Assignment-3 Report

Q1:

X_init = (0.1, 0.1)

Observations on number of iterations vs c1 for Armijo-Goldstein Line Search

c1 = 0.33143028484359627
Took 28 iterations to converge in Armijo-Goldstein Line Search.
Took 34 iterations to converge in Backtracking Armijo Line Search.

c1 = 0.2667117230872565
Took 28 iterations to converge in Armijo-Goldstein Line Search.
Took 34 iterations to converge in Backtracking Armijo Line Search.

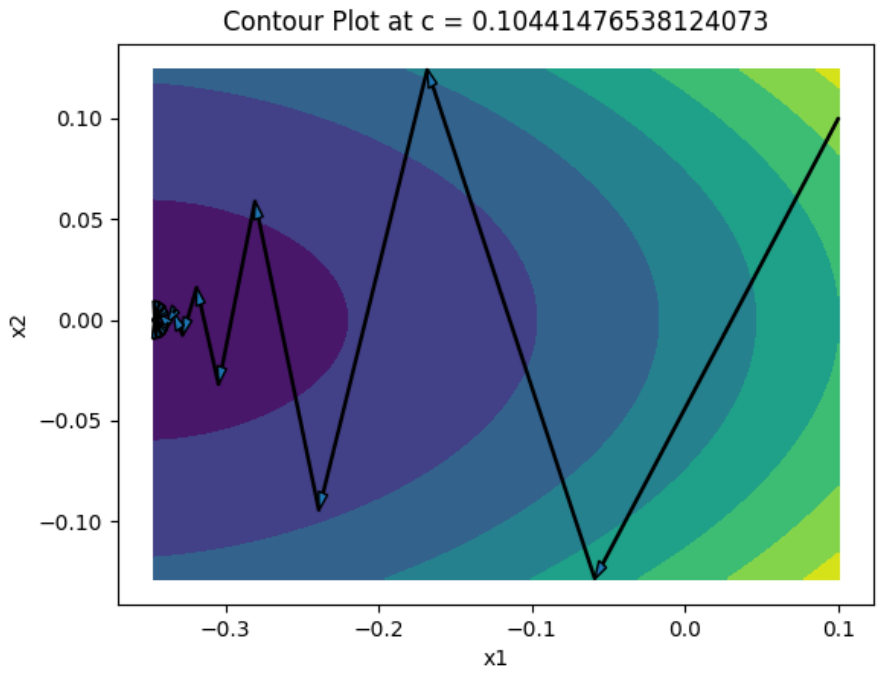
c1 = 0.049685846649421994
Took 30 iterations to converge in Armijo-Goldstein Line Search.
Took 34 iterations to converge in Backtracking Armijo Line Search.

c1 = 0.322407022570512
Took 27 iterations to converge in Armijo-Goldstein Line Search.
Took 34 iterations to converge in Backtracking Armijo Line Search.

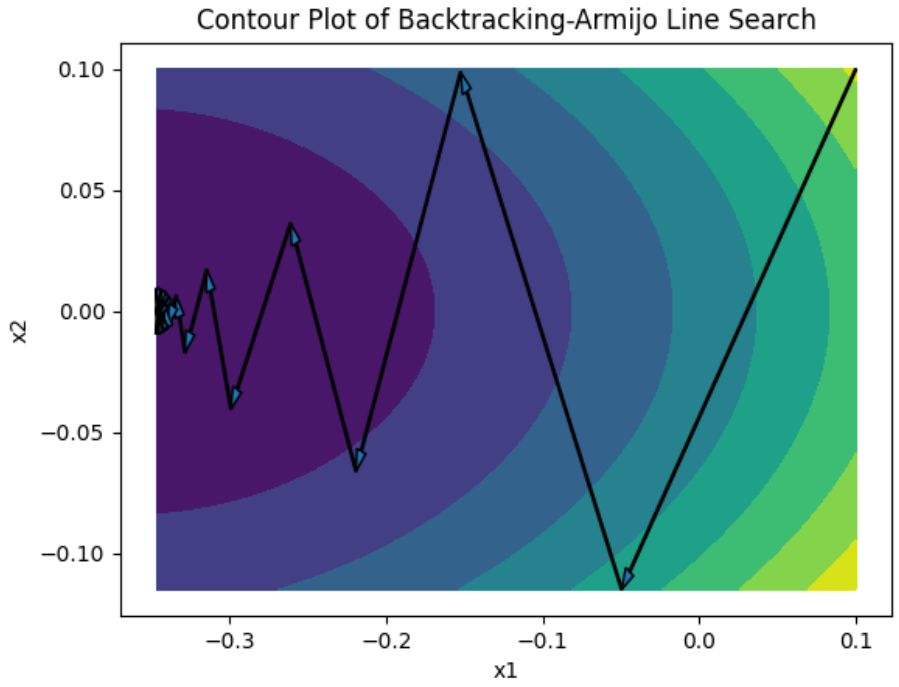
Submitted:
c1 = 0.10441476538124073
Took 30 iterations to converge in Armijo-Goldstein Line Search.
Took 33 iterations to converge in Backtracking Armijo Line Search.

