Appendix

February 2, 2026

Miguel Ángel Contreras Córdoba

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Evolutionary Algorithm Tables

Energy

Table 1: Energy results: mean ± std for 10 seeds

BitFlip Prob Population	0.0005	**0.001**	0.002	0.005	0.01
20	12813.10 ± 94.28	12831.40 ± 35.83	12828.30 ± 76.65	12521.80 ± 72.16	11358.40 ± 135.49
50	12811.40 ± 104.48	**12848.50 ± 57.62**	12824.00 ± 69.78	12358.40 ± 74.43	11267.50 ± 85.48
100	12800.60 ± 83.33	12774.90 ± 120.79	12711.60 ± 68.13	12133.30 ± 96.64	11062.10 ± 164.55
200	12725.90 ± 36.56	12712.70 ± 77.77	12524.30 ± 123.67	11886.70 ± 100.77	10685.60 ± 196.73
500	11930.00 ± 135.95	11963.20 ± 158.05	11862.40 ± 103.92	11258.30 ± 115.25	10068.30 ± 121.27
1000	10615.10 ± 317.98	10882.70 ± 154.74	10879.90 ± 133.97	10257.40 ± 136.22	9120.50 ± 142.42

Time

Table 2: Time results: mean ± std for 10 seeds

BitFlip Prob Population	0.0005	**0.001**	0.002	0.005	0.01
20	4.635 ± 0.239	4.595 ± 0.263	4.502 ± 0.189	4.458 ± 0.095	4.620 ± 0.239
50	4.444 ± 0.080	**4.416 ± 0.243**	4.652 ± 0.312	4.640 ± 0.205	4.518 ± 0.295
100	4.693 ± 0.332	4.503 ± 0.198	4.494 ± 0.221	4.493 ± 0.213	4.441 ± 0.182
200	4.683 ± 0.234	4.622 ± 0.238	4.747 ± 0.351	4.590 ± 0.217	4.526 ± 0.231
500	4.857 ± 0.310	4.862 ± 0.283	4.972 ± 0.361	4.949 ± 0.445	4.875 ± 0.352
1000	5.552 ± 0.279	5.245 ± 0.334	5.566 ± 0.397	5.463 ± 0.475	5.413 ± 0.271

Energy

Table 3: Energy results: : mean ± std for 10 seeds

BitFlip Prob Population	0.0005	**0.001**	0.002	0.005	0.01
20	12813.10 ± 94.28	12831.40 ± 35.83	12828.30 ± 76.65	12521.80 ± 72.16	11358.40 ± 135.49
50	12811.40 ± 104.48	**12848.50 ± 57.62**	12824.00 ± 69.78	12358.40 ± 74.43	11267.50 ± 85.48
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1000	10615.10 ± 317.98	10882.70 ± 154.74	10879.90 ± 133.97	10257.40 ± 136.22	9120.50 ± 142.42

Time

Table 4: Time results: mean ± std for 10 seeds

BitFlip Prob Population	0.0005	0.001	0.002	**0.005**	0.01
20	4.429 ± 0.139	4.494 ± 0.149	4.618 ± 0.267	4.483 ± 0.176	4.465 ± 0.090
50	4.519 ± 0.167	4.540 ± 0.184	4.448 ± 0.111	**4.424 ± 0.054**	4.617 ± 0.331
100	4.519 ± 0.181	4.575 ± 0.203	4.501 ± 0.181	4.593 ± 0.247	4.542 ± 0.200
200	4.545 ± 0.159	4.451 ± 0.215	4.744 ± 0.305	4.727 ± 0.336	4.645 ± 0.307
500	4.894 ± 0.390	4.825 ± 0.299	5.085 ± 0.421	5.106 ± 0.353	4.906 ± 0.257
1000	5.498 ± 0.705	5.460 ± 0.471	5.629 ± 0.607	5.750 ± 0.554	5.369 ± 0.316

