Evolutionary Algorithms
Problem Set - MATLAB

1. Implement in MATLAB the function (one line!)

$$\mathcal{M}(\vec{x}) = \frac{1}{n}\sum_{i=1}^{n}\sin^{\alpha}(m\pi x_i) \tag{1}$$

Hint: mean...

2. Implement in MATLAB the Ackley function:

$$\mathcal{A}(\vec{x}) = -c_1 \cdot \exp\left(-c_2\sqrt{\tfrac{1}{n}\textstyle\sum_{i=1}^{n} x_i^2}\right) - \exp\left(\tfrac{1}{n}\textstyle\sum_{i=1}^{n} cos(c_3 x_i)\right) + c_1 + e \tag{2}$$

Your m-file should start like this:

```
function [f] = Ackley (c1,c2,c3,X);
...
```

3. Introduce the function after Fletcher and Powell:

$$\begin{array}{l}\mathcal{F}(\vec{x}) = \sum_{i=1}^{n}(A_i - B_i)^2 \\ A_i = \sum_{j=1}^{n}(a_{ij}\cdot sin(\alpha_j) + b_{ij}\cdot cos(\alpha_j)) \\ B_i = \sum_{j=1}^{n}(a_{ij}\cdot sin(x_j) + b_{ij}\cdot cos(x_j))\end{array} \tag{3}$$

where $\mathbf{A} = (a_{ij})$, $\mathbf{B} = (b_{ij})$, and $\vec{\alpha} = (\alpha_j)$ have random elements.
($\mathcal{F}$ is an example of a nonlinear parameter estimation problem).
Assuming that $\mathbf{A}$, $\mathbf{B}$ and $\vec{\alpha}$ are given as input, implement this function in MATLAB.

4. Introduce the *Low Autocorrelation Problem of Binary Sequences*:
Feasible Solutions: Binary Sequences $\vec{y} \in \{-1, +1\}^n$
Objective Function:

$$f(\vec{y}) = \frac{n^2}{2\cdot E(\vec{y})} \longrightarrow maximization \tag{4}$$

s.t.

$$E(\vec{y}) = \sum_{k=1}^{n-1}\left(\sum_{i=1}^{n-k} y_i \cdot y_{i+k}\right)^2 \tag{5}$$

Implement in MATLAB this objective function for a population of feasible solutions, i.e. your MATLAB function should receive as an input a matrix containing binary sequences as columns, and produce as an output a raw vector of function values of those column vectors.

General

- Submit your solutions electronically - email the teaching assistant a tar or a zip file containing your **m-files**.
- Your m-files must run!
- Solutions will be graded according to correctness as well as to efficiency!