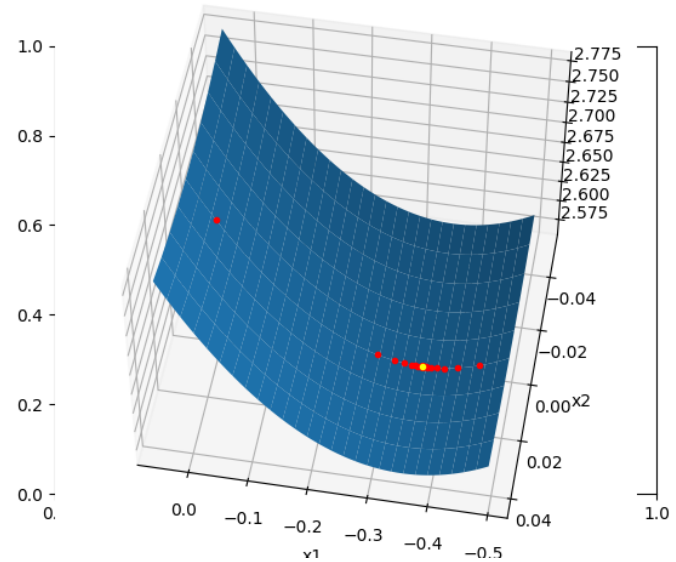
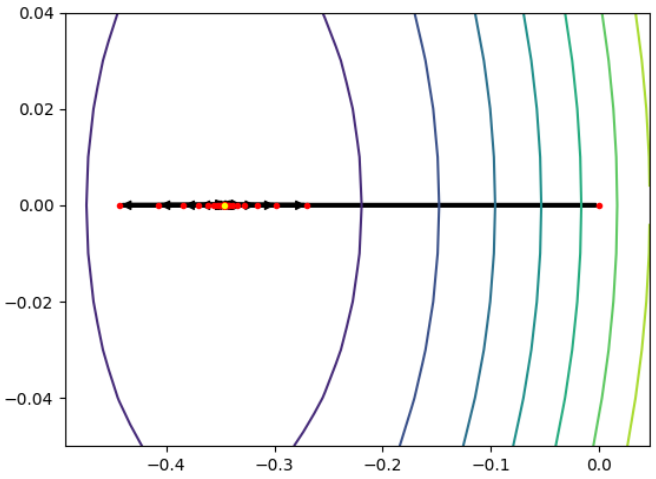
Optimization Methods Assignment 3
2019111021

Problem 1:

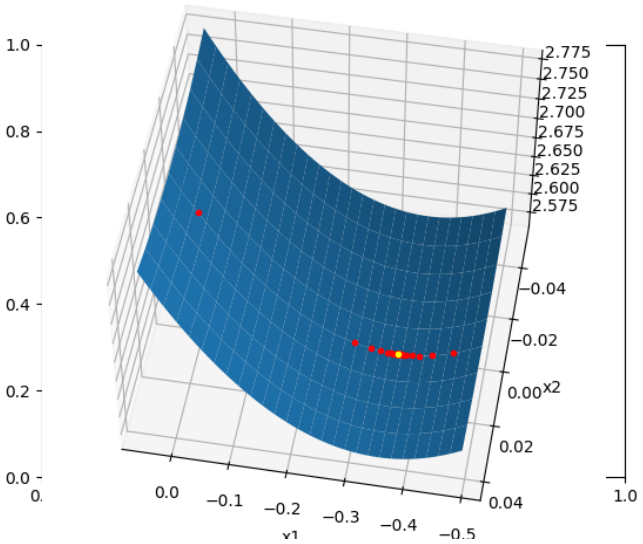
Part 1

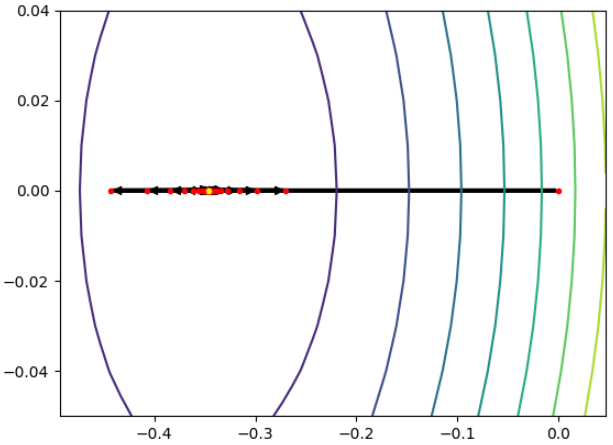




Required tolerance is achieved.
The method used: Steepest Gradient Descent with armijo-goldstein line search
Value of x1, x2: -0.3465739108716635, 0.0
Number of iterations: 55
Function value: 2.559266696658347

