The University of Jordan

School of Engineering

Department of Electrical Engineering

Fall Term – A.Y. 2020-2021

Special Topics: Optimization Techniques, EE729

Optimization Project

Project is due 15/1/2021

Problem 1: One-dimensional Problem

x_i	0	1	2	3	4	5
y_i	2.1	7.7	13.6	27.2	40.9	61.1

1) Use iterative steepest descent method to approximate by a first order polynomial :
   $y_i = a_1 x_i + a_0$
   Use initial guess for $a = \begin{bmatrix} a_0 \\ a_1 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$.
2) Repeat using iterative Levenberg-Marquardt algorithm.
3) It is required to approximate by a second order polynomial :
   $y_i = a_2 x_i^2 + a_1 x_i + a_0$

   Use Iterative Levenverg-Marquardt algorithm to find the best fitting curve.

   Use $a = \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ as initial guess.

4) In all cases above, plot the real data and the approximated curve on the same figure.
5) Plot the learning curve for each case, i.e. the sum of squared errors versus the number of iterations.
6) Plot the estimated coefficients versus the number of iterations and show the convergence of these parameters.

Problem 2: Two-dimensional Problem

x_{1i}	0	2	2.5	1	4	7
x_{2i}	0	1	2	3	6	2
y_i	5	10	9	0	3	27

1) Use Iterative Levenverg-Marquardt algorithm to find the best fitting curve. Use the approximation

$$y_i = a_2 x_{2i} + a_1 x_{1i} + a_0$$

Use $a = \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ as initial guess.

2) Plot the learning curve for each case, i.e. the sum of squared errors versus the number of iterations.
3) Plot the estimated coefficients versus the number of iterations and show the convergence of these parameters.

Problem 3: Particle Swarm Optimization (PSO)

Repeat Problem 1 and Problem 2 using PSO algorithm to find the best fitting curves.