Work Report 08.09.2017

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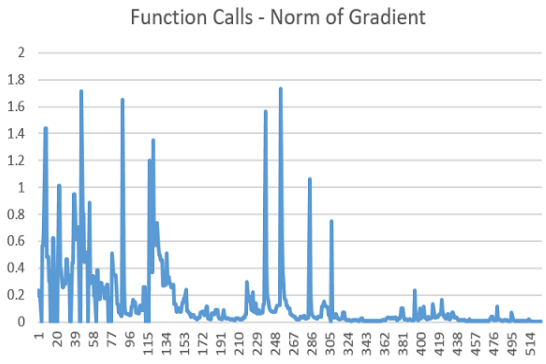
1 Curvature Plots for a Random Mitigation Vector

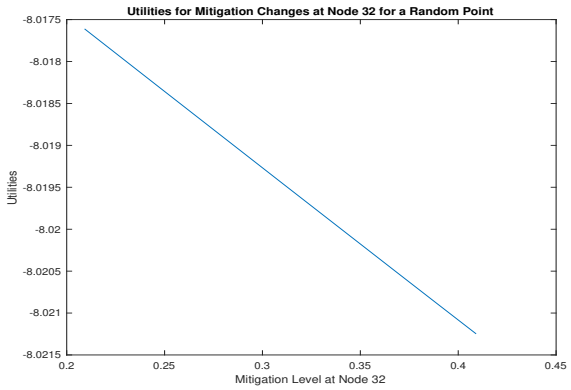
This time we would like to investigate the curvatures for points other than the optimal one. In this case, we fix an arbitrary point, a 63×1 vector, whose entries are randomly picked from (0,1]. Like what we did for the optimal point, we do mitigation changes of size 0.02 in 1 and 2 dimensions and generate the plots for utilities.

When we do 1-dimensional change, the plots typically look like the 2 shapes below. What we see in Figure 1b is more like a straight line.

Figure 1: Utilities with 1-dimension Mitigation Change



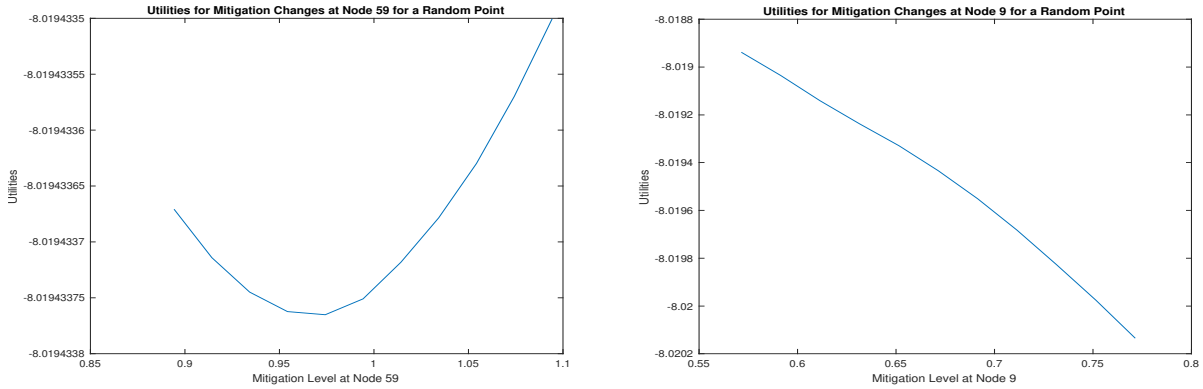
(a) Node 5



(b) Node 32

We get some convex curves, but we also observe a few concave ones. See Figure 2a and 2b.

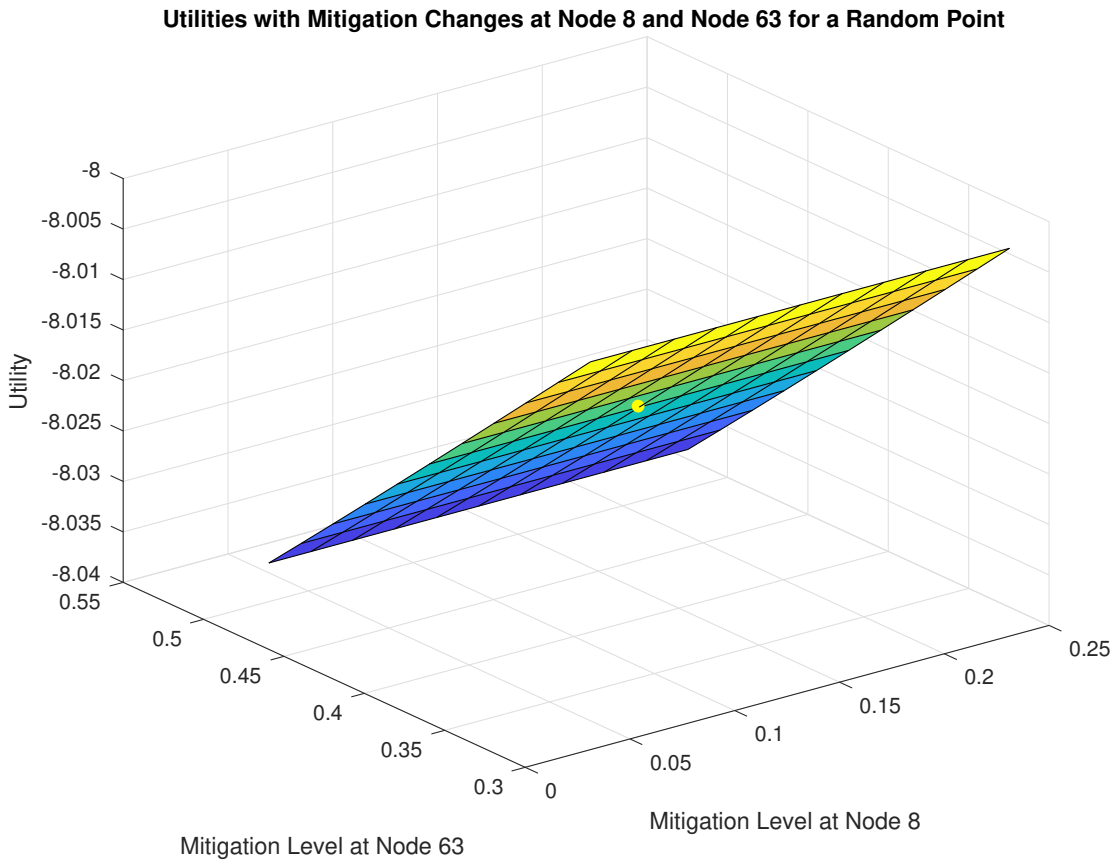
Figure 2: Utilities with 1-dimension Mitigation Change



(a) Node 59 (b) Node 9

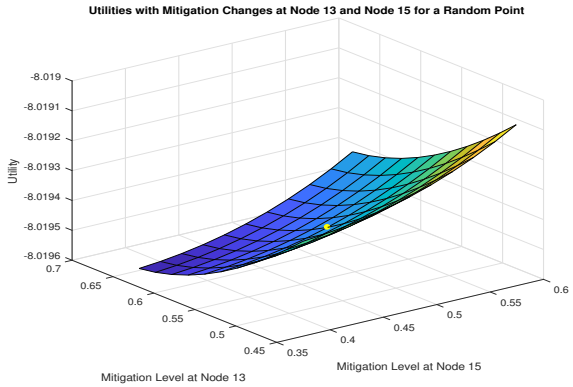
When it comes to the 2-dimensional changes, the resulted figures also look quite different from those at the optimal point. Most of the plots have a flat plane like Figure 3 below.

