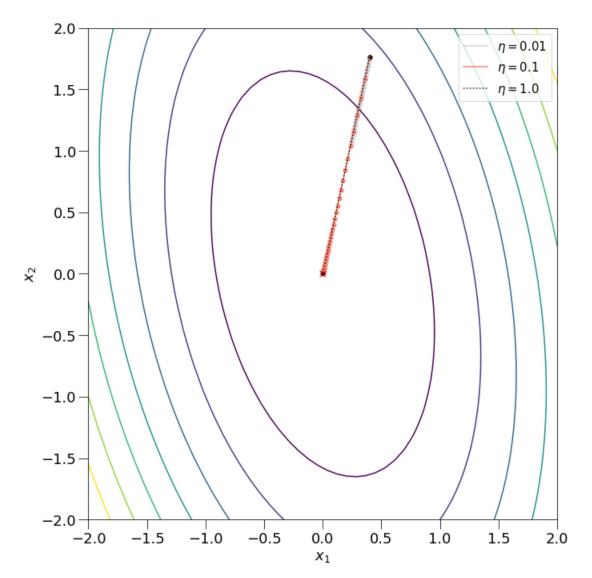
```
In [13]: # -*- coding: utf-8 -*-
         11 11 11
         Created on Sun Oct 27 02:10:04 2019
         @author: jorge
         import sympy as sym
         import numpy as np
         import matplotlib.pyplot as plt
         import matplotlib as mpl
         #get_ipython().run_line magic('matplotlib', 'inline')
         #https://scipy-lectures.org/packages/sympy.html
         # ^^ how to use sympy ^^
         height = 10
         width = 10
         mpl.rcParams['figure.figsize'] = (width, height)
         mpl.rcParams['font.size'] = 18
         mpl.rcParams['figure.titlesize'] = 'small'
         mpl.rcParams['legend.fontsize'] = 'small'
         mpl.rcParams['xtick.major.size'] = 12
         mpl.rcParams['xtick.minor.size'] = 8
         mpl.rcParams['xtick.labelsize'] = 18
         mpl.rcParams['ytick.major.size'] = 12
         mpl.rcParams['ytick.minor.size'] = 8
         mpl.rcParams['ytick.labelsize'] = 18
         HX, HY = 50,50 #number of x,y points for countour
         xmin, xmax = -2, 2
         ymin, ymax = -2, 2
         x1 = np.linspace(xmin, xmax, HX)
         x2 = np.linspace(ymin,ymax,HY)
         X1,X2 = np.meshgrid(x1,x2) # generate mesh grid
         w1=sym.Symbol('w1') # define symbols
         w2=sym.Symbol('w2')
         j = (w1**2+w1*w2+3*w2**2) \# define equation
         #compute gradient
         j grad1=sym.diff(j,w1)
         j grad2=sym.diff(j,w2)
         #compute hessian
         hess11=sym.diff(j_grad1,w1)
         hess12=sym.diff(j grad1,w2)
         hess21=sym.diff(j_grad2,w1)
         hess22=sym.diff(j_grad2,w2)
         #generate contour map
         ConMap=np.zeros((HX,HY))
         for i in range(HX):
             for k in range(HY):
                 ConMap[i,k]=j.subs(\{w1:x1[i],w2:x2[k]\})
         logetas ls = np.arange(-5, 0, 0.5)
         etas ls = 10**logetas ls
         logetas = np.array([-2, -1, 0], dtype=np.float)
         etas = 10**logetas
         lim=50 # number of iterations
         threshold = 1e-5
         wStar=[0,0] # ending point
         colors = ('lightgray', 'salmon', 'black')
         labels = [r'$\eta =$' + str(eta) for eta in etas]
         styles = ['-','-',':']
```

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In [14]: plt.figure(figsize=(10,10))
         plt.contour(X1, X2, ConMap)
         for i in range(len(etas)):
            np.random.seed(0)
             w=np.random.normal(0,1,2) # starting point
            ew=[]
            j w=[]
            count= 1
             line=[]
             while(True):
                 #compute gradient matrix and hessian matrix
                 g= np.array([float(j grad1.subs({w1:w[0],w2:w[1]})),float(j grad2.subs({w1:w[0],w2:w
         [1]}))])
                [1]}))],
                            [float(hess21.subs(\{w1:w[0],w2:w[1]\})),float(hess22.subs(\{w1:w[0],w2:w[1]\}))]
         [1]}))]])
                dw = -np.dot(np.linalg.inv(H), g)
                eta = etas[i]
                wnew = w+eta*dw
                line.append(w)
                 #loop check
                if(np.abs(wnew - w).mean() < threshold):</pre>
                    print('Converge break')
                    print(count)
                    break
                elif( count>lim ):
                    print('Count Break')
                    break
                 elif(np.isnan(g).any()):
                    print('nan break')
                    break
                 else:
                    count=count +1
                    wprev=w.copy()
                    w=wnew.copy()
                    ew.append(np.linalg.norm(w-wStar))
                     jw.append(j.subs({w1:w[0],w2:w[1]}))
             line=np.array(line)
            plt.plot(line[:,1],line[:,0], color=colors[i], linestyle=styles[i], label=labels[i],) # z
         order=len(etas)-i)
            plt.scatter(line[:,1],line[:,0], 25, color=colors[i], )#zorder=len(etas)-i)
         plt.plot(wStar[1], wStar[0], 'rx', markersize=8)
         plt.xlim(xmin, xmax)
         plt.ylim(ymin, ymax)
         plt.xlabel(r'$x_1$')
         plt.ylabel(r'$x 2$')
         plt.legend()
         plt.tight layout()
         #plt.savefig('../prob7.eps', dpi=500)
```

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Count Break
Count Break
Converge break
2



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