Indian Institute of Technology Palakkad

Convex Optimizations

Programming Assignment - 1

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Problem 1

1)

Let C be an 8x8 matrix with C_{ij} = max. allowed flow from vertex *i* to vertex *j*. Let F be another 8x8 matrix with F_{ij} = flow from vertex *i* to vertex *j*. Indices 1 and 8 are for source and sink vertices respectively..

Our problem becomes,

$$\max \sum_{j=1}^{8} F_{1j}$$, that is the total outflow from source vertex

subject to,

$$\sum_{j=1}^{8} F_{ij} = \sum_{j=1}^{8} F_{ji} \quad \forall i \in [2,7],$$

$$F_{ij} >= 0 \quad \forall i,j \in [1,8]$$

$$F_{ij} <= C_{ij} \quad \forall i,j \in [1,8]$$

2)Solving the problem with cvx in matlab gives maximum flow as 12.

Problem 2

1)

Let H and W be the ordered sets where H_i and W_i represent height and weight of i^{th} person respectively. Let n be the number of points in the dataset.

Our problem becomes,

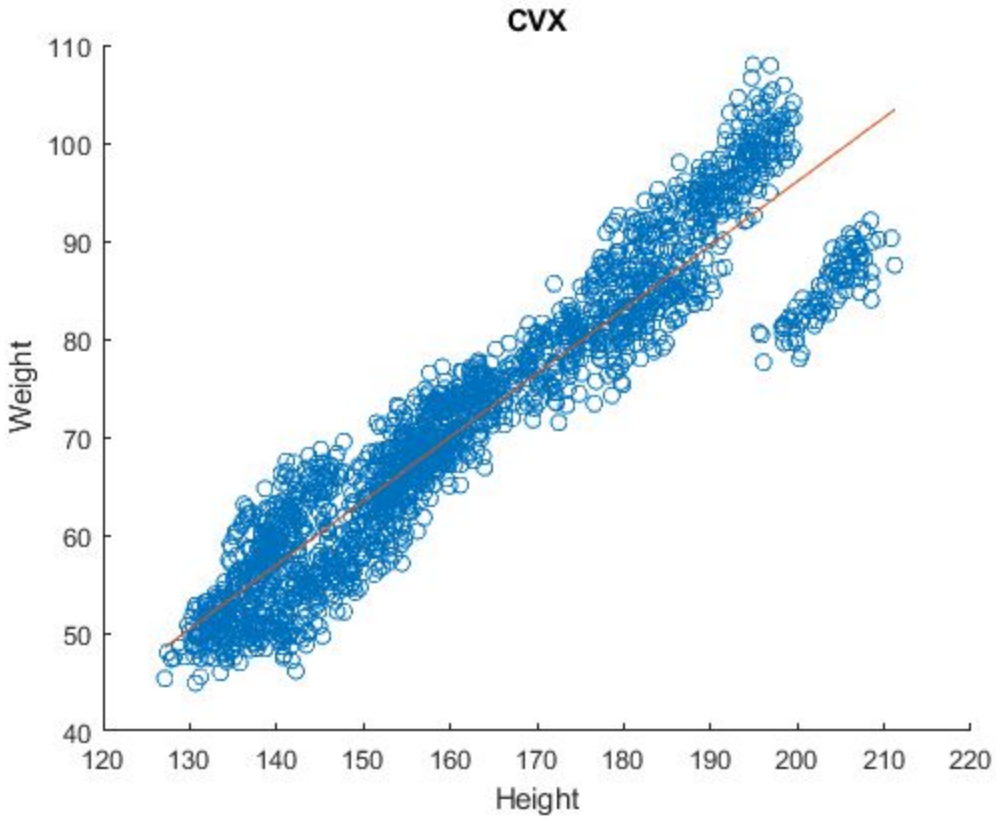
$$\min ||W - Xw||$$, where X is an n x 2 matrix with $X_{i1} = H_i$ and $X_{i2} = 1 \quad \forall i \in [1, n]$

2)

a) Solving this problem with cvx gives,

[a b] = [0.652628365662213; -34.439739356761166]

