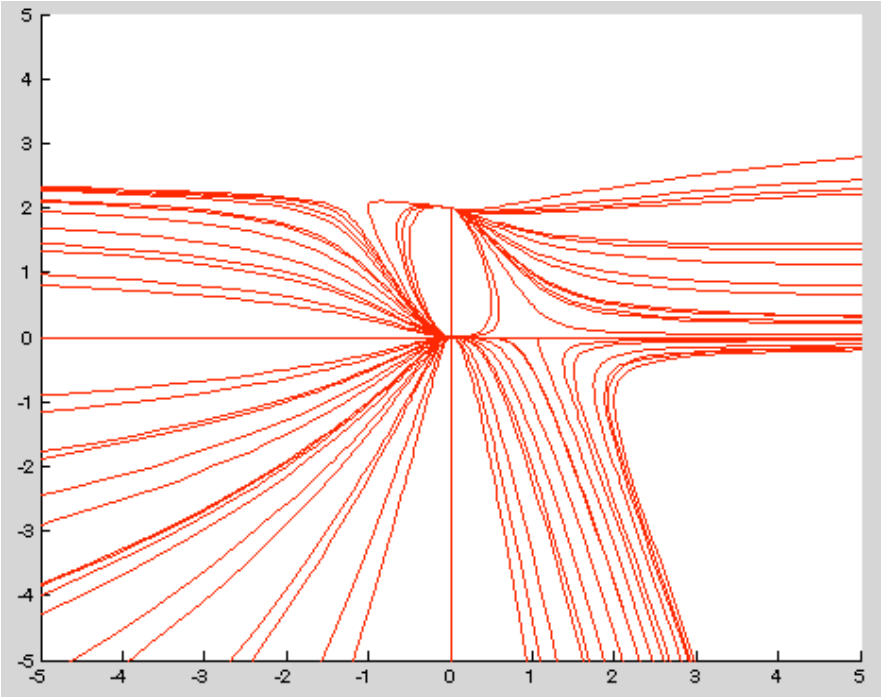
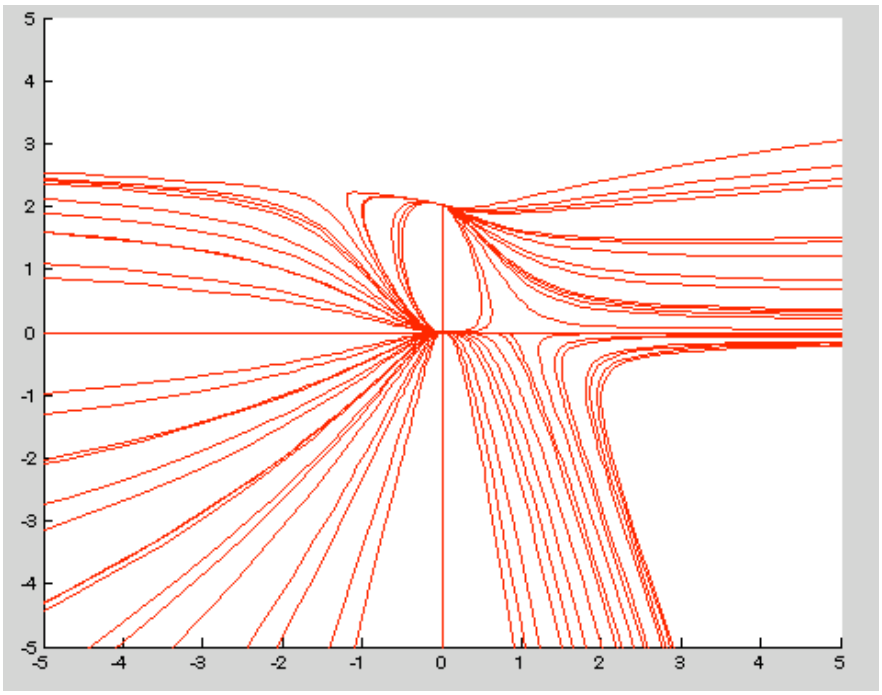
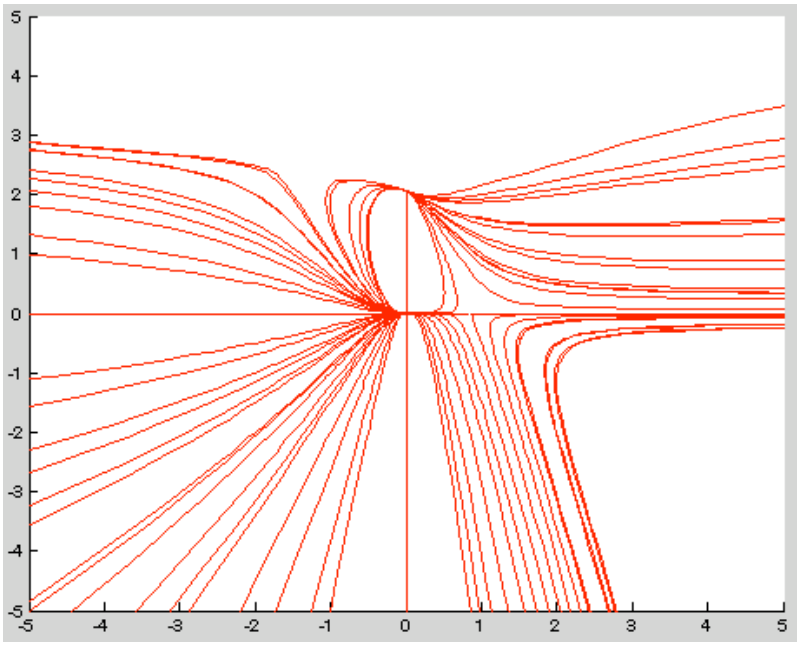
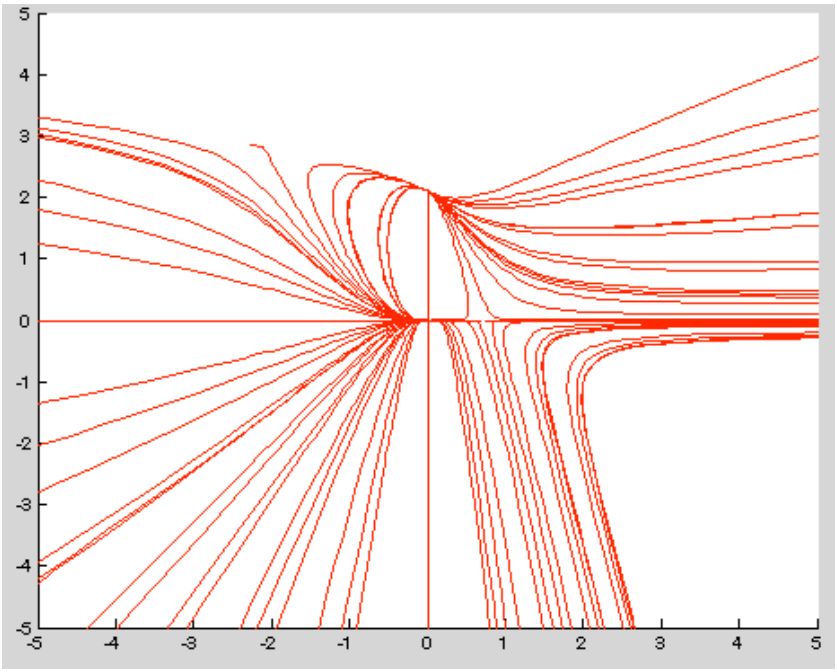
```
Nathan Ong
Math246
Extra Credit

syms x
syms y
%9.4#5
%dx/dt=x(1-x-y)
%dy/dt=y(2-y-.125x)
u1=x*(1-x-y);
v1=y*(2-y-.125*x);
%------------------
%9.5#3
%dx/dt=x(1-.5x-.5y)
%dy/dt=y(-.25+.5x)
u2=x*(1-.5*x-.5*y);
v2=y*(-.25+.5*x);
warning off all

for a=0:.1:1
   figure; hold on
