ASSIGNMENT-2 REPORT

All the data was initially normalized and new features were generated according to the degree of the polynomial to be fit. An N-th degree polynomial has ${}^{N+2}C_2$ coefficients.

Learning rate: (1e-6)
Stopping criteria: (E-E′ ≤ 5e-2)
Maximum iterations: 50000

Gradient Descent:

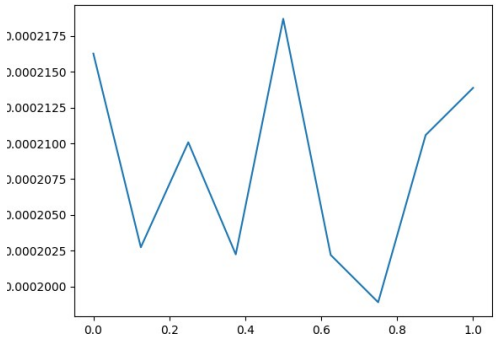
DEG	TRAIN ERR	AVG TEST ERR	R2 ERROR	RMSE	WEIGHTS(np.random.randn())
1	2504.969060	0.0082859983	2.5010214167	0.1287322	[0.20848472 0.09536773 -0.09982884]
2	2416.236659	0.008031471	6.212487647	0.1267396	[0.1423993 0.52602894 -0.47462574 -0.17928082 -0.03033481 0.13114884]
3	2243.467785	0.007348374	12.65263576	0.1212301	[0.22956625 -0.13999825 1.79395354 -2.04201335 -0.53483783 -1.52421099 1.46343568 1.93033192 0.42746262 -1.5781994]
4	2165.918867	0.007224321	15.68624651	0.1202025	[0.20091943 -0.00290968 1.27206105 -0.40164413 -1.72933962 -0.21291626 -1.98774206 1.08462712 1.66735796 0.57902535 0.02645383 0.27884248 1.56978226 -0.93956409 -1.40090874]
5	2124.145589	0.00695314	17.6060985	0.1179249	[0.17442318 0.00980305 1.31990218 -0.28355097 -1.4693503 -0.94444191 0.08125487 -1.98970689 0.69908159 1.32451212 1.63676402 -0.2194968 -0.29283898 0.28029615 0.39492675 1.56601267 -0.10389244 -0.71290387 0.67861609 -1.26979099 -0.87991535]
6	2110.53817	0.00695059	17.77905469	0.1179032	[0.17048744 -0.08962674 1.50332933 -0.02050638 -1.53132001 -1.52887083 -0.15819974 0.19751607 -1.95866819 0.57652114 0.99373625 1.036232 1.56734689 -0.37704709 -0.29113032 0.29275535 0.31045194 0.60387746 1.19626403 0.06177757 -0.36096084 -0.31454571 0.73898155 -0.59345753 -0.86432248 -0.03954899 -0.88730104 -0.15256575]

From the above data:

- As higher degree polynomials are fit to the data, the training error decreases while the R2 error increases, indicating some overfitting.
- Over fit: degree 6 polynomial
- Best fit: degree 4 polynomial

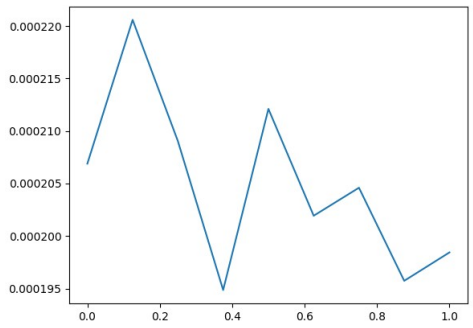
With L1 Regularization:

DEG	AVG TEST ERR	R2 ERROR	RMSE	REG. COEFF.	WEIGHTS
6	0.005767541	15.3936219	0.10740150	0.750	[0.22443079 0.06434552 0.4484087 0.16840746 -0.59062736 -0.63748462 -0.07625614 -0.27774885 -0.62978988 -0.15228207 0.43046438 0.32790992 0.02454909 0.15110341 0.44225115 0.25862018 0.36611453 0.25219859 0.32065097 0.42464265 -0.31452865 0.16880308 0.02215062 -0.42213197 -0.56118908 0.07997544 -0.1897593 -0.43929934]



With L2 Regularization:

DEG	AVG TEST ERR	R2 ERROR	RMSE	REG. COEFF.	WEIGHTS
6	0.005751591	15.6276033	0.10725289	0.375	[0.20728141 0.14860611 0.36461565 -0.11724464 0.02500055 -0.89191597 -0.13662495 -0.15469831 -1.070759 0.60531285 -0.140598 -0.0379052 0.67714743 0.03974865 0.6409446 0.54029996 -0.01648629 -0.045534 0.05002187 0.47055362 0.07705204 -0.03744093 0.30591422 0.02213287 -0.71178604 -0.31446844 -0.49900394 -0.19813366]



- After regularization, not much change in weights is seen, as they are already quite low.
- It is observed that the RMSE error approaches that of degree 4 after regularization.