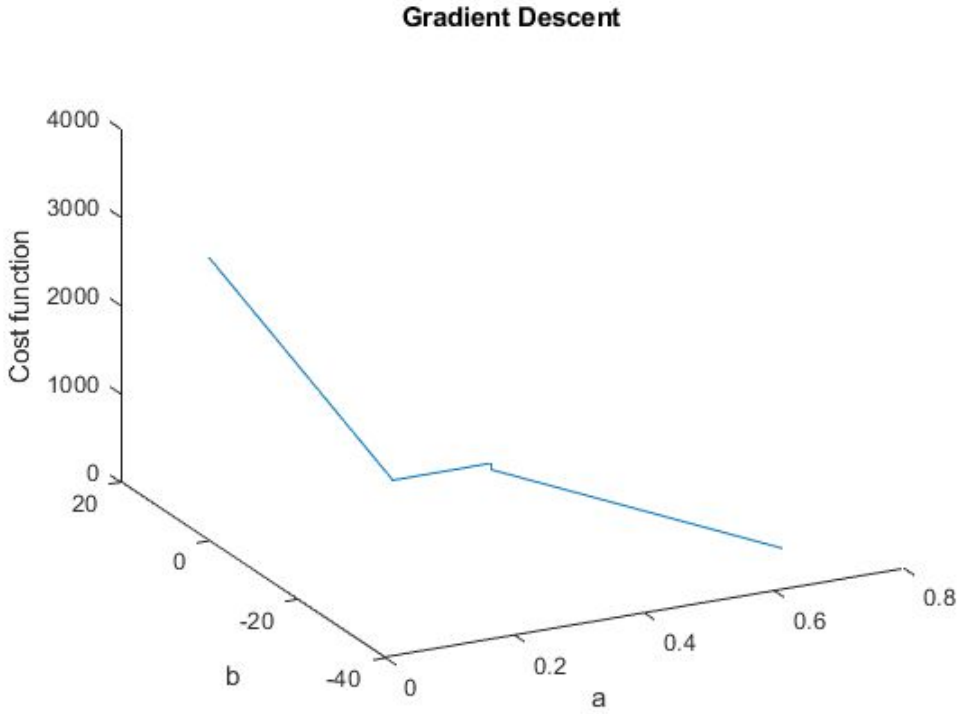
b)The graph plotted with the a and b found and the points scattered against height and weight gives:



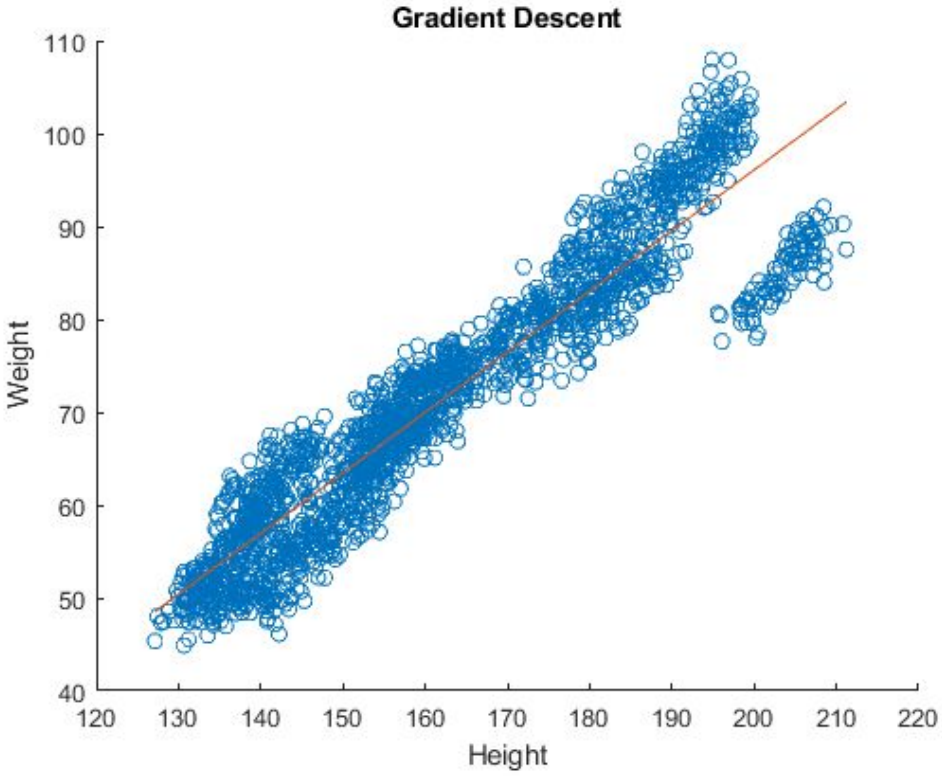
3)

a)Solving the problem with gradient descent gives the solution,
[a b] = [0.652628365975890; -34.439739408449455]

b)Plot with (a, b, objective function)