Figure 3: Utilities with 2-dimension Mitigation Change

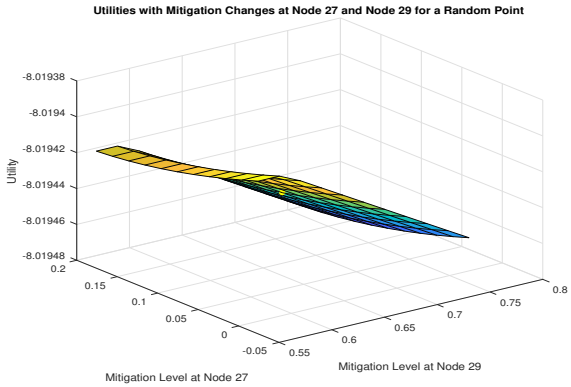


There are more typical shapes that we can take a look at.

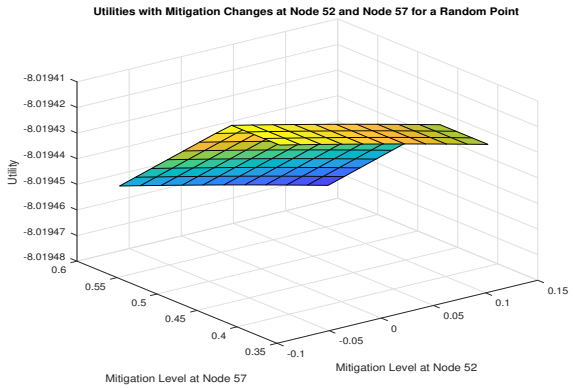
Figure 4: Utilities with 1-dimension Mitigation Change



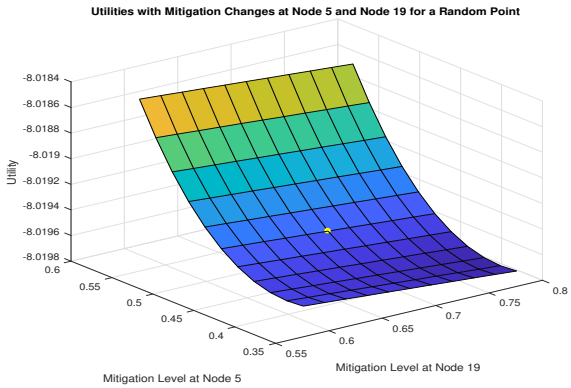
(a) Node 13 and 15



(b) Node 27 and 29



(c) Node 52 and 57



(d) Node 5 and 19

2 Plots for Norm of Gradients During Optimization

We draw graphs of the number of function (utility and gradient) evaluations v.s. norm of gradient to see whether the algorithm struggles far from the solution or in the neighbourhood of the solution.

Table 1: Iteration and Function Evaluation for Each Test

ID of test	1	2	3	4	5
Number of iterations	249	218	263	247	212
Number of Function Evaluation	615	594	288	670	557