Plots:

Armijo-Goldstein:

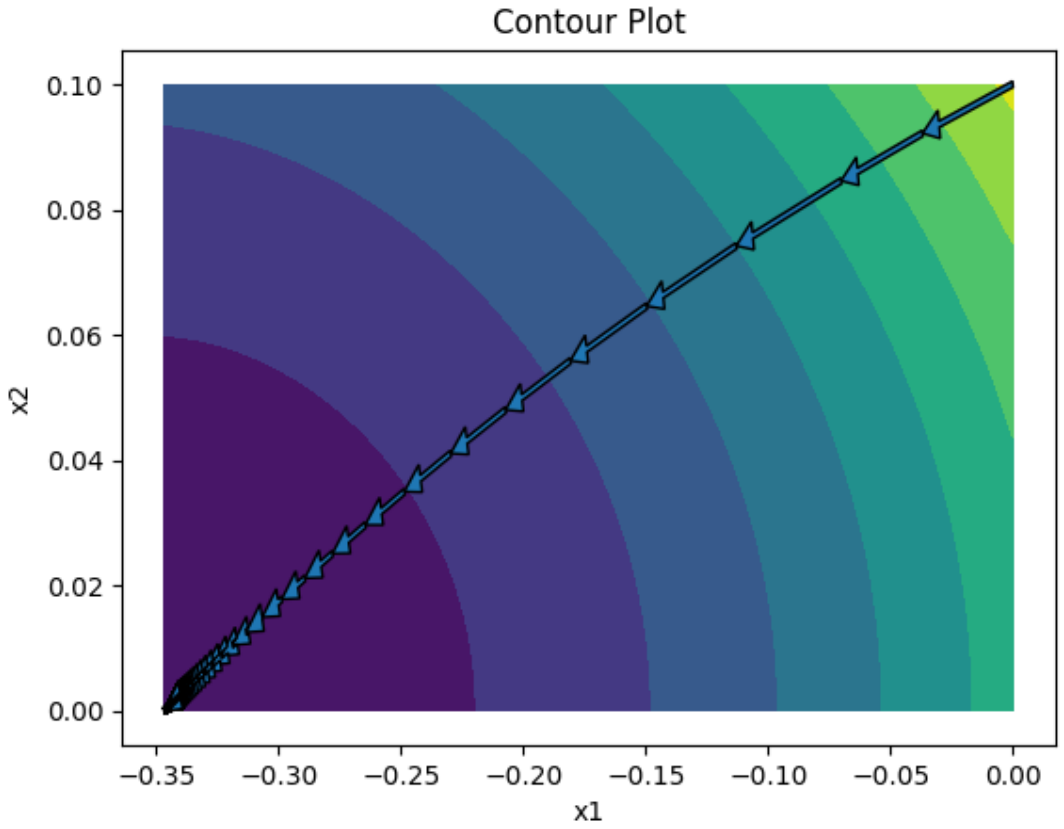


Backtracking Armijo:



Q2:

Took 80 iterations to converge
X init = (0, 0.1)
alpha (k) is calculated using Backtracking Armijo with beta = 0.1, tow = 0.7



Plots of $\{ x \mid (x - x^k)^T \nabla^2 f(x^k)(x - x^k) \leq 1\}$: here

Q3:

Largest eigenvalue is 11. X_init = (0.1, 0.2)

