In [65]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
plt.style.use('ggplot')
```

In [66]:
```python
#Read the training set from file
train = pd.read_csv('Train_1a.csv')
print("Train ", train.shape)
train.head()
```

```
Train  (177, 14)
```

Out[66]:

	Feature1	Feature2	Feature3	Feature4	Feature5	Feature6	Feature7	Feature8	Feature9	Feature10	Feature11	Feature12	Feature1
0	0.96971	-0.21141	0.019567	-0.104990	0.49927	0.21940	-0.376100	-0.77941	-0.62888	0.11155	-0.063305	0.44952	0.926
1	1.12910	1.72620	2.253300	1.971600	1.49180	0.83064	-0.301950	-0.35494	-0.15466	0.26529	-0.472900	-2.28370	-1.446
2	0.58824	0.20883	0.267020	0.792490	0.98504	0.85893	-0.035307	-0.72672	-0.65232	0.28964	-0.671170	-0.78219	-3.295
3	0.85289	0.97132	-0.209330	0.814060	0.67885	0.47691	-0.038935	0.22225	-0.67780	-0.59072	0.491200	1.16010	2.414
4	-1.90190	-1.20480	-1.103000	-0.050817	1.11800	0.61725	1.138100	1.83370	3.39220	4.21100	0.561280	0.50147	-1.337

In [67]:
```python
#Read the testing set that we're going to predict
test = pd.read_csv('Test_1a.csv')
print("Test ", test.shape)
test.head()
```

```
Test  (15, 13)
```

Out[67]:

	Feature1	Feature2	Feature3	Feature4	Feature5	Feature6	Feature7	Feature8	Feature9	Feature10	Feature11	Feature12	Feature1:
0	-1.23150	-1.01690	-0.61475	-0.258790	0.009898	-1.01320	0.24300	0.961700	0.38382	0.038324	0.80103	0.15615	-0.4089
1	-1.25870	-1.23540	-1.63320	-0.685130	-0.496210	0.13314	2.25520	2.192200	0.94823	0.855540	0.29763	1.79430	0.1145
2	-1.41580	-0.69971	-0.63847	-0.791670	0.238280	0.49237	0.37738	0.798280	0.67817	0.429860	0.33379	-3.73650	-3.1994
3	-0.97826	-0.32026	0.20579	0.335350	1.044700	0.53494	0.64235	0.455280	-0.28903	0.422880	0.48706	-1.69930	-0.3484
4	-0.91776	-0.80828	-0.16043	0.051664	0.974000	0.62442	0.94081	0.048564	0.26090	0.083265	0.27589	-2.44840	0.5975

In [68]:
```python
from sklearn.linear_model import Lasso, LassoCV
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
```

In [69]:
```python
#Select outliers by using Elliptic Envelope technique in Python. The index with value -1 is identified
 as an outlier
from sklearn.covariance import EllipticEnvelope
ee = EllipticEnvelope(contamination=0.01)
yhat = ee.fit_predict(train)
yhat
```

Out[69]:
```
array([ 1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1, -1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1, -1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,  1,
        1,  1,  1,  1,  1,  1,  1])
```

In [70]:
```python
#Find the row number that has the detected outliers
res_list = [i for i in range(len(yhat)) if yhat[i] == -1]
res_list
```

Out[70]:
```
[84, 114]
```

In [71]:
```python
#Remove the row in dataset that has the detected outliers
train = train.drop(res_list)
train.shape
```

Out[71]:
```
(175, 14)
```

In [72]:
```python
#Get the information of the dataset and explore its structure
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 175 entries, 0 to 176
Data columns (total 14 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   Feature1   175 non-null    float64
 1   Feature2   175 non-null    float64
 2   Feature3   175 non-null    float64
 3   Feature4   175 non-null    float64
 4   Feature5   175 non-null    float64
 5   Feature6   175 non-null    float64
 6   Feature7   175 non-null    float64
 7   Feature8   175 non-null    float64
 8   Feature9   175 non-null    float64
 9   Feature10  175 non-null    float64
 10  Feature11  175 non-null    float64
 11  Feature12  175 non-null    float64
 12  Feature13  175 non-null    float64
 13  Output     175 non-null    float64
dtypes: float64(14)
memory usage: 20.5 KB
```

In [73]:
```python
#Drop any row that has Null value
train = train.dropna()
train.shape
```

Out[73]:
```
(175, 14)
```

In [74]:
```python
#Create a list of features in dataset
features = list(train.iloc[:, :-1].columns)
features
```

Out[74]:
```
['Feature1',
 'Feature2',
 'Feature3',
 'Feature4',
 'Feature5',
 'Feature6',
 'Feature7',
 'Feature8',
 'Feature9',
 'Feature10',
 'Feature11',
 'Feature12',
 'Feature13']
```

In [75]:
```python
#Standardize the features with the module StandardScaler
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()

