CENTRAL WASHINGTON UNIVERSITY OF THE COMPUTER SCIENCE DEPARTMENT

Project 2

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1 INTRODUCTION

For this lab we took the 15 functions that we programmed in the previous lab and ran them through 3 different optimization functions, each more accurate than the previous. We have random search, which blindly tests randomized solutions looking for an optimum. Secondly we have local search, which takes an initial randomized solution and then attempts to optimize it until it's at its minimum. Thirdly we have iterative local search, which combines the two previous functions.

2 METHODS

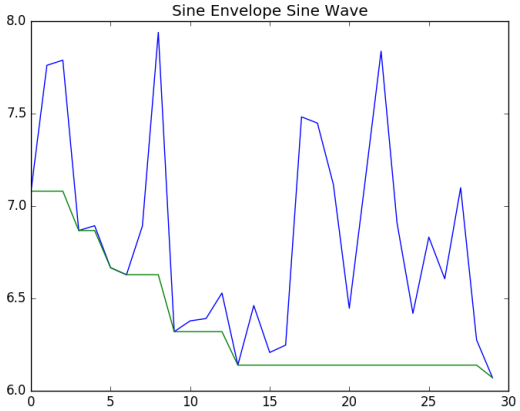
A significant portion of the code from the previous lab was rewritten to allow the functions and search methods to be run from the command line. Arguments specifying the dimensionality of the solution, id of the function, id of the search method, and a seed are all handled by the program. Using this backbone, we wrote a trivial python script that executes each search method on all of the 15 functions being tested for each dimensionality. There currently is an issue with run times being significant for a select few functions on high dimensionalties. As a result some data points have been omitted.

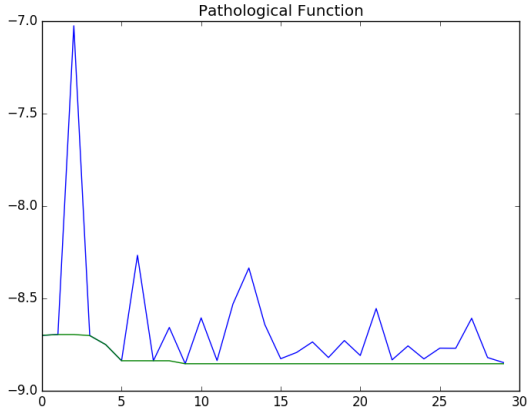
3 ANALYSIS

There were various interesting results both in the new data, what the new functions were able to find in terms of minimums, and how close some data points got to the last lab where the search was purely random.

Comparing the new data from the Iterative Local Search (ILS) and the Local Search (LS) with the previous results, we see that the purely naive method that we used previously is actually quite sufficient for a few select functions, namely: Sine Envelope Sine Wave, Pathological, Rosenbrok, and Ackleys Two functions. Each of these functions evaluated to very similar solutions in all three methods, naive, ILS and LS. Often being within 10% of each other.

The differences between the two new methods used in this lab, ILS and LS are mainly negligible in their cumulative accuracy. There are some examples where the search methods differ more than others. Griegwangk and Egg Holder differ the most between the two methods, with a 100 - 200 % difference seen between the methods. For single runs of the functions though, ILS is superior to LS as can be seen in the graphics below for two separate runs of ILS on differing functions. The top line being the single run results, and the bottom being the running best solution.





There were also a few problems with the experimentation, one being the fact that we neglected the fact that the delta value within the LS and ILS functions could throw the function outside of its specified bounds. The implementation checked each of these bounds each function call, but only returned 0 if it exceeded them. Thus some results have erroneous values of either 0 or some other integer value.

Another problem, as mentioned again in the conclusion, is the run time of these search methods. In particular, function 5 and 13 ran extremely slow. Slow enough for the results having to be omitted as it would take longer to obtain the results than we have time for the lab. We hope to speed up the implementation prior to the next lab and include those results then.

All testing was done on an i7-3630QM with 16GB ram using a single thread. Complete results can be viewed in the sections below.

4 Conclusion

The search functions in this lab seem to behave much more accurately than the random search in the previous lab. Not only are the new functions seemingly accurate, but they also appear to repeat their values consistently giving the appearance that they are coming up with a somewhat correct answer. Unfortunately, it seems where these new functions fall down is in

their performance. In the 30 dimension trials for this lab, there were multiple functions where results had to be omitted because of running time issues. Some taking up to multiple hours to run for their full permutation count. We hope to see functions which take care of these issues in the upcoming labs.

Random Search, 10 dimensions															
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-1223.19	13286	3.18E+09	24260	114.244	5.52567	18.2586	154.502	145.101	-1714.21	-1147.36	3.95561	-1.64259	-3.31459	-19.1981
	-1399.06	19906	1.96E+09	16700	90.6946	6.07905	20.4112	102.177	142.077	-1648.81	-1560.96	4.09041	-1.39102	-4.9016	-19.1981
	-1010.48	14917	6.76E+09	24520	51.8071	6.28399	21.7189	125.452	138.122	-1661.62	-1122.59	4.06708	-1.34332	-5.57971	-19.1981
	-1934.21	13942	4.96E+09	29540	122.229	5.67277	19.682	123.082	139.72	-2343.48	-1408.66	4.03919	-1.86534	-4.43512	-19.1981
	-794.372	14642	3.77E+09	19260	51.4992	5.64587	17.3606	130.231	146.019	-1927.46	-1392.74	4.02665	-0.919067	-2.9242	-19.1981
	-1431.49	10213	5.51E+09	15600	99.3078	6.37517	19.3915	106.105	147.534	-1693.06	-1590.86	3.81288	-1.94752	-4.41244	-19.1981
	-1222.58	14061	6.24E+09	27600	61.8407	5.95916	21.8219	134.971	138.811	-1120.32	-1274.41	3.90444	-0.949296	-5.21336	-19.1981
	-1659.45	14265	3.86E+09	12040	77.3118	6.59486	19.6264	107.374	137.152	-2115.97	-1151.79	3.9272	-2.01492	-4.14032	-10.3861
	-1495.15	16757	7.43E+09	29540	90.1975	5.82742	17.0893	118.252	133.507	-1385.32	-1145.69	4.03879	-1.59431	-4.89982	-19.1981
	-869.356	16426	4.32E+09	32060	34.4248	5.79818	19.4186	111.549	133.483	-1677.77	-859.394	4.00669	-0.948425	-5.22481	-13.4604
	-1039.51	18099	3.32E+09	34560	91.9329	6.26357	21.1327	114.807	140.81	-1668.54	-1128.23	4.07449	-1.05552	-3.01325	-19.1981
	-919.612	12176	6.94E+09	25180	90.0024	6.26924	16.2619	113.944	128.653	-2016.45	-873.684	4.06288	-1.4206	-4.45688	-19.1981
	-1506.41	14320	5.21E+08	31120	108.815	6.47541	18.8506	92.2691	142.909	-2022.87	-1605.81	4.00233	-1.76635	-2.84643	-19.1981
	-1418.55	20724	2.01E+09	26780	82.2471	6.03665	19.3898	106.227	133.068	-2409.09	-1688.21	4.16777	-2.26334	-4.32598	-19.1981
	-1011.89	18565	7.75E+09	23560	95.8855	6.32915	17.2525	114.955	133.399	-3479.56	-988.721	4.03036	-1.32162	-4.01327	-19.1981
	-1408.31	15157	5.16E+09	23300	85.4808	5.70288	18.6271	150.783	138.84	-2023.31	-1078.79	4.00918	-1.95085	-4.44009	-19.1981
	-748.024	23811	2.54E+09	18940	147.794	5.43586	20.034	137.888	138.61	-2389.56	-1342.49	3.70141	-1.36667	-4.68997	-19.1981
	-1638.56	18165	5.13E+08	15660	116.448	5.86329	18.6616	114.843	144.891	-2692.09	-1348.9	4.1051	-2.70373	-4.78687	-19.1981
	-840.918	20571	5.90E+09	29040	88.0594	6.07913	21.4554	108.89	148.508	-1373.66	-709.318	4.16242	-1.27512	-3.5624	-19.1981
	-918.388	19467	5.67E+09	18540	86.3758	5.50249	16.6631	117.034	138.953	-1841.87	-1118.65	4.05446	-1.43019	-4.92021	-19.1981
	-1914.4	14579	4.51E+09	35380	112.945	6.45106	17.4196	113.865	137.99	-1295.97	-1449.41	4.04415	-1.21765	-3.82571	-19.1981
	-1152.74	16613	8.29E+09	27140	93.3062	6.2383	18.8128	120.968	143.59	-1384.85	-1405.02	4.21014	-0.963691	-5.42752	-13.344
	-1484.78	18381	5.35E+09	36160	58.6201	6.30713	17.9042	130.23	135.182	-1930.82	-1426.85	4.00492	-1.37802	-4.93164	-19.1981
	-1049.66	8486	3.92E+09	19580	112.332	6.55806	19.9514	141.112	135.308	-1799.74	-884.562	4.23598	-2.511	-3.99085	-13.4604
	-1093.92	16661	6.44E+09	24500	92.3324	6.30898	20.232	121.163	130.104	-1710.14	-967.321	4.06013	-2.29801	-6.0234	-19.1981
	-1412.25	18188	5.81E+09	26880	109.978	5.70144	13.2134	90.171	134.353	-1785.93	-819.994	3.77693	-1.0307	-5.92079	-19.1981
	-1186.11	13189	3.77E+09	19320	106.128	6.27975	18.8899	136.097	146.582	-1703.69	-1298.35	3.73847	-0.944601	-3.52666	-19.1981
	-1356.38	18343	2.37E+09	13500	65.7106	5.97634	21.5128	115.854	140.762	-2070.81	-1319.27	4.18465	-1.24715	-5.7363	-19.1981
	-1528.85	17689	1.03E+10	18840	107.888	6.00707	15.2945	94.1472	144.7	-3449.27	-1375.83	4.14164	-1.64993	-3.02796	-19.1981
	-1063.76	15783	2.62E+09	32600	97.6585	6.46626	22.6138	123.843	131.62	-1700.03	-1291.51	4.01155	-1.00427	-4.24119	-19.1981
Avg.	-1257.7453333333	16246.0666666667	4.72E+09	2.44E+04	9.14E+01	6.07E+00	1.90E+01	1.19E+02	1.39E+02	-1.93E+03	-1.23E+03	4.02E+00	-1.51E+00	-4.43E+00	-1.83E+01
Med.	-1222.885	16519.5	4735540000	24510	92.13265	6.07909	19.13985	116.444	138.8255	-1792.835	-1282.96	4.03899	-1.38452	-4.437605	-19.1981
Std. Dev.	315.9494375281	3243.999978032	2288019739.0926	6682.1279905999	24.08152579	0.3362814731	2.0863159585	15.7480637114	5.4144432384	542.1878355628	253.2605529849	0.1313044821	0.4955181247	0.901789508	2.3117761941

