MAE 552 – Heuristic Optimization Homework #2
Due Date: Wed Feb 20, 2002 Instructor: Dr. Kurt Hacker

Problem One

You are presented with the following unconstrained optimization problem.

$$\text{Minimize } \mathbf{F}(\mathbf{x}) = [4 - 2.1\mathbf{x}_1^{\,2} + \mathbf{x}_1^{\,4}/3]\mathbf{x}_1^{\,2} + \mathbf{x}_1\mathbf{x}_2 + [-4 + 4\mathbf{x}_2^{\,2}]\mathbf{x}_2^{\,2}$$

$$\mathbf{g}_1 : 1 - \mathbf{x}_2^{\,2} - \mathbf{x}_1^{\,2} \le 0$$

$$-3 \le \mathbf{x}_1 \le 3$$

$$-2 \le \mathbf{x}_2 \le 2$$

You are to use the Simulated Annealing algorithm to solve the above optimization problem by writing your own SA code in your choice of computer language (Fortran, C/C++, Matlab, etc.). You will need to use one of the penalty function formulations discussed in class to handle the constraints.
To determine how the various SA parameters affect the performance of the SA, I would like you to run number of trials with your program. The parameters you will need to look at are:

1. Initial design point – consider starting points 'close' to the optimum, 'very far' from the optimum and randomly generated starting points.
2. Transition mechanism – look at different forms of the move set generator (i.e. consider both moving along one design variable and all three design variables.)
3. The initial size and final size of the neighborhood
4. The length of each Markov chain at a particular value of T_k.
5. The cooling schedule, including the starting value of the control parameter and the decrement rule.
6. The stopping/convergence criteria.
7. The number of times the objective function is evaluated for each run (this is a measure of the computational efficiency of your SA.

I would urge the student to consider at least 10-15 different scenarios using your SA code. Supply me with a printout of you computer code, properly commented so I can understand it, a 1-2-page description of the problem you are trying to solve, and the means that you are solving the problem (a description of your trial scenarios). Your discussion should be 3-4 pages and contain a description of your results including graphs charts and tables needed to demonstrate your results. The student is encouraged to solve the problem with the Excel or an equivalent solver in order to verify what the 'true' optimum is. This may assist you in you discussion.

Note: Every run may not reach the global optimum of the function. This is OK! That's why SA is called a heuristic optimization technique. If this turns out to be the case please comment on this.
Remember: Quality is more important than quantity!