Energy

Table 5: Energy results: : mean ± std for 10 seeds

BitFlip Prob Population	0.0005	**0.001**	0.002	0.005	0.01
20	12813.10 ± 94.28	12831.40 ± 35.83	12828.30 ± 76.65	12521.80 ± 72.16	11358.40 ± 135.49
50	12811.40 ± 104.48	**12848.50 ± 57.62**	12824.00 ± 69.78	12358.40 ± 74.43	11267.50 ± 85.48
100	12800.60 ± 83.33	12774.90 ± 120.79	12711.60 ± 68.13	12133.30 ± 96.64	11062.10 ± 164.55
200	12725.90 ± 36.56	12712.70 ± 77.77	12524.30 ± 123.67	11886.70 ± 100.77	10685.60 ± 196.73
500	11930.00 ± 135.95	11963.20 ± 158.05	11862.40 ± 103.92	11258.30 ± 115.25	10068.30 ± 121.27
1000	10615.10 ± 317.98	10882.70 ± 154.74	10879.90 ± 133.97	10257.40 ± 136.22	9120.50 ± 142.42

Time

Table 6: Time results: mean ± std for 10 seeds

BitFlip Prob Population	0.0005	0.001	0.002	0.005	**0.01**
20	4.544 ± 0.250	4.546 ± 0.229	4.417 ± 0.145	4.620 ± 0.205	4.573 ± 0.295
50	4.535 ± 0.196	4.606 ± 0.222	4.527 ± 0.202	4.535 ± 0.161	**4.414 ± 0.049**
100	4.417 ± 0.158	4.477 ± 0.148	4.635 ± 0.227	4.495 ± 0.137	4.528 ± 0.166
200	4.742 ± 0.311	4.448 ± 0.345	4.570 ± 0.203	4.750 ± 0.336	4.511 ± 0.124
500	4.963 ± 0.418	4.779 ± 0.331	4.810 ± 0.225	4.913 ± 0.345	5.000 ± 0.475
1000	5.292 ± 0.407	5.486 ± 0.531	5.559 ± 0.670	5.611 ± 0.342	5.589 ± 0.473

Simulated Annealing Tables

Energy

Table 7: Energy results: mean ± std for 10 seeds

Alpha Initial Temp	0.7	0.8	**0.9**	0.99
10	12854.20 ± 26.88	12862.20 ± 32.78	12884.20 ± 41.05	12897.40 ± 43.15
50	12850.80 ± 49.93	12888.70 ± 49.37	12889.10 ± 69.96	12868.80 ± 58.39
100	12868.20 ± 53.46	12892.90 ± 78.17	12837.20 ± 87.62	12905.90 ± 56.35
200	12858.20 ± 52.74	12866.60 ± 116.80	12876.40 ± 62.77	12851.10 ± 74.82
500	12884.80 ± 38.79	12821.10 ± 99.92	12870.20 ± 69.14	12864.40 ± 71.51
1000	12862.00 ± 64.58	12869.40 ± 62.45	**12907.70 ± 54.00**	12903.80 ± 53.52
2000	12814.30 ± 92.61	12867.00 ± 50.36	12858.70 ± 44.28	12880.00 ± 52.26
5000	12885.60 ± 52.54	12859.40 ± 59.44	12895.90 ± 37.10	12894.20 ± 61.20

Time

Table 8: Time results: mean ± std for 10 seeds

Alpha Initial Temp	**0.7**	0.8	0.9	0.99
10	3.048 ± 0.371	3.181 ± 0.618	3.189 ± 0.498	3.114 ± 0.395
50	3.123 ± 0.502	3.121 ± 0.355	3.299 ± 0.555	3.120 ± 0.454
100	3.417 ± 0.487	3.091 ± 0.274	3.007 ± 0.357	3.226 ± 0.366
200	3.182 ± 0.588	3.281 ± 0.446	3.059 ± 0.483	3.045 ± 0.408
500	**2.897 ± 0.315**	3.157 ± 0.470	3.071 ± 0.402	3.014 ± 0.330
1000	3.129 ± 0.482	2.960 ± 0.311	3.070 ± 0.384	3.223 ± 0.463
2000	3.046 ± 0.347	2.948 ± 0.247	3.249 ± 0.462	3.135 ± 0.489
5000	3.120 ± 0.501	3.093 ± 0.487	3.158 ± 0.228	3.075 ± 0.344

