CS 471 Project 2

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1 Introduction

The Project 2 is about to create and execute 3 Algorithms to find optimized result of 18 functions. First algorithm is Random Walk which is Blind Algorithm. The idea of algorithm randomly picks the solution and compare to initial solution until iteration time is expired. The Second and third algorithm is Local Search and Iterative Local search. The idea of Local Search is that randomly pick the solution from result.which is generated from random numbers. And from that point, search the solution which is neighbor of solution. Local search keep search until get the best value in the neighbor area of the randomly picked solution. Iterative Local Search algorithm is to find the best solution from iterating local search solution. The Ideal iteration time of Random Walk and Iterative Local Search Algorithms are infinite because it depends on luck. For project2, I set the 30 times iteration for Random Walk and Iterative Local Search.The Results are 30 times for 30 times iterative Random Walk and 30 times iterative iterative Local Search.

2 Analyze table

The result are 9 tables about 30 times iterative Random Walk, Local search ,and iterative local search with size 10, 20, and 30. Ideally, Iterative local search should have the most optimized values among the 3 algorithms' result because iterative local search has the biggest search area compare to Random Walk.And compare to local search, Iterative local search has more iteration time.

For the size 10 of 3 algorithms(Table1, Table4, and table7), Average of the results are lower than size 20 and 30 because statistically range of the size 10 input matrix is smaller than size 20 and 30. One interesting thing of size 10 is that Stretched V sine wave function has 0 standard deviation. It is because Stretched V Sine Wave has sine value inside. sine value's result range is -1 to 1. Execution time is larger in order Random search, Local Search, and local search.

For the size 20(Table2,Table5, and table8), average and median of the result for 18 functions are medium of size 10 and size 30. However, for the min value and max value of the result it can be smallest in size 10, 20, and 30.

For the size 30(Table3, Table6, and Table9), The average of result is higher than size 10 and size 20. According to all tables, Pathological(F(x12)) function and Masters'Cosine Wave(F(x14)) function has the smallest value which is the close to 0. The execution time for the algorithm Random Search is longer than Iterative Random Search.

3 Conclusion

As you seen from the 9 tables, I found that we cannot get the optimized values for all the functions without luck because for the input matrix, we generate randomly. And pick the value randomly from the result for 3 algorithms. In this case, to get a smallest value, we should increase iteration time and decrease size of input matrix.Even if we increase iteration time and decrease size of vectors, it will required too much time to get optimized solutions for 18 functions and still need fortune to get the optimized answer. Even if we get optimized value for the functions, it's only one time solution. we cannot

expect the same value come out for next execution. I assume that to get a optimized value with shorter time. I should find the best vectors for best solutions and set the input random range inside of the best vector's range for each function. I found that to get more optimized value, we should modify the range for each functions with analysis best solutionss' input vector's range.

Table 1: RANDOMSEARCH (30times)

size=10	AVERAGE	MIN(Best)	MAX	MEDIAN	SD	executionti
f(x1)	-1384.929138	-5148.397181	1658.722823	-1288.80156	1568.586404	92009.7582
f(x2)	46658.45428	17741.41202	100161.4716	30711.6703	26316.42481	
f(x3)	23116099872	6131264678	54855739423	18104307814	13668228331	
f(x4)	410419.7886	124799.1689	892037.7363	316847.3481	205953.4047	
f(x5)	304.4053182	131.1736308	756.8602445	233.7496344	171.5847318	
f(x6)	-3.85701194	-8.566174796	-0.60342367	-3.601951946	2.026427488	
f(x7)	24.85985829	16.57323886	49.71971659	16.57323886	11.30772596	
f(x8)	265.0505611	81.84066393	716.6244403	210.310737	143.163786	
f(x9)	268.8009345	142.468751	565.4389831	188.6283378	124.6761024	
f(x10)	-8442.256352	-12239.03249	-3425.467573	-8356.262273	2299.820295	
f(x11)	-4982.83117	-10100.04922	-2304.992339	-4738.763445	1666.457279	
f(x12)	6.385772973	3.271516496	13.69610694	4.516453015	2.978143184	
f(x13)	-32.62660451	-39.51381321	-29.14387922	-31.97886709	2.599878925	
f(x14)	-17.29925748	-30.47645716	-11.14591619	-17.20764385	3.999805939	
f(x15)	869517165.6	100959225.3	2163468119	646134459.7	625432443.1	
f(x16)	15578.40992	3326.717348	35818.1688	14563.39672	8667.861078	
f(x17)	47401.626	18109.14492	101858.6111	31169.42403	26709.15596	
f(x18)	448.9817525	176.6115429	1045.513031	322.7402084	251.9570522	