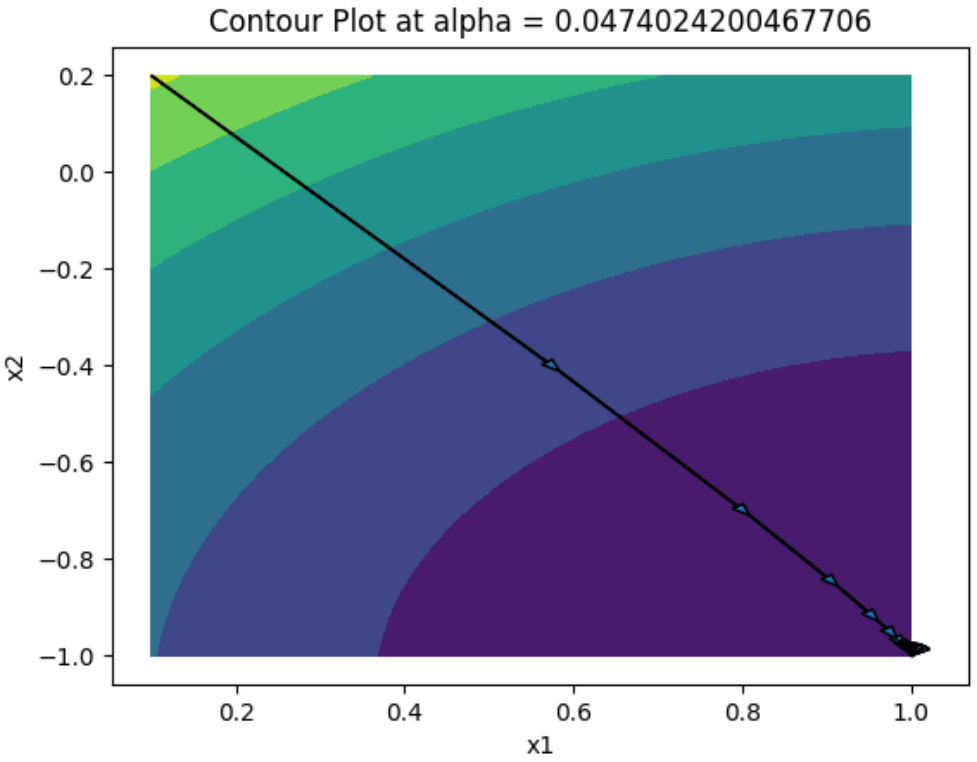
Observations

Took 14 iterations to converge when alpha is 0.0754405915189916
Took 167 iterations to converge when alpha is 0.17355543145335822
Took 123 iterations to converge when alpha is 0.013320986626617858
Took 31 iterations to converge when alpha is 0.14462928700477207
Took 16 iterations to converge when alpha is 0.07012168517910182

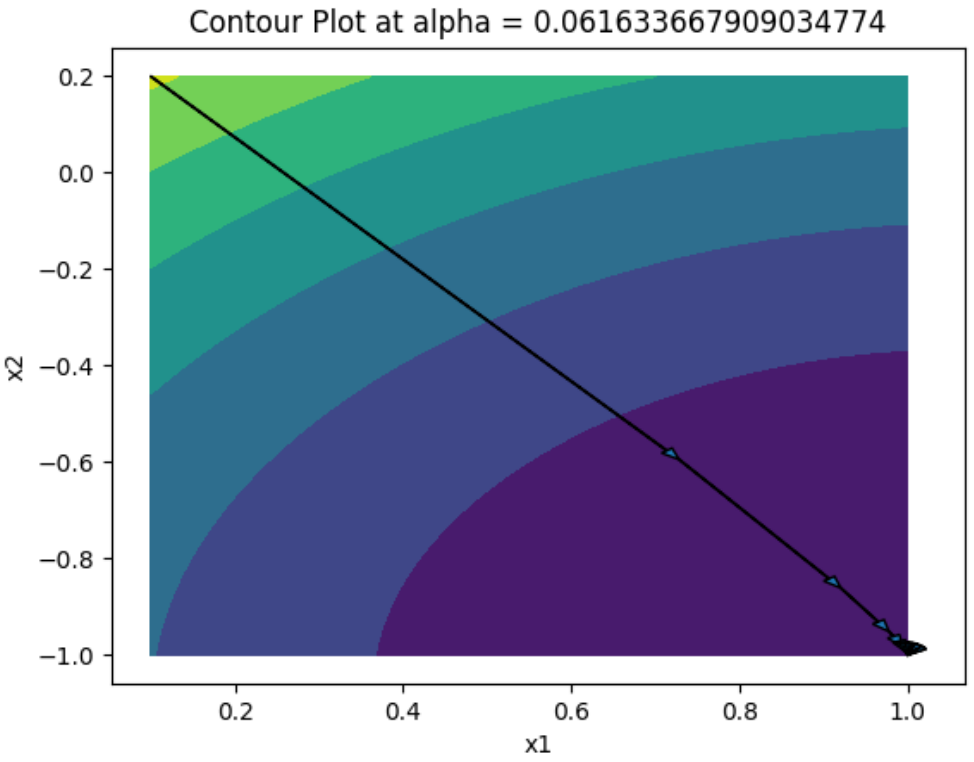
Took 461 iterations to converge when alpha is 0.5169402164927875