   U=(1-a)*u1+a*u2;
   V=(1-a)*v1+a*v2;
   L=sqrt(U.^2+V^2);


   k=@(t,x)[((a-1)*(x(1)-x(1)*x(1)-x(1)*x(2)))+a*(x(1)*(1-
0.5*x(1)-0.5*x(2)));((a-1)*(2*x(2)-x(2)^2-
.125*x(1)*x(2)))+a*(-.25*x(2)+.5*x(1)*x(2))];
       for a=-2:.5:2
        for b=-2:.5:2
           [t,xa]=ode45(k,[0 10],[a b]);
           plot(xa(:,1),xa(:,2),'r');
           [t,xa]=ode45(k,[0 -5],[a b]);
           plot(xa(:,1),xa(:,2),'r');
        end
       end
           axis([-5 5 -5 5])
end
```



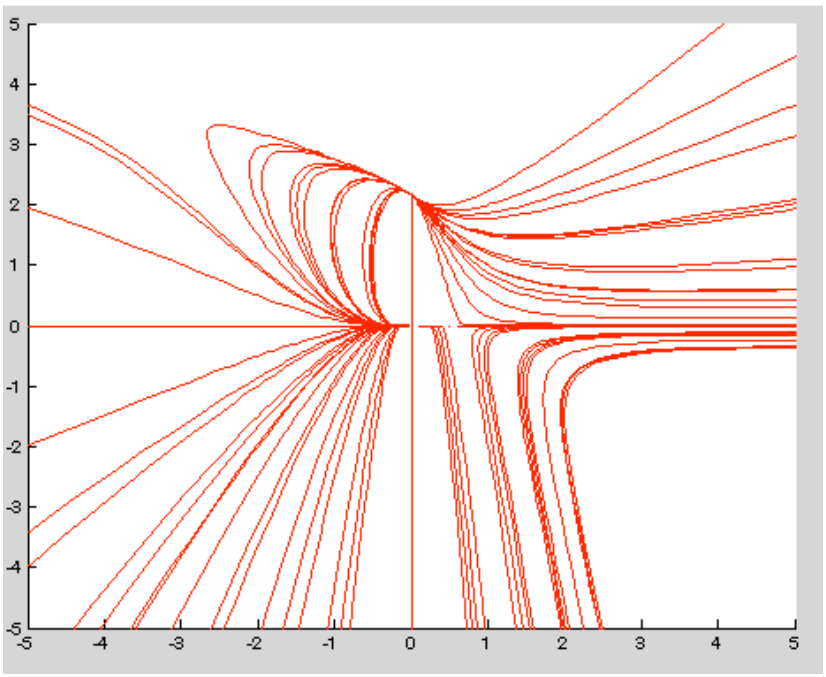


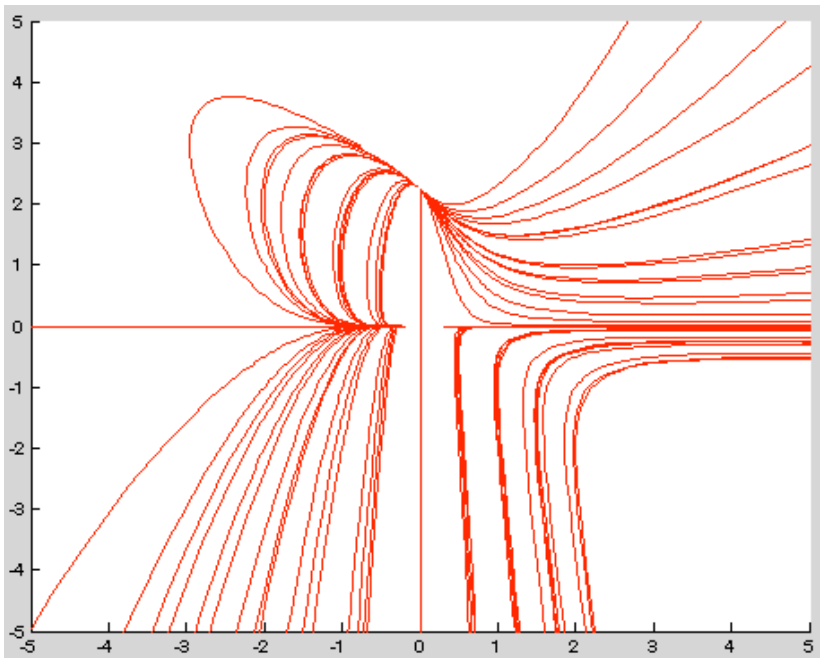
The first sets of graphs shown above reveal there are two critical points near the origin and at the point (0,2.25). These points are deteremined by the equations and represent where directional fields originate or move towards. In quadrant 1, 2 and 3 the direction field resembles a nodal direction field. Quadrant 4 has characteristics of a saddle.