Random Search, 20 dimensions															
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-1910.87	40054	1.87E+10	122800	316.532	13.3092	54.0294	272.443	302.424	-4041.92	-1817.15	8.84883	-2.46942	-5.56505	-12.4756
	-1696.99	45772	7.63E+09	147520	297.122	14.295	50.705	272.861	303.698	-4286.27	-2370.93	8.81079	-1.86537	-5.17117	-14.6404
	-3381.59	40944	1.07E+10	111960	261.007	14.2375	48.5996	293.562	312.574	-2033.17	-1370.09	7.86544	-1.92465	-5.47614	-14.6404
	-2309.24	43289	2.03E+10	114080	249.051	13.181	46.7492	254.37	312.802	-2243.62	-1637.31	8.75968	-3.27363	-7.05667	-14.6404
	-3308.55	45667	1.77E+10	98840	258.288	13.4705	48.7221	303.815	317.885	-2736.5	-1716.73	8.69769	-2.13134	-8.56678	-14.6404
	-1776.1	35152	1.97E+10	128360	282.098	14.0992	49.7351	295.107	293.715	-3083.96	-1337.39	8.904	-2.72989	-4.97279	-14.6404
	-2495.52	42321	1.55E+10	149040	314.038	12.2785	48.4086	311.61	312.538	-2241.98	-1953.24	8.84628	-2.22338	-5.40834	-14.6404
	-1753.65	54835	2.34E+10	144560	253.313	14.0274	52.4705	265.832	306.999	-2809.58	-1617.48	9.03187	-2.36168	-7.64268	-14.6404
	-1574.77	42698	1.66E+10	105920	253.962	13.7941	47.9362	205.073	314.335	-3135.48	-1120.02	8.97631	-1.76927	-7.50096	-12.4756
	-2206.58	47544	1.38E+10	92400	267.474	12.5201	50.5015	300.654	299.266	-2352.88	-1563.85	8.57557	-1.90659	-4.65802	-14.6404
	-2159.17	27230	1.29E+10	135280	252.351	13.261	45.9535	202.094	304.092	-3073.25	-2085.45	8.53621	-1.87303	-8.01815	-14.6404
	-2138.87	42123	1.63E+10	172680	271.911	13.2188	44.2571	238.99	310.573	-2373.5	-1490.61	8.82391	-1.49354	-5.60778	-14.6404
	-1491.32	41559	1.57E+10	120560	264.467	14.7017	49.9226	270.661	314.715	-4606.54	-1594.99	8.57499	-2.34868	-6.03643	-12.4756
	-1716.67	43371	1.96E+10	146160	256.312	13.2972	47.8418	296.121	299.162	-2949.32	-1714.88	8.94451	-1.42826	-7.75141	-14.6404
	-1353.62	30573	2.00E+10	160960	304.457	13.6341	44.8636	281.098	302.466	-2253.05	-1586.38	8.79012	-3.8665	-4.02897	-14.6404
	-1876.11	37188	1.04E+10	89680	268.29	12.9539	43.9137	251.274	294.581	-3173.41	-1092.65	8.51772	-2.85364	-4.28	-14.6404
	-1933.32	34504	2.32E+10	145600	255.038	14.1056	52.7792	271.035	300.68	-3193.08	-1565.67	8.89243	-1.22167	-6.49108	-14.6404
	-1778.81	32208	1.21E+10	164080	250.116	13.5012	48.5518	321.977	304.95	-2310.76	-1192.91	8.99516	-2.24735	-3.84925	-14.6404
	-1429.94	42230	1.93E+10	139160	279.049	14.2125	47.4455	275.462	308.209	-2107.31	-2552.48	8.58813	-1.87343	-8.05159	-14.6404
	-1987.26	40385	2.04E+10	151400	276.766	12.8164	53.0487	282.964	315.214	-2678.56	-2387	8.6457	-3.03476	-6.09081	-14.6404
	-1213.51	37332	1.51E+10	158560	261.681	13.675	47.6498	259.175	303.699	-2531.58	-1766.16	8.84001	-2.59238	-3.25015	-12.4756
	-1695.59	32437	1.90E+10	128640	275.131	13.0249	46.3462	248.083	306.287	-2644.79	-1901.53	8.95061	-2.73942	-4.03195	-14.6404
	-1844.9	40572	2.06E+10	166080	249.066	14.0993	44.662	267.558	302.1	-2844.67	-2131.51	9.07241	-1.88671	-4.71827	-14.6404
	-2039.62	48632	1.87E+10	138960	245.71	13.6312	38.0255	275.48	312.316	-1829.93	-2004.13	8.91483	-1.52482	-8.56454	-14.6404
	-1689.48	44937	1.61E+10	124600	282.54	13.3536	45.8805	290.598	305.559	-2133.36	-1566.78	8.72377	-3.27145	-6.96928	-14.6404
	-1633.96	51091	1.63E+10	117000	229.145	13.471	45.3704	307.327	311.438	-1961.85	-2460.35	8.80427	-2.06181	-7.33068	-14.6404
	-2439.89	45380	7.91E+09	140880	310.028	13.7849	39.4548	280.565	301.484	-3402.53	-2003.01	8.76709	-2.71809	-5.60029	-14.6404
	-2364.89	38298	1.23E+10	145760	238.505	14.0388	46.8051	290.425	309.168	-2827.15	-1049.02	8.70034	-2.46217	-7.9223	-14.6404
	-1855.61	47187	1.06E+10	137680	248.9	13.9612	48.5063	302.025	305.866	-2152.73	-1918.95	8.4452	-2.47409	-6.79521	-12.4756
	-1260.76	46347	1.16E+10	130600	281.027	13.9532	49.979	252.528	301.864	-1840.58	-1860.37	8.04923	-2.63026	-7.00734	-14.6404
Avg.	-1943.9053333333	41395.3333333333	1.61E+10	1.34E+05	2.68E+02	1.36E+01	4.76E+01	2.75E+02	3.06E+02	-2.73E+03	-1.75E+03	8.73E+00	-2.31E+00	-6.15E+00	-1.43E+01
Med.	-1850.255	42176.5	16269000000	138320	263.074	13.63265	47.889	275.471	305.7125	-2661.675	-1715.805	8.797195	-2.298015	-6.06362	-14.6404
Std. Dev.	503.7270251575	6204.5677408321	4287970694.60419	21553.682353336	22.5100649673	0.5550063904	3.5839928835	28.0219424426	6.1634317364	693.8827057417	399.7555341973	0.2654236567	0.6045133055	1.5251158054	0.8205653224

