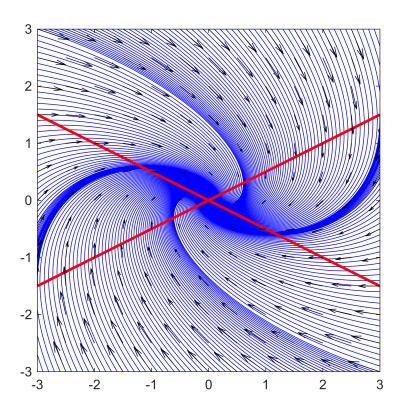
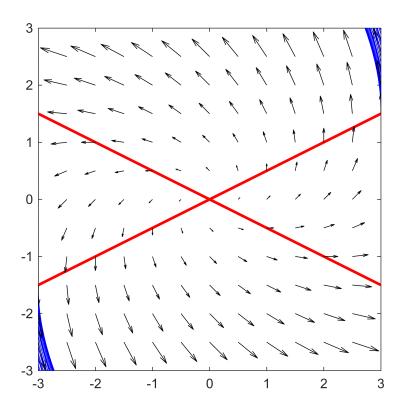
%% Q1 Simulate the linear dynamical system using dynamo4x.m (slides 33 and 34) given by the mat
M=[[-1 2];[-1 -2]];
figure
dynamo4x(-3:.1:3,.02,1000,M,[0 0]')



ans = ans(:,:,1)	=										
-0.3000 0.9000	-0.2000 0.8000	-0.1000 0.7000	0 0.6000	0.1000 0.5000	0.2000 0.4000	0.3000 0.3000	0.4000 0.2000	0.5000 0.1000	0.6000 0	0.7000 -0.1000	0 -0
ans(:,:,2)	=										
-0.3500 0.8500	-0.2500 0.7500	-0.1500 0.6500	-0.0500 0.5500	0.0500 0.4500	0.1500 0.3500	0.2500 0.2500	0.3500 0.1500	0.4500 0.0500	0.5500 -0.0500	0.6500 -0.1500	0 -0
ans(:,:,3)	=										
-0.4000 0.8000	-0.3000 0.7000	-0.2000 0.6000	-0.1000 0.5000	0 0.4000	0.1000 0.3000	0.2000 0.2000	0.3000 0.1000	0.4000	0.5000 -0.1000	0.6000 -0.2000	0 -0
ans(:,:,4)	=										
-0.4500 0.7500	-0.3500 0.6500	-0.2500 0.5500	-0.1500 0.4500	-0.0500 0.3500	0.0500 0.2500	0.1500 0.1500	0.2500 0.0500	0.3500 -0.0500	0.4500 -0.1500	0.5500 -0.2500	0 -0
ans(:,:,5)	=										
-0.5000	-0.4000	-0.3000	-0.2000	-0.1000	0	0.1000	0.2000	0.3000	0.4000	0.5000	0

0.7000	0.6000	0.5000	0.4000	0.3000	0.2000	0.1000	0	-0.1000	-0.2000	-0.3000	-0
ans(:,:,6) =	=										
-0.5500 0.6500	-0.4500 0.5500	-0.3500 0.4500	-0.2500 0.3500	-0.1500 0.2500	-0.0500 0.1500	0.0500 0.0500	0.1500 -0.0500	0.2500 -0.1500	0.3500 -0.2500	0.4500 -0.3500	0 -0
ans(:,:,7) =	=										
-0.6000 0.6000	-0.5000 0.5000	-0.4000 0.4000	-0.3000 0.3000	-0.2000 0.2000	-0.1000 0.1000	0 0	0.1000 -0.1000	0.2000 -0.2000	0.3000 -0.3000	0.4000 -0.4000	0 -0
ans(:,:,8) =	=										
-0.6500 0.5500	-0.5500 0.4500	-0.4500 0.3500	-0.3500 0.2500	-0.2500 0.1500	-0.1500 0.0500	-0.0500 -0.0500	0.0500 -0.1500	0.1500 -0.2500	0.2500 -0.3500	0.3500 -0.4500	0 -0
ans(:,:,9) =	=										
-0.7000 0.5000	-0.6000 0.4000	-0.5000 0.3000	-0.4000 0.2000	-0.3000 0.1000	-0.2000 0	-0.1000 -0.1000	0 -0.2000	0.1000 -0.3000	0.2000 -0.4000	0.3000 -0.5000	0 -0
ans(:,:,10)	=										