Submission:

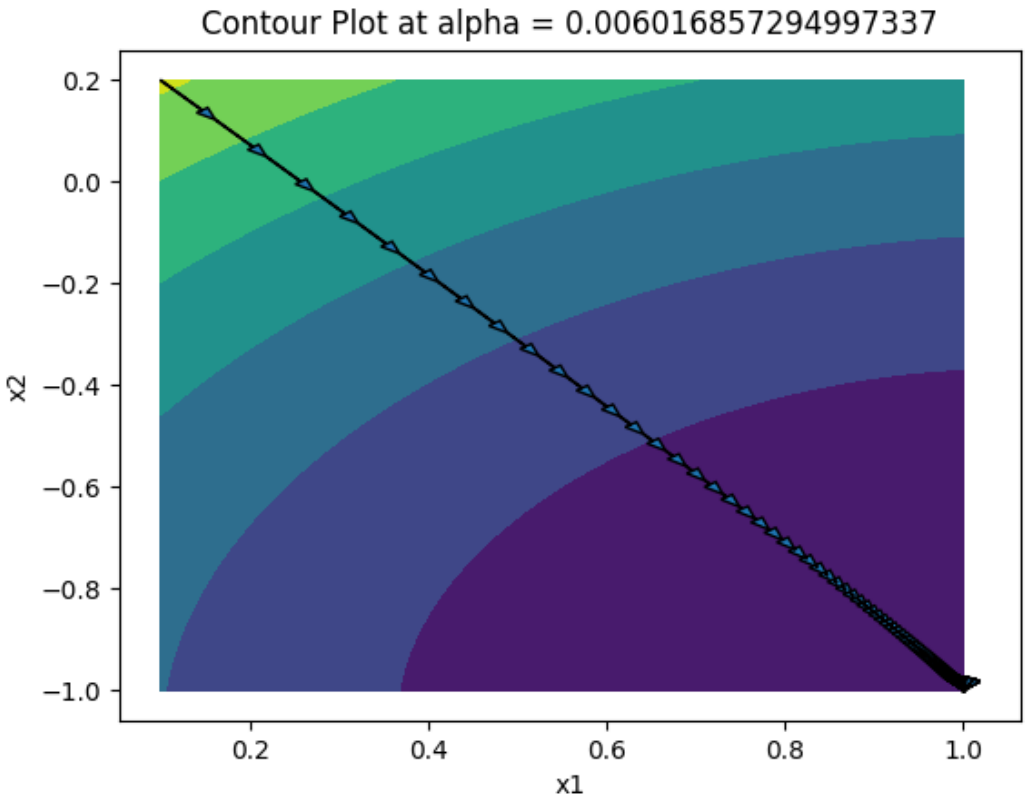
Took 27 iterations to converge when alpha is 0.0474024200467706