The graph plotted with the a and b found and the points scattered against height and weight gives:



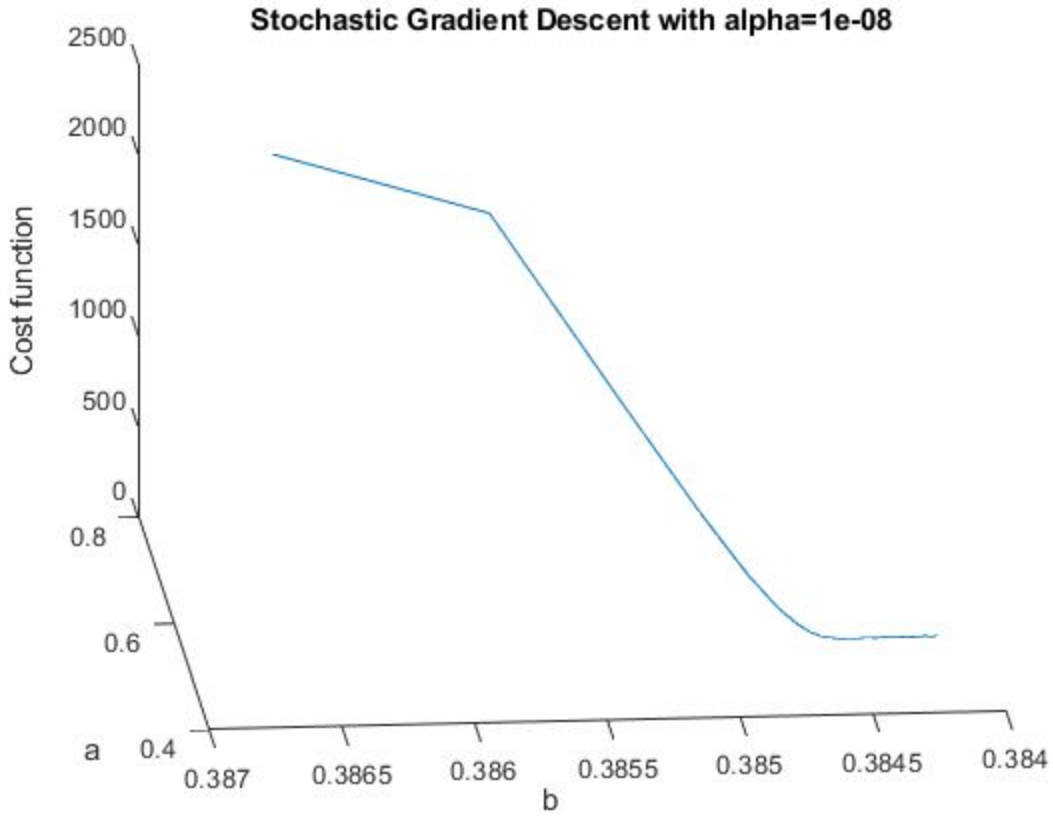
Elapsed time is 0.365805 seconds.

c)No. the result does not change when the initial positions are changed.