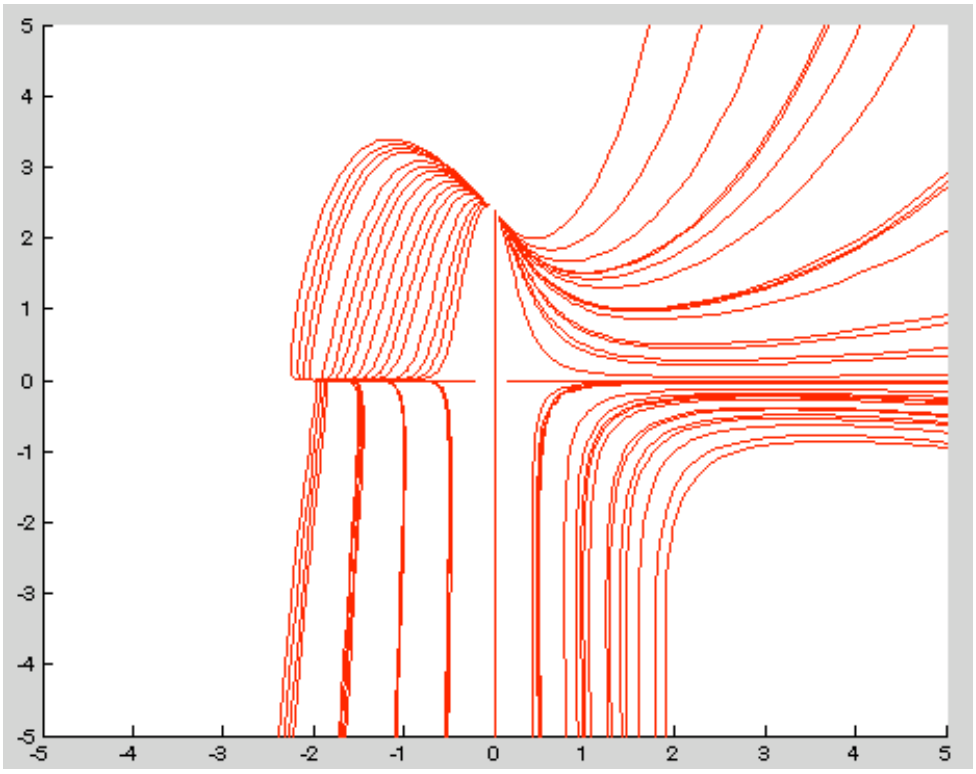


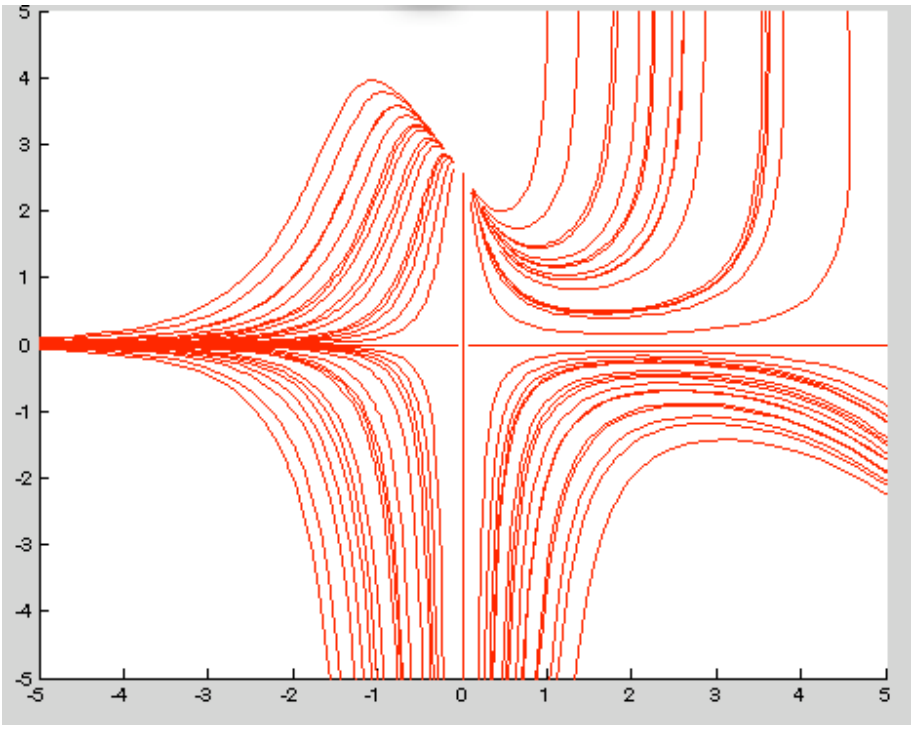
Here the most notable changes to the graph occurs in quadrants 2 and 3. The phase line which governs the field in quadrants 2 appears to become a steeper slope which is shown by the phase lanes rising above the point (-5,3). The critical