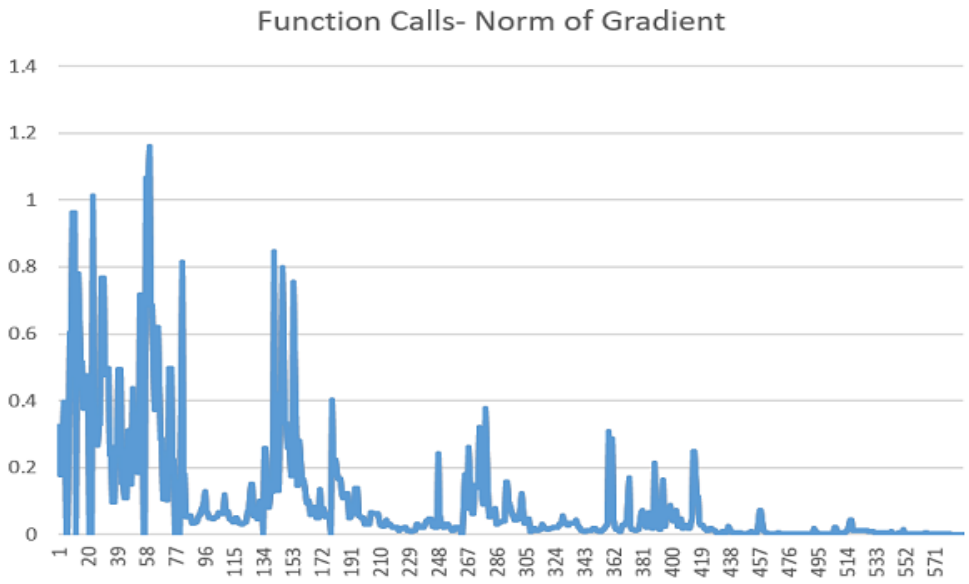


Figure 5: test1

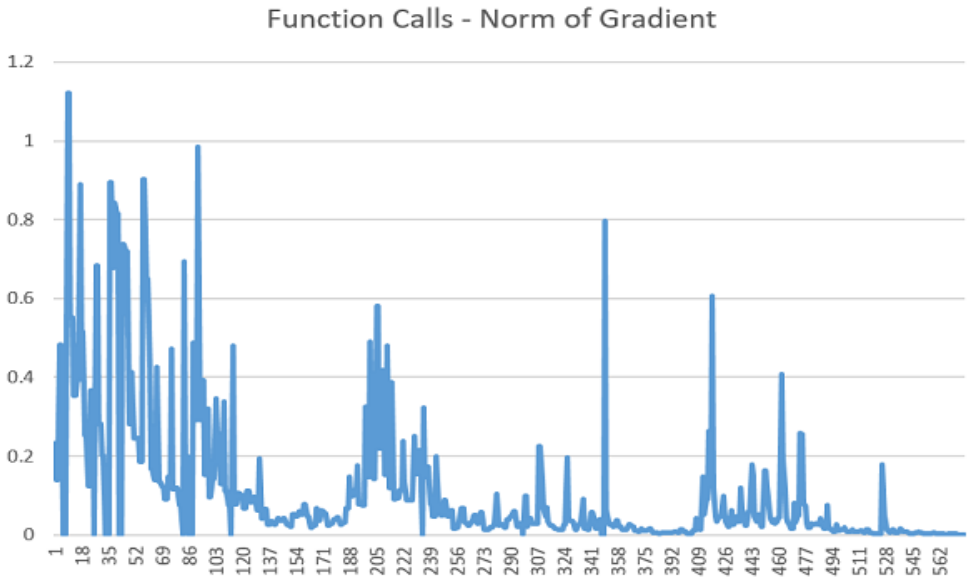


Figure 6: test2

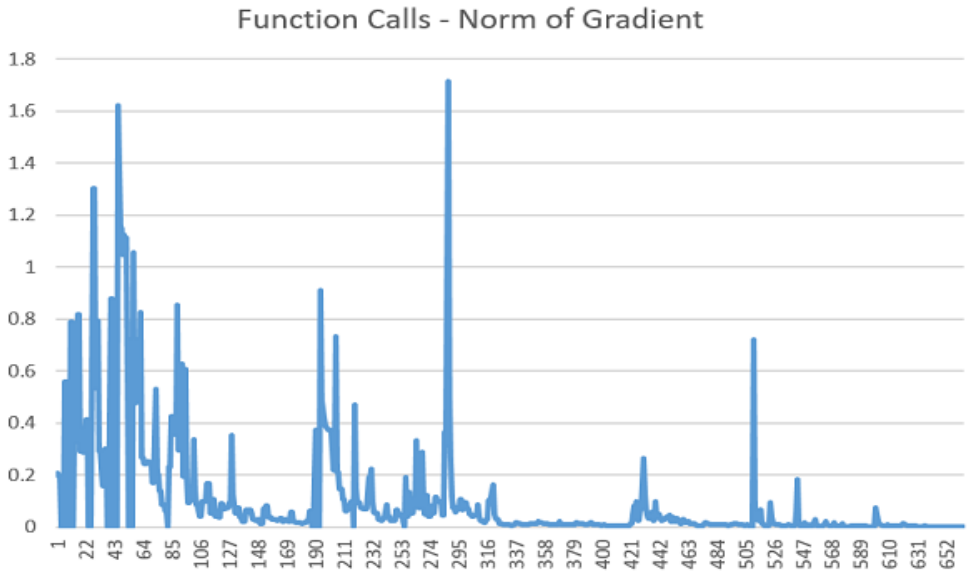


Figure 7: test3

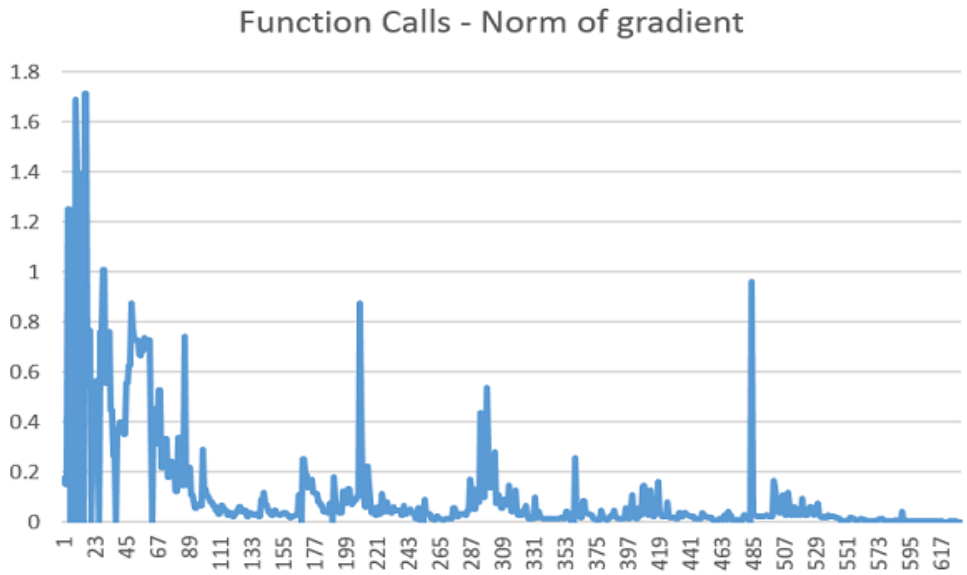


Figure 8: test4

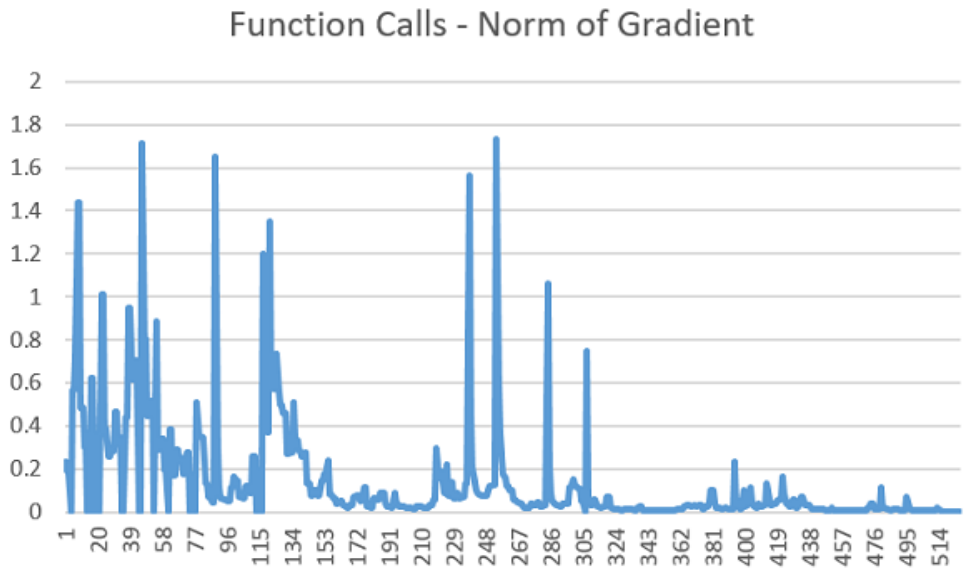
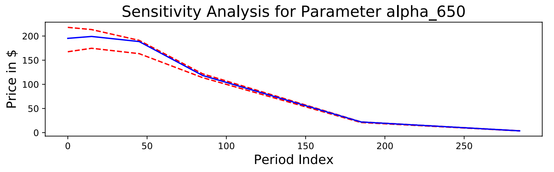


Figure 9: test5

Raw data are attached at the end of the report.



	In 0 Years	In 15 Years	In 45 Years	In 85 Years	In 185 Years	In 285 Years
Expected Price	194.73871499	196.809572587	182.021904937	116.904995828	21.3182780582	3.64956640826