-0.7500 0.4500	-0.6500 0.3500	-0.5500 0.2500	-0.4500 0.1500	-0.3500 0.0500	-0.2500 -0.0500	-0.1500 -0.1500	-0.0500 -0.2500	0.0500 -0.3500	0.1500 -0.4500	0.2500 -0.5500	0 -0
ans(:,:,11)	=										
-0.8000 0.4000	-0.7000 0.3000	-0.6000 0.2000	-0.5000 0.1000	-0.4000 0	-0.3000 -0.1000	-0.2000 -0.2000	-0.1000 -0.3000	0 -0.4000	0.1000 -0.5000	0.2000 -0.6000	0 -0
ans(:,:,12)	=										
-0.8500 0.3500	-0.7500 0.2500	-0.6500 0.1500	-0.5500 0.0500	-0.4500 -0.0500	-0.3500 -0.1500	-0.2500 -0.2500	-0.1500 -0.3500	-0.0500 -0.4500	0.0500 -0.5500	0.1500 -0.6500	0 -0
ans(:,:,13)	=										
-0.9000 0.3000 ans = 2×1001	-0.8000 0.2000	-0.7000 0.1000	-0.6000 0	-0.5000 -0.1000	-0.4000 -0.2000	-0.3000 -0.3000	-0.2000 -0.4000	-0.1000 -0.5000	0 -0.6000	0.1000 -0.7000	0 -0
3.0000 3.0000	3.0600 2.8200	3.1116 2.6460	3.1552 2.4779	3.1912 2.3157	3.2200 2.1593	3.2420 2.0085	3.2575 · 1.8633	• •			



ans =

ans(:,:	,1) =											
0.3 -0.9	000 000	0.2000 -0.8000	0.1000 -0.7000	0 -0.6000	-0.1000 -0.5000	-0.2000 -0.4000	-0.3000 -0.3000	-0.4000 -0.2000	-0.5000 -0.1000	-0.6000 0	-0.7000 0.1000	-0. 0.
ans(:,:	,2) =											
0.3 -0.8	500 500	0.2500 -0.7500	0.1500 -0.6500	0.0500 -0.5500	-0.0500 -0.4500	-0.1500 -0.3500	-0.2500 -0.2500	-0.3500 -0.1500	-0.4500 -0.0500	-0.5500 0.0500	-0.6500 0.1500	-0. 0.
ans(:,:	,3) =											
0.4 -0.8	.000 .000	0.3000 -0.7000	0.2000 -0.6000	0.1000 -0.5000	0-0.4000	-0.1000 -0.3000	-0.2000 -0.2000	-0.3000 -0.1000	-0.4000 0	-0.5000 0.1000	-0.6000 0.2000	-0 0
ans(:,:	,4) =											
0.4 -0.7	500 500	0.3500 -0.6500	0.2500 -0.5500	0.1500 -0.4500	0.0500 -0.3500	-0.0500 -0.2500	-0.1500 -0.1500	-0.2500 -0.0500	-0.3500 0.0500	-0.4500 0.1500	-0.5500 0.2500	-0. 0.
ans(:,:	,5) =											
0.5 -0.7	000	0.4000 -0.6000	0.3000 -0.5000	0.2000 -0.4000	0.1000 -0.3000	0 -0.2000	-0.1000 -0.1000	-0.2000 0	-0.3000 0.1000	-0.4000 0.2000	-0.5000 0.3000	-0 0
ans(:,:	,6) =											
0.5	500	0.4500	0.3500	0.2500	0.1500	0.0500	-0.0500	-0.1500	-0.2500	-0.3500	-0.4500	-0.

