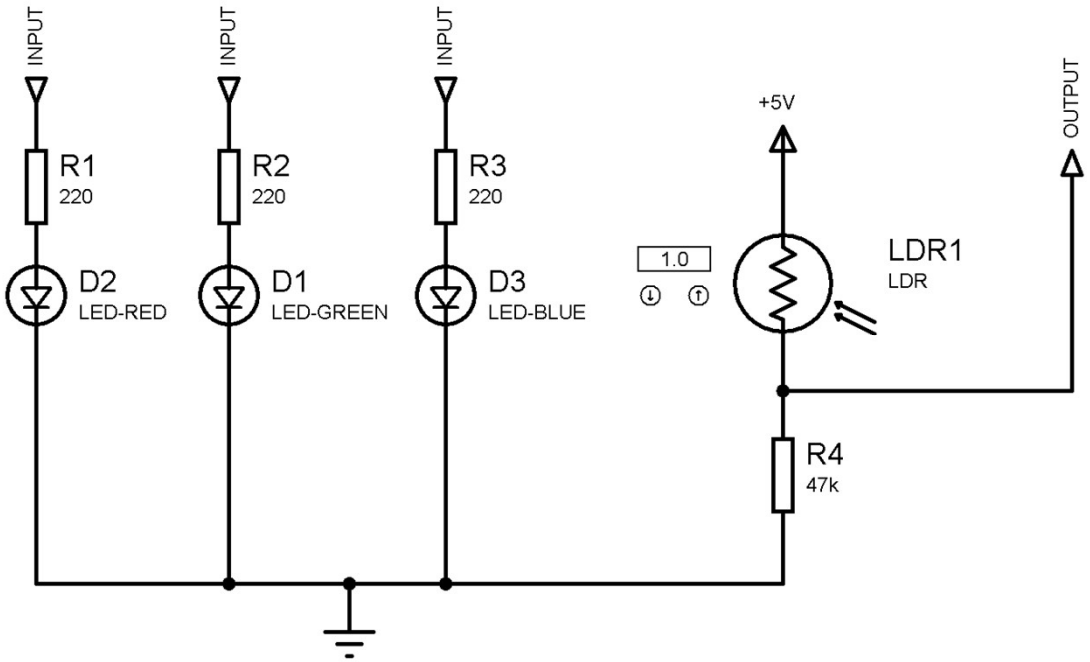
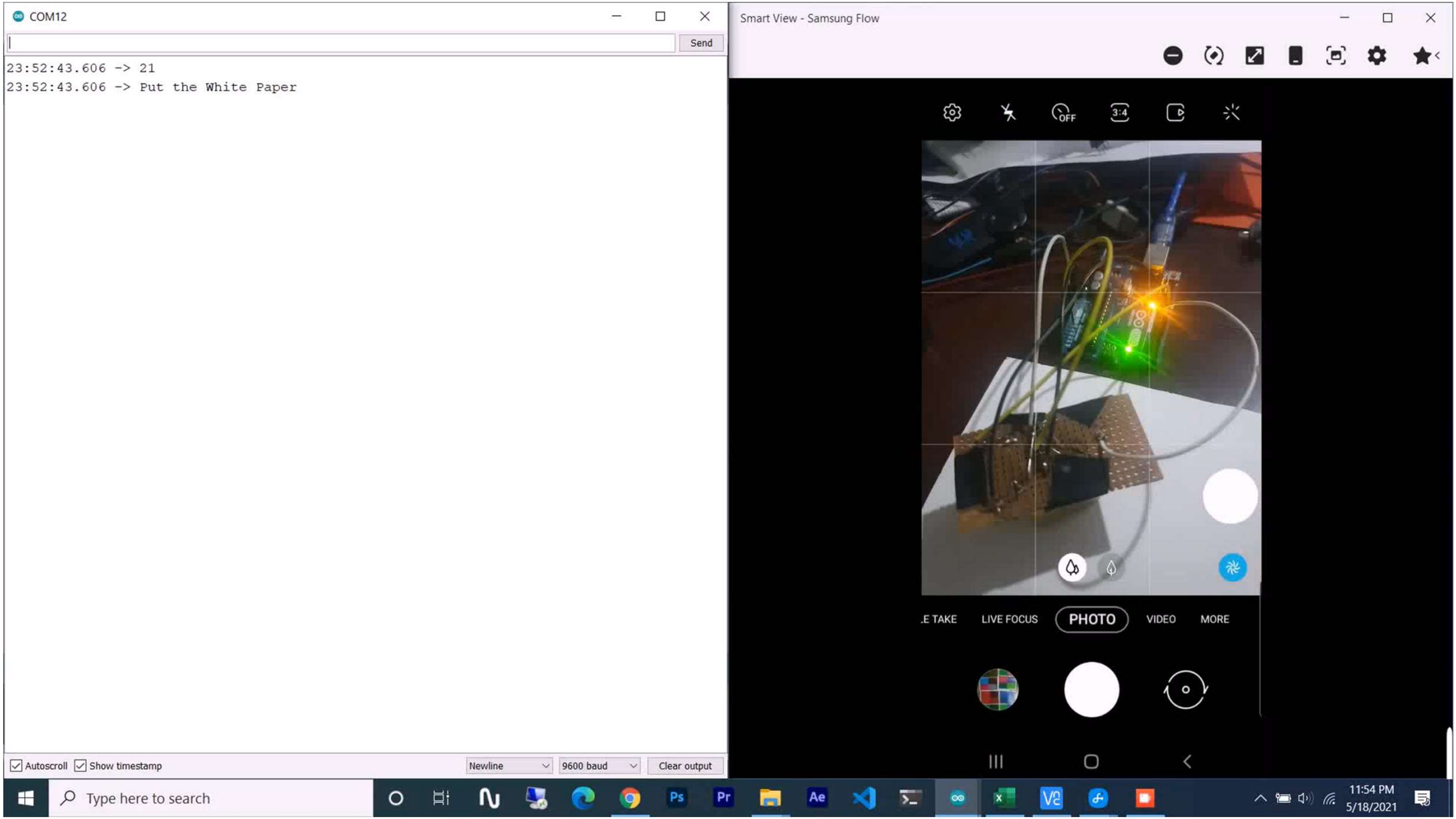

INPUT
INPUT
INPUT
R1
220
R2
220
R3
220
D2
LED-RED
D1
LED-GREEN
D3
LED-BLUE
1.0
+5V
LDR1
LDR
OUTPUT
R4
47k

Laser Printed Color Papers for different RGB Values


COM12
Send
23:52:43.606 -> 21
23:52:43.606 -> Put the White Paper
Autoscroll
Show timestamp
Newline
9600 baud
Clear output
Smart View - Samsung Flow
OFF
3:4
.E TAKE
LIVE FOCUS
PHOTO
VIDEO
MORE
Type here to search
11:54 PM
5/18/2021

True R	True G	True B	Reading R	Reading G	Reading B
255	0	0	0.94	0.39	0.24
240	0	0	0.96	0.44	0.22
200	0	0	0.93	0.34	0.27
160	0	0	0.74	0.27	0.15
123	0	0	0.4	0.16	0.09
100	0	0	0.29	0.1	0.01
0	255	0	0.27	0.78	0.34
0	240	0	0.32	0.77	0.31
0	200	0	0.23	0.74	0.35
0	160	0	0.22	0.69	0.32
0	123	0	0.14	0.44	0.13
0	100	0	0.1	0.37	0.11
0	0	255	0.13	0.48	0.78
0	0	240	0.12	0.51	0.78
0	0	200	0.05	0.4	0.73
0	0	160	0.1	0.39	0.74
0	0	123	0.18	0.34	0.64
0	0	100	0.08	0.22	0.57
255	255	0	0.98	0.98	0.38
0	255	255	0.25	0.76	0.97
255	0	255	0.96	0.26	0.61
123	123	0	0.44	0.49	0.17
0	123	123	0.05	0.32	0.34
123	0	123	0.55	0.13	0.33
255	123	0	0.97	0.64	0.25
255	0	123	0.96	0.39	0.49
123	255	0	0.44	0.8	0.32
123	0	255	0.33	0.38	0.69
0	255	123	0.27	0.77	0.5
255	123	123	0.97	0.66	0.6
123	123	255	0.44	0.73	0.89

Black Reading	374	656	572
White Reading	774	890	837

$$Color\ Ratio = \frac{(Color\ Reading\ - Black\ Reading)}{(White\ Reading\ - Black\ Reading)}$$

R	G	B	RR	GG	BB	RGB	RG	RB	GB	True R	True G	True B
357	642	525	127449	412164	275625	120326850	229194	187425	337050	0	0	0
789	891	830	622521	793881	688900	583489170	702999	654870	739530	255	255	255
767	747	626	588289	558009	391876	358666074	572949	480142	467622	255	0	0
768	750	630	589824	562500	396900	362880000	576000	483840	472500	240	0	0
750	738	636	562500	544644	404496	352026000	553500	477000	469368	200	0	0
687	725	605	471969	525625	366025	301335375	498075	415635	438625	160	0	0
543	690	560	294849	476100	313600	209815200	374670	304080	386400	123	0	0
514	676	564	264196	456976	318096	195969696	347464	289896	381264	100	0	0
495	833	643	245025	693889	413449	265131405	412335	318285	535619	0	255	0
500	833	646	250000	693889	417316	269059000	416500	323000	538118	0	240	0
477	828	645	227529	685584	416025	254746620	394956	307665	534060	0	200	0
471	815	624	221841	664225	389376	239531760	383865	293904	508560	0	160	0
433	757	570	187489	573049	324900	186835170	327781	246810	431490	0	123	0
399	738	562	159201	544644	315844	165487644	294462	224238	414756	0	100	0
423	768	758	178929	589824	574564	246246912	324864	320634	582144	0	0	255
417	771	758	173889	594441	574564	243702306	321507	316086	584418	0	0	240
421	761	750	177241	579121	562500	240285750	320381	315750	570750	0	0	200
422	757	743	178084	573049	552049	237354322	319454	313546	562451	0	0	160
453	734	716	205209	538756	512656	238071432	332502	324348	525544	0	0	123
413	714	695	170569	509796	483025	204942990	294882	287035	496230	0	0	100
777	885	649	603729	783225	421201	446281605	687645	504273	574365	255	255	0
490	838	818	240100	702244	669124	335887160	410620	400820	685484	0	255	255
769	726	711	591361	527076	505521	396947034	558294	546759	516186	255	0	255
560	774	581	313600	599076	337561	251828640	433440	325360	449694	123	123	0
385	725	639	148225	525625	408321	178360875	279125	246015	463275	0	123	123
598	696	627	357604	484416	393129	260962416	416208	374946	436392	123	0	123
773	801	605	597529	641601	366025	374599665	619173	467665	484605	255	123	0
767	745	679	588289	555025	461041	387990785	571415	520793	505855	255	0	123
564	848	625	318096	719104	390625	298920000	478272	352500	530000	123	255	0
514	747	739	264196	558009	546121	283744962	383958	379846	552033	123	0	255
492	834	685	242064	695556	469225	281074680	410328	337020	571290	0	255	123
777	808	728	603729	652864	529984	457050048	627816	565656	588224	255	123	123
556	821	797	309136	674041	635209	363811372	456476	443132	654337	123	123	255

Non-Linear Hypothesis Equation

$$y_1 = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \theta_4 x_1^2 + \theta_5 x_2^2 + \theta_6 x_3^2 + \theta_7 x_1 x_2 x_3 + \theta_8 x_1 x_2 + \theta_9 x_1 x_3 + \theta_{10} x_2 x_3$$

$$y_2 = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \theta_4 x_1^2 + \theta_5 x_2^2 + \theta_6 x_3^2 + \theta_7 x_1 x_2 x_3 + \theta_8 x_1 x_2 + \theta_9 x_1 x_3 + \theta_{10} x_2 x_3$$

$$y_3 = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \theta_4 x_1^2 + \theta_5 x_2^2 + \theta_6 x_3^2 + \theta_7 x_1 x_2 x_3 + \theta_8 x_1 x_2 + \theta_9 x_1 x_3 + \theta_{10} x_2 x_3$$

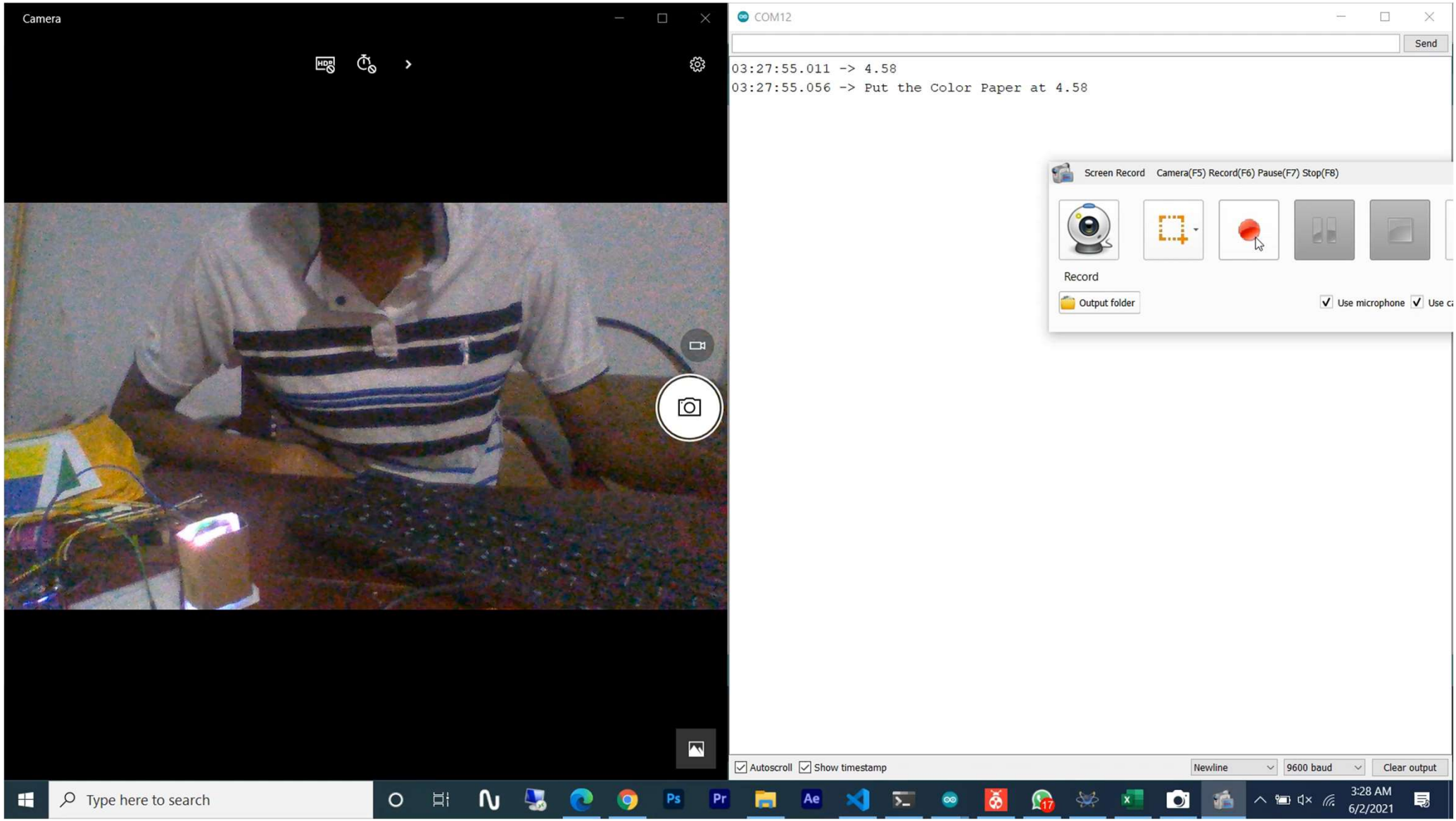
y1,y2,y3 = True RGB Values
X1,x2,x3 = RGB readings

Normal Equation

$$\theta = (X^T X)^{-1}(X^T Y)$$

```
[array([ 7.80644240e+02, -4.13541438e+00, 1.59315003e+00, -3.45407759e+00, -9.54168462e-04, -2.08982170e-03, 2.71439925e-03, -
6.38481761e-06, 7.25086177e-03, 5.62079704e-03, -6.56728901e-04]),
array([ 5.17850799e+03, -7.95412008e+00, -8.00483746e+00, -7.77173139e+00, -6.37863401e-04, -2.08148107e-04, -4.29135121e-03, -
1.52957332e-05, 9.63670908e-03, 1.34797074e-02, 1.59249269e-02]),
array([ 2.40181999e+03, -5.53947782e+00, -2.49122749e+00, -4.34062003e+00, -4.89891584e-04, 1.92371330e-03, 4.32416302e-03, -
9.86222636e-06, 6.19024560e-03, 9.65242368e-03, -1.46407617e-03])]
```

```python
# theta = (XTX)'XTY
import numpy as np
file = open("readings1.csv","r")
data = file.read().split('\n')
data.pop()
thetas = []
nX = 10

X = np.array(list(map(lambda a: [1]+ [float(i) for i  in a.split(',')[:nX]],data[1:])))

for i in range(3):
    Y = np.array(list(map(lambda a: float(a.split(',')[nX+i]),data[1:])))
    theta = np.matmul(np.linalg.inv(np.matmul(np.transpose(X),X)),np.matmul(np.transpose(X),Y))
    thetas.append(theta)

pred = np.array([1,433, 757 ,570,   187489, 573049, 324900  ,186835170, 327781  ,246810,    431490



])

for theta in thetas:
    print(np.dot(theta,pred))
print(thetas)
```


Camera
COM12
Send
03:27:55.011 -> 4.58
03:27:55.056 -> Put the Color Paper at 4.58
Screen Record Camera(F5) Record(F6) Pause(F7) Stop(F8)
Record
Output folder
Use microphone
Autoscroll
Show timestamp
Newline
9600 baud
Clear output
Type here to search
3:28 AM
6/2/2021