Table 2: RANDOMSEARCH (30times)

size=20	AVERAGE	MIN(Best)	Max	Median	Standard	time(ms)
f(x1)	654.6952716	-6445.460682	4446.152529	1096.792185	2221.597341	115448.181
f(x2)	104717.0063	42263.7533	225054.2579	79658.85796	52799.19539	
f(x3)	59795965282	22451956153	1.30004E+11	51799817292	28712357104	
f(x4)	1898479.543	795360.8222	4973822.531	1457676.041	1064034.232	
f(x5)	632.5194568	263.4205986	1533.034419	489.2679085	347.3963049	
f(x6)	-9.376407908	-14.68770344	-3.846593624	-9.148188314	2.911200914	
f(x7)	55.98071794	34.98794871	139.9517948	34.98794871	29.91489017	
f(x8)	619.1972846	291.3059615	1373.885994	427.7232099	331.9392567	
f(x9)	614.1073488	346.2962044	1470.238983	393.6223656	327.523732	
f(x10)	-12701.83708	-23988.60552	-6686.970599	-11721.9827	3765.904236	
f(x11)	-7881.906505	-12697.93582	-3548.79219	-7352.477308	2327.811144	
f(x12)	14.03591015	6.648822237	35.8677735	9.565370306	7.670935724	
f(x13)	-64.64988879	-71.07099682	-57.5336782	-64.30825673	3.5069618	
f(x14)	-27.45382149	-48.4393352	-12.26384586	-28.51528755	8.038804512	
f(x15)	5091687433	1065152084	11255310995	4930115776	2608978135	
f(x16)	37803.99044	12189.21123	85331.016	33864.21147	21056.69057	
f(x17)	106301.1027	42992.84307	228620.9869	80768.91671	53624.41499	
f(x18)	1014.349086	473.4451178	2277.18506	786.9055149	517.3341895	

Table 3: RANDOMSEARCH (30times)

size=30	AVERAGE	MIN(Best)	Max	Median	Standard	
f(x1)	2977.768215	-7385.527291	6611.353265	3651.06673	2991.333651	131570.0122
f(x2)	153740.7555	79632.34847	363380.5675	113539.3264	90894.46151	
f(x3)	88577977791	40043183915	2.08884E+11	71875529053	51717258535	
f(x4)	4124096.504	1538643.018	11216843.32	2791110.198	2664249.801	
f(x5)	920.2868635	387.6753447	2411.405708	669.7607629	604.5384881	
f(x6)	-17.13276765	-34.49605331	-8.443892969	-15.61473	6.876985541	
f(x7)	82.86619432	53.40265856	213.6106342	53.40265856	50.07650027	
f(x8)	896.0086158	455.7771256	2432.502876	614.5418875	558.970365	
f(x9)	902.2621404	545.4479867	2354.818519	595.372066	549.2819087	
f(x10)	-17499.63209	-26744.91314	-12239.17439	-16594.2594	4893.381592	
f(x11)	-8867.100578	-15102.02434	-4491.32849	-8476.917724	3129.012184	
f(x12)	21.25079069	10.99072197	56.72623775	14.57585751	13.21972003	
f(x13)	-98.55521803	-110.4669714	-88.83142581	-98.66116289	18.86493263	
f(x14)	-29.75881582	-46.95613459	-13.80931199	-27.63056071	10.07580256	
f(x15)	12218835052	3686652678	27757234817	10064816800	6757251152	
f(x16)	59219.84936	18453.56341	147288.006	44724.12304	37015.65559	
f(x17)	156065.657	81009.36676	369010.7422	115155.0788	92281.87037	
f(x18)	1521.668622	786.5293056	3834.099539	1022.377276	935.1915352	