	Iteration Number	Utility at Start Point	Norm of Gradient
Test 1	242.0	9.46115417106	0.000780044501014
Test 2	199.0	9.46588101504	0.000789716933154
Test 3	191.0	9.46890270608	0.000813179235259
Test 4	234.0	9.40920520007	0.000842571430383
Test 5	228.0	9.53901113366	0.000833015655218
Test 6	213.0	9.49616201189	0.000653497810532
Test 7	227.0	9.41546732809	0.000544053739924
Test 8	292.0	9.43505828367	0.000961569793356
Test 9	222.0	9.27017602096	0.000810957647261
Test 10	196.0	9.49830005261	0.000756597939517
Test 11	230.0	9.43885447873	0.000776367974391
Test 12	244.0	9.33087843575	0.000992286723712
Test 13	246.0	9.41976162518	0.000999952529078
Test 14	246.0	9.49481122729	0.000920325018434
Test 15	201.0	9.44506125494	0.000676412310411
Test 16	215.0	9.45565113758	0.000866989908511
Test 17	198.0	9.44640712551	0.000808102486123
Test 18	246.0	9.34023216228	0.000919999143385
Test 19	221.0	9.54316904857	0.00063396803125
Test 20	228.0	9.5056451619	0.000656066635701
Test 21	182.0	9.40424319064	0.000964618741292
Test 22	205.0	9.22948189357	0.000770434063176
Test 23	202.0	9.39641712607	0.000889309993124
Test 24	369.0	9.55405414006	0.00153530716365
Test 25	23.0	7.82024632799	0.000943536698864
Test 26	233.0	9.44083022993	0.000871143899072
Test 27	161.0	9.55008339237	0.00092346540538
Test 28	212.0	9.48349835182	0.000952359982479
Test 29	319.0	9.53186457149	0.000221151521851
Test 30	222.0	9.53128689362	0.000664991775223
Test 31	240.0	9.49645268289	0.000999151748778
Test 32	169.0	9.51247059568	0.000978191245101
Test 33	221.0	9.32826614329	0.000840881524548
Test 34	242.0	9.47870762801	0.000893160742002
Test 35	170.0	9.42173540468	0.000942910850069
Test 36	211.0	9.52381089286	0.000930979027628
Test 37	212.0	9.54520414226	0.000808483681067
Test 38	212.0	9.49087536636	0.000853128804149
Test 39	205.0	9.35033659097	0.00096611327023
Test 40	222.0	9.50455856835	0.000900017154851
Test 41	273.0	9.58330558141	0.000928780421208
Test 42	375.0	9.57020248567	0.0301135275814
Test 43	228.0	9.4167539443	0.000545094279155
Test 44	303.0	9.5432433217	0.000259100050401
Test 45	360.0	9.53661995065	0.00053430185743
Test 46	384.0	9.56848663477	0.00828408015656
Test 47	203.0	9.47723325725	0.000811971185977
Test 48	302.0	9.55721474711	0.000989470280304
Test 49	368.0	9.58298138431	4.30761955291e-05
Test 50	235.0	9.46927532754	0.000822229928395
Test 51	193.0	9.47475114632	0.000547304716527
Test 52	387.0	9.58111149115	0.00057381903567
Test 53	266.0	9.53729643987	0.000816549157227
Test 54	259.0	9.49570009368	0.000921845755874
Test 55	279.0	9.4523474601	0.000747277563168
Test 56	166.0	9.47490516764	0.000993421114485
Test 57	209.0	9.51754491982	0.00093976044094
Test 58	231.0	9.50239598555	0.000785971029293
Test 59	220.0	9.38182273605	0.000965979786858
Test 60	199.0	9.52567155596	0.000887158289408
Test 61	234.0	9.43499686875	0.000804884509234
Test 62	188.0	9.48657179843	0.00072073940688
Test 63	210.0	9.44317605356	0.000676184849012
Test 64	215.0	9.47878027722	0.000781843142351
Test 65	227.0	9.45903352552	0.000999264751854
Test 66	195.0	9.46150082065	0.000882322696193
Test 67	268.0	9.3317984254	0.000972842233228
Test 68	388.0	9.56725743387	0.00768147243552
Test 69	254.0	9.36840043335	0.000964569214323
Test 70	189.0	9.51965406032	0.000466923631553
Test 71	235.0	9.51997554389	0.000824694472684
Test 72	284.0	9.45684704742	0.000936807104987
Test 73	168.0	9.48190916501	0.000874015722967
Test 74	376.0	9.56159468487	0.00555708339902
Test 75	288.0	9.49989882811	0.000963384229069
Test 76	188.0	9.2643127422	0.000941621632036
Test 77	287.0	9.58397534772	6.07122413148e-05
Test 78	196.0	9.40075517021	0.000709631179744
Test 79	210.0	9.41767601196	0.000917759961371
Test 80	380.0	9.58364526993	0.0167835681865
Test 81	240.0	9.35458203134	0.000996404269428
Test 82	208.0	9.44246667083	0.000982983439863
Test 83	356.0	9.54083739898	0.000301455645519
Test 84	242.0	9.40665954435	0.000888361640892
Test 85	268.0	9.35041874063	0.000842962628219
Test 86	213.0	9.49232225853	0.00074280717323
Test 87	233.0	9.47501972811	0.000833818234353
Test 88	229.0	9.35500418113	0.000976657156857
Test 89	372.0	9.54937800017	0.0346810214518
Test 90	362.0	9.53786074147	0.00021495771107
Test 91	229.0	9.49249795718	0.000916620418447
Test 92	254.0	9.4124565445	0.000888252486251
Test 93	230.0	9.32704088831	0.000984450874383
Test 94	216.0	9.53492517624	0.000857223201225
Test 95	279.0	9.4428519408	0.000962839630195
Test 96	279.0	9.33827417038	0.000902216876153
Test 97	144.0	9.50339587337	0.00083307447568
Test 98	202.0	9.44820368916	0.000926654226946
Test 99	242.0	9.51851403309	0.000876566546266
Average	242.111111111	9.45017723658	0.00180328671365

utility	norm of grad	utility	norm of grad	utility	norm of grad
-8.0551	0.3242	-8.1016	0.2324	-8.1113	0.2057
-8.1259	0.1787	-8.1444	0.1399	-8.1472	0.1948
-8.1259	0.1787	-8.1444	0.1399	-8.1472	0.1948
-8.2053	0.3944	-8.2409	0.4816	-2.7648E-18	3.6735E-19
-8.2053	0.3944	-8.2409	0.4816	-5.4238E-17	1.7016E-18
-2.4862E-15	1.1692E-15	-8.6852	1.5875	-3.3187E-15	1.9992E-16
-8.8387E-13	7.6226E-13	-8.6852	1.5875	-8.6579	0.5587
-8.2206	16.9946	-2.197E-15	3.2618E-15	-8.6579	0.5587
-8.7491	0.6018	-1.001E-12	1.806E-13	-1.032E-12	1.4611E-13
-8.7415	4.8273	-4.3122E-09	9.0417E-08	-3.979E-07	7.537E-08
-8.8252	0.9628	-8.8185	1.1225	-8.5981	6.0818
-8.8583	1.1994	-8.8185	1.1225	-8.6747	0.7912
-2.8635E-15	9.2358E-16	-8.9448	0.5516	-8.6747	0.7912
-7.5962	35.0516	-8.9448	0.5516	-4.992E-09	2.7428E-09
-8.8668	0.7781	-8.8871	3.323	-8.6822	4.7955
-8.8668	0.7781	-9.0282	0.3529	-8.6822	4.7955
-8.994	2.501	-9.0282	0.3529	-8.833	0.6808
-8.994	2.501	-8.9426	2.0748	-8.833	0.6808
-9.0102	0.3778	-9.0366	0.3928	-8.077	28.1451
-9.0617	0.4746	-9.0441	0.5154	-8.9022	0.2919
-2.8555E-15	8.6707E-16	-9.0609	0.2525	-8.9294	0.2866
-3.259E-07	9.4852E-07	-9.0609	0.2525	-8.9908	0.4123
-9.0482	1.0118	-9.0781	0.1251	-8.9908	0.4123
-9.0895	0.3535	-9.0781	0.1251	-8.1623E-18	7.1639E-18
-9.0892	0.2676	-9.1088	0.3666	-2.4988E-15	1.1167E-15
-9.0902	0.3311	-9.1088	0.3666	-3.3302E-15	2.0431E-16
-8.8052	5.1834	-2.8941E-13	9.9629E-15	-9.0561	1.3038
-9.0909	0.7671	-8.4743	24.7942	-9.0561	1.3038
-9.0909	0.7671	-9.1143	0.6825	-9.0557	0.5345
-9.0271	1.4905	-9.1143	0.6825	-9.0816	0.7946
-9.1063	0.4781	-9.1397	0.2807	-9.0816	0.7946
-9.1063	0.4781	-9.1397	0.2807	-9.1188	0.2935
-9.0874	0.4951	-9.1839	0.201	-9.1188	0.2935
-9.1247	0.2401	-9.1839	0.201	-9.1297	0.1571
-9.1247	0.2401	-1.8242E-15	5.4773E-15	-9.1297	0.1571
-9.1644	0.1499	-9.2493	0.7374	-5.0558E-17	1.1351E-16
-9.1644	0.1499	-9.2493	0.7374	-2.7768E-15	7.9256E-16
-9.1471	0.4364	-9.0112	5.7636	-3.3126E-15	2.334E-16
-9.1663	0.2191	-9.2582	0.7192	-2.8565E-11	5.5893E-11
-9.1663	0.2191	-9.2582	0.7192	-9.1657	1.6216
-9.18	0.1855	-9.2833	0.2806	-9.1926	1.1487
-9.18	0.1855	-9.2833	0.2806	-9.1926	1.1487
-8.8614	10.7615	-9.2665	0.4121	-9.1883	1.0478
-9.1985	0.7165	-9.2886	0.2458	-9.1925	1.1262
-9.1985	0.7165	-9.2886	0.2458	-9.1932	1.1124
-2.9634E-15	2.504E-16	-9.2979	0.2455	-9.1932	1.1124