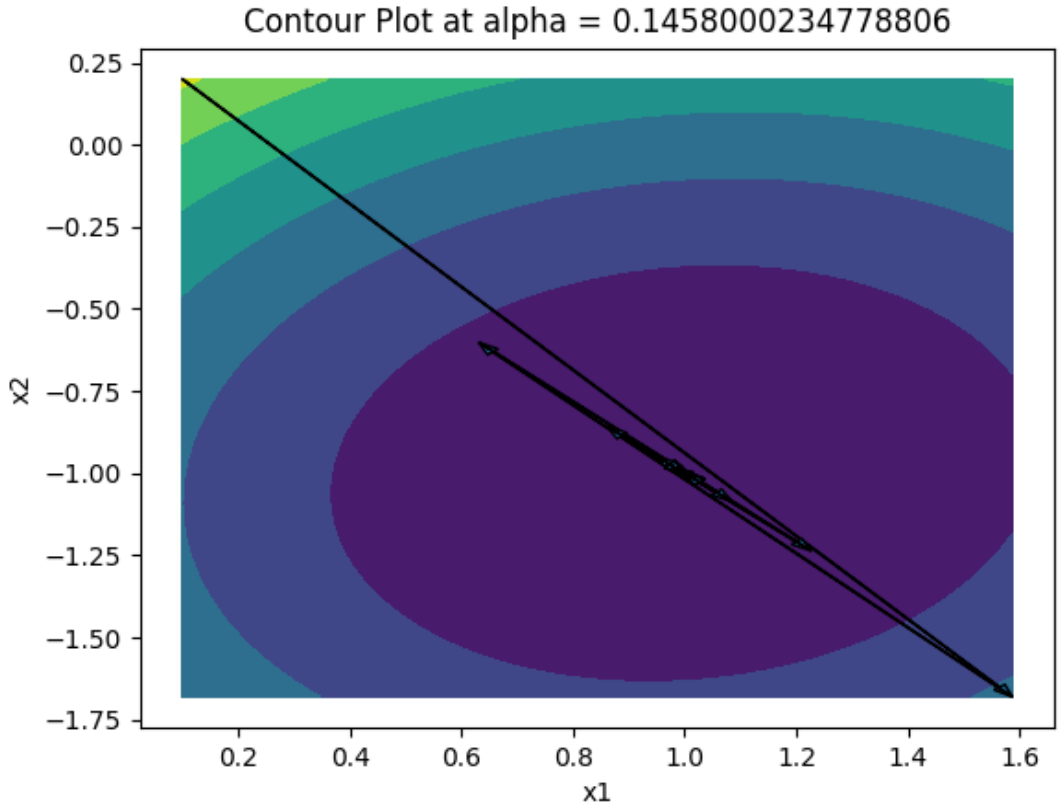
Took 18 iterations to converge when alpha is 0.061633667909034774



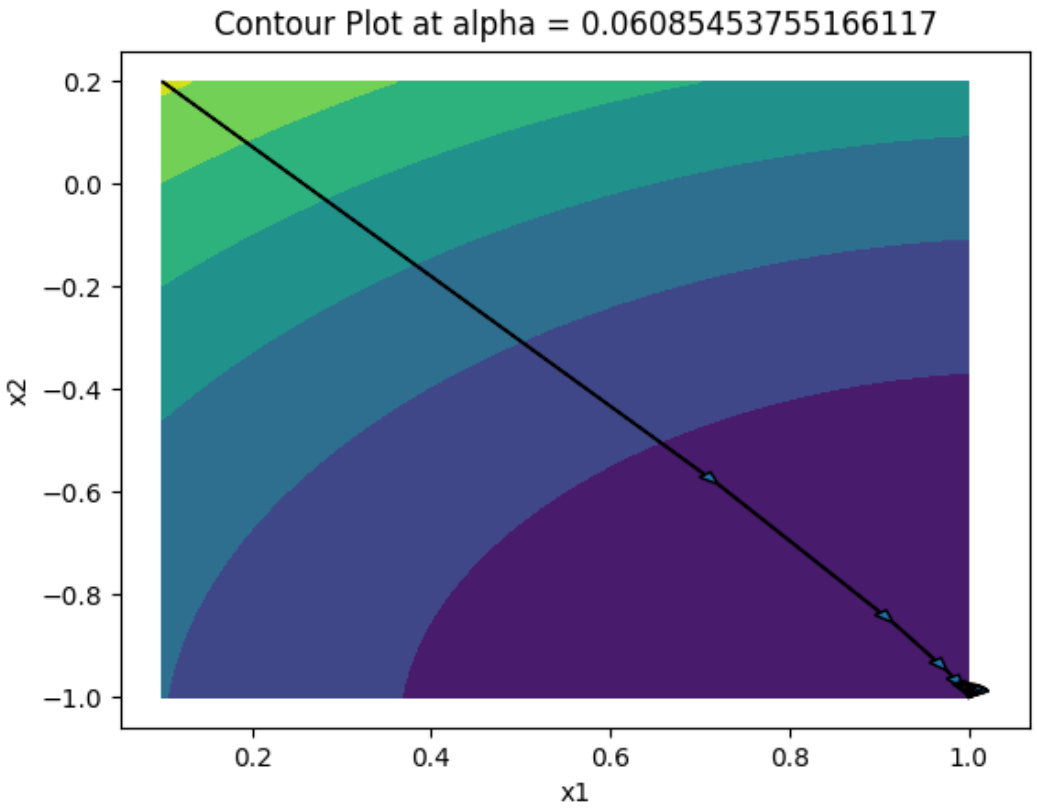
Took 261 iterations to converge when alpha is 0.006016857294997337