Random Search, 30 dimensions															
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-2360.73	76232	3.56E+10	354540	429.015	21.1792	78.9986	444.386	468.28	-3685.03	-2174.65	13.6966	-3.39811	-7.7131	-18.886
	-2223.96	77130	2.33E+10	427440	482.271	21.4306	78.5455	477.565	481.841	-3105.05	-1719.81	13.3772	-2.28782	-5.96241	-18.886
	-2310.43	79924	2.53E+10	381060	438.418	22.4267	85.9081	431.309	476.297	-2717.31	-3512.41	13.4609	-2.95267	-9.47434	-18.886
	-1233.77	74245	3.11E+10	405060	500.971	20.6669	77.8205	460.647	478.937	-3095.92	-2547.58	13.8835	-3.62638	-9.1978	-18.886
	-1528.18	72335	3.46E+10	407400	480.637	21.006	85.0255	492.562	464.278	-5541.45	-2344.66	13.9109	-2.60874	-9.66453	-13.3197
	-1924.52	62337	2.96E+10	350940	400.405	21.2461	72.6017	482.764	483.487	-3317.2	-2334.39	13.194	-2.35764	-10.1073	-18.886
	-2423.33	65161	2.41E+10	257700	455.803	21.3956	79.6323	453.521	483.905	-2929.27	-3939.27	13.9277	-2.81222	-11.1674	-18.886
	-3297.71	56282	2.22E+10	333720	423.001	21.1405	72.1825	455.991	472.822	-3685.92	-2244.92	13.5072	-3.4393	-8.00828	-13.3197
	-2605.99	55514	2.99E+10	258960	432.783	20.5493	77.5907	487.188	468.534	-2270.3	-1770.48	13.8159	-2.20179	-7.3187	-18.886
	-2324.67	56507	3.57E+10	321720	497.616	21.1693	81.6804	548.596	472.64	-4354.96	-2232.69	13.4288	-3.11785	-9.96651	-18.886
	-3097.93	68919	3.54E+10	281160	311.272	21.3644	76.7997	473.195	482.708	-3184.8	-1491.68	13.6581	-4.08066	-11.396	-18.886
	-1810.75	74399	2.33E+10	325980	488.695	20.1705	79.5259	425.339	467.469	-3514.4	-2784.74	13.3882	-2.20352	-5.85588	-13.3197
	-2695.32	74130	2.86E+10	286740	445.725	21.7638	78.5654	443.915	465.322	-3661.35	-2224.44	13.7479	-2.58372	-8.03162	-18.886
	-1394.7	45078	4.43E+10	366540	392.949	19.8834	78.3782	443.771	474.73	-2292.49	-2073.16	13.8387	-1.60751	-8.19351	-18.886
	-2988.33	76470	3.30E+10	356040	403.55	22.1061	66.4539	479.545	474.343	-5213	-2393.19	13.621	-1.97457	-7.41504	-18.886
	-2107.9	64868	2.55E+10	335760	315.955	21.3366	76.1817	456.456	475.502	-3594.52	-1990.68	13.2762	-1.95789	-9.20082	-18.886
	-2979.51	66791	3.77E+10	300600	476.424	22.0409	79.8235	481.37	480.499	-3226.79	-2044.33	13.4292	-3.30836	-8.31641	-18.886
	-2513.73	63196	2.56E+10	378900	308.324	22.2978	73.8612	430.727	475.581	-3321.28	-2602.19	13.2479	-3.04897	-7.98816	-18.886
	-1622.69	62073	2.68E+10	370080	453.052	21.0996	80.359	480.134	477.041	-3560.86	-2227.66	13.4122	-2.65343	-9.57417	-13.3197
	-898.919	71119	3.36E+10	275400	394.268	21.1665	76.3499	475.151	482.187	-3499.9	-2010.88	13.8071	-1.77653	-6.50943	-18.886
	-2228.64	59344	2.66E+10	365520	446.585	21.9857	81.2511	473.327	469.027	-4350.96	-2530.21	13.1101	-2.27438	-6.5663	-18.886
	-2524.28	70564	2.93E+10	375960	467.46	20.6626	76.0828	458.589	473.993	-3010.55	-2107.52	13.5724	-2.93552	-3.36125	-13.3197
	-2141.75	69544	3.38E+10	275040	410.104	20.1186	72.5838	471.886	472.222	-2617.06	-2105.35	13.348	-2.82033	-5.74818	-18.886
	-2203.34	72793	3.62E+10	380220	406.591	22.0699	71.4693	407.417	484.37	-2650.34	-2240.99	13.9337	-1.66277	-8.93489	-18.886
	-1836.75	73045	3.98E+10	379800	514.007	22.242	79.9503	478.007	471.384	-4044.69	-2652.98	13.6287	-2.44844	-7.85381	-18.886
	-1787.41	50713	3.85E+10	296100	445.226	20.0734	76.9451	459.307	448.98	-3725.34	-1302.85	13.9199	-2.28859	-7.12064	-18.886
	-3185.05	70905	2.69E+10	374640	424.633	22.0167	74.4666	459.963	469.897	-4000.25	-2647.59	13.8378	-3.37299	-10.0858	-18.886
	-2551.98	57495	3.29E+10	370380	352.025	21.2376	81.8073	458.902	480.163	-2257.61	-2125.84	13.3929	-1.83939	-6.25541	-18.886
	-2406.77	78787	2.80E+10	403560	472.017	20.9728	79.011	416.437	481.494	-2723.46	-1653.13	13.5631	-1.96041	-5.54987	-13.3197
	-2783.41	66765	2.70E+10	322920	330.427	21.3975	80.8424	466.09	467.905	-3393.49	-2011.66	13.5916	-2.33285	-5.45623	-18.886
Avg.	-2266.4149666667	67088.8333333333	3.08E+10	3.44E+05	4.27E+02	2.13E+01	7.77E+01	4.62E+02	4.74E+02	-3.42E+03	-2.27E+03	1.36E+01	-2.60E+00	-7.93E+00	-1.78E+01
Med.	-2317.55	69231.5	29737350000	355290	435.6005	21.24185	78.46185	460.305	474.5365	-3357.385	-2226.05	13.582	-2.51608	-7.99822	-18.886
Std. Dev.	584.4233609571	8739.8871218282	5587568894.7127	47357.674511872	57.409444418	0.6956118635	4.0959187591	26.9132515273	7.5943841166	775.2133686027	526.201488921	0.2412609758	0.6322303515	1.8774263418	2.2645829281