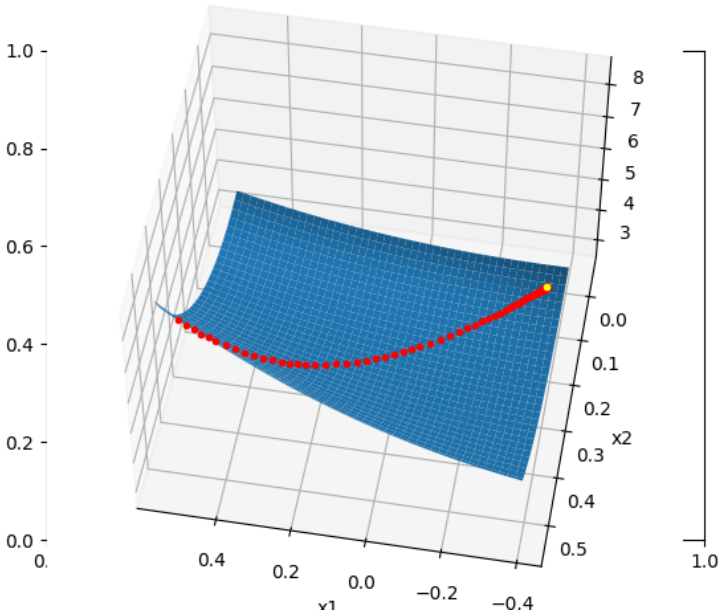
Part 2

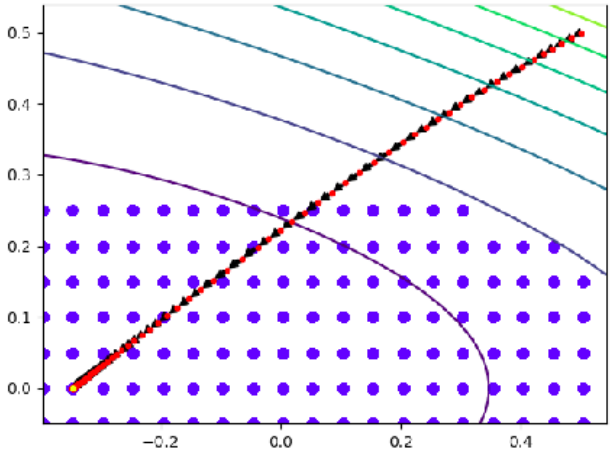




Required tolerance is achieved.
The method used: Steepest Gradient Descent with backtracking line search
Value of x1, x2: -0.3465739108716635, 0.0
Number of iterations: 55
Function value: 2.559266696658347

Problem 2:

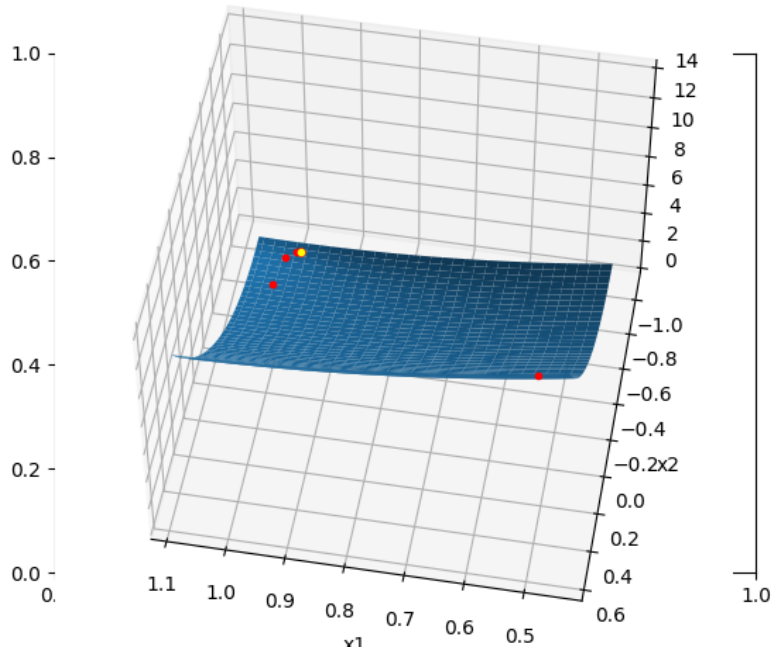


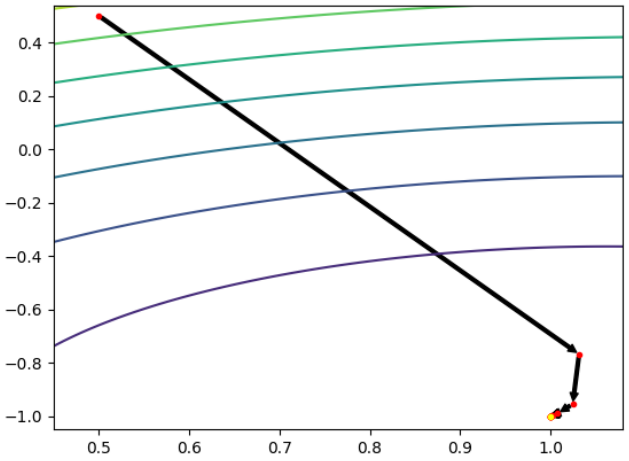


Required tolerance is achieved.
Method used: Newton's Method with backtracking line search
Value of x1, x2: -0.34657347162025154, 7.792009834092442e-08
Number of iterations: 119
Function value: 2.559266696658269

