CSE-488-Project 1

➢ Introduction:

Optimization is finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones. In comparison, maximization means trying to attain the highest or maximum result or outcome without regard to cost or expense. Practice of optimization is restricted by the lack of full information, and the lack of time to evaluate what information is available (see bounded reality for details). In computer simulation (modeling) of business problems, optimization is achieved usually by using linear programming techniques of operations research.

➢ Problem definition:

Find a solution for a set of non-linear equations using different optimization techniques, so the problem now is to minimize the function.

➢ Importance of Gradient Descent:

First gradient is first-order iterative optimization algorithm for finding the minimum of a function. So its importance:

1- To find a local minimum of a function using gradient descent.
2- Unless you provide the library the objective function and the gradient function, it could be fairly slow, because approximating the gradient from the objective function might be computationally expensive. So if you need to provide the objective function and a gradient function, you've done most work required to write a gradient descent algorithm already.
3- You get better control of the algorithm. Most libraries would not, for instance, allow you to control how the step size goes down.

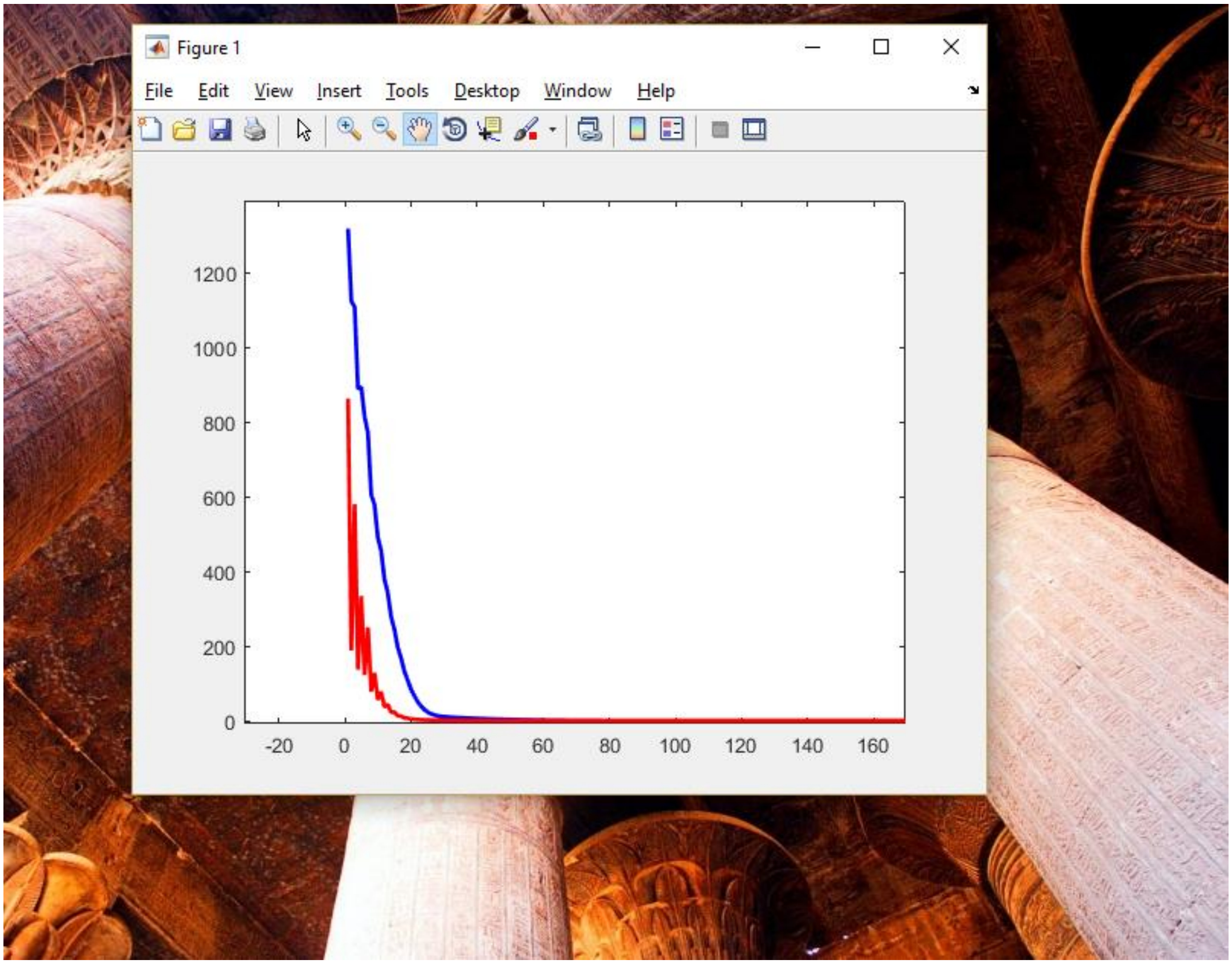
➢ Methods and Algorithms

Gradient descent can be extended to handle constraints by including a projection onto the set of constraints. This method is only feasible when the projection is efficiently computable on a computer. Under suitable assumptions, this method converges. This method is a specific case of the forward-backward algorithm for monotone inclusions (which includes convex programming and variational inequalities).

Fast gradient methods:
Another extension of gradient descent is due to Yurii Nesterov from 1983, and has been subsequently generalized. He provides a simple modification of the algorithm that enables faster convergence for convex problems. For unconstrained smooth problems the method is called the Fast Gradient Method (FGM) or the Accelerated Gradient Method (AGM).
For constrained or non-smooth problems, Nesterov's FGM is called the fast proximal gradient method (FPGM), an acceleration of the proximal gradient method.

The momentum method:
Yet another extension, that reduces the risk of getting stuck in a local minimum, as well as speeds up the convergence considerably in cases where the process would otherwise zig-zag heavily, is the momentum method, which uses a momentum term in analogy to "the mass of Newtonian particles that move through a viscous medium in a conservative force field". This method is often used as an extension to the backpropagation algorithms used to train artificial neural networks.

➢ Experimental Results and discussions:



From tracing code more than one time its shown that the value of the curve changes as the random value change.

➢ Appendix with codes:

It will be attached with the submitted file.