points are still near the origin and point (0,2.25)



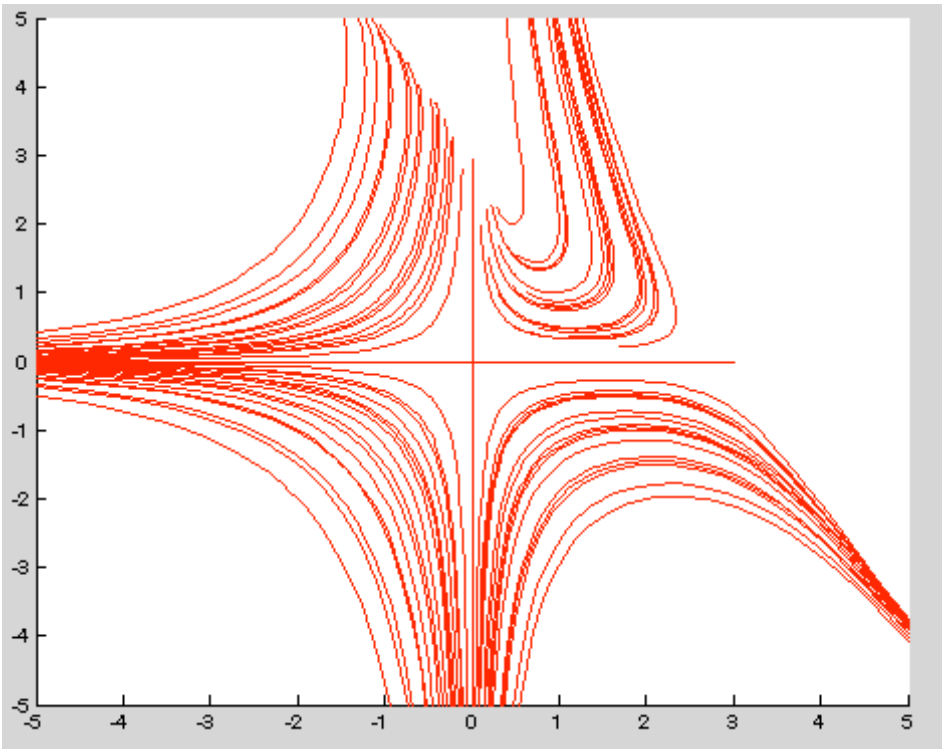


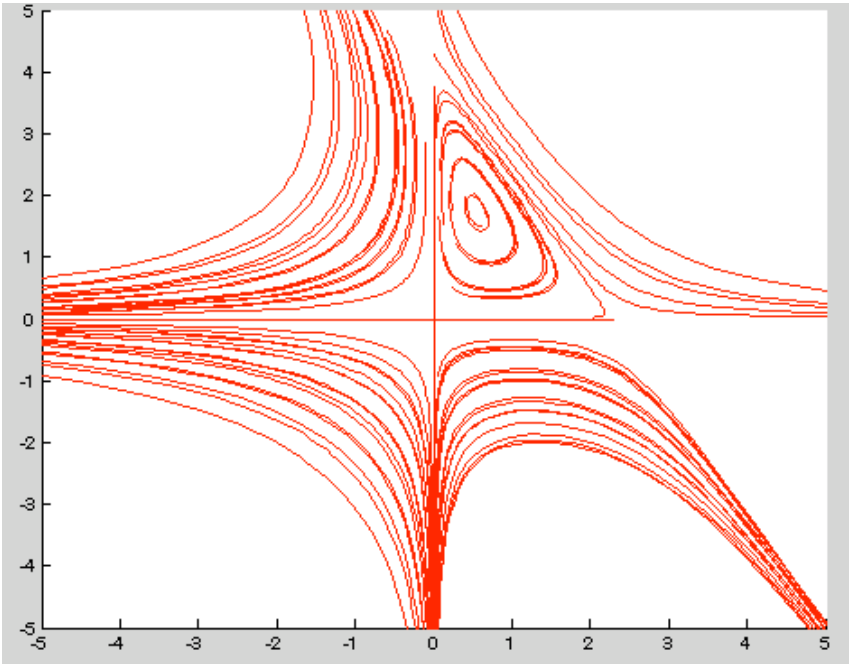
In these sets of graphs quadrant 2 is being affected by both critical points where the field is staying within the the quadrant rather than approaching infinity as the others are.



