MECH 579: Multidisciplinary Design Optimization
Department of Mechanical Engineering, McGill University

Project #4: Derivative Free Optimization
Due 12th. November, 2013

Minimize the following Gaussian distribution defined below using a genetic algorithm. The function contains three different minimums at centered at $(1, 1)$, $(-1, -1)$, and $(3, 3)$. The Gaussian distribution at $(1, 1)$ has the lowest minimum, hence its the global minimum point. Use the genetic algorithm that is provided for this assignment and implement the following function. Modify the algorithm if necessary and conduct the following numerical experiments. x and y may be bounded by $[-5, 5]$.

$$
\begin{aligned}
\text{minimize} \quad & f(x, y) = -10\mathrm{e}^{-[(x-1)^2+0.25(y-1)^2]} - 5\mathrm{e}^{-[(x+1)^2+0.25(y+1)^2]} - 5\mathrm{e}^{-[5(x-3)^2+0.25(y-3)^2]} \\
\text{with respect to} \quad & x, y \in \mathbb{R}^n \\
\text{subject to} \quad & -5 \leq x \leq 5, -5 \leq y \leq 5
\end{aligned}
$$

1. Implement two different methods to track the convergence of the algorithm as it approaches the minimum point. Discuss the approaches, conduct sufficient numerical experiments as well as provide graphs comparing the two different approaches. Investigate if you are generating sub-clusters of the population for each local minimum as well as the global minimum.

2. Investigate the effect of the size of the population as well as the length of the chromosome on the optimization problem. Investigate the effect on the local versus global minimums.

3. Repeat (2) by investigating the effect of the mutation. Does turning off the mutation allow for a faster convergence? Does increasing the probability of mutation affect the convergence rate of the objective function.

Reports must be handed in a PDF format. All plots must have both x- and y-axis labels, a legend clearly describing the various lines, and a title with a Figure number. Plots generated with MS Excel are not acceptable and assignments will not be graded.