Energy

Table 9: Energy results: : mean ± std for 10 seeds

Alpha Initial Temp	0.7	0.8	**0.9**	0.99
10	12854.20 ± 26.88	12862.20 ± 32.78	12884.20 ± 41.05	12897.40 ± 43.15
50	12850.80 ± 49.93	12888.70 ± 49.37	12889.10 ± 69.96	12868.80 ± 58.39
100	12868.20 ± 53.46	12892.90 ± 78.17	12837.20 ± 87.62	12905.90 ± 56.35
200	12858.20 ± 52.74	12866.60 ± 116.80	12876.40 ± 62.77	12851.10 ± 74.82
500	12884.80 ± 38.79	12821.10 ± 99.92	12870.20 ± 69.14	12864.40 ± 71.51
1000	12862.00 ± 64.58	12869.40 ± 62.45	**12907.70 ± 54.00**	12903.80 ± 53.52
2000	12814.30 ± 92.61	12867.00 ± 50.36	12858.70 ± 44.28	12880.00 ± 52.26
5000	12885.60 ± 52.54	12859.40 ± 59.44	12895.90 ± 37.10	12894.20 ± 61.20

Time

Table 10: Time results: mean ± std for 10 seeds

Alpha Initial Temp	0.7	0.8	0.9	**0.99**
10	3.024 ± 0.320	3.076 ± 0.384	3.240 ± 0.416	3.027 ± 0.435
50	3.126 ± 0.499	3.207 ± 0.461	3.138 ± 0.538	3.188 ± 0.472
100	3.103 ± 0.367	2.929 ± 0.363	3.056 ± 0.358	3.037 ± 0.372
200	2.880 ± 0.307	3.060 ± 0.441	3.124 ± 0.484	3.086 ± 0.492
500	2.963 ± 0.346	3.170 ± 0.437	3.037 ± 0.336	3.037 ± 0.476
1000	3.155 ± 0.575	3.024 ± 0.479	3.112 ± 0.314	**2.829 ± 0.329**
2000	3.066 ± 0.428	3.000 ± 0.212	3.103 ± 0.462	3.125 ± 0.523
5000	2.954 ± 0.415	2.952 ± 0.310	2.991 ± 0.307	2.944 ± 0.386

Energy

Table 11: Energy results: : mean ± std for 10 seeds

Alpha Initial Temp	0.7	0.8	**0.9**	0.99
10	12854.20 ± 26.88	12862.20 ± 32.78	12884.20 ± 41.05	12897.40 ± 43.15
50	12850.80 ± 49.93	12888.70 ± 49.37	12889.10 ± 69.96	12868.80 ± 58.39
100	12868.20 ± 53.46	12892.90 ± 78.17	12837.20 ± 87.62	12905.90 ± 56.35
200	12858.20 ± 52.74	12866.60 ± 116.80	12876.40 ± 62.77	12851.10 ± 74.82
500	12884.80 ± 38.79	12821.10 ± 99.92	12870.20 ± 69.14	12864.40 ± 71.51
1000	12862.00 ± 64.58	12869.40 ± 62.45	**12907.70 ± 54.0**0	12903.80 ± 53.52
2000	12814.30 ± 92.61	12867.00 ± 50.36	12858.70 ± 44.28	12880.00 ± 52.26
5000	12885.60 ± 52.54	12859.40 ± 59.44	12895.90 ± 37.10	12894.20 ± 61.20

