Scale Features and Build Model

Scales Raw Features

Import CSV of Aggregated Darshan Logs
Apply Log10 and Percent Scaling

In [1]:
```
import os
import pandas as pd
import numpy as np
import math
import matplotlib.pyplot as plt
```

In [2]:
```
df = pd.read_csv("./raws.csv")
#df.mean()
```

In [3]:
```
df = df.drop(df.columns[0],axis = 1)
df = df.drop(df.columns[0],axis = 1)
f = pd.DataFrame()
```

In [4]:
```
df
```

Out[4]:

x_bytes_read_1K	posix_bytes_read_10K	posix_bytes_read_100K	posix_bytes_read_1IM	posix_bytes_read
0.0	0.0	0.0	0.0	
141853.0	33215.0	261267.0	51049.0	
684893.0	130143.0	919688.0	2515.0	
767.0	508381.0	2040.0	13683.0	626
2926599.0	425127.0	336133.0	98.0	
...	...	...	...	
535152.0	99814.0	889010.0	12485.0	
0.0	180662.0	0.0	0.0	
0.0	0.0	0.0	0.0	
0.0	0.0	0.0	0.0	
1545229.0	305757.0	1897233.0	1068.0	

In [5]:
```
df = df.dropna(axis=0, how='any')
df
```

Out[5]:

	posix_read_time	posix_write_time	posix_meta_time	posix_bytes_read	posix_bytes_read_100
0	0.000000	0.000000	0.000000	0.000000e+00	0.0
1	104.611641	10.024055	20.060841	2.390891e+10	147688.0
2	124.560730	42.051125	54.839272	5.019637e+10	332059.0
3	25763.292969	582.297363	24.895737	5.488943e+12	30785.0
4	154.534821	681.548279	658.484985	2.293203e+10	588029.0
...	...	...	...	...	...
875282	138.354477	82.278084	194.485565	5.593977e+10	216146.0
875283	54.443073	231.440857	25.271391	1.465277e+09	3099.0
875284	0.000000	0.000000	0.000000	0.000000e+00	0.0
875285	0.000000	0.000000	0.000000	0.000000e+00	0.0
875286	227.063828	191.747269	172.671997	1.077412e+11	775359.0

875287 rows × 50 columns

In [6]:
```
#files
f['p_files'] = df['posix_number_of_files']  + 1
```

In [7]:
```
#accesses
df['p_accesses'] = df['posix_reads'] + df['posix_writes']
f['p_accesses'] = df['p_accesses']

f['p_accesses']
```

Out[7]:
```
0              0.0
1         880136.0
2        2379598.0
3        8903411.0
4        7846387.0
             ...
875282   2234152.0
875283    197651.0
875284         0.0
875285         0.0
875286   6065006.0
Name: p_accesses, Length: 875287, dtype: float64
```

In [8]:
```
#bytes
f['log10_p_bytes'] = df['posix_bytes_read']
```

In [9]:
```
f['log10_p_opens'] = df['posix_opens']
f['log10_p_seeks'] = df['posix_seeks']
f['log10_p_stats'] = df['posix_stats']
f['log10_p_mode'] = df['posix_renamed_mode']
```

In [ ]:
```
```

In [10]:
```
f['log10_p_nprocs'] = np.log10(df['nprocs'])
f['log10_p_falign'] = np.log10(df['posix_f_align'])
f['log10_p_malign'] = np.log10(df['posix_m_align'])
```

```
/Users/dave/opt/anaconda3/lib/python3.8/site-packages/pandas/core/arrayli
ke.py:358: RuntimeWarning: divide by zero encountered in log10
  result = getattr(ufunc, method)(*inputs, **kwargs)
```

In [11]:
```
f['p_reads'] = df['posix_reads']
f['p_writes'] = df['posix_writes']
```