-9.2683	0.6841	-9.3063	0.9024	-9.0105	7.8998
-9.2987	0.373	-9.2797	1.2609	-9.2357	1.0566
-9.2987	0.373	-9.3152	0.6508	-9.2488	0.4798
-9.3173	0.6205	-9.3152	0.6508	-9.2488	0.4798
-9.3173	0.6205	-9.2909	0.4259	-9.1946	2.6446
-9.3271	0.2844	-9.332	0.1669	-9.2825	0.5749
-9.3271	0.2844	-9.332	0.1669	-9.2825	0.5749
-9.34	0.1061	-9.3426	0.1403	-8.9762	4.7465
-9.34	0.1061	-9.3426	0.1403	-9.2679	0.8259
-9.349	0.1038	-9.3379	0.4255	-9.3007	0.2692
-9.349	0.1038	-9.3462	0.1335	-9.3007	0.2692
-9.3498	0.4973	-9.3462	0.1335	-9.3093	0.2441
-9.3643	0.2221	-9.3504	0.1204	-9.3093	0.2441
-9.3643	0.2221	-9.3504	0.1204	-9.3135	0.2529
-1.0306E-12	1.3366E-13	-9.3585	0.0917	-9.3135	0.2529
-9.2442	4.1939	-9.3585	0.0917	-9.3235	0.2496
-9.396	0.1585	-9.2157	4.929	-9.3235	0.2496
-9.396	0.1585	-9.3683	0.1479	-9.3443	0.1707
-1.0316E-12	1.2935E-13	-9.3683	0.1479	-9.3443	0.1707
-7.6067	39.8813	-9.3576	0.4726	-9.1246	5.5758
-9.3748	0.8145	-9.3696	0.1155	-9.3319	0.5322
-9.3994	0.1783	-9.3696	0.1155	-9.3448	0.2021
-9.3994	0.1783	-9.3719	0.1182	-9.3448	0.2021
-9.4058	0.0527	-9.3719	0.1182	-9.3508	0.1391
-9.4058	0.0527	-9.3751	0.0759	-9.3508	0.1391
-9.4098	0.0575	-9.3751	0.0759	-9.3535	0.0875
-9.4098	0.0575	-2.8408E-15	6.2445E-16	-9.3535	0.0875
-9.4115	0.035	-3.0968	140.4448	-9.3594	0.0635
-9.4115	0.035	-9.3695	0.6939	-9.3594	0.0635
-9.4128	0.0385	-9.3866	0.1998	-3.2425E-13	4.6423E-15
-9.4128	0.0385	-9.3866	0.1998	-9.3102	2.1984
-9.4137	0.061	-5.0524E-17	6.9427E-17	-9.3764	0.2318
-9.4137	0.061	-5.4903E-17	7.7463E-19	-9.3764	0.2318
-9.4148	0.0791	-2.9459E-15	3.3529E-16	-9.2767	3.2878
-9.4148	0.0791	-5.6918	43.6537	-9.3772	0.4255
-9.411	0.1293	-9.2946	1.8148	-9.3772	0.4255
-9.416	0.065	-9.3828	0.4875	-9.3842	0.3574
-9.416	0.065	-9.3907	0.2904	-9.3842	0.3574
-9.4171	0.0501	-9.3907	0.2904	-9.3746	0.8548
-9.4171	0.0501	-9.1585	5.5859	-9.3945	0.2952
-9.4181	0.0462	-9.3694	0.9859	-9.3945	0.2952
-9.4181	0.0462	-9.3953	0.2927	-9.2218	2.2167
-9.419	0.0528	-9.3953	0.2927	-9.3766	0.6293
-9.419	0.0528	-9.3293	1.4698	-9.3977	0.1953
-9.4209	0.0668	-9.3894	0.391	-9.3977	0.1953
-9.4209	0.0668	-9.3988	0.1512	-9.3804	0.6061
-9.4227	0.0624	-9.3988	0.1512	-9.3977	0.1991

-9.4227	0.0624	-9.3964	0.3206	-9.3997	0.0935
-9.2273	7.2812	-9.401	0.0956	-9.3997	0.0935
-9.4217	0.118	-9.401	0.0956	-9.4022	0.108
-9.4237	0.0678	-9.4033	0.1418	-9.4022	0.108
-9.4237	0.0678	-9.4033	0.1418	-9.3906	0.3372
-9.4257	0.0477	-9.3966	0.3452	-9.4018	0.1465
-9.4257	0.0477	-9.4034	0.2589	-9.4032	0.0844
-9.4262	0.038	-9.4034	0.2589	-9.4032	0.0844
-9.4262	0.038	-9.4063	0.1278	-9.4042	0.0432
-9.4268	0.0507	-9.4063	0.1278	-9.4042	0.0432
-9.4268	0.0507	-9.4018	0.3384	-9.4052	0.097
-9.4271	0.0352	-9.4086	0.1109	-9.4052	0.097
-9.4271	0.0352	-9.4086	0.1109	-9.4062	0.0965
-9.4274	0.0306	-9.4126	0.0756	-9.4062	0.0965
-9.4274	0.0306	-9.4126	0.0756	-9.4066	0.1672
-9.4282	0.0387	-3.7541E-07	7.0492E-07	-9.4066	0.1672
-9.4282	0.0387	-9.4036	0.4802	-9.4104	0.0542
-9.4293	0.0675	-9.4169	0.0769	-9.4104	0.0542
-9.4293	0.0675	-9.4169	0.0769	-9.4119	0.1066
-9.4302	0.1516	-9.4181	0.1064	-9.4119	0.1066
-9.4302	0.1516	-9.4181	0.1064	-9.4141	0.0398
-2.9862E-11	2.2956E-11	-9.4242	0.0821	-9.4199	0.0716
-9.4396	0.2579	-9.4242	0.0821	-9.4223	0.075
-9.4396	0.2579	-9.4259	0.0953	-9.4223	0.075
-9.4416	0.0824	-9.4259	0.0953	-9.4233	0.0942
-9.4416	0.0824	-9.4275	0.0618	-9.4233	0.0942
-9.4475	0.1286	-9.4275	0.0618	-9.4085	0.3526
-9.4146	0.845	-9.423	0.1941	-9.4227	0.1267
-9.4458	0.1931	-9.4283	0.0425	-9.4245	0.0552
-9.4486	0.1318	-9.4283	0.0425	-9.4245	0.0552
-9.4487	0.4214	-9.4288	0.0657	-9.4246	0.0755
-9.4487	0.4214	-9.4288	0.0657	-9.4246	0.0755
-9.2851	6.879	-9.4292	0.0251	-9.4258	0.0355
-9.4417	0.7972	-9.4292	0.0251	-9.4258	0.0355
-9.4524	0.3334	-9.4294	0.0338	-9.4262	0.0214
-9.4524	0.3334	-9.4294	0.0338	-9.4262	0.0214
-9.4093	1.2605	-9.4298	0.0263	-9.4266	0.0643
-9.4563	0.2621	-9.4298	0.0263	-9.4266	0.0643
-9.4563	0.2621	-9.4305	0.0402	-9.4263	0.0586
-9.4619	0.1753	-9.4305	0.0402	-9.4269	0.0641
-9.4619	0.1753	-9.4305	0.0357	-9.4269	0.0641
-9.4149	0.7552	-9.4305	0.0357	-9.4274	0.0284
-9.4549	0.368	-9.4309	0.0406	-9.4274	0.0284
-9.4635	0.1479	-9.4309	0.0406	-9.4278	0.0238
-9.4635	0.1479	-9.4311	0.0269	-9.4278	0.0238
-9.4587	0.2792	-9.4311	0.0269	-9.4281	0.0297
-9.4637	0.1665	-9.4314	0.0201	-9.4281	0.0297