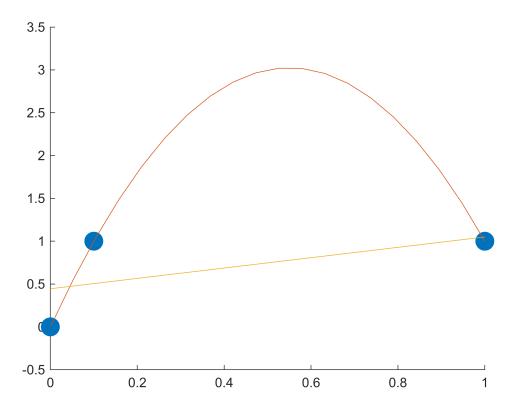
```
-0.6500
             -0.5500
                        -0.4500
                                  -0.3500
                                            -0.2500
                                                       -0.1500
                                                                 -0.0500
                                                                            0.0500
                                                                                       0.1500
                                                                                                 0.2500
                                                                                                           0.3500
                                                                                                                      0
ans(:,:,7) =
    0.6000
              0.5000
                        0.4000
                                   0.3000
                                             0.2000
                                                       0.1000
                                                                       0
                                                                           -0.1000
                                                                                      -0.2000
                                                                                                -0.3000
                                                                                                          -0.4000
                                                                                                                     -0
   -0.6000
             -0.5000
                        -0.4000
                                  -0.3000
                                            -0.2000
                                                       -0.1000
                                                                       0
                                                                            0.1000
                                                                                       0.2000
                                                                                                 0.3000
                                                                                                           0.4000
ans(:,:,8) =
                        0.4500
                                                       0.1500
    0.6500
              0.5500
                                   0.3500
                                             0.2500
                                                                  0.0500
                                                                           -0.0500
                                                                                      -0.1500
                                                                                                -0.2500
                                                                                                          -0.3500
                                                                                                                     -0
             -0.4500
                        -0.3500
                                  -0.2500
   -0.5500
                                            -0.1500
                                                       -0.0500
                                                                  0.0500
                                                                            0.1500
                                                                                      0.2500
                                                                                                 0.3500
                                                                                                           0.4500
                                                                                                                      0
ans(:,:,9) =
    0.7000
              0.6000
                        0.5000
                                   0.4000
                                             0.3000
                                                        0.2000
                                                                  0.1000
                                                                                 0
                                                                                      -0.1000
                                                                                                -0.2000
                                                                                                          -0.3000
                                                                                                                     -0
   -0.5000
             -0.4000
                        -0.3000
                                  -0.2000
                                            -0.1000
                                                             0
                                                                  0.1000
                                                                            0.2000
                                                                                       0.3000
                                                                                                 0.4000
                                                                                                           0.5000
ans(:,:,10) =
    0.7500
              0.6500
                        0.5500
                                   0.4500
                                             0.3500
                                                        0.2500
                                                                  0.1500
                                                                            0.0500
                                                                                      -0.0500
                                                                                                -0.1500
                                                                                                          -0.2500
                                                                                                                     -0
   -0.4500
             -0.3500
                        -0.2500
                                  -0.1500
                                            -0.0500
                                                       0.0500
                                                                  0.1500
                                                                            0.2500
                                                                                       0.3500
                                                                                                 0.4500
                                                                                                           0.5500
                                                                                                                     0
ans(:,:,11) =
    0.8000
                                             0.4000
              0.7000
                        0.6000
                                   0.5000
                                                        0.3000
                                                                  0.2000
                                                                            0.1000
                                                                                            0
                                                                                                -0.1000
                                                                                                          -0.2000
                                                                                                                     -0
   -0.4000
             -0.3000
                                                                            0.3000
                                                                                       0.4000
                                                                                                 0.5000
                        -0.2000
                                  -0.1000
                                                  0
                                                        0.1000
                                                                  0.2000
                                                                                                           0.6000
                                                                                                                      0
ans(:,:,12) =
    0.8500
              0.7500
                        0.6500
                                   0.5500
                                             0.4500
                                                        0.3500
                                                                  0.2500
                                                                            0.1500
                                                                                       0.0500
                                                                                                -0.0500
                                                                                                          -0.1500
                                                                                                                     -0
   -0.3500
             -0.2500
                        -0.1500
                                  -0.0500
                                             0.0500
                                                       0.1500
                                                                  0.2500
                                                                            0.3500
                                                                                       0.4500
                                                                                                 0.5500
                                                                                                           0.6500
                                                                                                                      0
ans(:,:,13) =
    0.9000
              0.8000
                        0.7000
                                   0.6000
                                             0.5000
                                                        0.4000
                                                                  0.3000
                                                                            0.2000
                                                                                       0.1000
                                                                                                          -0.1000
                                                                                                                     -0
   -0.3000
             -0.2000
                        -0.1000
                                        0
                                             0.1000
                                                        0.2000
                                                                  0.3000
                                                                            0.4000
                                                                                       0.5000
                                                                                                 0.6000
                                                                                                           0.7000
                                                                                                                      0
ans = 2 \times 1001
10^{13} \times
    0.0000
                                                                            0.0000 · · ·
              0.0000
                        0.0000
                                   0.0000
                                             0.0000
                                                       0.0000
                                                                  0.0000
    0.0000
              0.0000
                        0.0000
                                   0.0000
                                             0.0000
                                                       0.0000
                                                                  0.0000
                                                                            0.0000
% It reverse the quiver thus make it a spiral out
\%\% Q3 Fit a second order polynomial to the data points (0,0, (0.1,1), and (1,1).
