Homework 02

Problem 1

Consider using a gradient algorithm to minimize the function . With the initial guess as

* 1. To initialize the line-search apply bracketing procedure along the line starting at in the direction of negative gradient. Use = 0.075
  2. Apply the golden section method to reduce the width of uncertainty region to 0.01. Organize results of your computation in table format.
  3. Repeat the above using Fibonacci method.

Solution:

*Matlab code – problem1.m*

To run general gradient algorithm on the problem

*Matlab code – Brackting.m*



*Matlab code – GoldenSection.m*

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Figure 1. Minimizing the function using Gradient descent. Alpha chosen through Golden section.

Problem 2

For the function  
f(x1, x2) = (x2 - x1)4 + 12x1x2 - x1 + x2 - 3,

1. Use MATLAB’s commands meshgrid and mesh to generate its 3D plot. The range of  
   x1 and x2 is the same and it should be equal to [-1, 1]. Set the box on.
2. A close up of a map

   Description automatically generatedUse the command contour to generate 20 contours. Use the same range for x1 and x2 as in (a)

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Description automatically generatedFig 1. 3D plot of the function using the mesh function in MATLAB

Fig 2. Contours of the function generated in MATLAB

*MATLAB Code – Problem2.m*



Problem 3

Minimize the above function using the method of the gradient descent when α = 0.02 and  
locate these points on the level sets of f. Connect the successive points with lines or lines  
with arrows to show clearly the progression of the optimization process. Use two staring  
points,  
 and

Obtain the sequence of points using the steepest descent method and locate these points on  
the level sets of f

**Solution:** *MATLAB Code – Problem3.m*



*MATLAB Code – gradDescent.m*

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Fig 3. The sequence of points plotted on level set of the function for starting point [0.55, 0.7]T

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Description automatically generated Fig 4. The sequence of points plotted on level set of the function for starting point [-0.9,-0.5]T

Problem 4

Minimize the above function using Newton’s method. Locate the points on Level sets of f.

The given function has the very first Hessian which is not pd. So, the Newtons method won’t converge for this function.   
The code is written to handle this condition. However, we can still run the code to visualize the sequence of points on the level sets

Solution:



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Description automatically generatedFigure 5. Sequence of point obtained by ignoring the fact that the Hessian is pd.

The plot shown above shows that if we try to apply the Newtons method to a point away from the minimizer and to a function whose Hessian is not positive definite, the method fails to converge to a minimizer. We can see that the method reaches the saddle point and stops there.