-9.4637	0.1665	-9.4314	0.0201	-9.4283	0.0135
-9.4634	0.1527	-9.4318	0.053	-9.4283	0.0135
-9.4649	0.0955	-9.4318	0.053	-9.4284	0.0685
-9.4649	0.0955	-9.4321	0.0461	-9.4284	0.0685
-9.4647	0.0998	-9.4321	0.0461	-9.4286	0.0828
-9.4658	0.061	-9.4319	0.0596	-9.4286	0.0828
-9.4658	0.061	-9.4324	0.0517	-9.4289	0.0369
-9.466	0.0817	-9.4324	0.0517	-9.4289	0.0369
-9.466	0.0817	-9.4329	0.0763	-9.4293	0.03
-9.4668	0.0499	-9.4329	0.0763	-9.4293	0.03
-9.4668	0.0499	-9.433	0.0467	-9.4297	0.0301
-9.4662	0.1355	-9.433	0.0467	-9.4297	0.0301
-9.4671	0.0772	-9.4336	0.0172	-9.4301	0.0246
-9.4671	0.0772	-9.4336	0.0172	-9.4301	0.0246
-9.4678	0.052	-9.4337	0.0231	-9.4303	0.0315
-9.4678	0.052	-9.4337	0.0231	-9.4303	0.0315
-9.4693	0.0606	-9.4335	0.0682	-9.4306	0.0225
-9.4693	0.0606	-9.4338	0.0365	-9.4306	0.0225
-8.8531E-13	1.0417E-12	-9.4337	0.0585	-9.4312	0.0208
-8.2544	24.3574	-9.4338	0.0542	-9.4312	0.0208
-9.4562	0.4031	-9.4338	0.0542	-9.4315	0.0576
-9.4714	0.2216	-9.434	0.0227	-9.4315	0.0576
-9.4714	0.2216	-9.434	0.0227	-9.4317	0.0202
-9.4699	0.1853	-9.4341	0.0296	-9.4317	0.0202
-9.4718	0.1672	-9.4341	0.0296	-9.4319	0.0169
-9.4718	0.1672	-9.4346	0.0385	-9.4319	0.0169
-9.4718	0.1241	-9.4346	0.0385	-9.4321	0.0168
-9.4734	0.1086	-9.435	0.0442	-9.4321	0.0168
-9.4734	0.1086	-9.435	0.0442	-9.4324	0.015
-9.4752	0.1237	-9.4353	0.0252	-9.4324	0.015
-9.4752	0.1237	-9.4353	0.0252	-9.4325	0.0174
-9.4761	0.0514	-9.4359	0.0303	-9.4325	0.0174
-9.4761	0.0514	-9.4359	0.0303	-9.433	0.0241
-9.477	0.0619	-9.4363	0.0683	-9.433	0.0241
-9.477	0.0619	-9.4363	0.0683	-9.434	0.0603
-9.4776	0.1378	-9.4357	0.1479	-9.434	0.0603
-9.4784	0.056	-9.4369	0.0991	-2.9571E-15	2.3513E-16
-9.4784	0.056	-9.4401	0.1133	-3.0556E-07	2.9179E-06
-9.4796	0.0487	-9.4401	0.1133	-9.4378	0.3742
-9.4796	0.0487	-9.4284	0.1751	-9.4378	0.3742
-9.48	0.0317	-9.44	0.0824	-3.1484E-13	1.3437E-13
-9.4802	0.0298	-9.4403	0.0762	-3.1909E-07	2.1019E-06
-9.4802	0.0298	-9.4403	0.0762	-8.9012	24.0411
-9.4803	0.0653	-9.4357	0.3238	-9.4104	0.9109
-9.4803	0.0653	-9.4409	0.1475	-9.4326	0.4904
-9.4806	0.063	-9.4409	0.1475	-9.4364	0.4195
-9.4806	0.063	-9.4343	0.4899	-9.4374	0.3906

-9.4807	0.0619	-9.4402	0.2254	-9.4377	0.3863
-9.481	0.0282	-9.4422	0.5813	-9.4378	0.3733
-9.4812	0.0243	-9.4422	0.5813	-9.4378	0.3733
-9.4812	0.0243	-9.4609	0.218	-9.4451	0.2179
-9.481	0.0428	-9.4609	0.218	-9.4451	0.2179
-9.4811	0.028	-9.4468	0.4176	-9.4392	0.733
-9.4812	0.0303	-9.4631	0.1522	-9.4506	0.211
-9.4812	0.0303	-9.4631	0.1522	-9.4506	0.211
-9.4813	0.023	-9.4527	0.4796	-9.4557	0.1449
-9.4813	0.023	-9.4647	0.1179	-9.4557	0.1449
-9.4813	0.0229	-9.4647	0.1179	-9.4599	0.1055
-9.4813	0.0229	-9.4622	0.388	-9.4599	0.1055
-9.4814	0.0138	-9.4666	0.0902	-9.4629	0.0611
-9.4814	0.0138	-9.4666	0.0902	-9.4629	0.0611
-9.4815	0.0182	-9.4675	0.0931	-9.4643	0.0691
-9.4815	0.0182	-9.4675	0.0931	-9.4643	0.0691
-9.4816	0.0207	-9.4687	0.1136	-9.4725	0.0964
-9.4816	0.0207	-9.4687	0.1136	-9.4725	0.0964
-9.4817	0.0122	-9.4641	0.2379	-3.4117E-09	1.3591E-08
-9.4817	0.0122	-9.4678	0.1333	-9.0728	9.5987
-9.4818	0.0081	-9.4686	0.0888	-9.454	0.4689
-9.4818	0.0081	-9.4688	0.088	-9.4707	0.1488
-9.4818	0.0131	-9.4688	0.088	-9.4729	0.0946
-9.4818	0.0131	-9.4703	0.0881	-9.4729	0.0946
-9.482	0.0298	-9.4703	0.0881	-9.4748	0.0745
-9.482	0.0298	-9.4701	0.2509	-9.4748	0.0745
-9.4821	0.0205	-9.4716	0.1538	-9.4774	0.0705
-9.4821	0.0205	-9.4716	0.1538	-9.4774	0.0705
-9.4823	0.0219	-9.4752	0.213	-9.4789	0.0698
-9.4823	0.0219	-9.4752	0.213	-9.4789	0.0698
-9.4826	0.042	-5.7182E-09	1.58E-09	-9.4803	0.1914
-9.4826	0.042	-9.323	3.3709	-9.4803	0.1914
-9.4829	0.048	-9.4664	0.3234	-9.4738	0.2239
-9.4829	0.048	-9.4764	0.146	-9.4793	0.0988
-9.4832	0.0256	-9.4764	0.146	-9.4802	0.0595
-9.4832	0.0256	-9.476	0.1719	-9.4803	0.0525
-9.4836	0.0225	-9.4785	0.0764	-9.4803	0.0525
-9.4836	0.0225	-9.4785	0.0764	-9.4809	0.0288
-9.4718	0.2408	-9.4794	0.0457	-9.4809	0.0288
-9.482	0.058	-9.4794	0.0457	-9.4813	0.0253
-9.4834	0.0395	-9.4782	0.1984	-9.4813	0.0253
-9.4836	0.022	-9.4795	0.0788	-9.4815	0.0347
-9.4836	0.022	-9.4795	0.0788	-9.4815	0.0347
-9.4838	0.0305	-9.4802	0.0484	-9.4813	0.0854
-9.4838	0.0305	-9.4802	0.0484	-9.4817	0.0396
-9.484	0.0216	-9.4811	0.0873	-9.4817	0.0396
-9.484	0.0216	-9.4811	0.0873	-9.4818	0.0259