Table 4: Local Search(30times)

SIZE=10	Average	MIN(Best)	MAX	MEDIAN	SD	time(ms)
f(x1)	3102.766112	-2378.13469	6608.720933	3760.311375	2377.216665	3057.8929
f(x2)	33510.87686	9125.330721	48514.96477	34700.67362	8097.937949	
f(x3)	18500708977	1729816757	32676003582	18627350458	7102701487	
f(x4)	275591.8675	122766.6817	443704.8101	265745.2515	72343.49851	
f(x5)	216.6725666	99.21967664	323.1774525	206.1111745	60.49301421	
f(x6)	-2.116490317	-17.51376997	5.650508789	-2.300753187	4.287856988	
f(x7)	16.57323886	16.57323886	16.57323886	16.57323886	0	
f(x8)	176.0732626	134.8118526	236.1379123	171.5364283	24.62259202	
f(x9)	180.4719525	161.477638	193.6448299	181.6210905	7.742811686	
f(x10)	-1835.01953	-14393.22979	7315.9656	-1365.717315	4215.692099	
f(x11)	-714.021397	-6031.44859	3498.479909	-702.6268143	2057.833401	
f(x12)	4.380658845	3.253049952	4.961191412	4.487666889	0.409421016	
f(x13)	-30.27522184	-38.15292021	-24.20160317	-29.47314847	3.356660712	
f(x14)	-2.759363046	-14.96623649	9.174944526	-2.497646081	6.355970876	
f(x15)	782411423.3	24462844.41	1373411311	789190870	359401660.8	
f(x16)	11767.91782	3679.917759	24447.063	11888.25196	5319.134556	
f(x17)	34013.27952	9375.750835	49163.50039	35221.21081	8174.64794	
f(x18)	324.2977814	119.5903157	525.9498768	300.3098449	86.87963459	

Table 5: Local Search(30times)

SIZE=20	Average	MIN(Best)	MAX	MEDIAN	SD	time(ms)
f(x1)	5519.880659	-718.5028931	13376.5796	6025.821334	3534.196379	3843.1747
f(x2)	66296.42243	47351.68743	94928.14309	63821.73324	13608.63468	
f(x3)	37196416479	22938540978	61497539202	32900202370	11536023906	
f(x4)	1180561.303	711638.7225	1523842.363	1212109.174	228433.6976	
f(x5)	396.9314663	271.3415601	521.8372332	402.8762352	64.34524839	
f(x6)	-3.455208827	-16.24410318	9.99452703	-2.174986556	6.547145707	
f(x7)	34.98794871	34.98794871	34.98794871	34.98794871	7.23E-15	
f(x8)	377.6810227	301.7722711	447.9611803	381.449725	39.23687738	
f(x9)	382.4194739	355.5844202	399.5461433	384.1191687	11.17117415	
f(x10)	-3594.478666	-10824.22423	2571.005584	-2452.796436	3567.983479	
f(x11)	-1655.328089	-8623.927406	6098.270077	-1789.399518	3332.161305	
f(x12)	8.939345384	4.966490524	10.0618443	9.257655338	1.012697541	
f(x13)	-63.17069489	-72.89493381	-52.16625161	-62.6204449	4.997324581	
f(x14)	-5.842829499	-33.21520825	25.84819913	-6.562579754	14.4545393	
f(x15)	3393745896	1443370450	6282326542	3118625770	1279794056	
f(x16)	27182.05107	12860.16067	42472.89463	25872.08857	8225.790245	
f(x17)	67303.41369	48192.06585	96208.24963	64780.35838	13732.18831	
f(x18)	637.4943682	449.4013922	830.093114	654.0096021	89.74471626	