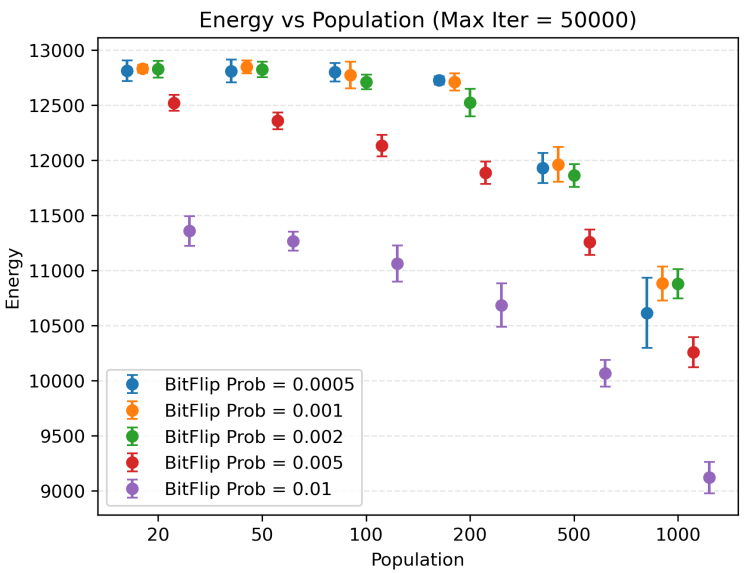
Time

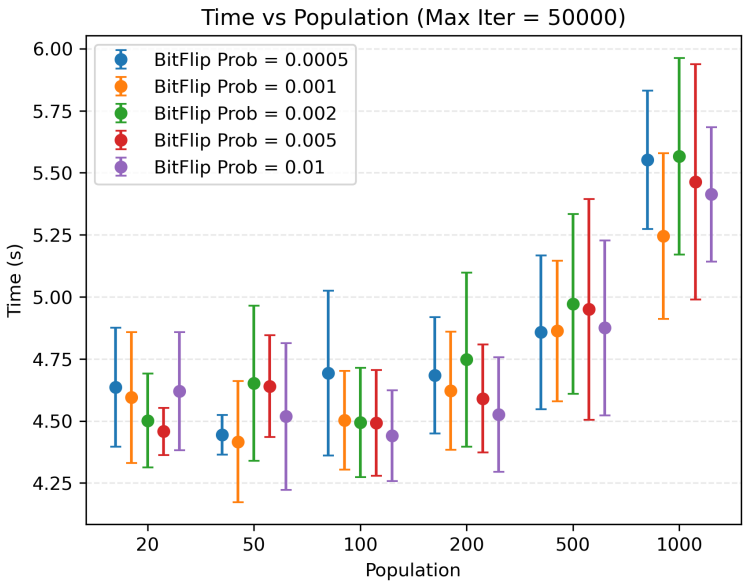
Table 12: Time results: mean ± std for 10 seeds

Alpha Initial Temp	**0.7**	0.8	0.9	0.99
10	**2.852 ± 0.287**	3.260 ± 0.435	3.346 ± 0.504	3.029 ± 0.434
50	3.196 ± 0.378	3.155 ± 0.505	3.067 ± 0.510	3.104 ± 0.446
100	3.070 ± 0.437	2.972 ± 0.369	3.133 ± 0.442	2.974 ± 0.369
200	3.264 ± 0.563	3.040 ± 0.563	3.211 ± 0.572	2.994 ± 0.334
500	3.186 ± 0.419	3.190 ± 0.428	3.128 ± 0.558	3.093 ± 0.315
1000	3.281 ± 0.387	3.335 ± 0.418	3.299 ± 0.465	2.986 ± 0.405
2000	3.016 ± 0.351	2.905 ± 0.381	3.102 ± 0.515	2.975 ± 0.381
5000	3.109 ± 0.467	3.141 ± 0.516	3.180 ± 0.497	2.999 ± 0.260