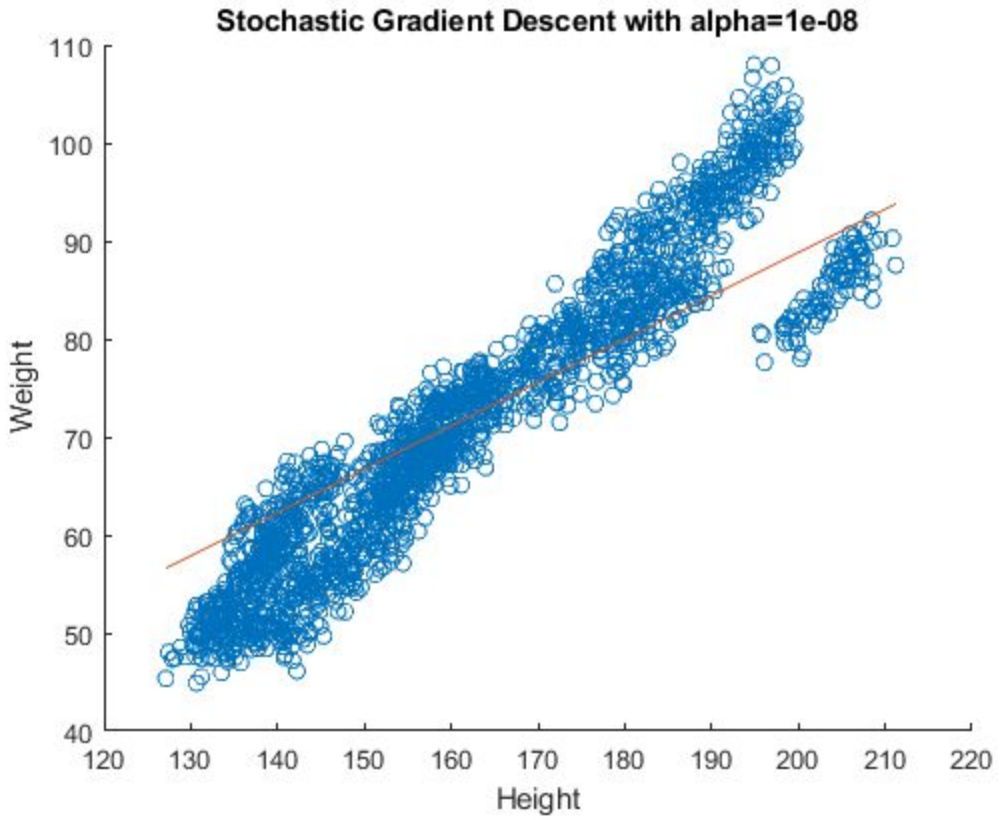
4)

a)Solving the problem with stochastic gradient descent,
with alpha = 1E-08,
[a, b] =[0.4426,0.3842]

b)Plot with (a, b, objective function)



The graph plotted with the a and b found and the points scattered against height and weight gives:



Elapsed time is 0.241135 seconds.

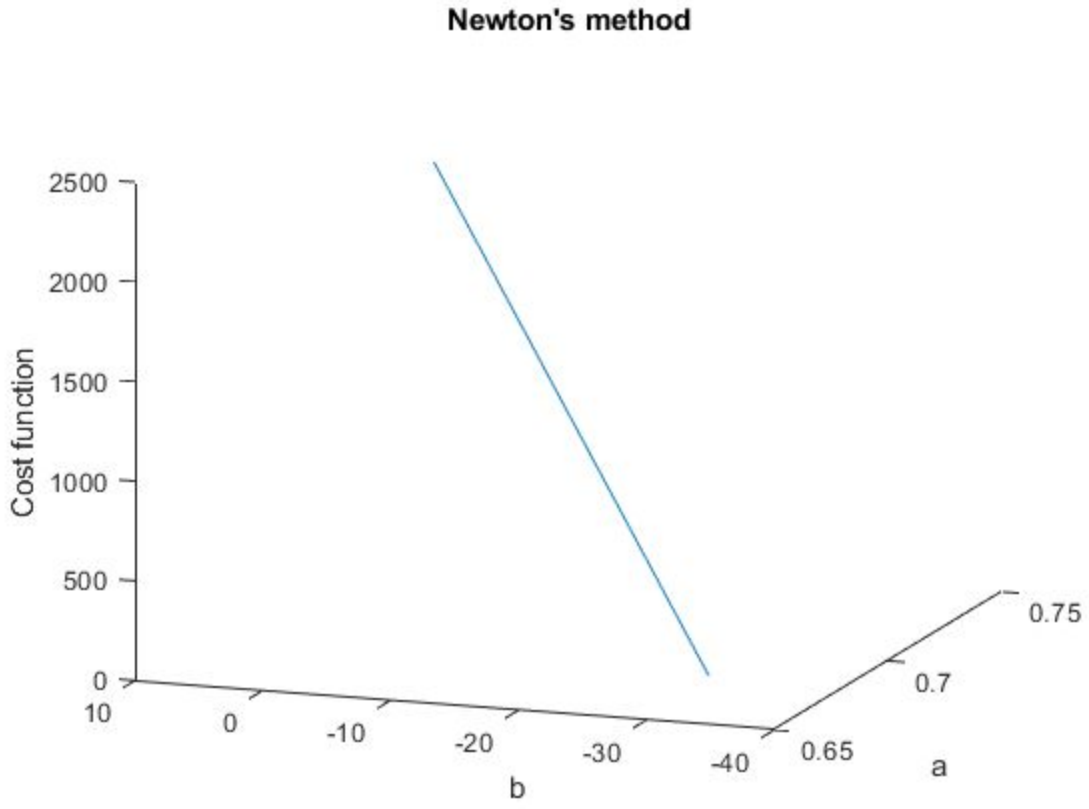
The path followed by gradient descent and stochastic gradient are different. Gradient Descent **always** got closer to the optimum value. Whereas for stochastic gradient descent, after the second step, it was slightly jumping around even though it was getting closer to the optimum value. The time taken for stochastic descent is found to be lower than that of gradient descent. The solution does depend on the initial values of a and b.