Local Search, 10 dimensions																
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-1722.16	0.03025	1.31E+10	5978.56	69.3764	7.53377	9.04847	181.426	151.893	-754.573	-2406.31	4.19767	-2.05904	-8.82787	-8.1772
	-2788.25	0.03025	1.59E+10	29804.2	69.0028	6.62654	9.08272	121.985	157.316	482.297	-2056.85	4.27003	-0.232247	-8.81589	-8.1772
	-1839.66	0.03025	2.15E+10	17368.8	63.9238	7.28417	9.19482	170.218	140.056	-1188.15	-2643.43	4.22798	0.00103445	-8.76307	-8.1772
	-3498.88	0.0300057	1.25E+10	20604.7	68.4473	5.87015	10.7235	109.273	156.978	765.691	-2240.2	4.50026	0.0612122	-8.79559	-19.1981
	-2373.7	0.03025	1.93E+10	13430.3	34.2408	7.98904	9.18401	130.203	151.598	357.187	-2195.2	4.49177	0.843228	-8.72636	-19.2635
	-2669.32	0.03025	1.38E+10	13495.7	60.3948	7.3257	9.63616	126.236	150.787	-701.815	-2689.55	4.52112	-0.563567	-8.62028	-19.2635
	-2412.63	0.0288532	1.22E+10	30023.6	74.2869	7.63259	9.07038	153.164	157.549	-394.844	-2613.69	4.45488	0.147295	-8.74889	-19.2635
	-2452.59	0.03025	2.45E+10	22446.9	42.4768	6.59059	9.49866	167.659	153.588	-2790.05	-884.232	4.49433	-1.58924	-8.68392	-22.0872
	-2827.23	0.03025	6.57E+09	18043.7	64.0325	6.60687	9.40728	137.864	155.09	167.839	-3035.03	4.10601	2.38E-05	-8.77553	-8.1772
	-3577.85	0.0248398	1.74E+10	25988.4	74.2439	6.73684	9.28461	132.581	144.729	-91.2695	-1509.7	4.46538	-1.92424	-8.45917	-11.5852
	-1326.85	0.03025	2.68E+10	7867.05	70.423	7.52619	9.06149	111.908	154.855	-117.596	-2566.91	4.49956	-0.783772	-8.59181	-8.1772
	-3735.8	0.03025	1.80E+10	22752.2	50.6174	6.33447	9.1547	139.641	152.514	-1316.55	-2518	4.47642	-0.0463014	-8.75746	-19.27
	-2393.27	0.03025	1.14E+10	14274.5	40.5886	6.41117	10.6114	224.812	151.689	-1288.83	-2630.38	3.96854	-1.52409	-8.57556	-8.1772
	-2136.79	0.0251012	1.16E+10	13427.8	74.9665	6.62278	9.18783	124.629	154.597	-1036	-2279.34	4.08355	-0.337027	-8.83124	-19.27
	-2551.26	0.03025	2.09E+10	14787	71.8753	6.1052	10.2295	144.82	149.299	-2255.52	-2667.36	4.48691	-0.522676	-8.6941	-19.27
	-2610.58	0.0275071	2.19E+10	23744.9	51.3633	6.37208	9.21428	170.428	154.633	499.723	-1960.24	4.49717	-0.225219	-8.82633	-22.0364
	-3301.42	0.03025	1.42E+10	17620.1	58.3238	6.90171	9.09557	109.074	155.68	-413.377	-2868.24	4.28546	-0.609139	-8.78285	-22.0364
	-2610.41	0.0293121	1.09E+10	27801.8	95.0175	6.93148	9.15471	167.973	150.033	689.394	-2833.55	4.28827	0.0360106	-8.26686	-8.1772
	-3183.07	0.0290287	1.69E+10	20238.5	60.3234	6.74264	9.67354	102.391	156.435	-1058.05	-2757.67	4.00982	-0.78522	-8.08889	-8.1772
	-2432.85	0.0301624	3.56E+10	22842.4	35.3722	6.46636	11.4128	170.701	148.289	1105.59	-2210.27	4.77573	-1.19427	-8.509	-21.9278
	-2630.3	0.0278163	2.73E+10	25658.9	83.3985	6.10535	9.14037	121.269	154.065	-958.512	-2575.3	4.48104	-1.21108	-7.78537	-11.6076
	-2095.89	0.03025	9.81E+09	20270.9	40.2026	7.20097	9.0472	104.663	154.173	-505.146	-1771.42	4.11262	-0.613923	-8.83158	-8.1772
	-3301.53	0.0302264	1.35E+10	13708.2	62.5321	8.05472	11.0529	165.973	155.957	-2069.58	-2830.66	4.2232	0.124692	-8.83616	-19.2635
	-2314.48	0.0296459	1.98E+10	21595.5	66.9216	5.32096	9.18803	119.401	156.968	-728.852	-3393.19	4.37753	-1.01123	-8.81274	-11.6076
	-3380.47	0.0302365	9.73E+09	26948.7	96.7156	7.25999	9.21712	187.299	153.919	-213.715	-2813.35	3.95788	0.110539	-8.7079	-8.1772
	-3143.51	0.0199678	2.03E+10	11383	68.7048	6.28303	9.25189	188.644	157.746	110.405	-1688.99	4.49839	-1.74384	-8.7247	-8.1772
	-2847.49	0.029854	1.84E+10	23915.5	72.8991	6.63326	9.38279	105.037	150.94	862.177	-2078.53	4.58513	-1.08988	-8.61938	-11.5852
	-2926.46	0.03025	1.77E+10	21728.5	81.07	6.60333	9.31926	150.771	152.901	-1333.47	-2068.27	4.05192	-0.656969	-8.55918	-21.9278
	-2195.99	0.03025	2.26E+10	19417.8	76.3799	6.66027	9.09237	125.473	153.158	-1148.96	-2269.14	4.4759	-1.44312	-8.40539	-8.1772
	-2610.57	0.03025	1.95E+10	10095	51.5363	6.21274	9.11763	159.311	154.965	-304.918	-2250.28	4.4864	0.365686	-8.75928	-8.1772
Avg.	-2663.042	0.02921857	1.75E+10	1.92E+04	6.43E+01	6.76E+00	9.49E+00	1.44E+02	1.53E+02	-5.21E+02	-2.38E+03	4.35E+00	-6.16E-01	-8.64E+00	-1.39E+01
Med.	-2610.575	0.03025	17541950000	20254.7	67.68445	6.6299	9.20455	138.7525	153.992	-459.2615	-2462.155	4.46013	-0.586353	-8.72553	-11.5964
Std. Dev.	565.9521286104	0.0022586778	6227253551.6775	6364.105861632	15.8722794272	0.6200294914	0.6404997265	30.5973750771	3.8796949489	947.6193603132	502.5410994529	0.2088816019	0.7371789862	0.2404532	5.8867273045

Local Search, 20 dimensions															
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-5793.64	0.0605	2.54E+10	84243.8	0.00544314	15.7534	22.794	388.743	318.54	872.22	-4878.35	9.29745	-0.868549	-17.4433	-18.4163
	-6425.36	0.0605	3.40E+10	83330.5	2.59579	15.18	19.4765	282.217	326.136	-890.302	-5205.81	9.19442	-1.71722	-18.36	-18.1189
	-5773.94	0.0605	5.03E+10	81685.7	0.0325362	14.6438	19.2967	414.614	325.683	-38.8792	-4808.13	8.96731	-1.28757	-18.4541	-18.1189
	-4312.14	0.0605	4.46E+10	84028.2	0.012734	14.8892	20.1529	248.993	329.517	-49.3419	-5762.01	8.95851	-0.769716	-18.3303	-11.5925
	-5201.29	0.0528605	2.90E+10	85961.1	0.0175917	14.6958	20.7801	295.784	326.719	131.108	-4284.49	9.19177	-0.978247	-17.4535	-11.5925
	-5437.26	0.0484009	4.27E+10	81010.4	0.0128073	14.7319	20.2851	308.26	321.815	-3179.98	-5910.02	8.83616	-1.10339	-18.3132	-12.1791
	-5911.51	0.0605	4.18E+10	82890.4	0.0127846	15.3506	24.845	297.244	320.763	124.661	359.29	9.15435	-0.821465	-18.5011	-11.5925
	-5852.3	0.0605	3.89E+10	80465.7	0.50121	13.8042	24.586	358.358	328.323	-1240.58	-5701.28	9.48494	-2.10437	-17.7341	-11.5925
	-4549.95	0.0554514	2.43E+10	82872.7	0.0150484	14.0756	21.9814	378.772	320.122	866.459	-4804.78	9.32682	0.177762	-18.4128	-11.5924
	-5615.93	0.0594314	3.87E+10	85395.4	0.0177641	14.9938	21.737	348.39	330.393	-40.7054	-803.14	9.46576	-0.757524	-17.8996	-12.1455
	-6128.66	0.0599989	5.86E+09	82482.7	0.022684	15.7937	23.5337	318.578	313.61	-1594.82	-5561.16	9.47295	-0.0502173	-18.3411	-12.1791
	-5911.12	0.06046	3.82E+10	79597.1	0.00540948	14.6048	19.8786	343.956	316.997	-1549.64	-4889	9.12806	0.593797	-17.5708	-11.5925
	-5378.96	0.0546049	3.55E+10	79844.9	0.513188	13.4111	20.819	237.504	323.974	-236.878	-2783.49	9.40669	-1.5814	-17.8182	-11.5925
	-6208.09	0.0605	4.11E+10	82806.8	0.0423564	13.6263	19.9244	338.475	330.509	145.801	-5149.57	8.85904	0.0709934	-17.7823	-11.5925
	-6365.98	0.0604318	3.95E+10	82980.4	0.00544314	14.5561	29.7907	373.119	316.579	-3981.64	-589.742	9.45594	-0.734831	-17.6115	-12.1791
	-4865.5	0.0605	2.70E+10	81023.3	0.022684	14.1321	19.6227	264.108	329.156	-895.345	-5298.19	9.31191	-0.709717	-17.9523	-12.1791
	-5753.31	0.0592495	5.53E+10	83182.6	0.0177641	14.3879	19.4463	326.461	329.266	-736.031	-36.6239	9.20092	-1.01499	-18.0679	-11.5925
	-4964.05	0.0495827	3.22E+10	86350.6	7.65341	14.4621	19.5375	354.537	329.072	-98.6246	-4398.36	9.44551	-1.39255	-18.4823	-11.5925
	-5161.97	0.0605	3.97E+10	79778.4	0.0244744	14.5572	22.6856	320.654	312.234	-6486.32	-4736.91	9.2983	-1.06507	-17.1146	-11.5925
	-5635.57	0.0605	4.11E+10	81383.2	0.0054374	14.5234	22.1856	287.145	323.708	562.055	-5532.35	9.13131	0.712591	-18.4878	-12.1791
	-5477.18	0.0605	2.88E+10	83253.2	0.012837	14.4646	20.9163	383.667	322.139	-2281.67	-4092.8	9.208	-2.1219	-18.2742	-11.5925
	-5240.77	0.0605	5.57E+10	82110.1	13.4906	15.0371	19.3914	205.418	324.571	-3193.3	-6020.24	8.90623	-2.27157	-16.7489	-11.5924
	-5635.19	0.0605	2.74E+10	84813.3	0.0447807	15.5438	19.7167	245.99	327.78	-1235.47	-3310.1	9.39152	-1.5261	-17.3734	-11.5925
	-3246.38	0.0605	3.80E+10	83219.6	0.00544314	14.7169	23.0755	303.558	313.476	-1673.84	-4972.31	8.87996	0.484031	-18.4883	-11.5925
	-6168.66	0.0558529	4.47E+10	84716.8	2.94032	13.5461	19.8038	247.696	325.746	-550.653	-5601.88	9.47937	-0.144748	-17.0377	-11.5925
	-4213.77	0.0581465	3.19E+10	80103	0.00538645	16.5718	25.1075	282.189	323.021	-137.129	-5451.53	9.11948	-1.01489	-17.6702	-11.5729
	-3384.87	0.0595524	4.13E+10	82072.8	0.00541907	15.7239	19.2661	329.103	324.07	-1101.79	-4311.6	9.49093	-0.162895	-18.1284	-11.5925
	-5437.75	0.0590881	2.77E+10	87335.7	0.486232	13.3387	19.7886	289.14	323.126	-2199.9	-5897.58	9.47676	0.0210599	-17.9211	-18.4163
	-4154.64	0.0605	3.50E+10	80441.7	0.0226616	15.9632	19.6977	323.442	319.648	-2319.97	-4943.11	9.3123	-1.96752	-16.6269	-11.5925
	-4727.06	0.0605	5.57E+10	83475	0.0300529	15.2459	20.5533	339.345	325.59	2361.6	-3509.27	9.4069	-2.61652	-17.0723	-11.5925
Avg.	-5297.76	0.05870373	3.70E+10	8.28E+04	9.53E-01	1.47E+01	2.14E+01	3.15E+02	3.23E+02	-1.02E+03	-4.30E+03	9.24E+00	-8.91E-01	-1.78E+01	-1.26E+01
Med.	-5457.465	0.0605	38465350000	82881.55	0.02021285	14.6698	20.4192	319.616	324.022	-813.1665	-4883.675	9.297875	-0.923398	-17.91035	-11.5925
Std. Dev.	817.3212483051	0.0033237366	10498474328.5921	2030.9259258268	2.8130712982	0.7900945894	2.3862355564	50.2442400537	5.1944841414	1705.6218308227	1790.4080474217	0.210871267	0.8822055188	0.5520760648	2.2743612411