Problem 3:

Part 1





Required tolerance is achieved.
Method used: Steepest Descent Method with 0.08181818182351588 step size
Value of x1, x2: 1.0000000563671467, -0.9999999436308532
Number of iterations: 12
Function value: 2.6645352591003757e-14

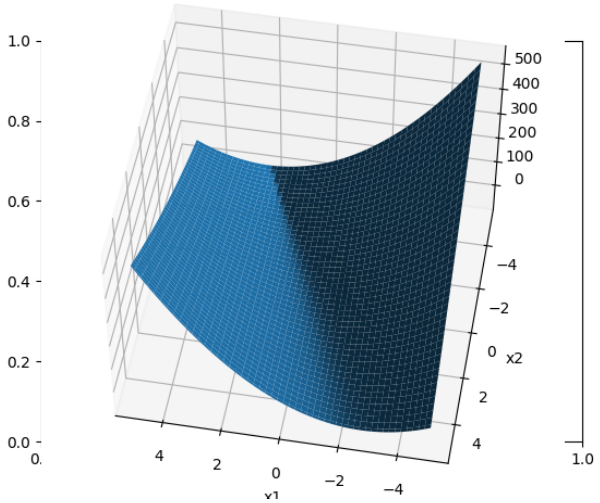
Part 2

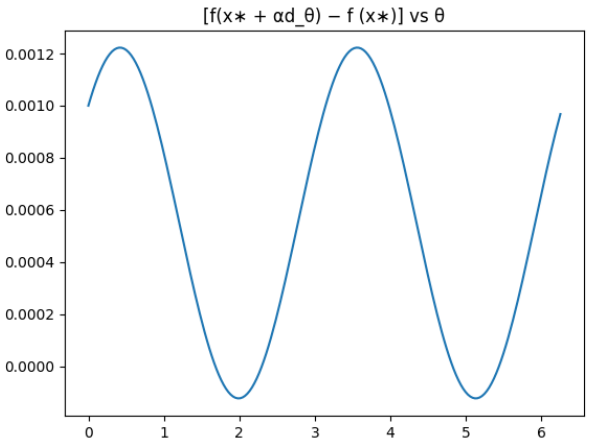
Maximum iteration exceeded.
Method used: Steepest Descent Method with 0.2818181818235159 step size
Value of x1, x2: -1.6669764890539366e+32, 1.6669764890539812e+32
Number of iterations: 100
Function value: 3.05669167656453e+65

We see that the algorithm converges in the first part but when alpha is greater than 2/lamda_max, it does not converge.

Problem 4:

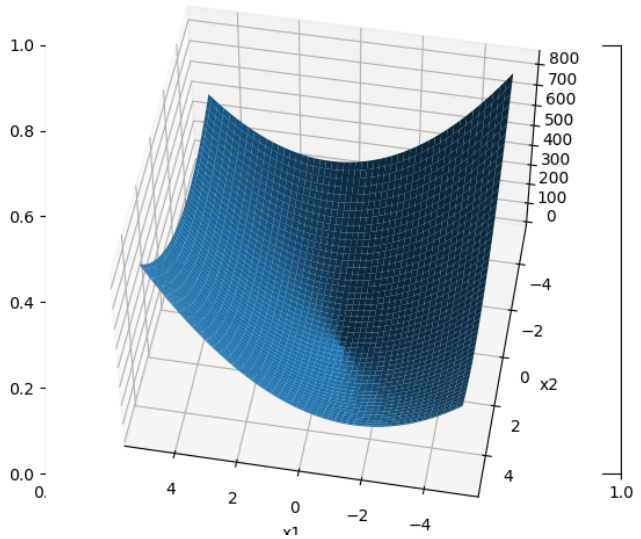
Part 1

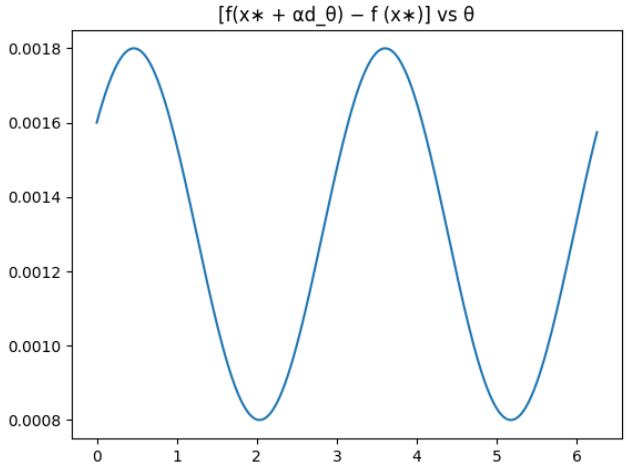




The gradient is [0. 0.]
Eigenvalues of the Hessian Matrix are [24.45362405 -2.45362405]
Saddle point as plotted curve gives both non-negative and non-positive values.

Part 2





The gradient is [0. 0.]
Eigenvalues of the Hessian Matrix are [36. 16.]
Local minima as plotted curve always non-negative.