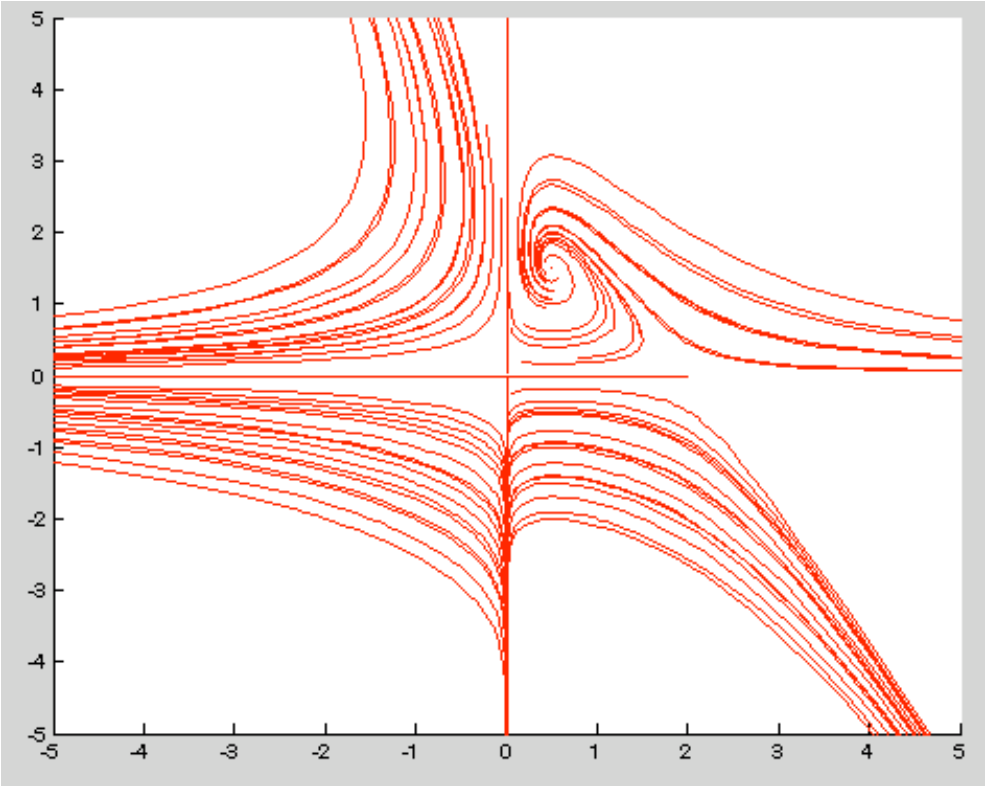


Quadrants 2, 3, and 4 are beginning to look like a saddle phase portrait however with a critical point near (0,2.25) is still a node where the points are either originating or sinking.





In these portraits quadrant 1 appears to have changed into a “center” where there the direction field orbits a point in the graph. That point is around (.75, 1.8). Quadrant 2,3, and 4 (and some of 1) still remains a saddle.



This is the last graph generated by the code and the center has become a spiral point where the directional field is being pulled or originating from the point (.75,1.75). The axis' are lines which the phase portrait is "saddling."