Local Search, 30 dimensions															
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-8720.03	0.09075	6.14E+10		468222	25.6736	29.4629	465.724	492.399	-709.211	-9489.6	14.5445		-23.8513	-19.687
	-6962.47	0.09075	8.45E+10		544786	26.105	37.1947	476.184	495.891	-2092.66	-1548.36	14.1196		-27.6662	-18.039
	-6961.87	0.0899048	4.08E+10		566160	22.9069	32.2468	572.709	495.119	-724.496	-1085.52	13.6181		-26.3649	-9.98237
	-7022.1	0.09075	4.80E+10		507124	23.5184	32.8019	474.808	504.87	1441.2	-298.734	14.6858		-27.5487	-11.4003
	-7554.77	0.09075	5.62E+10		534480	21.3856	45.2881	407.728	499.809	-1117.15	-6155.89	14.1285		-28.0375	-18.8073
	-7930.32	0.0901661	3.89E+10		507272	21.786	39.2269	585.973	489.683	-559.234	-6021.34	14.2482		-26.9184	-17.1526
	-7671.66	0.09075	6.33E+10		544748	23.9949	39.7063	410.723	496.021	-706.327	-8420.73	14.4966		-27.7328	-18.8073
	-9153.89	0.0896031	5.37E+10		527930	22.0799	31.5884	432.908	498.172	-1000.39	-7023.77	14.0189		-27.4268	-19.6821
	-7475.88	0.0825127	7.43E+10		441660	24.9363	30.6169	441.306	495.542	727.837	-2984.97	14.1608		-27.0882	-18.1224
	-7140.58	0.09075	6.14E+10		461520	22.1797	32.6729	418.557	493.104	-2038.59	-8148.21	13.8726		-27.3871	-17.6842
	-6765.1	0.09075	5.12E+10		442200	22.8712	30.8062	469.99	489.318	-3404.86	-1965.15	13.9313		-27.7029	-11.4003
	-7278.84	0.0705322	4.88E+10		387826	23.6452	29.7264	530.633	493.766	659.589	-2082.03	14.7356		-26.4235	-18.039
	-9804.77	0.09075	3.16E+10		594900	22.2526	30.373	506.952	499.083	-6243.21	-7264.67	14.0242		-25.9648	-11.4003
	-7258.63	0.0815248	5.80E+10		506574	22.0017	38.3344	481.961	499.895	-182.164	-7375.24	14.1801		-26.8838	-17.1526
	-7752.47	0.09075	6.81E+10		594960	23.3336	32.0357	448.093	497.64	121.125	-6137.77	13.9758		-25.8605	-19.5175
	-6427.54	0.0901747	6.75E+10		499020	24.788	39.219	550.8	497.778	197.675	-6537.16	14.0494		-26.9742	-18.3945
	-8048.75	0.09075	7.70E+10		345160	22.4005	31.9327	351.905	500.411	-5356.76	-5318.86	14.3997		-25.4607	-18.3945
	-6922.6	0.0897579	7.72E+10		424932	21.4528	33.8182	440.397	494.772	-670.487	239.404	13.8857		-25.2136	-18.039
	-7534.96	0.09075	5.81E+10		510105	24.7605	34.6564	481.573	493.94	-2080.9	-6633.34	14.5802		-27.3547	-11.4003
	-6626.39	0.0840877	6.24E+10		356637	26.2454	36.2963	508.941	499.447	-1921.38	-7225.03	14.007		-28.186	-19.6828
	-8739.22	0.0833573	6.99E+10		546298	21.9408	33.581	543.216	491.856	-1567.4	-6976.34	13.9828		-28.2896	-11.3613
	-8818.69	0.0885963	3.97E+10		438240	21.1752	36.2528	460.593	499.554	72.1365	-6627.36	14.0521		-27.4075	-11.4003
	-7258.09	0.0861417	3.49E+10		544831	25.094	30.5593	548.84	499.339	-5073.7	-8456.63	14.2453		-25.5684	-19.8561
	-8087.75	0.0903371	5.46E+10		446157	22.9032	32.1424	421.646	492.63	-3900.26	1353.84	13.7392		-26.6823	-19.2993
	-8482.43	0.090039	4.66E+10		552581	22.3861	36.5625	457.61	499.245	1.35286	-7844.48	13.7055		-28.0855	-19.687
	-6528.81	0.09075	6.70E+10		498480	19.5627	34.625	464.465	492.466	-6965.86	-9712.34	14.1021		-26.9693	-18.8073
	-8463.27	0.09075	6.34E+10		479280	24.0583	34.4645	608.036	473.426	-7745.87	-7636.44	14.4946		-26.258	-12.3742
	-8956.81	0.0893575	4.27E+10		431907	23.3802	37.1508	605.869	486.893	-6378.37	-7262.28	13.9651		-27.4611	-12.3742
	-8443.14	0.09075	4.63E+10		660240	23.5017	36.0516	503.756	478.32	-1278.35	-4455.43	13.9693		-27.2419	-17.1526
	-6843.66	0.0894151	7.43E+10		481320	23.2531	29.9386	478.08	499.71	-4075.12	-5839.02	14.2467		-27.0834	-9.98237
Avg.	-7721.183	0.0885336	5.74E+10	4.95E+05	2.32E+01	3.43E+01	4.85E+02	4.95E+02	-2.09E+03	-5.50E+03	-5.50E+03	1.41E+01	-2.69E+01	-2.69E+01	-1.62E+01
Med.	-7544.865	0.0902559	58031700000	502797	23.08	33.6996	475.496	495.7165	-1197.75	-6582.26	-6582.26	14.0771	-27.0858	-27.0858	-18.039
Std. Dev.	879.654776568	0.004344398	13715570303.9744	70598.3086040107	1.561052308	3.7073113996	61.9062241299	6.4821907987	2517.8253815732	3015.9014409368	3015.9014409368	0.2842525403	1.0005521456	1.0005521456	3.6031873219

