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 ${}^{N+1}C_2$ 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	VAL ERR	AVG TEST ERR	R2 ERROR	RMSE	REG. COEFF.	WEIGHTS
6	645.36448	0.007294469	14.2374103	0.12078467	0.875	[0.18457507 -0.07398244 1.71922973 -1.7966707 0.44542585 -0.806041 -0.581372 -0.11608601 -0.81777302 -0.09801393 -0.87337241 0.40464632 2.5543963 -0.12994462 1.07814396 0.33470576 -0.42566046 -0.09357612 0.6889279 -0.36274973 0.72563591 -0.44936528 0.10844836 -0.27020638 0.10681549 -0.79221959 -0.63772207 0.25556698]

After L1-regularization:

- Regularization coeff = 0.875. The accuracy after regularization is close to that of degree 4 polynomial.

With L2 Regularization:

DEG	VAL ERR	AVG TEST ERR	R2 ERROR	RMSE	REG. COEFF.	WEIGHTS
6	648.47769	0.007259853	11.9812831	0.12049774	0.0	[0.16959764 0.18025695 0.65518339 -0.06978974 -0.58611338 -0.57898445 -0.16013752 -0.31185269 -0.4559507 -0.43000127 -0.33544481 0.07765144 0.75703779 0.55313306 -0.15820445 -0.19200157 0.24284709 1.00197346 0.63461067 -0.08260375 0.11207165 0.82501614 0.15354349 -0.17163259 0.36499707 -0.42624223 -0.25293941 -0.89574433]

After L2-regularization:

- Regularization coeff = 0, indicating no regularization in this case will yield a better answer.