Homework # 01

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(**Total**: **18 points**)

Submission Deadline: 9^{th} February (Sunday) 23:00 PM

1 Optimization problem example – 1 point

Find the dimensions (height h and radius r) that will minimize the surface area of the metal to manufacture a circular cylindrical can of volume V.

2 Optimally conditions – 3 points

Consider the unconstrained optimization problem to minimize the function,

$$f(x_1, x_2) = \frac{3}{2}(x_1^2 + x_2^2) + (1 + a)x_1x_2 - (x_1 + x_2) + b, \quad \& \qquad a, b \in \mathbb{R}$$

over $\mathbb{R}^2$, where a and b are real-valued parameters. Find all values of a and b such that the problem has a unique optimal solution.

3 Nelder Mead method – 8 points

Implement Nelder-Mead method for the Mishra's Bird function

$$f(x, y) = \sin(y)e^{(1-\cos(x))^2} + \cos(x)e^{(1-\sin(y))^2} + (x - y)^2$$

subjected to, $(x + 5)^2 + (y + 5)^2 < 25$

1. To illustrate the behavior of the methods plot simplex (triangle) for every iteration. Provide the link to code repository.
2. Demonstrate that the algorithm may converge to different points depending on the starting point. Report explicitly two distinct starting points x^0 and the corresponding x^*
3. Examine the behavior of the method for various parameters α, β and γ. For one chosen x^0 show that the method may converge to different points. Report parameter values and x^*.

4 Coordinate descend – 6 points

Implement coordinate descend for x^0 and f from Task 3. Compare the number of function evaluations (Oracle calls) for Nelder Mead algorithm and Coordinate descend. Report parameters of the algorithm. Provide the link to code repository. Make a conclusion.