Assignment 1

Data Mining for Networks

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Exercise 1 [Gradient descent algorithm]

$$f(x) = 2x^4 - 4x^3 + 3x^2 + 4x - 3$$

1. The derivative:

$$\frac{\partial f}{\partial x} = 8x^3 - 12x^2 + 6x + 4$$

2. The algorithm:
   Update function: $x := x - \alpha \frac{\partial f}{\partial x}$
   using (1) we get,

$$x := x - \alpha(8x^3 - 12x^2 + 6x + 4)$$
$$x := x(1 - 6\alpha) - \alpha(8x^3 - 12x^2 + 4)$$

   By setting $\alpha = \frac{1}{10}$ we get:

$$x := -0.8x^3 + 1.2x^2 + 0.4x - 0.4$$

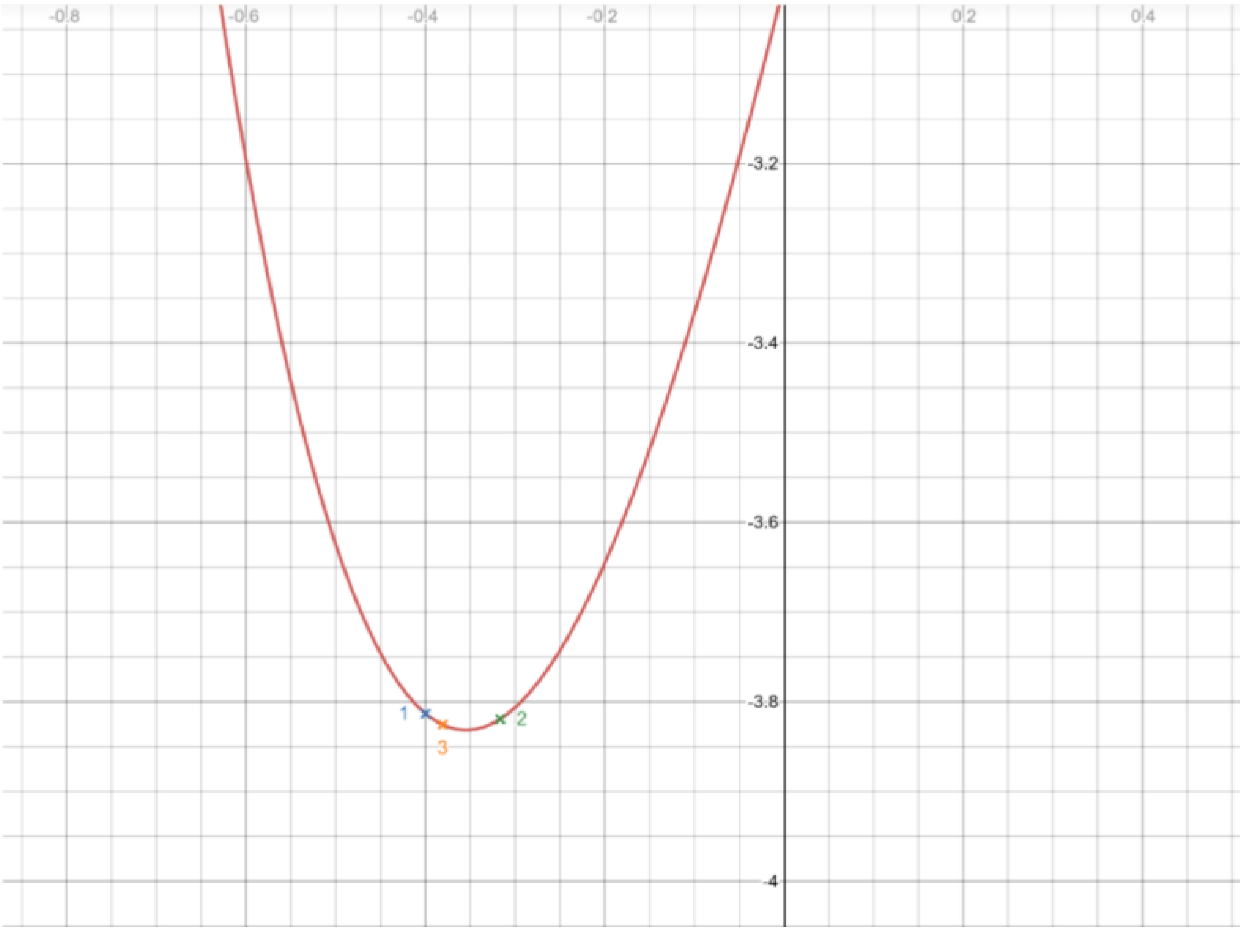
3. Application (3steps)

Iteration	x	$f(x)$
0	0	-3
1	$-0.8 \times 0^3 + 1.2 \times 0^2 + 0.4 \times 0 - 0.4 = -0.4$	-3.8128
2	$-0.8 \times (-0.4)^3 + 1.2 \times (-0.4)^2 + 0.4 \times (-0.4) - 0.4 = -0.3168$	-3.81879
3	$-0.8 \times (-0.3168)^3 + 1.2 \times (-0.3168)^2 + 0.4 \times (-0.3168) - 0.4 = -0.38085$	-3.82522

4. Comment:

   During the first three steps of Gradient Descent three Points were calculated to find the global minimum of the derivative of the function.

   The three points and the derivative are visualized in the following plot:



   We notice that after the first two iterations, the algorithm converges quite quickly to the neighborhood of the minimum which can be observed visually. However, during each iteration we jump over the minimum. That is because, the alpha value taken is large. It is therefore necessary to truncate it to a smaller value in order to ensure convergence.

Exercise 2 [Linear regression and Gradient descent]

Notebook