-9.4843	0.0136	-9.4817	0.0477	-9.4818	0.0259
-9.4843	0.0136	-9.4817	0.0477	-9.4821	0.0245
-9.4844	0.0206	-9.4821	0.062	-9.4821	0.0245
-9.4844	0.0206	-9.4821	0.062	-9.4824	0.0676
-9.4849	0.0219	-9.4823	0.0167	-9.4824	0.0676
-9.4849	0.0219	-9.4823	0.0167	-9.4827	0.0483
-3.2119E-13	4.0602E-14	-9.4825	0.0194	-9.4827	0.0483
-4.6455E-07	4.7624E-08	-9.4825	0.0194	-9.4834	0.041
-9.4876	0.078	-9.4823	0.0504	-9.4834	0.041
-9.4876	0.078	-9.4825	0.0676	-2.9578E-11	2.0458E-11
-9.4816	0.2618	-9.4825	0.0676	-9.4821	0.1915
-9.4868	0.0935	-9.4826	0.0318	-9.4855	0.0403
-9.4877	0.0637	-9.4826	0.0318	-9.4855	0.0403
-9.4877	0.0637	-9.4827	0.023	-9.4849	0.1333
-9.4877	0.1488	-9.4827	0.023	-9.4858	0.0549
-9.4881	0.1407	-9.4829	0.0345	-9.4858	0.0549
-9.4881	0.1407	-9.4829	0.0345	-9.4865	0.0804
-9.4873	0.1333	-9.4833	0.0124	-9.4865	0.0923
-9.489	0.0535	-9.4833	0.0124	-9.4873	0.0505
-9.489	0.0535	-9.4834	0.014	-9.4873	0.0505
-9.4891	0.0763	-9.4834	0.014	-9.4872	0.1241
-9.4891	0.0763	-9.4835	0.0191	-9.4876	0.0421
-9.489	0.0776	-9.4835	0.0191	-9.4876	0.0421
-9.4895	0.0307	-9.4835	0.0238	-9.4874	0.0803
-9.4895	0.0307	-9.4835	0.0238	-9.4878	0.0529
-9.4896	0.0387	-9.4822	0.1043	-9.4878	0.0529
-9.4896	0.0387	-9.4833	0.0684	-9.4878	0.1123
-9.4898	0.042	-9.4835	0.0238	-9.4878	0.1123
-9.4898	0.042	-9.4836	0.0264	-9.4886	0.0981
-9.4898	0.1563	-9.4836	0.0264	-9.4886	0.0981
-9.4898	0.1563	-9.4837	0.0175	-9.4886	0.0998
-9.4894	0.1014	-9.4837	0.0175	-9.489	0.0463
-9.4898	0.0784	-9.484	0.0376	-9.489	0.0463
-9.4899	0.0597	-9.484	0.0376	-9.4894	0.3641
-9.4899	0.0597	-9.4841	0.0467	-9.4894	0.3641
-9.4901	0.0427	-9.4841	0.0467	-9.362	1.714
-9.4901	0.0427	-9.4845	0.059	-9.4646	0.5028
-9.4903	0.046	-9.4845	0.059	-9.4838	0.2503
-9.4903	0.046	-9.4848	0.0221	-9.488	0.1164
-9.4887	0.1227	-9.4848	0.0221	-9.489	0.0759
-9.4901	0.0806	-9.4855	0.0275	-9.4893	0.0788
-9.4903	0.0359	-9.4855	0.0275	-9.4894	0.0597
-9.4903	0.0359	-3.1645E-07	1.2349E-06	-9.4894	0.0693
-9.4903	0.0469	-9.4881	0.0988	-9.4894	0.0693
-9.4903	0.0469	-9.4881	0.0988	-9.4898	0.1051
-9.4906	0.0106	-9.4858	0.0219	-9.4898	0.1051
-9.4906	0.0106	-9.4892	0.0403	-9.4897	0.0641

-9.4906	0.0179	-9.4892	0.0403	-9.4899	0.0953
-9.4906	0.0179	-9.4901	0.0285	-9.4899	0.0953
-9.4907	0.0114	-9.4901	0.0285	-9.4899	0.0713
-9.4907	0.0114	-9.4911	0.0295	-9.4899	0.0713
-9.4907	0.0169	-9.4911	0.0295	-9.4902	0.0489
-9.4907	0.0169	-9.4912	0.2238	-9.4902	0.0489
-9.4907	0.0301	-9.4912	0.2238	-9.4902	0.0427
-9.4908	0.0187	-9.4754	0.144	-9.4902	0.0427
-9.4908	0.0187	-9.4847	0.0664	-9.4904	0.0476
-9.4909	0.014	-9.4892	0.0467	-9.4904	0.0476
-9.4909	0.0175	-9.4905	0.0686	-9.4897	0.0868
-9.4909	0.0175	-9.491	0.0348	-9.4903	0.0423
-9.491	0.0231	-9.4912	0.0247	-9.4904	0.0265
-9.491	0.0231	-9.4912	0.0226	-9.4904	0.0265
-9.4911	0.0208	-9.4912	0.0226	-9.4905	0.0176
-9.4911	0.0208	-9.4915	0.0156	-9.4905	0.0176
-9.4914	0.032	-9.4915	0.0156	-9.4905	0.0292
-9.4914	0.032	-9.4918	0.014	-9.4905	0.0292
-9.4348	2.2068	-9.4918	0.014	-9.4906	0.1029
-9.4909	0.0566	-9.4919	0.0127	-9.4906	0.1029
-9.4916	0.0372	-9.4919	0.0127	-9.4881	0.1128
-9.4916	0.0372	-9.4922	0.0266	-9.49	0.1614
-9.4918	0.0279	-9.4922	0.0266	-9.4905	0.05
-9.4918	0.0279	-9.491	0.1972	-9.4906	0.0342
-9.4918	0.0335	-9.4922	0.0354	-9.4906	0.0297
-9.4918	0.0335	-9.4922	0.0354	-9.4906	0.0297
-9.492	0.0359	-9.4924	0.0345	-9.4907	0.0129
-9.492	0.0359	-9.4924	0.0345	-9.4907	0.0129
-9.4916	0.0424	-9.4925	0.0143	-9.4907	0.0103
-9.4921	0.0206	-9.4925	0.0143	-9.4907	0.0103
-9.4921	0.0206	-9.4925	0.0261	-9.4908	0.0111
-9.4922	0.0135	-9.4925	0.0261	-9.4908	0.0111
-9.4922	0.0135	-9.4923	0.034	-9.4908	0.0107
-9.4922	0.0079	-9.4925	0.0915	-9.4908	0.0107
-9.4922	0.0079	-9.4925	0.0166	-9.4909	0.007
-9.4923	0.0129	-9.4925	0.0166	-9.4909	0.007
-9.4923	0.0129	-9.4926	0.0129	-9.4909	0.0105
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-9.4923	0.0133	-9.4926	0.0569	-9.491	0.0186
-9.4922	0.0179	-9.4926	0.0569	-9.491	0.0186
-9.4923	0.0175	-9.4926	0.045	-9.491	0.0147
-9.4923	0.0125	-9.4926	0.015	-9.491	0.0147
-9.4923	0.0125	-9.4926	0.015	-9.4911	0.0106
-9.4923	0.0098	-9.4927	0.0388	-9.4911	0.0106
-9.4923	0.0098	-9.4927	0.0388	-9.4912	0.0098
-9.4923	0.0147	-2.7752E-11	2.2338E-13	-9.4912	0.0098
-9.4923	0.0147	-3.1088E-11	2.4573E-13	-9.4913	0.0102