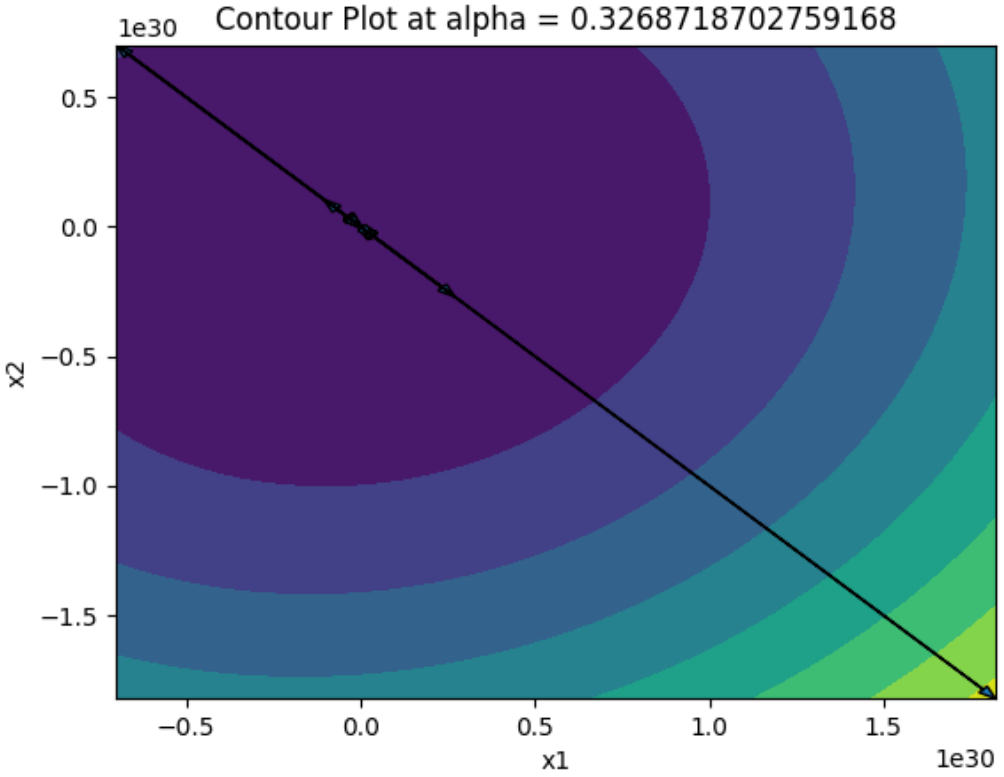
Took 33 iterations to converge when alpha is 0.1458000234778806



Took 19 iterations to converge when alpha is 0.06085453755166117



(alpha > $2/\lambda_{max}$) Took 73 iterations to converge when alpha is 0.3268718702759168