train[features] = scaler.fit_transform(train[features])
train.head(5)
```

Out[75]:

	Feature1	Feature2	Feature3	Feature4	Feature5	Feature6	Feature7	Feature8	Feature9	Feature10	Feature11	Feature12	Featu
0	0.864130	-0.321914	-0.036255	-0.079814	0.514480	0.265996	-0.226149	-0.693136	-0.581329	0.155200	-0.060481	0.159019	0.60
1	1.021869	1.567994	1.992826	1.798584	1.442493	0.841206	-0.152706	-0.249418	-0.092840	0.314674	-0.426784	-1.038236	-0.34
2	0.486613	0.087980	0.188527	0.732010	0.968674	0.867828	0.111393	-0.638057	-0.605474	0.339932	-0.604098	-0.380517	-1.09
3	0.748521	0.831698	-0.244181	0.751521	0.682387	0.508327	0.107799	0.353946	-0.631721	-0.573259	0.435416	0.470280	1.20
4	-1.977727	-1.290847	-1.055974	-0.030811	1.092991	0.640394	1.273604	2.038469	3.560737	4.407530	0.498089	0.181775	-0.30

In [76]:
```python
#Prepare sklearn-style objects X (features) and y (target)
X = train.drop(['Output'], axis=1)
y = train['Output']
```

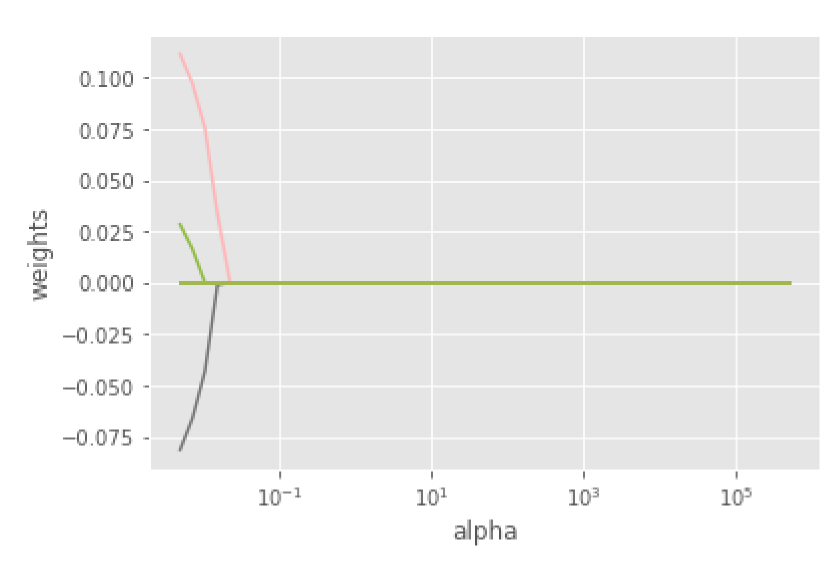
In [77]:
```python
#Use the cross-validation package to split data into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.10, random_state = 10)
```

In [78]:
```python
#Fit a Set of Lasso Models
alphas = 10**np.linspace(6,-2,50)*0.5
lasso = Lasso(max_iter=10000, normalize=True)
coefs = []

for a in alphas:
    lasso.set_params(alpha=a)
    lasso.fit(X, y)
    coefs.append(lasso.coef_)

np.shape(coefs)
```

Out[78]:
```
(50, 13)
```

In [79]:
```python
#Plot Lasso tuning parameter alpha, the relationship between alpha and the weight (regression parameter
s)
ax = plt.gca()
ax.plot(alphas, coefs)
ax.set_xscale('log')
plt.axis('tight')
plt.xlabel('alpha')
plt.ylabel('weights')
```

Out[79]:
```
Text(0, 0.5, 'weights')
```



In [80]:
```python
#Cross Validation Lasso (10-fold cross-validation)
lassocv = LassoCV(alphas=None, cv=10, max_iter=100000, normalize=True)
lassocv.fit(X_train, y_train)
lasso.set_params(alpha=lassocv.alpha_)
print("Alpha=", lassocv.alpha_)
lasso.fit(X_train, y_train)
mse = mean_squared_error(y_test, lasso.predict(X_test))
print("mse = ", mse)
print("rmse = ", np.sqrt(mse))
print("best model coefficients:")
pd.Series(lasso.coef_, index=X.columns)
```

```
Alpha= 0.0006566779176820057
mse =  0.04905193967868 7234
rmse =  0.22147672491412554
best model coefficients:
```

Out[80]:
```
Feature1    -0.056607
Feature2     0.000000
Feature3    -0.013479
Feature4     0.000000
Feature5     0.000000
Feature6     0.071985
Feature7     0.108834
Feature8     0.010618
Feature9    -0.000000
Feature10   -0.024205
Feature11   -0.151454
Feature12    0.020411
Feature13   -0.008024
dtype: float64
```

In [81]:
```python
#Use the model to predict the output for testing dataset
test_predictions = lasso.predict(test)
test_predictions
```

Out[81]:
```
array([-0.2362403 ,  0.17930402, -0.09999174, -0.11221827, -0.05877882,
        0.11350225,  0.0922628 ,  0.06160995, -0.01055881, -0.02966442,
       -0.02341146, -0.00521872, -0.07692268,  0.0039371 ,  0.05186225])
```