Table 6: Local Search(30times)

SIZE30	Average	MIN(Best)	MAX	MEDIAN	SD	time(ms)
f(x1)	10582.58158	2313.928992	20440.24701	11686.57924	3867.711811	4204.47071
f(x2)	100610.7237	64895.9671	123913.5505	103357.6518	13850.57489	
f(x3)	58888928708	23829158503	79093003283	60395850220	12634677101	
f(x4)	2829327.346	2382629.339	3581493.384	2799802.323	324998.6999	
f(x5)	656.7719625	469.0013793	931.0040118	654.4501415	116.3607396	
f(x6)	-2.905215247	-18.81102487	6.671370962	-1.661647049	6.286453928	
f(x7)	53.40265856	53.40265856	53.40265856	53.40265856	2.17E-14	
f(x8)	576.7108708	444.1058655	711.1366845	569.9334992	55.29136608	
f(x9)	581.8022712	538.7515236	605.2156223	583.1379927	16.34543334	
f(x10)	-6554.427606	-22423.7427	3440.339563	-5213.27439	5968.218725	
f(x11)	-2356.335767	-8691.463261	7451.202909	-2105.874724	3510.764594	
f(x12)	13.47190158	11.33044015	15.01291943	13.75900025	1.149893575	
f(x13)	-99.29313138	-110.0667705	-87.60991951	-98.95549484	6.185594842	
f(x14)	-5.105066651	-33.40382493	32.4497605	-5.198169232	13.68399008	
f(x15)	8177965937	3660177011	12134012971	8116242647	2203972863	
f(x16)	38400.79339	19679.08026	66349.49024	39350.00005	8867.75725	
f(x17)	102126.6303	66047.29301	125668.6757	104918.74	13987.92726	
f(x18)	968.4614893	644.9655686	1157.616231	999.0216917	129.9037795	

Table 7: Iterative Local Search(30times)

SIZE=10	Average	MIN(Best)	MAX	MEDIAN	SD	time(ms)
f(x1)	-2025.814463	-4883.788912	-176.9119193	-1915.078999	1509.898545	90763.774
f(x2)	16146.78724	8350.688423	21258.23262	14801.68607	3577.749378	
f(x3)	4461869322	1532541857	8802164609	4177896452	1862383878	
f(x4)	138579.2126	72727.3375	189040.2623	148834.7838	34831.16809	
f(x5)	100.934348	70.46418619	149.3275585	104.5144551	19.43009947	
f(x6)	-5.337973703	-7.665450038	-2.218863003	-4.085835088	1.359678709	
f(x7)	16.57323886	16.57323886	16.57323886	16.57323886	0	
f(x8)	110.5721362	56.64193098	134.5807487	115.2831823	19.72631034	
f(x9)	154.7861992	122.2525629	170.2745444	159.2971183	10.61657241	
f(x10)	-9453.156529	-13280.78678	-6147.732554	-8756.764061	1767.59572	
f(x11)	-6215.754098	-9319.616872	-3778.772198	-6033.301305	1432.341265	
f(x12)	2.642682344	0.94638375	3.33502565	2.915146041	0.530154316	
f(x13)	-37.78829594	-41.07182114	-33.86943522	-36.63588941	1.833158938	
f(x14)	-23.22744742	-33.93422615	-14.93213602	-17.87292847	4.838162896	
f(x15)	137148621.3	14992431.39	279447803.4	108015225.3	60965728.03	
f(x16)	4211.501062	1686.739887	6397.006562	3663.668445	1175.305062	
f(x17)	16473.30033	8578.12119	21654.82667	15110.80666	3622.826119	
f(x18)	168.096305	119.809061	210.6645567	147.4472018	26.21261021	