-9.4923	0.0273	-9.4646	0.796	-9.4913	0.0102
-9.4923	0.0273	-9.4911	0.0646	-9.4913	0.0121
-9.4732	0.3085	-9.4925	0.0347	-9.4913	0.0121
-9.4876	0.1572	-9.4927	0.0252	-9.4913	0.0139
-9.4913	0.2868	-9.4927	0.0252	-9.4913	0.0139
-9.4921	0.0443	-9.4928	0.021	-9.4914	0.015
-9.4923	0.0264	-9.4928	0.021	-9.4914	0.015
-9.4923	0.0142	-9.4928	0.037	-9.4913	0.0197
-9.4923	0.0142	-9.4928	0.037	-9.4914	0.0178
-9.4924	0.008	-9.4929	0.0214	-9.4914	0.0158
-9.4924	0.008	-9.4929	0.0214	-9.4914	0.0158
-9.4924	0.0296	-9.4929	0.0125	-9.4915	0.0132
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-9.4924	0.0376	-9.493	0.0122	-9.4915	0.0118
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-9.4921	0.1692	-9.493	0.025	-9.4915	0.0094
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-9.4925	0.0143	-9.493	0.021	-9.4916	0.008
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-9.4919	0.2128	-9.4934	0.0051	-9.4917	0.008
-9.4926	0.1102	-9.4934	0.0051	-9.4917	0.0102
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-9.4907	0.1144	-9.4936	0.0378	-9.4922	0.0059
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-9.4931	0.0174	-9.4936	0.0896	-9.4922	0.007
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utility	grad	utility	grad
-8.0829	0.1769	-8.0354	0.2335
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-8.1121	0.1503	-8.084	0.1905
-8.4902	1.2494	-5.5206E-09	2.7281E-09
-8.4902	1.2494	-8.2564	0.5641
-1.3103E-18	7.1988E-20	-8.2564	0.5641
-1.0285E-16	7.7457E-17	-8.4628	7.7809
-2.675E-16	1.3097E-17	-8.4628	7.7809

-6.6091E-15	2.7841E-15	-8.4046	0.7313
-8.1597	4.0605	-8.6469	1.4353
-8.4685	1.69	-8.6469	1.4353
-8.4967	1.3942	-8.3708	25.5371
-8.4967	1.3942	-8.7384	0.4852
-3.348E-15	1.5936E-16	-8.7384	0.4852
-8.619	2.4521	-8.7693	0.3039
-8.619	2.4521	-8.7693	0.3039
-9.4406E-13	1.2623E-12	-7.098E-16	1.3374E-16
-8.6195	6.1778	-3.1913E-15	8.4069E-16
-8.6195	6.1778	-8.599	5.4267
-1.1672E-11	1.5325E-12	-6.7638E-16	5.1479E-16
-8.753	1.7139	-5.4343E-09	8.2283E-09
-8.7389	0.6145	-8.7708	2.3264
-8.9088	0.765	-8.8601	1.0129
-8.9088	0.765	-8.8601	1.0129
-9.2308E-13	1.889E-13	-8.8929	0.3896
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-8.9988	0.5519	-8.9166	0.2567
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-9.0507	0.5662	-8.9419	0.2806
-9.0507	0.5662	-8.9419	0.2806
-3.2143E-07	5.6212E-07	-8.7131	9.0892
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-9.0666	0.76	-8.9818	0.3476
-8.9713	2.8651	-8.9818	0.3476
-9.1476	3.0566	-7.8517	26.9836
-9.1476	3.0566	-9.0895	0.9461
-9.161	0.3604	-9.0895	0.9461
-9.161	0.3604	-9.1126	0.6129
-9.1764	0.3968	-9.1126	0.6129
-9.1764	0.3968	-9.0993	2.3515
-8.6794	19.6759	-9.1423	0.7033
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-8.1277	16.0106	-9.1744	0.8035
-9.2247	1.9475	-9.187	0.4441
-9.2865	0.6292	-9.187	0.4441
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-9.285	0.7742	-3.3226E-15	2.1722E-16
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-9.2867	0.7264	-9.2735	0.2904

-9.2811	0.6723	-9.2735	0.2904
-9.2852	0.6667	-9.2885	0.3384
-9.2864	0.6935	-9.2885	0.3384
-9.2866	0.6831	-9.3069	0.1963
-9.2867	0.7357	-9.3069	0.1963
-9.2867	0.7277	-4.1639E-09	8.8302E-09
-9.2867	0.7277	-9.0869	5.7561
-9.2867	0.7265	-9.3212	0.3808
-9.2867	0.7265	-9.3212	0.3808
-3.6345E-09	1.8551E-07	-9.3304	0.1726
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-9.258	1.6913	-9.3362	0.2869
-9.3157	0.452	-9.3362	0.2869
-9.3157	0.452	-9.3476	0.2523
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-9.2719	1.7937	-9.3586	0.1783
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-9.3504	0.2178	-3.2415E-13	4.5242E-15
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-9.3519	0.3346	-9.2147	3.8529
-9.3637	0.18	-9.3773	0.5064
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-9.3649	0.2439	-9.3856	0.3545
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-9.3685	0.2051	-9.3938	0.3455
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-9.3755	0.1222	-9.4034	0.1325
-9.3755	0.1222	-9.4098	0.0719
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-9.3947	0.3353	-9.4119	0.0452
-9.4029	0.1484	-9.4119	0.0452
-9.4029	0.1484	-9.3447	1.6535
-9.3784	0.742	-9.4052	0.2989
-9.4026	0.2044	-9.4118	0.1157
-9.4046	0.1468	-9.4125	0.0642
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-9.4037	0.2198	-9.414	0.0548
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-9.4105	0.0689	-9.4165	0.1645

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-9.4103	0.2905	-9.4215	0.0666
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-9.4227	0.0817	-9.4267	0.1169
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-9.4273	0.0359	-3.4977E-07	1.5199E-06
-9.4273	0.0359	-9.3987	1.2011
-9.4276	0.0241	-9.4311	0.5438
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-9.4295	0.0429	-9.4337	0.572
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-9.4304	0.0491	-9.4268	0.736
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-9.431	0.0396	-9.4362	0.4585
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-9.4312	0.0292	-9.4365	0.2725
-9.4312	0.0292	-9.4365	0.2725
-9.4314	0.0312	-9.441	0.2769
-9.4314	0.0312	-9.441	0.2769
-9.4315	0.0239	-9.1397	7.1533
-9.4315	0.0239	-9.4318	0.5092
-9.432	0.0914	-9.4437	0.3302
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-9.4313	0.1175	-9.4469	0.2831
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-9.4358	0.0164	-9.4749	0.0838
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-9.2776	4.0349	-9.4767	0.0509
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-9.4594	0.1717	-9.479	0.048
-9.4651	0.1195	-9.4794	0.1109
-9.4725	0.1113	-9.4794	0.1109
-9.4725	0.1113	-9.4796	0.0265
-9.4752	0.0783	-9.4796	0.0265
-9.4772	0.0655	-9.4798	0.0204
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-9.4783	0.0407	-9.4801	0.066
-9.4783	0.0407	-9.4801	0.0557
-9.4794	0.0373	-9.4801	0.0557
-9.4794	0.0373	-9.4805	0.0868
-9.4802	0.0767	-9.4805	0.0868
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-9.482	0.0806	-9.4824	0.0242
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-9.482	0.1051	-9.4825	0.0245
-9.482	0.1051	-9.4825	0.0245
-9.4475	0.8742	-9.4828	0.021
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-9.4804	0.1863	-9.483	0.022
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-9.4837	0.0324	-9.4899	0.0564
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-9.4841	0.0332	-9.4901	0.0447
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-9.4852	0.0217	-9.4428	1.0635
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-9.4853	0.0329	-9.4905	0.051
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