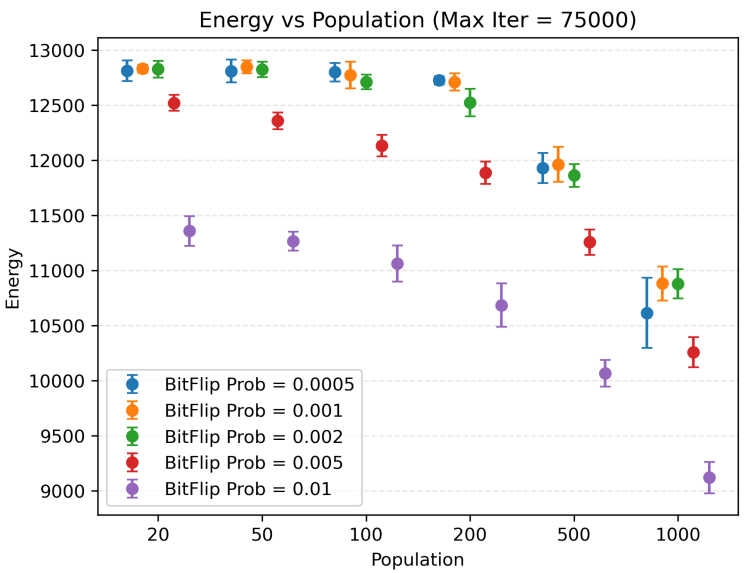
Evolutionary Algorithm Plots

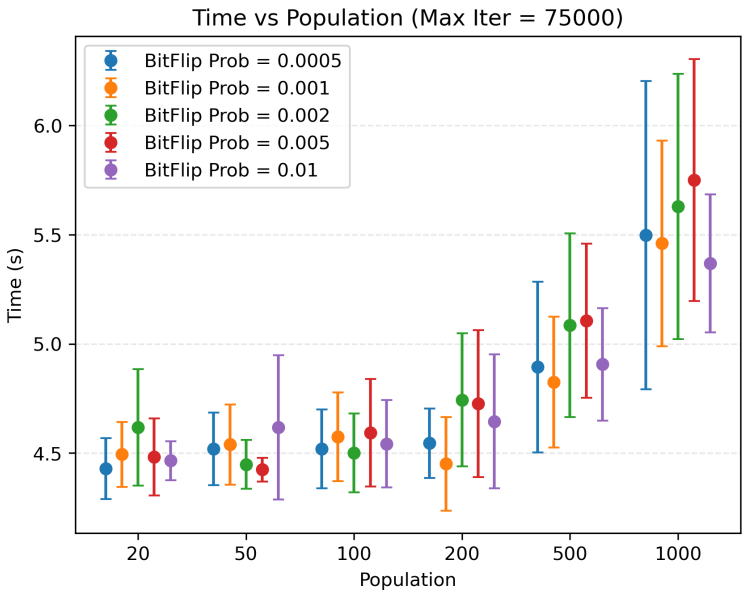
Energy and Time





Energy and Time





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