Iterative Local Search, 10 dimensions																
Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	-2353.48	0.03025	1.88E+10	24168.4	59.988	6.39537	9.35607	117.932	155.879	-145.889	-1646.86	4.03982	-0.302471	-8.64558	-11.5852	
	-2294.56	0.0278096	2.01E+10	23308.8	54.3803	7.99499	9.10285	166.587	155.557	-479.37	-2949.33	4.21134	-0.408084	-8.79464	-8.1772	
	-2847.49	0.0296792	1.70E+10	32302.9	46.5895	7.22062	9.07374	161.811	148.705	-56.1015	-2988.2	3.99908	-0.616554	-8.82742	-8.1772	
	-1682.61	0.0286486	1.90E+10	26081.4	61.7176	6.47021	10.7403	138.539	151.489	-235.288	-2321.48	4.49389	-1.30566	-8.4728	-8.1772	
	-3163.22	0.03025	1.44E+10	15665.2	46.493	7.87339	11.6635	143.48	152.545	-1197.31	-3124.24	4.06124	-1.18534	-8.60302	-8.1772	
	-1564.28	0.0292164	3.22E+10	9609.37	63.0245	6.84956	9.12636	77.5438	158.222	-1306.25	-2504.62	4.49975	-0.577118	-8.69359	-8.1772	
	-3005.3	0.03025	2.60E+10	29121.3	42.5946	7.03493	11.0323	121.662	156.691	-457.272	-2495.34	4.48833	-0.676501	-8.81122	-8.1772	
	-2196.03	0.03025	9.37E+09	24244.2	67.6498	6.47648	9.77288	118.753	156.684	-78.0806	-1123.95	4.65848	-1.34652	-8.80146	-8.1772	
	-2451.6	0.0301868	1.89E+10	31828.8	54.9617	7.78021	9.1522	198.115	153.576	-44.7555	-1719.94	4.49672	0.0368576	-8.82573	-8.1772	
	-2649.5	0.03025	2.35E+10	24122.5	78.0887	7.02654	9.08477	145.058	146.57	-359.588	-2690.69	4.44189	-0.600237	-8.85059	-8.1772	
	-1978.6	0.0302292	1.92E+10	26676.1	67.6724	6.72453	9.32724	184.502	154.944	-978.036	-2567.04	4.49746	0.352732	-8.72541	-8.1772	
	-2590.35	0.03025	1.86E+10	22140.2	67.8106	7.22723	9.27195	184.804	149.624	228.958	-2156.38	4.63231	0.000805103	-8.82982	-19.2635	
	-2492.14	0.0302253	1.45E+10	23038.2	54.4243	6.35673	9.37548	64.1279	158.208	-1552.16	-2516.99	4.1252	-0.977698	-8.62522	-8.1772	
	-3024.64	0.0302113	2.35E+10	21144	68.705	7.64069	15.3717	175.471	156.45	-188.369	-2261.48	4.50388	-0.189495	-8.82071	-19.27	
	-2787.77	0.0299542	3.51E+10	30959.5	87.3445	7.258	9.17457	174.921	154.939	-549.431	-2337.16	4.51863	-0.100004	-8.71327	-11.6076	
	-2412.16	0.03025	2.46E+10	10038.6	49.23	7.00135	9.18972	203.733	153.641	-279.738	-813.436	4.13809	0.0861884	-8.70443	-22.0364	
	-2156.47	0.03025	3.45E+09	7563.02	90.5625	6.32097	9.77328	161.579	153.295	-83.3801	-1182.55	4.45449	-0.394575	-8.82684	-19.2635	
	-3044.69	0.03025	1.32E+10	18228.9	53.0633	6.98713	9.22125	139.567	151.861	-101.129	-2341.09	4.27863	-0.295665	-8.4791	-20.3627	
	-2294.74	0.0128203	6.91E+09	13513	64.0312	8.51433	9.30183	142.512	156.996	-1863.03	-1398.12	4.49987	-0.496323	-8.84694	-8.1772	
	-2946.18	0.0182463	4.41E+09	10620.3	76.5551	7.01442	9.13523	175.317	152.924	63.6296	-2397.78	4.50181	0.0984758	-8.7853	-21.9278	
	-2412.71	0.03025	6.12E+09	21231.5	47.6436	6.37215	9.12583	152.503	151.491	662.344	-2139.36	4.50024	-0.769488	-8.30502	-8.1772	
	-2669.73	0.03025	2.28E+10	18635	46.5956	6.62651	9.1969	179.575	155.756	-1622.23	-2579.85	4.49683	-0.639761	-8.72133	-19.1981	
	-2235.49	0.03025	1.40E+10	28141.5	72.5154	6.69095	9.79442	127.291	145.443	-2020.13	-1634.23	4.42869	-1.00679	-8.78072	-19.2635	
	-2985.69	0.0300519	9.28E+09	37770.1	96.61	7.83742	14.026	184.708	146.4	-590.179	-2498.13	4.26544	-0.0294331	-8.87411	-8.1772	
	-2353.88	0.03025	1.14E+10	38853.2	55.7939	7.34237	9.23642	155.955	156.938	-298.932	-2034.12	4.68428	0.020851	-8.83159	-21.9278	
	-1899.75	0.03025	3.03E+10	19359.5	64.5918	7.09233	10.284	99.3849	153.521	-801.555	-2416.07	4.08334	-0.124733	-8.71859	-19.27	
	-1623.43	0.03025	1.17E+10	18194	72.4011	6.26496	9.88647	133.847	156.223	-1354.62	-2445.64	4.09028	-1.742	-8.69851	-20.3627	
	-3222.55	0.03025	1.86E+10	33430.4	75.1929	6.67338	9.50346	219.224	156.195	-894.692	-1572.32	4.40705	-0.587073	-8.64298	-8.1772	
	-3498.88	0.0256026	1.53E+10	23899.7	72.4134	6.26663	9.14707	169.249	154.033	-1419.25	-2628.3	4.49581	-0.0643777	-8.10856	-8.1772	
	-3044.4	0.0301924	3.41E+10	11088.4	51.1488	6.8859	9.41934	103.838	155.568	-2127.94	-2428.83	4.49982	-1.26039	-8.74994	-8.1772	
Avg.	-2529.4106666667	0.02890247	1.79E+10	2.25E+04	6.37E+01	7.01E+00	9.90E+00	1.51E+02	1.54E+02	-6.71E+02	-2.20E+03	4.38E+00	-5.03E-01	-8.70E+00	-1.28E+01	
Med.	-2471.87	0.03025	18559750000	23173.5	63.52785	6.99424	9.314535	154.229	154.486	-468.321	-2369.435	4.49111	-0.4522035	-8.737675	-8.1772	
Std. Dev.	495.6619476322	0.0038284652	8448356883.66839	8305.8388465674	13.8542434661	0.5807405608	1.4575514207	36.4813660807	3.4660196682	719.7744604556	569.5535684889	0.1984223336	0.5169316097	0.17100592	5.8206220674	