In [12]:
```
df['histogram_r_sum'] = df['posix_bytes_read_100'] + df['posix_bytes_read_1
df['posix_bytes_read_4M'] + df['posix_bytes_read_10M'] + df['posix_bytes_re
df['posix_bytes_read_1G'] + df['posix_bytes_read_PLUS']

f['perc_p_bytes_read_100'] = df['posix_bytes_read_100']
f['perc_p_bytes_read_1K'] = df['posix_bytes_read_1K']
f['perc_p_bytes_read_10K'] = df['posix_bytes_read_10K']
f['perc_p_bytes_read_100K'] = df['posix_bytes_read_100K']
f['perc_p_bytes_read_1M'] = df['posix_bytes_read_1lM']
f['perc_p_bytes_read_4M'] = df['posix_bytes_read_4M']
f['perc_p_bytes_read_10M'] = df['posix_bytes_read_10M']
f['perc_p_bytes_read_100M'] = df['posix_bytes_read_100M']
f['perc_p_bytes_read_1G'] = df['posix_bytes_read_1G']
f['perc_p_bytes_read_PLUS'] = df['posix_bytes_read_PLUS']
```

In [13]:
```
df['histogram_w_sum'] = df['posix_bytes_write_100'] + df['posix_bytes_write
df['posix_bytes_write_10K'] + df['posix_bytes_write_100K'] + df['posix_byte
df['posix_bytes_write_4M'] + df['posix_bytes_write_10M'] + df['posix_bytes_
df['posix_bytes_write_1G'] + df['posix_bytes_write_PLUS']

f['perc_p_bytes_write_100'] = df['posix_bytes_write_100']
f['perc_p_bytes_write_1K'] = df['posix_bytes_write_1K']
f['perc_p_bytes_write_10K'] = df['posix_bytes_write_10K']
f['perc_p_bytes_write_100K'] = df['posix_bytes_write_100K']
f['perc_p_bytes_write_1M'] = df['posix_bytes_write_1M']
f['perc_p_bytes_write_4M'] = df['posix_bytes_write_4M']
f['perc_p_bytes_write_10M'] = df['posix_bytes_write_10M']
f['perc_p_bytes_write_100M'] = df['posix_bytes_write_100M']
f['perc_p_bytes_write_1G'] = df['posix_bytes_write_1G']
f['perc_p_bytes_write_PLUS'] = df['posix_bytes_write_PLUS']


f = f.replace(-np.inf, -1)
f = f.replace(np.nan, 0)
```

In [14]:
```
df['time'] = df['posix_write_time'] + df['posix_read_time'] + df['posix_met
df['bytes'] = df['posix_bytes_read'] + df['posix_bytes_write']

t = pd.DataFrame()
f['throughput'] = df['bytes'] / df['time']
```

In [15]:
```
#delete columns with all zeros
f = f.loc[:, (f != 0).any(axis=0)]

#remove infinite values
f = f.replace([np.inf, -np.inf], np.nan).dropna(axis=0)

f.max()
```

Out[15]:
```
p_files                  1.340070e+05
p_accesses               2.251942e+10
log10_p_bytes            3.038456e+14
log10_p_opens            5.531094e+08
log10_p_seeks            1.445220e+10
log10_p_stats            6.522921e+07
log10_p_mode             5.337293e+07
log10_p_nprocs           5.719570e+00
log10_p_falign           1.115306e+01
log10_p_malign           6.035555e+00
p_reads                  2.237846e+10
p_writes                 1.302770e+10
perc_p_bytes_read_100    5.221517e+08
perc_p_bytes_read_1K     2.074657e+10
perc_p_bytes_read_10K    1.536278e+09
perc_p_bytes_read_100K   1.515506e+08
perc_p_bytes_read_1M     4.044503e+08
perc_p_bytes_read_4M     6.561462e+07
perc_p_bytes_read_10M    2.083200e+06
perc_p_bytes_read_100M   2.872090e+05
perc_p_bytes_read_1G     1.792000e+06
perc_p_bytes_write_100   1.302770e+10
perc_p_bytes_write_1K    2.852127e+09
perc_p_bytes_write_10K   3.867477e+08
perc_p_bytes_write_100K  8.347452e+07
perc_p_bytes_write_1M    1.357245e+07
perc_p_bytes_write_4M    3.839488e+06
perc_p_bytes_write_10M   6.190660e+05
perc_p_bytes_write_100M  1.249280e+06
perc_p_bytes_write_1G    1.937500e+04
throughput               2.344536e+09
dtype: float64
```