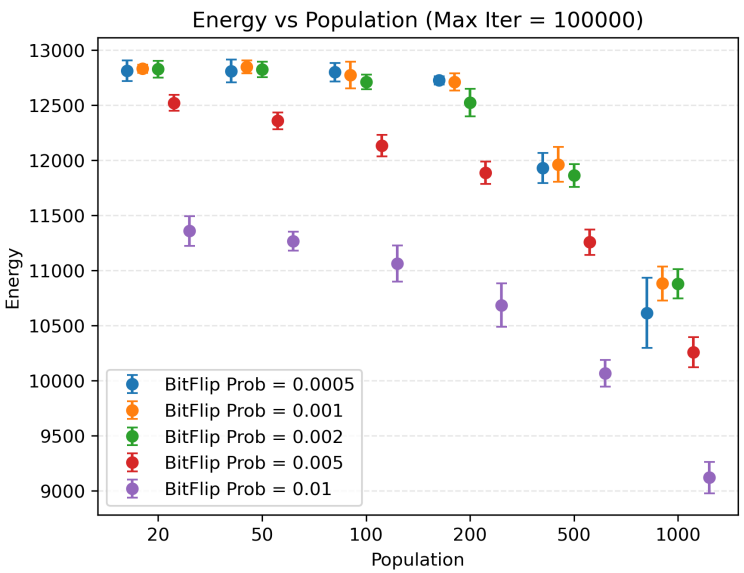
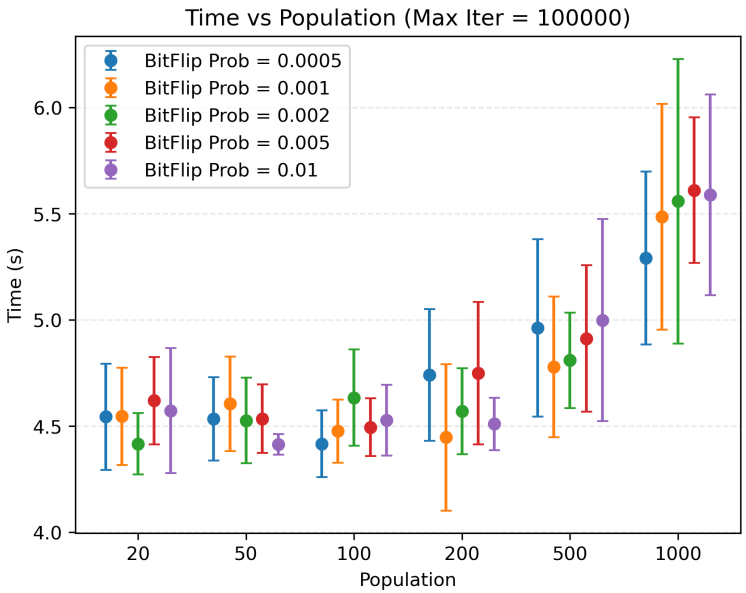
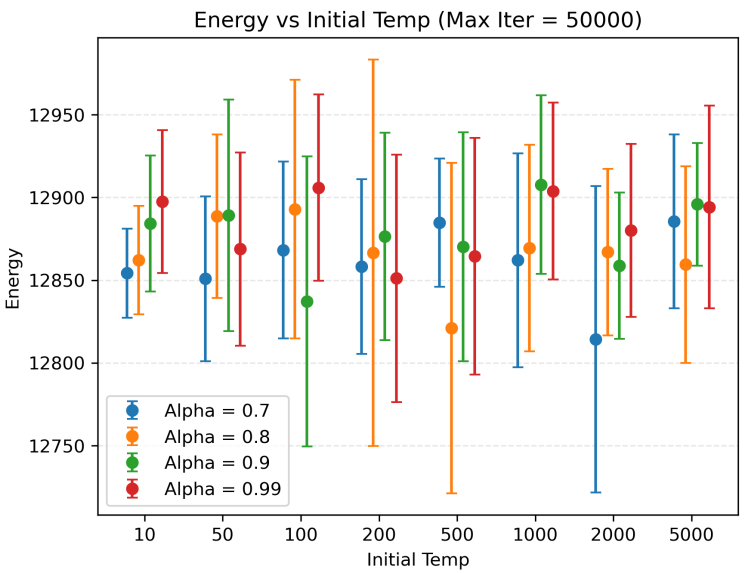
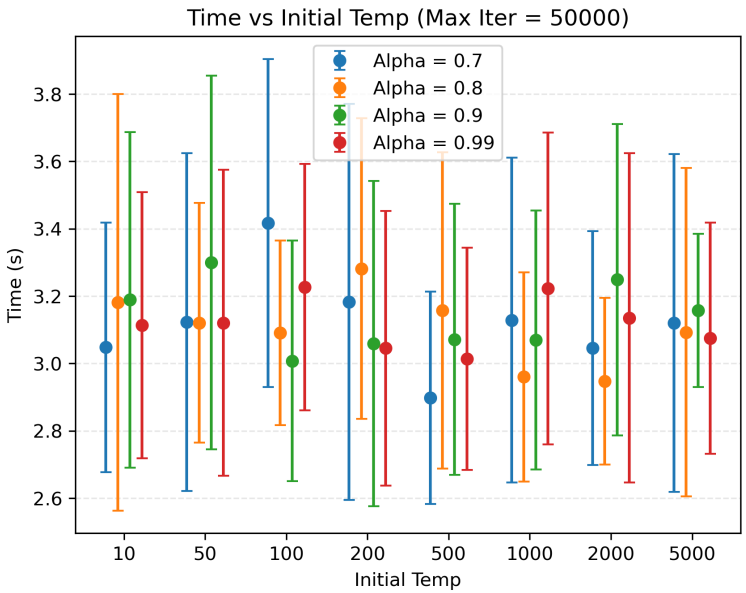




