HW4 P4

November 28, 2019

[230]:
```
import pandas as pd
import sklearn
import numpy as np
import os
from scipy.optimize import curve_fit
from sklearn.linear_model import Ridge
import matplotlib.pyplot as plt
```

[6]:
```
print(files)
```

```
['optimus_56_K80.csv', 'optimus_32_P100.csv', 'optimus_26_k80.csv',
'optimus_50_P100.csv', 'optimus_50_K80.csv', 'optimus_20_V100.csv',
'optimus_32_V100.csv', 'optimus_20_P100.csv', 'optimus_44_V100.csv',
'optimus_20_K80.csv', 'optimus_44_K80.csv', 'optimus_56_V100.csv',
'optimus_26_P100.csv', 'optimus_26_V100.csv', 'optimus_56_P100.csv',
'optimus_32_k80.csv', 'optimus_50_V100.csv', 'optimus_44_P100.csv']
```

Helper functions

[131]:
```
def fnc(l,k,b0,b1,b2):
    f = l-1/(b0*k+b1)-b2
    return f

def wrapped_fnc(obs, b0, b1, b2):
    l,k = obs
    return fnc(l,k,b0,b1,b2)
```

[141]:
```
def sanity_check(l,params):
    b0, b1, b2 = params
    x = [i for i in range(len(l))]
    l_pred = [1/(b0*k + b1)+b2 for k in x]
    plt.plot(x,l)
    plt.plot(x,l_pred)
    plt.show()
```

Fit the data and get parameters b0, b1 and b2

[175]:
```
all_params = np.empty((3))

files = os.listdir('model_data/')
files = sorted(files)
#files= ['optimus_56_K80.csv']
for file in files:
    if(file.endswith('.csv')):
        file = 'model_data/'+file
        #print(file)
        df = pd.read_csv(file)
        df.drop(df.tail(5).index, inplace=True)
        l = df['loss'].values
        k = df['step'].values
        xdata = np.vstack((l,k))
        ydata = np.zeros(l.shape)
        params, cov = curve_fit(wrapped_fnc,xdata,ydata,bounds=(0,np.inf))
        all_params = np.vstack((all_params,params))

#sanity_check() ## call with args l, parameters. Plots l vs l_pred
```

[233]:
```
beta_df = pd.DataFrame({'b0':all_params[:,0], 'b1': all_params[:,1], 'b2':␣
 ↪all_params[:,2]})[1:]
beta_df['GPU'] = ['K80','P100', 'V100','K80','P100', 'V100','K80','P100',␣
 ↪'V100','K80','P100', 'V100','K80','P100', 'V100']
beta_df['depth'] = [20,20,20,26,26,26,32,32,32,44,44,44,56,56,56]
beta_df = pd.concat([beta_df,pd.get_dummies(beta_df['GPU'])],axis=1)
print(beta_df)

x_pred = {'depth':[50,50,50], 'K80':[1,0,0], 'P100':[0,1,0], 'V100':[0,0,1]}
x_pred_df = pd.DataFrame(x_pred,columns=['depth','K80', 'V100', 'P100'])
```

	b0	b1	b2	GPU	depth	K80	P100	V100
1	0.000809	0.574052	0.202183	K80	20	1	0	0
2	0.000798	0.567968	0.198846	P100	20	0	1	0
3	0.000850	0.559622	0.202118	V100	20	0	0	1
4	0.000891	0.492385	0.228858	K80	26	1	0	0
5	0.000841	0.556948	0.229808	P100	26	0	1	0
6	0.000824	0.532168	0.226193	V100	26	0	0	1
7	0.000844	0.503837	0.249446	K80	32	1	0	0
8	0.000805	0.543303	0.245730	P100	32	0	1	0
9	0.000262	0.684735	0.040838	V100	32	0	0	1
10	0.000744	0.450322	0.251371	K80	44	1	0	0
11	0.000808	0.478097	0.281110	P100	44	0	1	0
12	0.000428	0.570911	0.145277	V100	44	0	0	1
13	0.000291	0.585948	0.107607	K80	56	1	0	0
14	0.000169	0.653758	0.005425	P100	56	0	1	0
15	0.000731	0.491864	0.293040	V100	56	0	0	1

