    X_test = X[:div]
    y_test = y[:div]
    X_train = X[div:]
    y_train = y[div:]
    rf = RandomForestRegressor(n_estimators = 100, random_state = 1) #the best one
    rf.fit(X_train, y_train)
    y_pred = rf.predict(X_test)
    preds = [1 if val > 0.5 else 0 for val in y_pred]
    try:
        roc = roc_auc_score(y_test, y_pred)
    except:
        roc = 0
    conf_mat = metrics.confusion_matrix(y_test, preds)
    accuracy = accuracy_score(y_test, preds)
    results.append({
    "roc" : roc,
    "accuracy" : accuracy,
```

```
    "conf_mat" : conf_mat,
    "time_chunk" : time_chunk
    })
```

```
time_chunk:0.0 starts
time_chunk:0.05 starts
time_chunk:0.1 starts
time_chunk:0.15 starts
time_chunk:0.2 starts
time_chunk:0.25 starts
time_chunk:0.3 starts
time_chunk:0.35 starts
time_chunk:0.4 starts
time_chunk:0.45 starts
time_chunk:0.5 starts
time_chunk:0.55 starts
```

In [13]:

```
results_df = pd.DataFrame(results)
results_df
```

Out[13]:

	accuracy	conf_mat	roc	time_chunk
0	0.571429	[[8, 7], [5, 8]]	0.553846	0.00
1	0.687500	[[13, 6], [4, 9]]	0.589069	0.05
2	0.542857	[[9, 11], [5, 10]]	0.591667	0.10
3	0.641026	[[16, 4], [10, 9]]	0.713158	0.15

	accuracy	conf_mat	roc	time_chunk
4	0.547619	[[10, 12], [7, 13]]	0.579545	0.20
5	0.608696	[[18, 5], [13, 10]]	0.612476	0.25
6	0.551020	[[15, 10], [12, 12]]	0.550000	0.30
7	0.622642	[[19, 7], [13, 14]]	0.644587	0.35
8	0.589286	[[20, 8], [15, 13]]	0.620536	0.40
9	0.550000	[[19, 11], [16, 14]]	0.647778	0.45
10	0.531250	[[24, 8], [22, 10]]	0.527344	0.50
11	0.507463	[[30, 3], [30, 4]]	0.549465	0.55

In [14]:

```
print(results_df.accuracy.mean())
```

```
0.5792321977962018
```

Post Covid period

'date_filter':{"start_date":"2020-04-06T00:00:00.000Z",
"end_date":"2020-12-04T0:00:00.000Z"}

In [15]:

```
# pre-period 4/6/20~12/4/20
# Specify the action
action = 'API_getObservationsFromDataset'
# Specify your Token
token = '5fcf7b349516296fad52cb7502QLyBLsCWOGE3W7rcOb6lv3IdplI7'

interval = 60 * 60 * 24 # One day
parameters = {
 'token' : token,
    ##'id_dataset':'5d4ca8709516290b01c9d725', #microsoft
    'id_dataset':'5d4c39d09516290b01c8307b', #apple
    'date_filter':{"start_date":"2020-04-06T00:00:00.000Z",
                   "end_date":"2020-12-04T0:00:00.000Z"},
    'aggregate_in_time_interval' : {
              'time_interval_size' : interval,
              'output' : 'avg',
              'empty_intervals' : 'impute'
      }
}

# Pull the data into a Pandas Dataframe
df = pd.read_json(json.dumps(OpenBlender.call(action, parameters)['sample']), convert_d
df.reset_index(drop=True, inplace=True)
df['date'] = [OpenBlender.unixToDate(ts, timezone = 'GMT') for ts in df.timestamp]
#df = df.drop('timestamp', axis = 1)
#df['date'] = [OpenBlender.unixToDate(ts, timezone = 'GMT') for ts in df.timestamp]
#df = df.drop('timestamp', axis = 1)
```

```
Task ID: '5fcf7c220895fafb4a9d8d4b'.
Total estimated consumption: 5857.3 processing units.
Task confirmed. Starting download..
100.0 % completed.
```

In [16]:

```
positive_filter = {'name' : 'apple',
                   'match_ngrams': ['apple', 'iphone', 'ipad',
                                    'tim cook', 'mac store','mac','silicon']}
```

```
# We need to pass the 'id_dataset', the name of the
# column (which is 'text') and an optional filter.
blend_source = {
                'id_dataset':'5e2ef74e9516294390e810a9',#Wall Street Journal Twitter
                'feature' : 'text',
                'filter_text' : positive_filter
            }
df_blend = OpenBlender.timeBlend( token = token,
                                  anchor_ts = df.timestamp,
                                  blend_source = blend_source,
                                  blend_type = 'agg_in_intervals',
                                  interval_size = 60 * 60 * 24,
                                  direction = 'time_prior',
                                  interval_output = 'list')
df_anchor = pd.concat([df, df_blend.loc[:, df_blend.columns != 'timestamp']], axis = 1)
df_anchor.head()
```

```
Task ID: '5fcf7c2b0895fafb4a9d8d4c'.
Total estimated consumption: 9680.0 processing units.
Task confirmed. Starting download..
100%
```

Out[16]:

	change	count_agg	high	low	open	price	timestamp	date	WALL_STREE.
0	0.290000	1	123.37	120.920000	122.150000	123.080000	1606953600	03-12-2020 00:00:00	
1	3.080000	1	123.47	120.010000	121.010000	122.720000	1606867200	02-12-2020 00:00:00	
2	-2.346667	0	117.98	114.943333	117.646667	115.013333	1606089600	23-11-2020 00:00:00	
3	1.200000	1	515.14	495.740000	514.790000	503.430000	1598313600	25-08-2020 00:00:00	
4	2.516667	0	509.91	489.560000	502.526667	501.446667	1598227200	24-08-2020 00:00:00	

In [17]:

```
start_time = timeit.default_timer()
blend_source = {
                'id_textVectorizer':'5fcf36029516296fad52c8f2'
               }

df_blend = OpenBlender.timeBlend( token = token,
                                  anchor_ts = df_anchor.timestamp,
                                  blend_source = blend_source,
                                  blend_type = 'agg_in_intervals',
                                  interval_size = 60 * 60 * 24,
                                  direction = 'time_prior_strict') .add_prefix('VEC.')
df_anchor = pd.concat([df_anchor, df_blend.loc[:, df_blend.columns != 'timestamp']], ax
print(timeit.default_timer() - start_time)
df_anchor.head()
```

```
Task ID: '5fcf7c530895fafb4a9d8d4c'.
Total estimated consumption: 149535.54 processing units.
Task confirmed. Starting download..
100%
138.81486909999876
```

Out[17]:

	change	count_agg	high	low	open	price	timestamp	date	WALL_STREE.
0	0.290000	1	123.37	120.920000	122.150000	123.080000	1606953600	03-12-2020 00:00:00	

	change	count_agg	high	low	open	price	timestamp	date	WALL_STREE.
1	3.080000	1	123.47	120.010000	121.010000	122.720000	1606867200	02-12-2020 00:00:00	
2	-2.346667	0	117.98	114.943333	117.646667	115.013333	1606089600	23-11-2020 00:00:00	
3	1.200000	1	515.14	495.740000	514.790000	503.430000	1598313600	25-08-2020 00:00:00	
4	2.516667	0	509.91	489.560000	502.526667	501.446667	1598227200	24-08-2020 00:00:00	

5 rows × 4898 columns

In [18]:
```
df_anchor.shape
```

Out[18]:
```
(242, 4898)
```

In [19]:

```
# Where ‘change’ decreased more than 0.5%
df_anchor['negative_poc'] = [1 if log_diff < -0.005 else 0 for log_diff in df_anchor['c
# Where ‘change’ increased more than 0.5%
df_anchor['positive_poc'] = [1 if log_diff > 0.005 else 0 for log_diff in df_anchor['ch
# We need to shift our target one day so that we predict
# for what will happen 'tomorrow' with news and data from 'today'
df_anchor['target'] = df_anchor['positive_poc'].shift(-1)
df_anchor[['change', 'positive_poc', 'target']].head(3)
```

Out[19]:

	change	positive_poc	target
0	0.290000	1	1.0
1	3.080000	1	0.0
2	-2.346667	0	1.0

In [20]:

```
df_anchor = df_anchor[:-1] # Remove the last one with NaN
# Define target
target = 'target'
df_positive = df_anchor[1:].select_dtypes(['number'])
# Create train/test sets
X = df_positive.loc[:, df_positive.columns != target].values
y = df_positive.loc[:,[target]].values
div = int(round(len(X) * 0.7)) #prop for training set
X_train = X[:div]
y_train = y[:div]
X_test = X[div:]
y_test = y[div:]

print('Train:')
print(X_train.shape)
print(y_train.shape)
print('Test:')
```

```
print(X_test.shape)
print(y_test.shape)
```

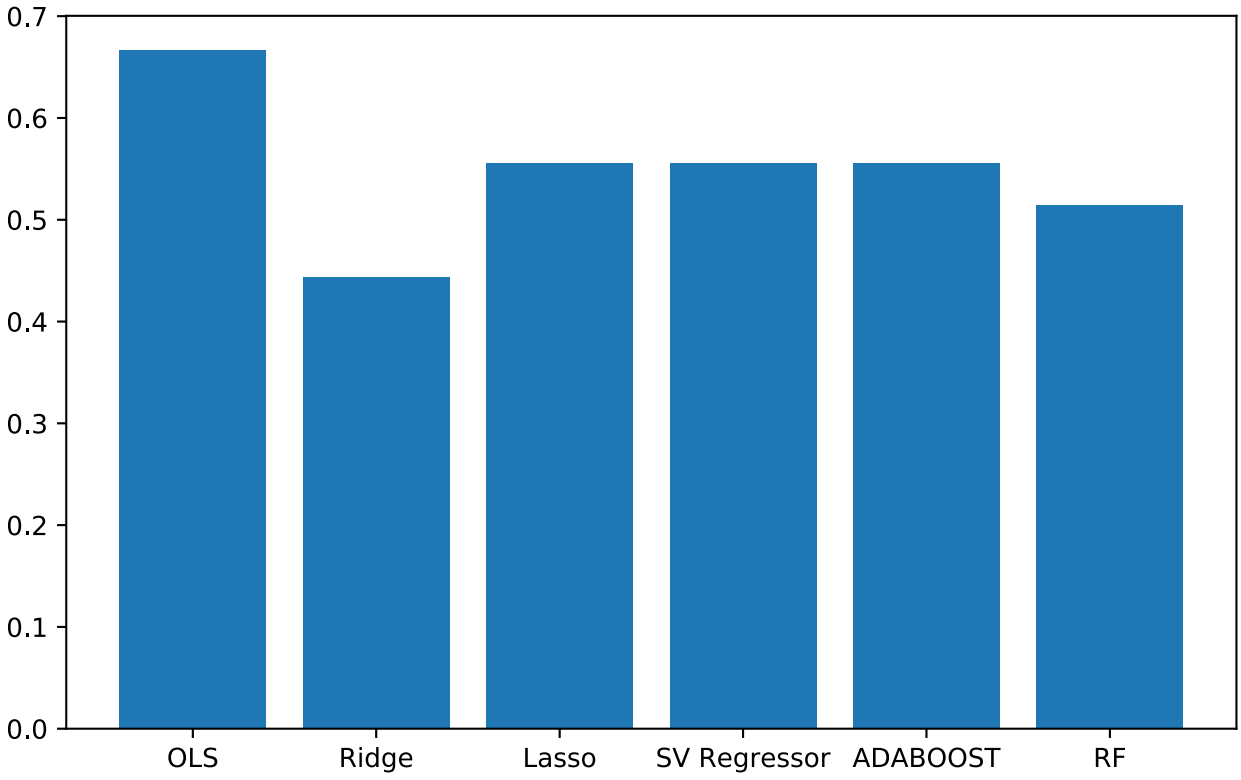
```
Train:
(168, 4897)
(168, 1)
Test:
(72, 4897)
(72, 1)
```

In [23]:

```
# Compare Algorithms
seed = 0
# prepare models
models = []
models.append(('OLS', linear_model.LinearRegression()))
models.append(('Ridge', linear_model.Ridge(alpha=0.1)))
models.append(('Lasso', linear_model.Lasso(alpha=0.1)))
models.append(('SV Regressor', svm.SVR()))
models.append(('ADABOOST', AdaBoostRegressor(DecisionTreeRegressor(max_depth=4), n_esti
models.append(('RF', RandomForestRegressor(n_estimators = 200, random_state = seed)))


# evaluate each model in turn
results = dict()

scoring = 'accuracy'
for name, model in models:
    mod = model
    mod.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    preds = [1 if val > 0.5 else 0 for val in y_pred]
    results[name] = round(accuracy_score(y_test, preds),3)


# print("AUC score:")
# print(roc_auc_score(y_test, y_pred))
```

In [24]:

```
import matplotlib.pyplot as plt
plt.figure(figsize=(8,5))
plt.bar(*zip(*results.items()))
plt.show()
```



In [25]:

```
results = []
for i in range(0, 60, 5):
    time_chunk = i/100
    print("time_chunk:" + str(time_chunk) + " starts")
    df_ml = df_positive[:int(round(df_positive.shape[0] * (time_chunk + 0.4)))]
    X = df_ml.loc[:, df_ml.columns != target].values
    y = df_ml.loc[:,[target]].values
    div = int(round(len(X) * 0.29))
    X_test = X[:div]
    y_test = y[:div]
    X_train = X[div:]
    y_train = y[div:]
    rf = RandomForestRegressor(n_estimators = 100, random_state = 1) #the best one
    rf.fit(X_train, y_train)
    y_pred = rf.predict(X_test)
    preds = [1 if val > 0.5 else 0 for val in y_pred]
    try:
        roc = roc_auc_score(y_test, y_pred)
    except:
        roc = 0
    conf_mat = metrics.confusion_matrix(y_test, preds)
    accuracy = accuracy_score(y_test, preds)
    results.append({
    "roc" : roc,
    "accuracy" : accuracy,
    "conf_mat" : conf_mat,
    "time_chunk" : time_chunk
    })
```

```
time_chunk:0.0 starts
time_chunk:0.05 starts
time_chunk:0.1 starts
time_chunk:0.15 starts
time_chunk:0.2 starts
time_chunk:0.25 starts
time_chunk:0.3 starts
time_chunk:0.35 starts
time_chunk:0.4 starts
time_chunk:0.45 starts
time_chunk:0.5 starts
time_chunk:0.55 starts
```

In [26]:

```
results_df = pd.DataFrame(results)
results_df
```

Out[26]:

	accuracy	conf_mat	roc	time_chunk
0	0.464286	[[7, 1], [14, 6]]	0.606250	0.00
1	0.516129	[[3, 6], [9, 13]]	0.540404	0.05
2	0.514286	[[6, 6], [11, 12]]	0.586957	0.10
3	0.631579	[[8, 6], [8, 16]]	0.629464	0.15
4	0.714286	[[6, 9], [3, 24]]	0.701235	0.20
5	0.555556	[[5, 13], [7, 20]]	0.521605	0.25
6	0.653061	[[4, 16], [1, 28]]	0.531897	0.30
7	0.653846	[[4, 16], [2, 30]]	0.588281	0.35
8	0.571429	[[4, 18], [6, 28]]	0.554813	0.40
9	0.644068	[[6, 16], [5, 32]]	0.622850	0.45
10	0.571429	[[6, 18], [9, 30]]	0.564637	0.50
11	0.621212	[[8, 18], [7, 33]]	0.564904	0.55

In [27]:

```
print(results_df.accuracy.mean())
```

```
0.5925970930878806
```