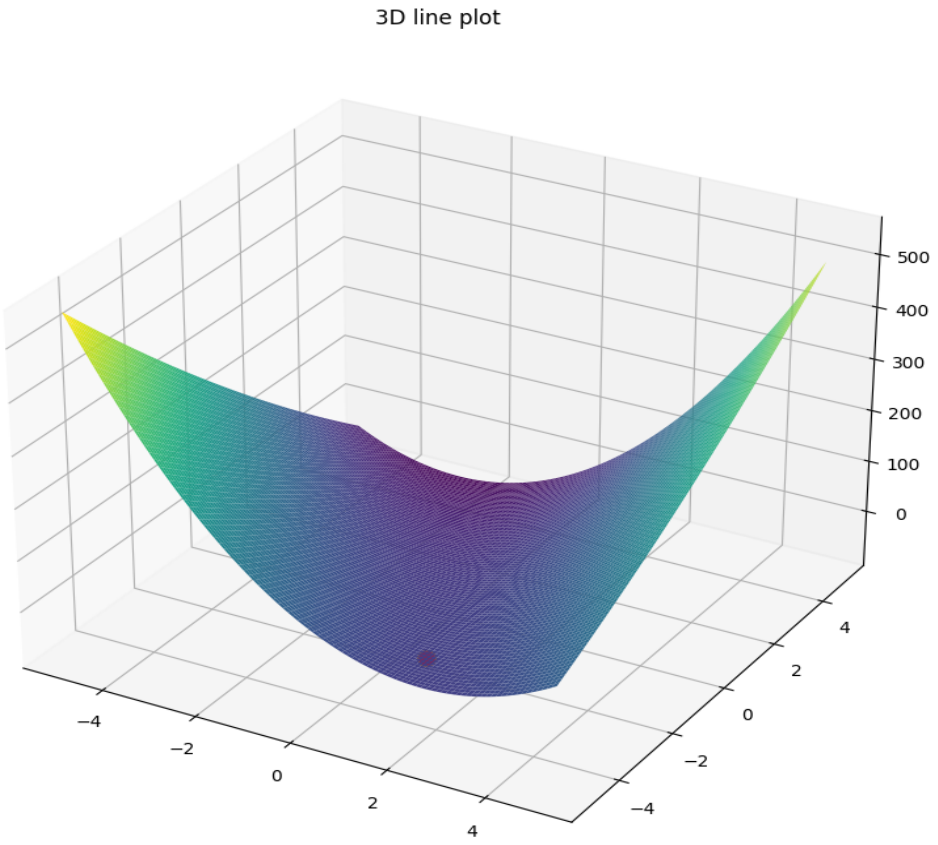
What do you conclude with this exercise?
For larger values i.e alpha > $2/\lambda_{max}$ the function doesn't converge, the above convergence is due to the stopping condition if x1 > 1e30 or x2 > 1e30 exit. Which breaks the loop since algo is moving towards infinity. Rather in the case alpha < $2/\lambda_{max}$ it converges to a point.

Q4:

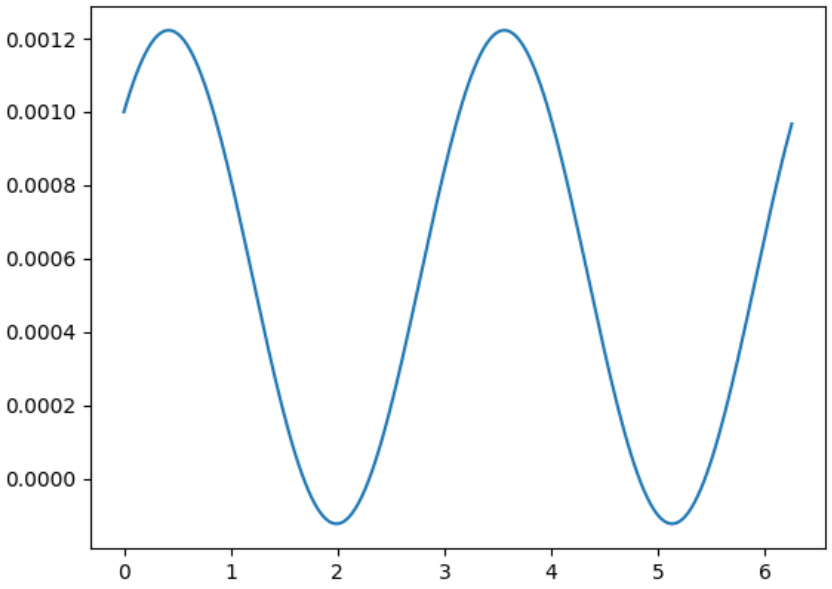
Part	$\nabla f(x^*)$	eigenvalues of $\nabla^2 f(x^*)$	at x* local maxima/minima/saddle point?
1	(0,0)	-2.45362405 24.45362405	Saddle Point
2	(0,0)	16 36	Local Minima

Plots:

