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from numpy import eye,zeros,ones,dot,exp
from numpy.random import rand, randn
from numpy.linalg import inv
from matplotlib.pyplot import figure,grid,plot,show,xlabel,semilogy,title,subplot
#--- my functions ---
def phi(ny):
    bz=2./(1.+exp(-ny))-1.
    return(bz)

def dphidny(ny):
    bzz=2.*exp(-ny)/(1.+exp(-ny))**2
    return(bzz)

# Artificial data
N=300
x1=randn(N)
x2=randn(N)
yr=5*x1+x2-0.1*x1**4

#--- SETUP ----
muW=0.005  # learning rate of hidden neurons
muv=0.001 # learning rate of output neuron

epochs=300

n1=5  # neurons in hidden layer
nx=1+2 # length of input x
nv=1+n1   # of output neuron weights
nxi=nv


#---INIT------
# weight init
W=randn(n1,nx)/nx  # keeping init. weights small
v=randn(nv)/nv
e=zeros(N)
y=zeros(N)   # network ouptut
x=ones(nx) #x=[1 x1 x2 ...]
xi=ones(nxi)
dxidny=zeros(n1+1)
dydv=zeros((N,nv))
Lv=eye(nv)
Lw=eye(nx)
dydW=zeros((N,nx,n1))
SSE=zeros(epochs)

for epoch in range(epochs):
    for k in range(N):
        x[1]=x1[k]
        x[2]=x2[k]
        ny=dot(W,x)
        xi[1:]=phi(ny)
        y[k]=dot(v,xi)
        e[k]=yr[k]-y[k]
    #-------derivatives for Jacobians
        # output neuron
        dydv[k,:]=xi
       # hidden neurons
        dxidny[1:]=dphidny(ny)
        for i in range(1,n1+1): # for each neuron
            dydW[k,:,i-1]=v[i]*dxidny[i]*x
    # update output neuron
    Jv=dydv
    dv=dot(dot(inv(dot(Jv.T,Jv)+1./muv*Lv),Jv.T),e)
    v=v+dv
    # update hidden neurons
    for i in range(1,n1+1): # for each neuron
        Jw=dydW[:,:,i-1]
        dw=dot(dot(inv(dot(Jw.T,Jw)+1./muW*Lw),Jw.T),e)
        W[i-1,:]=W[i-1,:]+dw

    SSE[epoch]=dot(e,e)
    print SSE[epoch]

figure()
subplot(311)
plot(yr),title('yr,y'),xlabel('k')
plot(y,'g'),grid()
subplot(312)
semilogy(SSE,'k'),title('SSE'),xlabel('epoch'),grid()
subplot(313)
plot(W.T),title('W')
show()
```

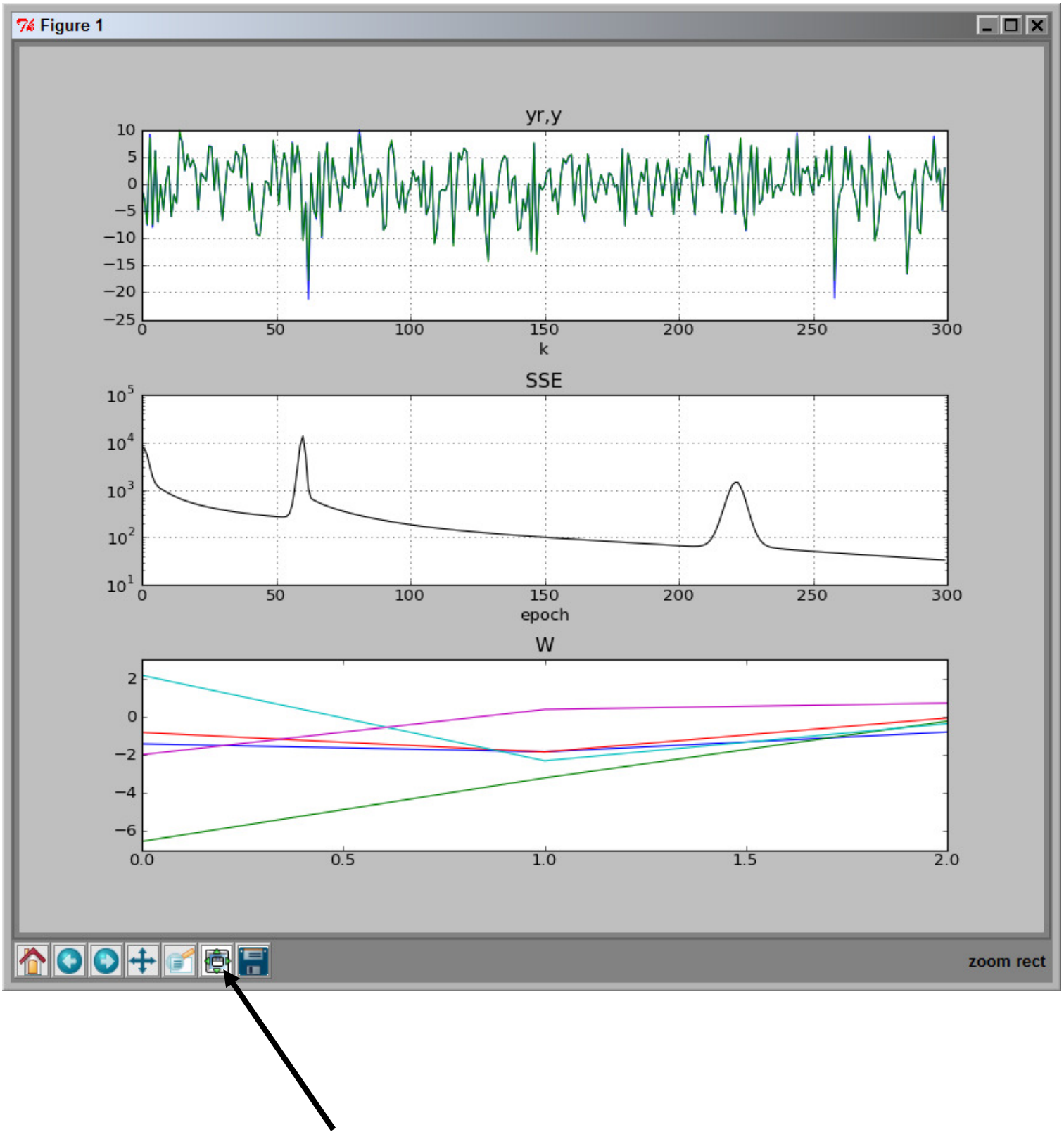
Figure 1
yr,y
k
SSE
epoch
W
zoom rect