                                                                                                       Plot the resi
clear;
xdata = [0 \ 0.1 \ 1];
ydata = [0 1 1];
figure
scatter(xdata,ydata,200,"filled")
hold on % this command is important to get the curves
% on the same graph as the points and each other
xvals=linspace(0,1,20);
p2=polyfit(xdata,ydata,2) % second order
```

```
p2 = 1×3
-10.0000 11.0000 -0.0000
```

```
yvals=polyval(p2,xvals);
plot(xvals,yvals)
p1=polyfit(xdata,ydata,1) % linear
```

```
p1 = 1×2
0.6044 0.4451
```

```
yvals=polyval(p1,xvals);
plot(xvals,yvals)
```



```
%% Attachments
% scraped from lecture slides
```

```
function ptseq = dynamo4x( rang, step, niter, cmtx, cvct )
figure
xinit=[rang rang rang(1)*ones(size(rang)) rang(end)*ones(size(rang))];
yinit=[rang(1)*ones(size(rang)) rang(end)*ones(size(rang)) rang rang];
[xcr,ycr] = meshgrid(linspace(rang(1), rang(end), 100));
nullx=cmtx(1,1)*xcr+cmtx(1,2)*ycr+cvct(1,1);
nully=cmtx(2,1)*xcr+cmtx(2,2)*ycr+cvct(2,1);
% size(xinit)
for k=1:max(size(xinit))
```

```
ptseq=[xinit(k);yinit(k)];
    curr=[xinit(k);yinit(k)];
    for i=1:niter
        curr=onestep(curr,cmtx,cvct,step);
        ptseq=[ptseq,curr];
    end
    plot(ptseq(1,:),ptseq(2,:),'blue')
    axis equal
    hold on ;
end
axis([rang(1) rang(end) rang(1) rang(end)])
contour(xcr,ycr,nullx,[0 0],'red','LineWidth',2);
contour(xcr,ycr,nully,[0 0],'red','LineWidth',2);
qplot(cmtx,cvct,rang(1):.5:rang(end))
end
function newx = onestep(oldx,cmat,cvec,dt)
newx=oldx+(cmat*oldx+cvec)*dt ;
end
function qv = qplot( cmat, cvec, rang )
%This function generates a quiver plot for the linear system
%specified by cmat. rang is the range (for both x and y)
[xx, yy] = meshgrid(rang);
qv=[];
for xp=rang
   tcol=[];
    for yp=rang
        temp=.1*(cmat*[xp yp]'+cvec);
       tcol=[tcol,temp];
    end
    qv=cat(3,qv,tcol);
end
qx=reshape(qv(1,:,:),size(xx,1),size(xx,2));
qy=reshape(qv(2,:,:),size(yy,1),size(yy,2));
quiver(xx,yy,qx,qy,'black');
axis equal
axis([[rang(1) rang(end)],[rang(1) rang(end)]]);
end
function [pfinal, xpow] = gdpoly( xx, yy, pinit, niter, eta )
% gradient descent in a polynomial function
    dak/dt = 2(y^*-y)x^k
nn=max(size(pinit));
kk=max(size(xx));
xmin=min(xx)-.1*(max(xx)-min(xx));
```

```
xmax=max(xx)+.1*(max(xx)-min(xx));
ymin=min(yy)-.1*(max(yy)-min(yy));
ymax=max(yy)+.1*(max(yy)-min(yy));
xstep=.02*(xmax-xmin);
xvals=xmin:xstep:xmax ;
xpow=ones(kk,1);
for ii=2:nn
   xpow=[xx'.*xpow(:,1),xpow] ;
end
pfinal=pinit;
figure
h1=scatter(xx,yy,250,'red','filled');
hold on
yest=polyval(pfinal,xvals);
h2=plot(xvals,yest);
axis([xmin xmax ymin ymax]);
for ii=1:niter
   datapt=irand(kk,1);
   yest=polyval(pfinal,xx(datapt));
   dp=(yest-yy(datapt))*xpow(datapt,:);
   pfinal=pfinal - dp*eta ;
   ycurve=polyval(pfinal,xvals);
   set(h2,'XData',xvals,'YData',ycurve);
   drawnow
end
end
```