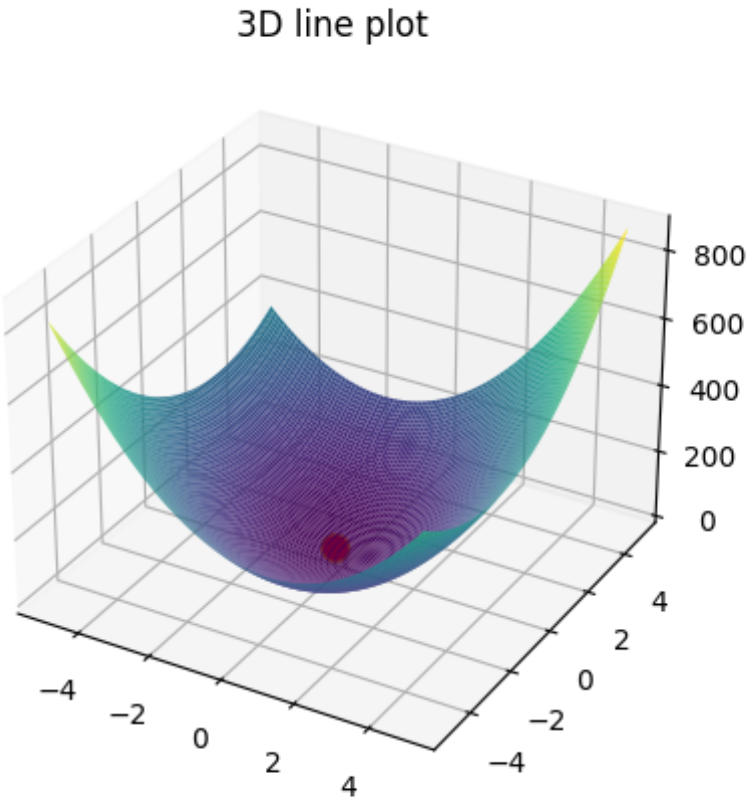
Part 1:



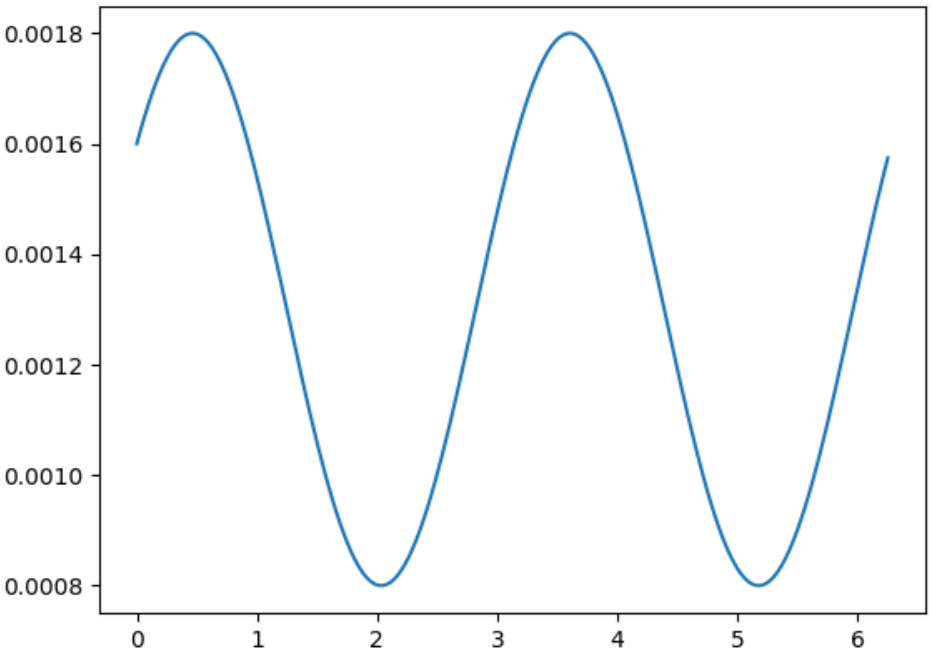
[f (x* + αdθ) − f (x*)] vs θ



Part 2:



[f (x* + αdθ) − f (x*)] vs θ


0.0018
0.0016
0.0014
0.0012
0.0010
0.0008
0
1
2
3
4
5
6