Simulated Annealing Plots

Energy and Time





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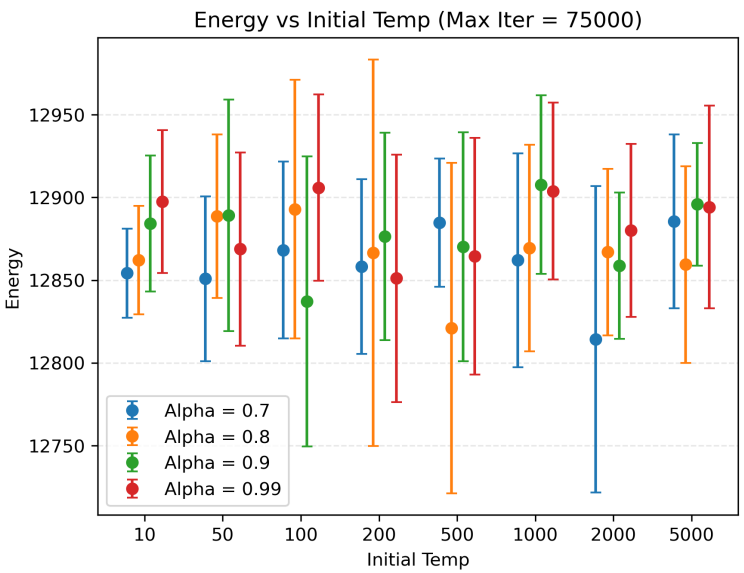
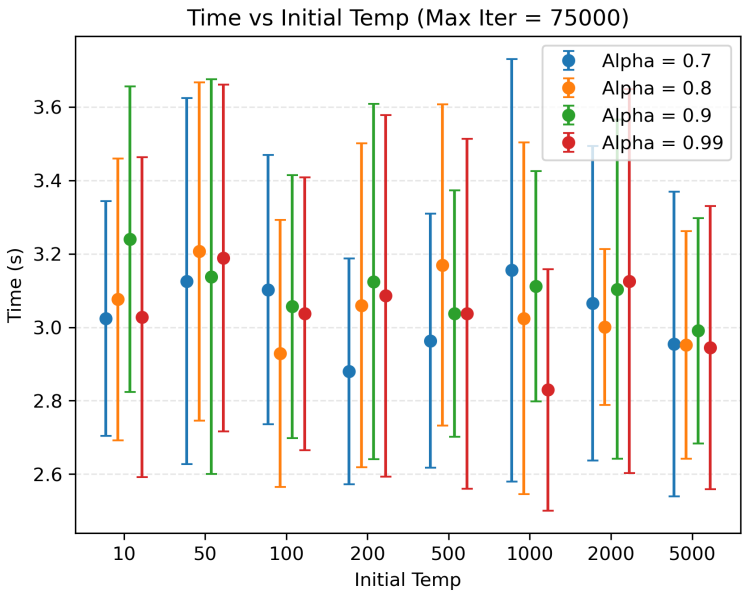
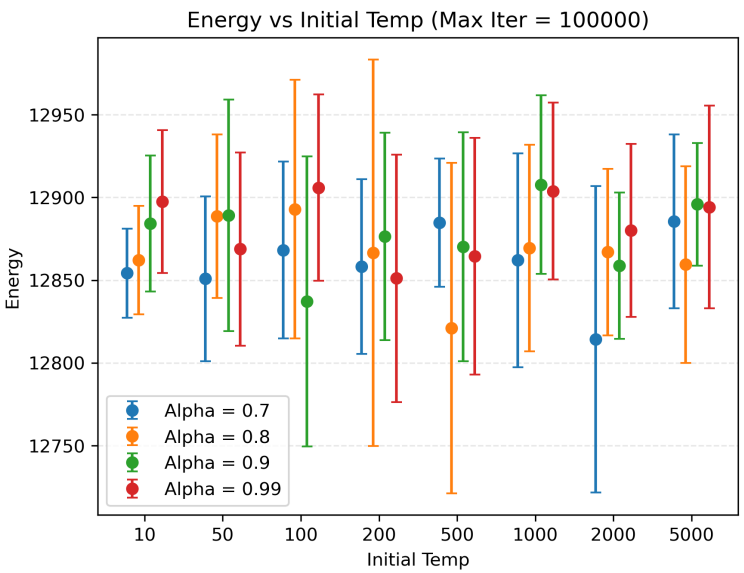
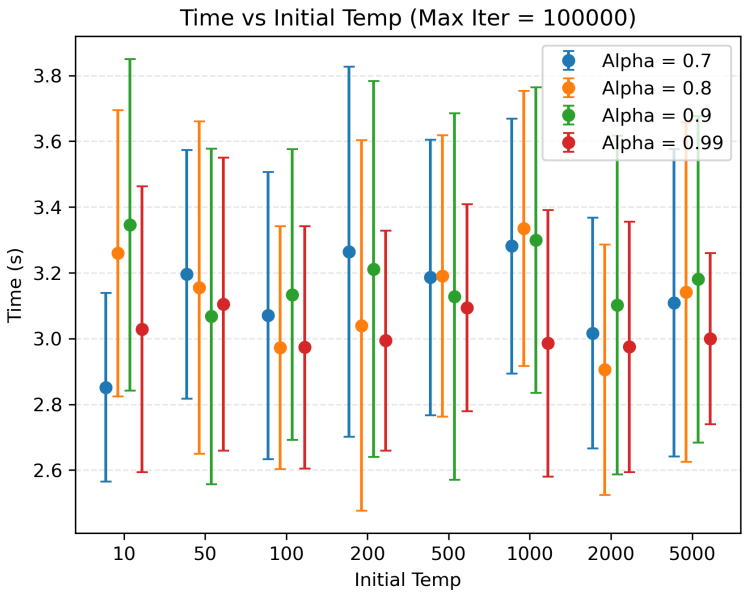




Energy and Time





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