Make Predictions for resnet50

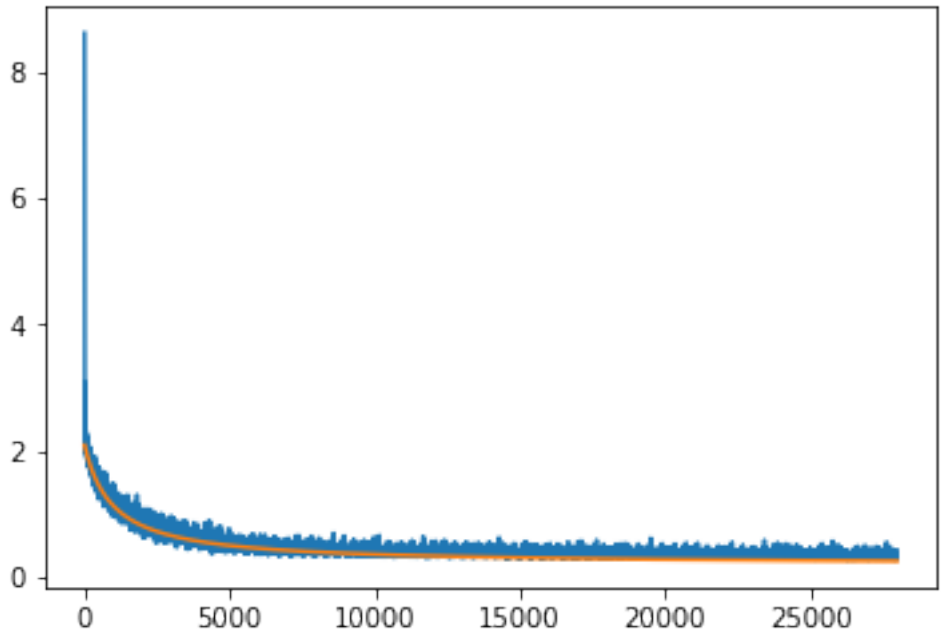
[261]:
```
predicted_params = np.empty((1))

for param in ['b0','b1','b2']:
    x = beta_df[['depth','K80', 'P100', 'V100']]
    y = beta_df[[param]]
    model = Ridge()
    model.fit(x,y)
    y_pred = model.predict(x_pred_df)
    predicted_params = np.vstack((predicted_params,y_pred))

predicted_params = predicted_params[1:].reshape(3,3)
print(predicted_params)
## array structure: parameters are rows, GPUs are columns
```

```
[[5.43137200e-04 4.62532210e-04 5.16954755e-04]
 [5.25790356e-01 5.64583146e-01 5.58045235e-01]
 [1.82939894e-01 1.60939939e-01 1.69848644e-01]]
```