Iterative Local Search, 20 dimensions

Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-4549.4	0.0605	2.51E+10	83731.6	0.651206	14.7944	21.9681	279.695	321.001	-1566.84	-5338.46	9.21621	-0.142619	-17.715	-11.8869
	-6050.16	0.0605	4.55E+10	80745.8	0.268086	16.284	19.3337	343.725	313.969	-1993.75	-4148.75	9.46446	-0.548652	-18.1772	-11.5925
	-5398.23	0.0591995	5.06E+10	82401.3	0.032413	15.3526	23.9768	296.889	321.956	-4633.19	-4848.21	9.01646	0.218791	-18.4282	-11.5925
	-5675.22	0.0605	4.42E+10	82591.3	0.00544314	14.7622	22.6234	331.276	323.228	-4014.04	-5436.05	9.26537	0.626347	-18.2969	-12.1455
	-3976.37	0.0588747	3.25E+10	82036.8	0.0128344	13.9223	25.6647	325.015	329.982	-1246.54	-4823.87	9.12409	-1.33997	-17.3054	-11.5925
	-5082.38	0.0605	2.61E+10	87382.5	0.0201434	14.3422	21.3897	396.392	326.205	-392.775	-6280.62	9.13477	-2.26781	-18.1703	-11.5925
	-5891.86	0.0605	3.85E+10	89279.1	0.684922	15.2594	23.0754	329.302	326.381	-337.14	-3871.16	9.02972	-0.0242582	-18.4513	-11.5925
	-5003.93	0.0605	3.00E+10	85879	0.0151074	14.8268	19.9157	325.527	314.19	-1212.15	-4189.52	9.17302	0.0681864	-18.2963	-11.5925
	-5418.57	0.0605	4.30E+10	82890.7	0.00544314	15.9129	20.2634	332.571	325.788	-1548.21	-5548.41	9.39065	-0.906265	-18.5396	-11.5925
	-5516.7	0.0599162	3.51E+10	82665.9	0.03008	16.1692	19.9074	388.651	327.169	923.714	-563.104	9.20288	-1.59829	-18.1054	-11.5925
	-3937.92	0.0547374	3.35E+10	86354.3	0.0153078	15.3926	19.532	312.15	322.111	-1598.94	-4648.01	8.87789	-1.49817	-17.8506	-11.5925
	-4588.88	0.0605	3.51E+10	81101.4	0.00542657	15.7841	21.7808	357.263	330.684	-1319.67	-4261.9	9.33048	-1.93719	-18.2627	-12.1791
	-5082.97	0.0559769	2.42E+10	76218.4	0.00544314	15.1429	22.4065	346.209	324.783	1500.62	-6032.9	9.18852	-1.88437	-18.2285	-11.5925
	-6070.01	0.0594556	3.21E+10	83486.2	0.0201913	14.966	19.342	393.145	324.682	-404.273	-5094.61	8.57302	0.126058	-16.446	-11.5925
	-5043.31	0.0605	1.85E+10	82935.5	0.220955	14.0295	20.2134	316.233	325.996	2079.2	-4572.43	9.70061	-1.33897	-18.2227	-11.5925
	-5161.34	0.0605	3.87E+10	85337.7	0.00541984	14.9478	19.5923	274.232	327.758	-1727.17	-4684.33	9.01989	0.290542	-18.4796	-12.1791
	-4589.3	0.060484	3.08E+10	83765.5	0.01776	14.714	20.0449	314.196	325.896	-1632.08	-5179.06	8.52944	-0.524841	-18.3505	-18.4163
	-4332.6	0.0600202	6.77E+10	81498.7	0.0153003	16.5447	20.0096	314.165	307.423	1567.7	-4461.73	9.43874	-1.20997	-18.3268	-11.5925
	-6267.41	0.0605	4.65E+10	81603.3	1.88596	16.1234	20.2482	316.52	317.494	-5550.9	-3693.39	9.4962	0.510028	-18.1621	-11.5925
	-4588.98	0.0605	4.06E+10	85076.2	0.0225431	14.0527	20.8396	325.67	324.854	-2326.43	-5346.36	9.33666	-1.32004	-18.555	-11.5925
	-5477.69	0.0604347	5.13E+10	80799.5	0.00535823	14.7108	20.8015	261.241	319.17	485.619	-4782.73	9.17792	-1.22079	-17.7232	-18.1189
	-6109.42	0.0472961	2.54E+10	83373.9	0.177322	15.6127	22.9987	286.368	321.812	-2998.41	-4456.01	8.6997	-2.29998	-18.4625	-11.5925
	-4885.09	0.0570039	4.39E+10	80163.4	0.255374	15.6927	23.8355	324.354	325.002	-1578.78	-4075.51	9.10547	-0.131814	-17.7901	-11.5925
	-4035.51	0.0600693	4.32E+10	81415.3	0.0152417	14.9575	19.5572	296.019	321.434	824.034	-4011.91	9.31902	-1.51993	-17.8755	-11.5924
	-3917.22	0.0586818	4.16E+10	87878.4	0.0128369	14.4221	19.8007	375.301	300.768	1043.95	-5037.25	9.57629	-1.73324	-18.2571	-11.5925
	-5754.04	0.0575467	2.76E+10	83622.3	0.272711	17.8043	20.3977	370.717	317.424	-1133.68	-4973.3	9.0252	-1.10353	-18.3087	-11.5925
	-4786.87	0.0605	5.54E+10	81190	0.0324796	14.4401	19.8204	358.965	296.103	692.475	-4121.91	8.76355	-0.860885	-18.484	-18.4163
	-4510.47	0.0597792	3.24E+10	83530.5	4.0042	16.0272	20.4454	225.399	326.39	-478.625	-5370.33	9.32801	-1.13941	-18.4418	-11.5729
	-5398.26	0.0605	2.12E+10	85510.6	0.43707	14.8375	19.3774	332.986	327.903	-985.672	-316.499	8.94067	0.336942	-17.9256	-11.5925
	-4253.69	0.0600716	3.11E+10	84551	0.0128391	15.5474	21.1043	361.928	322.473	-2662.15	-5159.38	7.88002	-0.784451	-18.5094	-11.5924
Avg.	-5045.1266666667	0.05921826	3.70E+10	8.33E+04	3.06E-01	1.52E+01	2.10E+01	3.27E+02	3.21E+02	-1.07E+03	-4.51E+03	9.11E+00	-8.39E-01	-1.81E+01	-1.23E+01
Med.	-5062.845	0.06045935	35130150000	83154.7	0.02016735	15.05445	20.33055	325.5985	323.955	-1229.345	-4733.53	9.17547	-1.0048975	-18.2599	-11.5925
Std. Dev.	698.8094252189	0.0026900942	10975111347.1528	2619.8872400694	0.791604351	0.8539153929	1.6317417953	39.4394076324	8.0216805796	1808.4389363295	1268.809305736	0.3628603461	0.8562948838	0.4364346365	2.0376857083

Iterative Local Search, 30 dimensions

Function	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	-9410.25	0.0833082	2.47E+10	320497		21.2591	29.99	368.495	473.165	-6278.62	-8324.6	13.026		-28.105	-19.687
	-8976.5	0.0769728	2.89E+10	255960		21.382	29.5846	390.77	473.46	-6837.82	-9171.82	13.5603		-28.2307	-19.8561
	-9489.96	0.0869344	3.07E+10	349495		20.4102	29.7188	389.025	476.709	-6935.81	-9139.13	13.5408		-28.2876	-19.687
	-9074.77	0.0754036	2.83E+10	337920		21.3585	29.459	330.204	459.783	-7391.32	-8408.34	12.9661		-28.411	-19.687
	-9568.94	0.0569313	3.10E+10	338600		21.4582	29.6347	379.984	477.567	-6970.99	-9684.67	13.1975		-28.3428	-19.8561
	-9351.64	-0.0490078	2.68E+10	345600		20.7617	29.9363	7.87853	475.43	-6241.29	-9773.48	13.359		-28.1681	-19.8561
	-124.883	0.0683202	3.31E+10	277860		20.4901	29.4315	374.832	472.378	-7256.36	-9653.19	13.1889		-28.1063	-19.687
	-9924.25	0.0791061	3.19E+10	372780		20.9216	29.7907	373.748	455.648	-6665.63	283.59	12.8196		-28.1588	-19.8561
	-9311.68	0.0746452	3.24E+10	334380		21.3375	29.6274	372.786	472.562	-6572.91	-8859.86	13.3459		-28.316	-19.8561
	-9035.97	0.0662556	3.18E+10	349440		20.4238	30.1293	352.798	478.836	-7007.39	-9049.74	13.4248		-28.2245	-19.8561
	-9864.99	-0.0636759	3.03E+10	312060		21.0197	29.4352	376.266	466.391	-8396.7	-9143.81	13.5041		-28.2922	-19.8561
	-8996.29	0.0789434	2.87E+10	-1.66599		20.6647	29.6205	358.251	479.544	-8751	-10268.6	13.2663		-28.1594	-19.8561
	-9391.2	0.0749528	2.68E+10	338160		20.4382	29.777	345.008	458.006	-5866.24	-8878.84	13.203		-28.3379	-19.8561
	-9450.26	0.0845282	2.94E+10	368202		20.5752	29.6886	368.195	474.65	-8633.36	464.389	13.6934		-3.43673	-19.8561
	-9746.52	0.0751487	2.75E+10	357000		21.1032	29.7037	351.542	467.12	-7698.6	-8541.65	13.0522		-28.3234	-19.8561
	-9865.04	0.0805431	-1.00E+01	330432		20.6857	29.5885	-7.69393	473.355	-6756.61	-9540.85	13.5152		-28.2612	-19.687
	-9272.8	0.0795918	3.80E+10	286598		20.6426	19.8658	371.765	486.552	-6547.46	-9854.97	13.5049		-28.1688	-19.8561
	-10062.5	0.0768222	3.74E+10	350160		20.0135	29.7339	390.477	475.739	-6719.72	-9440.52	13.4156		-28.2127	-19.8561
	-9134.53	0.0711327	3.08E+10	360420		20.3865	29.9421	378.888	462.393	-8281.31	-9663.62	12.4277		-28.2074	-19.8561
	-9390.69	-0.0309291	3.97E+10	295997		20.7647	30.6015	359.88	484.513	-5065.59	-9134.86	13.6274		-28.3904	-19.8561
	-9134.47	0.0804281	4.70E+10	334360		20.6145	27.8698	381.484	474.708	-4226.77	-8811.44	13.4809		-28.0928	-19.8561
	-9568.88	0.0785976	3.02E+10	296580		20.5503	29.785	398.854	455.846	-7596.93	-8997.45	13.5753		-28.1787	-19.8561
	-9272.85	0.0817261	2.52E+10	306300		20.8571	29.6731	380.627	470.576	-6667.08	-9397.49	13.1267		-28.1215	-19.6839
	-9212.05	0.0702678	2.59E+10	335460		20.1083	30.1306	381.129	463.962	-8674.4	-9315.6	12.7335		-28.2767	-19.8561
	-9726.64	0.0741334	3.79E+10	363524		21.4061	29.8537	332.172	458.809	-6933.42	-9365.76	13.402		-28.2994	-19.8561
	-10457.2	0.081483	3.46E+10	313260		21.4092	29.7197	333.342	476.861	-8640.37	-9338.14	13.5832		-28.3677	-19.8561
	-9173.48	0.0870585	3.42E+10	312000		20.6161	29.6849	336	471.518	-6486.48	-9721.42	13.651		-28.1929	-19.8561
	-9133.36	0.0840459	3.16E+10	381645		20.5456	30.4368	362.339	459.739	-6593.12	-9396.22	13.5676		-28.2393	-19.8561
	-9391.21	0.0797617	4.23E+10	346620		20.5208	29.7877	368.834	477.598	-6145.95	-9651.49	13.1248		-28.3445	-19.8561
	-9568.74	0.074442	2.17E+10	311040		18.9379	29.5349	355.219	475.06	-8780	-9200.77	13.5091		-28.3269	-19.8561
Avg.	-9136.0847666667	0.06459572	3.06E+10	3.19E+05	2.07E+01	2.94E+01	3.42E+02	4.71E+02	4.71E+02	-7.05E+03	-8.63E+03	1.33E+01	-2.74E+01	-2.74E+01	-1.98E+01
Med.	-9390.945	0.0768975	30729500000	334920	20.65365	29.71125	368.6645	473.26	473.26	-6885.62	-9258.185	13.4088	-28.235	-28.235	-19.8561
Std. Dev.	1736.4971456685	0.0388817803	7961125157.97467	67087.9428677671	0.5231419506	1.8518270929	94.7625256457	8.3344717638	8.3344717638	1094.2052693977	2486.4963265932	0.3016843863	4.5304816776	4.5304816776	0.0690085236