In [16]:
```
t['throughput'] = f['throughput']
f = f.drop(labels = 'throughput', axis = 1)
f
```

Out[16]:

	p_files	p_accesses	log10_p_bytes	log10_p_opens	log10_p_seeks	log10_p_stats	log10_p_r
1	800.0	880136.0	2.390891e+10	8858.0	319241.0	34901.0	37
2	361.0	2379598.0	5.019637e+10	62398.0	1107764.0	270222.0	27
3	291.0	8903411.0	5.488943e+12	8711.0	2010273.0	28432.0	115
4	320.0	7846387.0	2.293203e+10	23158.0	6015926.0	400399.0	31
5	145.0	0.0	0.000000e+00	0.0	0.0	176.0	
...	...	...	...	...	...	...	
875280	2.0	57344.0	3.006477e+10	1808.0	59128.0	12.0	
875281	14.0	102439.0	7.467916e+08	193.0	91.0	385.0	4
875282	625.0	2234152.0	5.593977e+10	35112.0	1035457.0	159180.0	16
875283	1089.0	197651.0	1.465277e+09	2112.0	12509.0	4198.0	473
875286	583.0	6065006.0	1.077412e+11	119432.0	2750807.0	578508.0	17

708907 rows × 30 columns

In [17]:
```
from sklearn.preprocessing import StandardScaler
f = StandardScaler().fit_transform(f)
```

In [18]:
```
t.max()
```

Out[18]:
```
throughput    2.344536e+09
dtype: float64
```

In [19]:
```
print(t.min())
print(t.max())
```

```
throughput    0.0
dtype: float64
throughput    2.344536e+09
dtype: float64
```

In [20]:
```
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
from sklearn.metrics import mean_squared_log_error
from sklearn.metrics import mean_absolute_percentage_error
```

In [21]:
```
import random
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
rseed = 0
t_size = 0.1

for i in range(3):

    rseed = random.randint(1,10000)
    print(rseed)
    train_data, test_data, train_labels, test_labels = train_test_split(f,t

    reg = LinearRegression().fit(train_data, train_labels)

    predicted_labels = reg.predict(test_data)

    print("Mean True Value: \t",int(test_labels.mean() ))
    print("Mean Absolute Error: \t", int(mean_absolute_error(test_labels, p
    print("Mean Squared Error: ", mean_squared_error(test_labels, predicted
    print("Root Mean Squared Error: ", mean_squared_error(test_labels, pred
    print("MAPE :" + str(mean_absolute_percentage_error( test_labels, predi
    print("R2: " + str(r2_score(test_labels,predicted_labels)) + "\n")
```

```
2825
Mean True Value:         80247938
Mean Absolute Error:     51128803
Mean Squared Error:  8049291975754185.0
Root Mean Squared Error:  89717846.47300772
MAPE :9.48740052737349e+21
R2: 0.3157999993460463

3696
Mean True Value:         79774347
Mean Absolute Error:     50994053
Mean Squared Error:  8398636528105234.0
Root Mean Squared Error:  91644075.24824086
MAPE :9.669046250027161e+21
R2: 0.2813313403030343

3650
Mean True Value:         80041315
Mean Absolute Error:     50781597
Mean Squared Error:  7814574077175511.0
Root Mean Squared Error:  88400079.62199758
MAPE :9.067264526818159e+21
R2: 0.32493823392307575
```