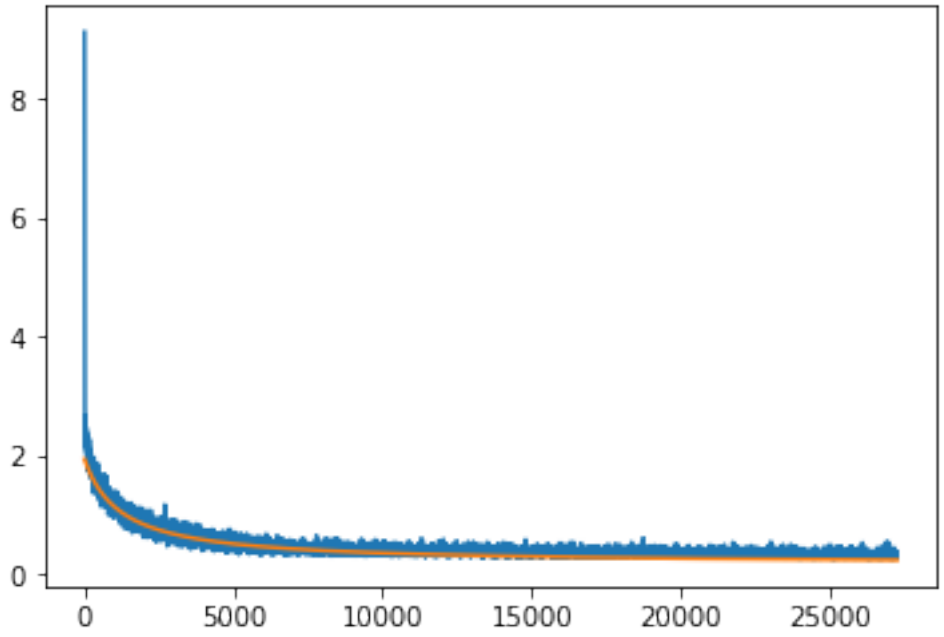
Load original data and compare

[250]:
```
k80 = pd.read_csv('resnet50_data/optimus_50_K80.csv')
v100 = pd.read_csv('resnet50_data/optimus_50_V100.csv')
p100 = pd.read_csv('resnet50_data/optimus_50_P100.csv')
```

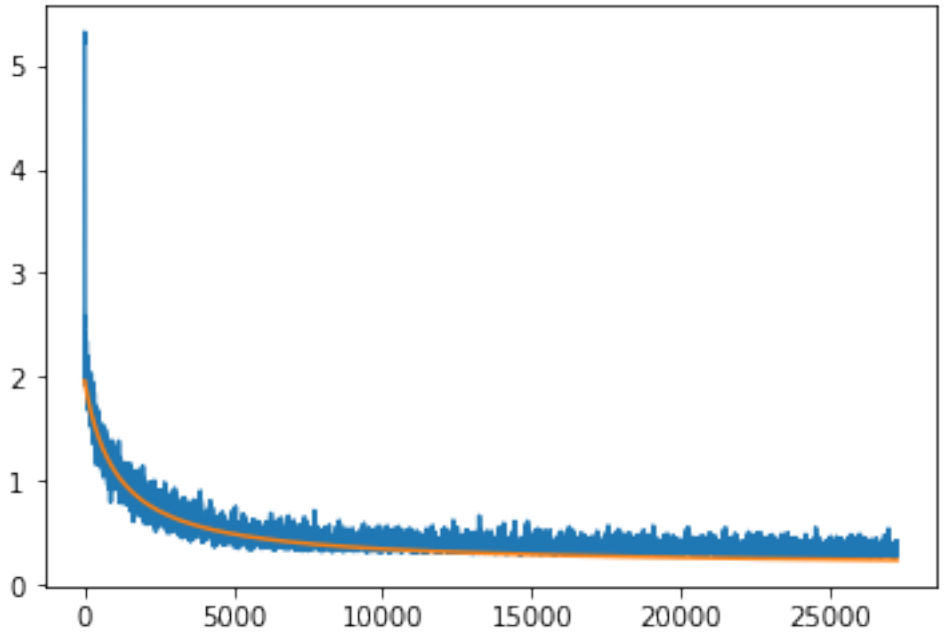
[256]:
```
lk80 = k80['loss']
sanity_check(lk80, predicted_params[:,0])
```



[258]:
```
lp100 = p100['loss']
sanity_check(lp100, predicted_params[:,1])
```



[260]:
```
lv100 = v100['loss']
sanity_check(lv100, predicted_params[:,2])
```



0.1 4.3: Time vs Number of Workers

No. of steps per poch = 50000/128 = 391

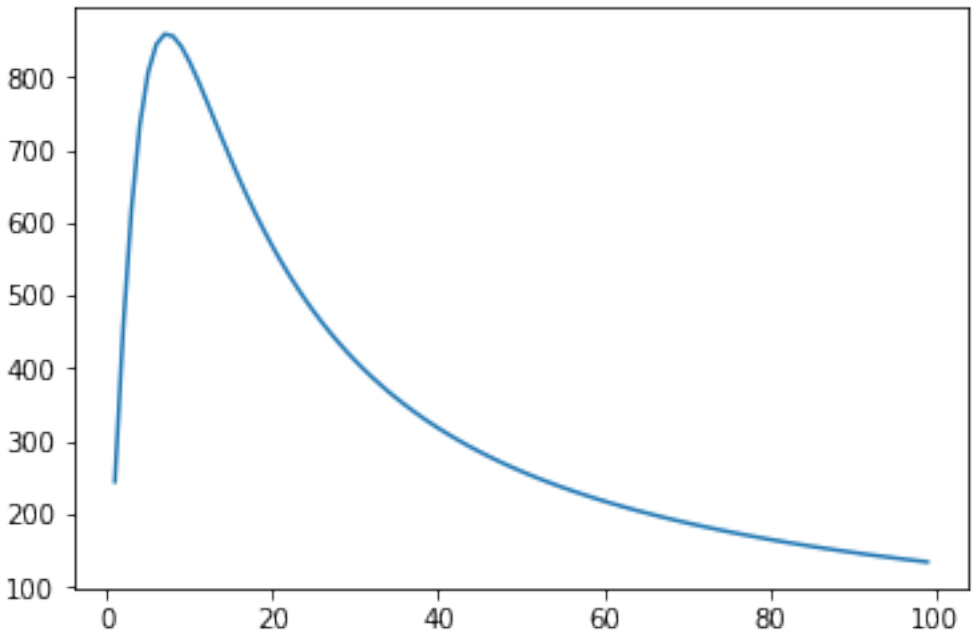
No. of epochs to convergence = 85.

Parameters (as per table): - $\theta_0 = 1.02$ - $\theta_1 = 2.78$ - $\theta_2 = 4.92$ - $\theta_3 = 0.00$ - $\theta_0 = 0.02$

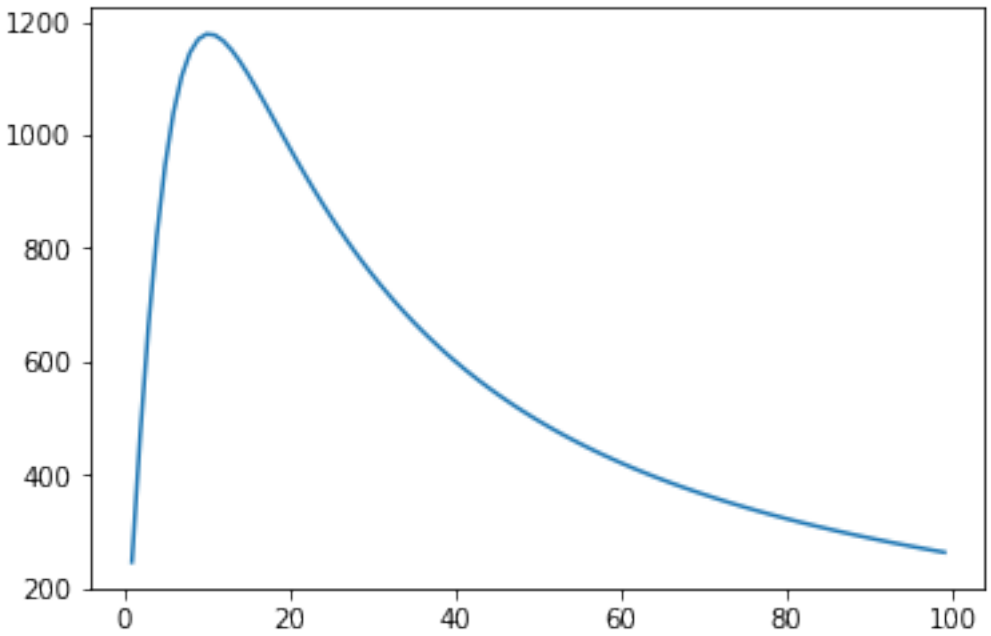
To plot: Time taken to convergence vs Number of workers for Parameter servers in [1,2]

[272]:
```
def ftime(w,p):
    theta_0 = 1.02
    theta_1 = 2.78
    theta_2 = 4.92
    theta_3 = 0.00
    theta_4 = 0.02
    return 391*85/(theta_0*128/w + theta_1 + theta_2*w/p + theta_3*w +␣
 ↪theta_4*p)
```

[273]:
```
# 2 parameter servers

w = [w for w in range(1,100)]
time_2 = [ftime(nw,2) for nw in w]
plt.plot(w,time_2)
plt.show()
```



[274]:
```
# 4 parameter servers

time_4 = [ftime(nw,4) for nw in w]
plt.plot(w,time_4)
plt.show()
```



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