Random Search Running Times in Seconds

Dimensions	10	20	30
Function 1	0.0028796196	0.0027256012	0.004216671
Function 2	0.0037307739	0.0027096272	0.0042328835
Function 3	0.0027823448	0.0035073757	0.003777504
Function 4	0.0041363239	0.0041460991	0.0026381016
Function 5	0.0037288666	0.003030777	0.0026414394
Function 6	0.0037727356	0.0028493404	0.0026321411
Function 7	0.0035896301	0.0027751923	0.0037312508
Function 8	0.0035607815	0.0028815269	0.0037713051
Function 9	0.0044622421	0.0026602745	0.0027508736
Function 10	0.0040593147	0.0027322769	0.0027010441
Function 11	0.0030579567	0.0026328564	0.0026137829
Function 12	0.0029666424	0.0026972294	0.0026974678
Function 13	0.0027945042	0.003254652	0.0025961399
Function 14	0.0028162003	0.004308939	0.0026042461
Function 15	0.0027165413	0.0028510094	0.0024940968

Local Search Running Times in Seconds

Dimensions	10	20	30
Function 1	0.2714903355	0.3662781715	0.8037896156
Function 2	0.0122189522	0.1061990261	0.0311796665
Function 3	0.0036041737	0.0034754276	0.0039658546
Function 4	0.0045986176	0.0037958622	0.0057651997
Function 5	3.5046873093	107.3777658939	237.3515529633
Function 6	0.0053646564	0.0071499348	0.0078163147
Function 7	0.1593027115	0.1934890747	36.0658888817
Function 8	0.0124971867	0.1606588364	0.0684037209
Function 9	0.0049269199	0.0049231052	0.0069723129
Function 10	0.0056340694	0.0120668411	0.0046567917
Function 11	0.0049116611	0.1781361103	3.4641461372
Function 12	0.0035014153	0.0031409264	0.0071520805
Function 13	0.0022878647	0.0031747818	0.008487463
Function 14	0.0166265965	0.1419093609	0.2867805958
Function 15	0.0709223747	0.0597565174	0.1033499241

Iterative Local Search Running Times in Seconds

Dimensions	10	20	30
Function 1	5.355587244	21.5247523785	47.5882720947
Function 2	0.4999251366	1.151144743	2.4649145603
Function 3	0.0042607784	0.0112228394	0.0144929886
Function 4	0.0058951378	0.0114533901	0.0161828995
Function 5	150.1059572697	2928.3961615563	N/A
Function 6	0.0101454258	0.0255510807	0.0222308636
Function 7	32.4964332581	41.5021996498	168.8056237698
Function 8	0.3526818752	1.6770370007	3.8826031685
Function 9	0.0110986233	0.0125215054	0.0229070187
Function 10	0.0899729729	0.2644715309	0.7342042923
Function 11	30.093629837	165.0208876133	384.6772966385
Function 12	297.458874464	25.3617525101	21.2174470425
Function 13	0.0197796822	0.0436241627	0.0463643074
Function 14	1.5726833344	7.7616007328	9.7854065895
Function 15	6.6486163139	23.9164574146	32.7224471569

6 Previous Results

Function	Dimensionality	Mean	Median	Deviation	Avg. Time
Schwefel's	10	40.03647	0.0623	547.27404	3.1285
	20	-273.92765	16.52	883.3137	2.942
	30	-63.79153	255.3487	925.71758	3.132
De Jong's	10	3775.96667	3772	3116.12957	0.667
	20	3748.5	4105	2885.095608	0.132
	30	3429.8334	3429	2608.0073	0.0933
Rosenbrock	10	2093118197.7	951513386	2466626292.4	0.90
	20	2109933654.57	997811808.5	2696811330.46	1.679
	30	1784558137.97	543961363	2372214627.61	2.98
Rastrigin	10	318.2	262.5	289.575003684	1.04
	20	202.2666667	111	232.951516834	1.98
	30	309.9	246	264.111829763	2.788
Griegwangk	10	27.326983	22.8316	19.94304775	1.32
	20	22.247975	18.4916	17.41881647	4.98
	30	25.04950833	24.1043	19.11108789	5.67
Sine Envelope Sine Wave	10	-4.70534	-4.6083	0.2380683	1.112
	20	-9.805175	-9.6732	0.3503130	2.223
	30	-15.1282	-15.0166	0.410964	4.121
Stretched V Sine Wave	10	-5.85114	-5.8511	4.5168102e-15	3.55
	20	-12.3524	-12.35	5.420172e-15	6.88
	30	-18.8536	-18.8537	3.61344822e-15	9.87
Ackley's One	10	187.917	184.0721	33.190007	3.1298
	20	389.45238	382.962	40.1378	4.6731
	30	593.39786	599.1116	64.28003	8.7728
Ackley's Two	10	217.1978	217.922	2.26465	3.055
	20	456.7024	459.70244	6.447889	7.001
	30	698.9139	700.1936	4.42437	8.4356
Egg Holder	10	-374.3114	-529.396	877.367109	1.998
	20	-197.32204	-339.2197	1196.0543	4.7621
	30	-533.43484	-507.8253	1366.0572	6.9981
Rana	10	126.682	92.4435	762.991158	5.1433
	20	44.632258	144.748	897.22947	9.4239
	30	147.21517	280.21517	1161.5825	14.221
Pathological	10	4.7605744	4.5666	0.320334	3.1561
	20	10.02892	9.9324	0.485784	3.9714
	30	15.28425	15.1622	0.66075	4.9912
Michalewicz	10	0.904288	0.942	0.544008	1.3241
	20	1.73464	1.5955	0.733736	3.1149
	30	2.108609	1.9897	0.974908	4.8229
Masters Cosine Wave	10	0.6488827	0.5623	2.0702	2.3341
	20	-1.492407	-1.0483	2.270724	3.4256
	30	0.885458	0.9459	3.441345	5.3243
Shekel's Foxhole	10	-0.2105669	-0.2023	0.038925	4.5623