In [22]:
```
#EXTREME GRADIENT BOOST
import xgboost as xg
for i in range(3):
    rseed = random.randint(1,10000)
    print(rseed)

    train_data, test_data, train_labels, test_labels = train_test_split(f,t
    xgb_r = xg.XGBRegressor(n_estimators = 1000, seed = 123)
    xgb_r.fit(train_data, train_labels)
    predicted_labels = xgb_r.predict(test_data)

    print("Mean True Value: \t",int(test_labels.mean() ))
    print("Mean Absolute Error: \t", int(mean_absolute_error(test_labels, p
    print("Mean Squared Error: ", mean_squared_error(test_labels, predicted
    print("Root Mean Squared Error: ", mean_squared_error(test_labels, pred
    print("MAPE :" + str(mean_absolute_percentage_error( test_labels, predi
    print("R2: " + str(r2_score(test_labels,predicted_labels)) + "\n")
```

```
4291
Mean True Value:         79671972
Mean Absolute Error:     15775270
Mean Squared Error:  1182917720629453.5
Root Mean Squared Error:  34393570.92000558
MAPE :5.928271388112404e+19
R2: 0.8964572242755775

5005
Mean True Value:         79970693
Mean Absolute Error:     15753294
Mean Squared Error:  1171118466969232.2
Root Mean Squared Error:  34221608.18794512
MAPE :7.529020324371345e+19
R2: 0.9001025528311228

1952
Mean True Value:         80010257
Mean Absolute Error:     15694609
Mean Squared Error:  1167859298304569.8
Root Mean Squared Error:  34173956.43329244
MAPE :7.649769608686325e+19
R2: 0.9004918036900794
```

In [23]:
```
from sklearn.tree import DecisionTreeRegressor

for i in range(3):
    rseed = random.randint(1,10000)
    print(rseed)

    train_data, test_data, train_labels, test_labels = train_test_split(f,t


    reg = DecisionTreeRegressor(max_depth = 4)


    reg.fit(train_data, train_labels)
    predicted_labels = reg.predict(test_data)


    print("Mean True Value: \t",int(test_labels.mean() ))
    print("Mean Absolute Error: \t", int(mean_absolute_error(test_labels, p
    print("Mean Squared Error: ", mean_squared_error(test_labels, predicted
    print("Root Mean Squared Error: ", mean_squared_error(test_labels, pred
    print("MAPE :" + str(mean_absolute_percentage_error( test_labels, predi
    print("R2: " + str(r2_score(test_labels,predicted_labels)) + "\n")
```

```
9163
Mean True Value:         79868453
Mean Absolute Error:     33248390
Mean Squared Error:  3218231073977619.5
Root Mean Squared Error:  56729455.08267834
MAPE :7.696365899110741e+21
R2: 0.721500661764336

3420
Mean True Value:         79722234
Mean Absolute Error:     33700230
Mean Squared Error:  3251758114891718.5
Root Mean Squared Error:  57024188.8578147
MAPE :7.824038340112399e+21
R2: 0.7186109537851515

5522
Mean True Value:         80104539
Mean Absolute Error:     33107125
Mean Squared Error:  3156004880382560.0
Root Mean Squared Error:  56178331.05729076
MAPE :7.758545262697204e+21
R2: 0.7284183849924653
```

In [ ]:

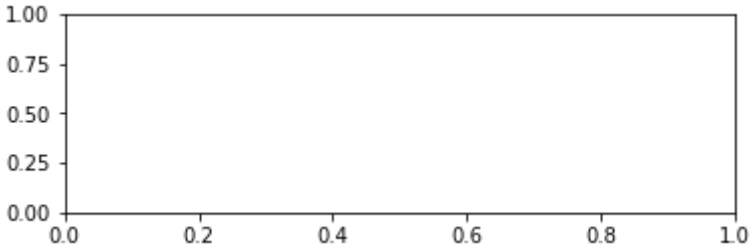
In [ ]:

In [ ]:

In [24]:

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call las
t)
<ipython-input-24-afbf8c2948db> in <module>
      2 plt.figure()
      3 plt.subplot(2,1,1)
----> 4 plt.plot(x, y, 'bo-')
      5 plt.title('Using 1D Cubic Spline Interpolation')
      6

NameError: name 'x' is not defined
```



In [ ]:

In [ ]:

```
t_size = 0.2
rseed = 1
train_data, test_data, train_labels, test_labels = train_test_split(f,t, te

new_length = 500

new_x = np.linspace(train_data.min(), train_data.max(), new_length)
print((train_data.shape))
print((train_labels.shape))
```

In [ ]:

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In [ ]: