Homework 3 Report

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1(a)

Test simulated annealing on N by N chessboard with 0/1 coloring.

Coding in Matlab: “hw3main1a.m”.

Temperature starts at 100 and cooling rate is 0.99.

Metropolis method is applied when determining if updated variable is accepted.

Stopping criteria is number of violations is 0.

Max size on the test run is 15 by 15 which cost about 20 seconds.

Data is saved in “chessboard01.txt”.

1(b)

Test simulated annealing on N by N chessboard with 4 colors (0,1,2,3).

Coding in Matlab: “hw3main1b.m”.

Temperature starts at 100 and cooling rate is 0.99.

Metropolis method is applied when determining if updated variable is accepted.

Stopping criteria: the number of violations is 0.

Max size on the test run is 22 by 22 which cost about 60 seconds.

Data is saved in “chessboard0123.txt”.

2. Compare simulated annealing method with coordinate descend method for the same 2-dimension function below. Number of samples is 50.

Coding in Matlab: “hw3main2.m” Data is saved in “saCont.txt” and also listed in the next page.

The coordinate descend result is copied from HW2 directly

The stopping criteria for SA method is temperature T < 0.001.

With this criteria, the times of evaluation is an exact number.

The accuracy for SA method is lower than the coordinate descend method, and the running time is 10^4 times larger.

If the function has only global minimum, the SA method is not competitive, because the probability of accepting a worse result makes it away from the global minimum. In the program, adjust step size also slow down the speed, because it keeps the ratio of acceptation over rejection roughly on between 0.4~0.6.

With many local minimum case, SA method has the ability to jump out of local minimum and move to global minimum. However, the coordinate descend cannot. If in the bracketing process, the coordinated descend brackets a local minimum, it will not find a better case.

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|  | SA Method | Coordinate descend |
| Average x1 | 3.344043735369832e-01 | 0.33333390373098204 |
| Sample variance x1 | 5.030104994746765e-04 | 8.560842564427188E-13 |
| Error bar x1 | 2.242789556500289e-02 | 9.299094429912852E-8 |
| Average x2 | 1.331467896962945e+00 | 1.3333330462295832 |
| Variance x2 | 6.270888375726237e-04 | 6.557699206337E-13 |
| Error bar x2 | 2.504174190372195e-02 | 8.13875825434052E-8 |
| Average f(x) | -1.832516706024982e+00 | -1.8333333333321777 |
| Sample variance f(x) | 4.542449670708548e-07 | 4.162393647981565E-24 |
| Error bar f(x) | 6.739769781460304e-04 | 2.0504726353365965E-13 |
| Average times of evaluation | 1.146000000000000e+06 | 30 |
| Sample variance ToE | 0 | 4.83 |
| Error bar ToE | 0 | 0.22087978356535662 |
| Average running time (s) | 6.693230288220001e+00 | 2.12075.5e-4 |
| Variance of running time | 3.924578954557947e-03 | 1.2591054606815E2 |
| Error bar running time | 6.264646003213548e-02 | 1.109783422762205e-03 |
| Average relative distance | 8.166273083503128e-04 | 0.833333333332177 |
| Variance of relative distance | 4.542449670708549e-07 | 4.16239341674671e-24 |
| Error bar of relative distance | 6.739769781460305e-04 | 2.05047257838130e-13 |