5)

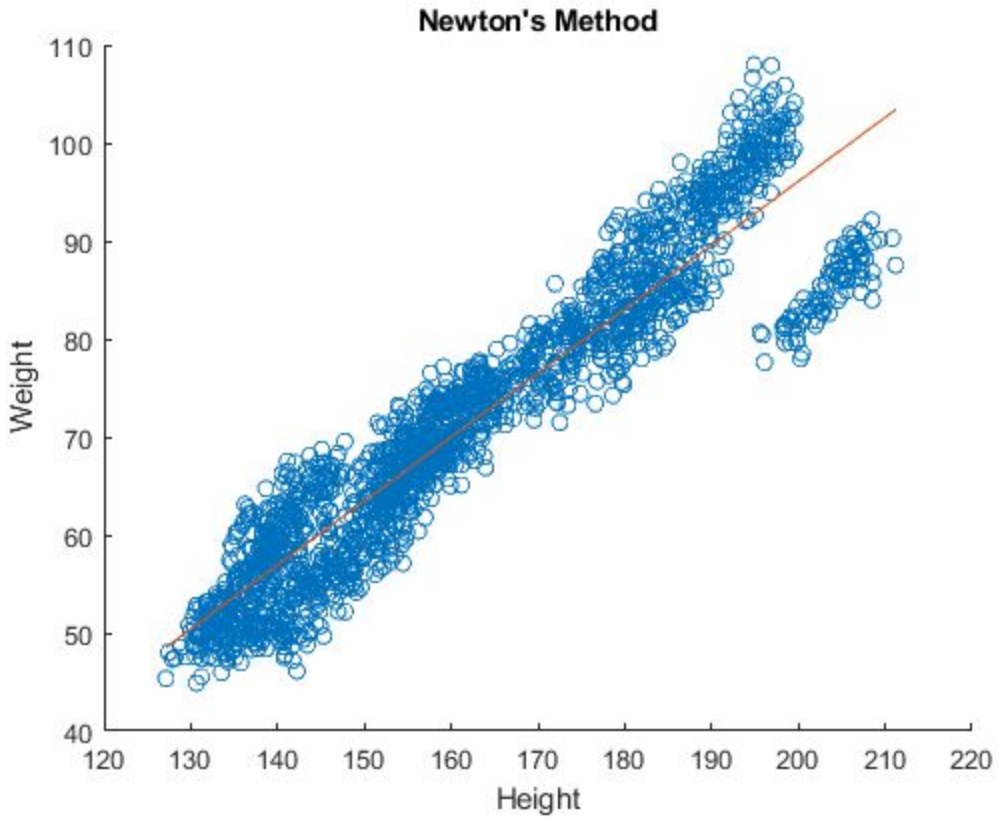
a)solving the problem with Newton's method gives,

[a, b] = [0.652628365975890, -34.439739408449430];

b)Plot with (a, b, objective function)



The graph plotted with the a and b found and the points scattered against height and weight gives:



Elapsed time is 0.084199 seconds..

The number of iterations needed for converging is 2.