Table 8: Iterative Local Search(30times)

SIZE=20	Average	MIN(Best)	MAX	MEDIAN	SD	time(ms)
f(x1)	-921.878087	-5334.991462	2567.971844	-1468.380891	2091.870074	113358.30
f(x2)	39791.50277	31485.909	48865.84087	35429.59408	4169.513879	
f(x3)	16621968618	9213041356	25056361145	16571443378	3493857082	
f(x4)	730374.5323	587631.9696	949465.3837	666545.042	99818.55462	
f(x5)	247.996336	193.2839977	298.3346766	259.343394	26.23257587	
f(x6)	-14.20566105	-19.82064653	-7.876032381	-12.13060437	3.401209538	
f(x7)	34.98794871	34.98794871	34.98794871	34.98794871	7.23E-15	
f(x8)	280.341937	212.2186421	334.1527063	275.9713999	22.81839029	
f(x9)	348.8708369	327.8301953	363.5687469	348.8796881	9.390414425	
f(x10)	-14641.98418	-22190.90729	-9338.400377	-17764.32006	3857.199491	
f(x11)	-9911.592582	-17642.10557	-5340.931685	-11289.01543	2838.137851	
f(x12)	6.781970453	4.222497496	7.98790941	6.445669956	0.867262476	
f(x13)	-74.81718794	-81.11453274	-70.61400019	-74.64436925	2.559967691	
f(x14)	-31.74503598	-48.43198641	-19.55593374	-30.4503526	6.63897331	
f(x15)	1289244221	862150229.8	1720991500	1614874673	254657040.3	
f(x16)	13254.16914	7854.201379	16964.65691	12751.09236	1856.454864	
f(x17)	40531.68922	32145.99025	49724.09565	36099.3054	4214.357628	
f(x18)	413.4502848	301.2242239	494.7229997	433.284854	40.17118636	

Table 9: Iterative Local Search(30times)

SIZE=30	Average	MIN(Best)	MAX	MEDIAN	SD	time(ms)
f(x1)	1773.799933	-3526.004821	6166.211889	-234.5870631	2499.320194	131125.12
f(x2)	68373.95886	49694.86586	79297.80981	67801.01587	6890.778111	
f(x3)	31477898420	22228473642	37984994975	34308550499	4562417362	
f(x4)	1850107.229	1215170.547	2234576.797	2076652.336	199640.0562	
f(x5)	422.3739281	316.5284457	511.9451145	385.9210378	44.44749498	
f(x6)	-19.68457596	-28.77191416	-10.96580516	-19.30537731	3.985320156	
f(x7)	53.40265856	53.40265856	53.40265856	53.40265856	2.17E-14	
f(x8)	458.689725	417.4345401	512.9906563	463.7232812	21.48658974	
f(x9)	544.0829099	518.3570003	561.7990444	538.5319454	11.05573653	
f(x10)	-18477.88311	-30100.41937	-11646.55043	-22119.63977	3615.615765	
f(x11)	-11903.39601	-21470.43301	-6476.455105	-9888.055581	3236.624579	
f(x12)	11.11437085	8.985050563	12.80631024	10.77621305	0.858799848	
f(x13)	-110.8109424	-118.8554189	-104.9300386	-108.2779092	2.874312657	
f(x14)	-39.7190528	-61.54058267	-26.17552644	-50.09380492	8.916369963	
f(x15)	3759873867	2382677393	4800045529	4149564414	653859006.5	
f(x16)	23234.2925	16964.68776	31530.4787	20173.91087	3282.564703	
f(x17)	69575.8267	50673.44978	80583.18315	68956.914	6966.140452	
f(x18)	688.5272243	564.6272454	801.8245152	687.7368975	61.46736134	