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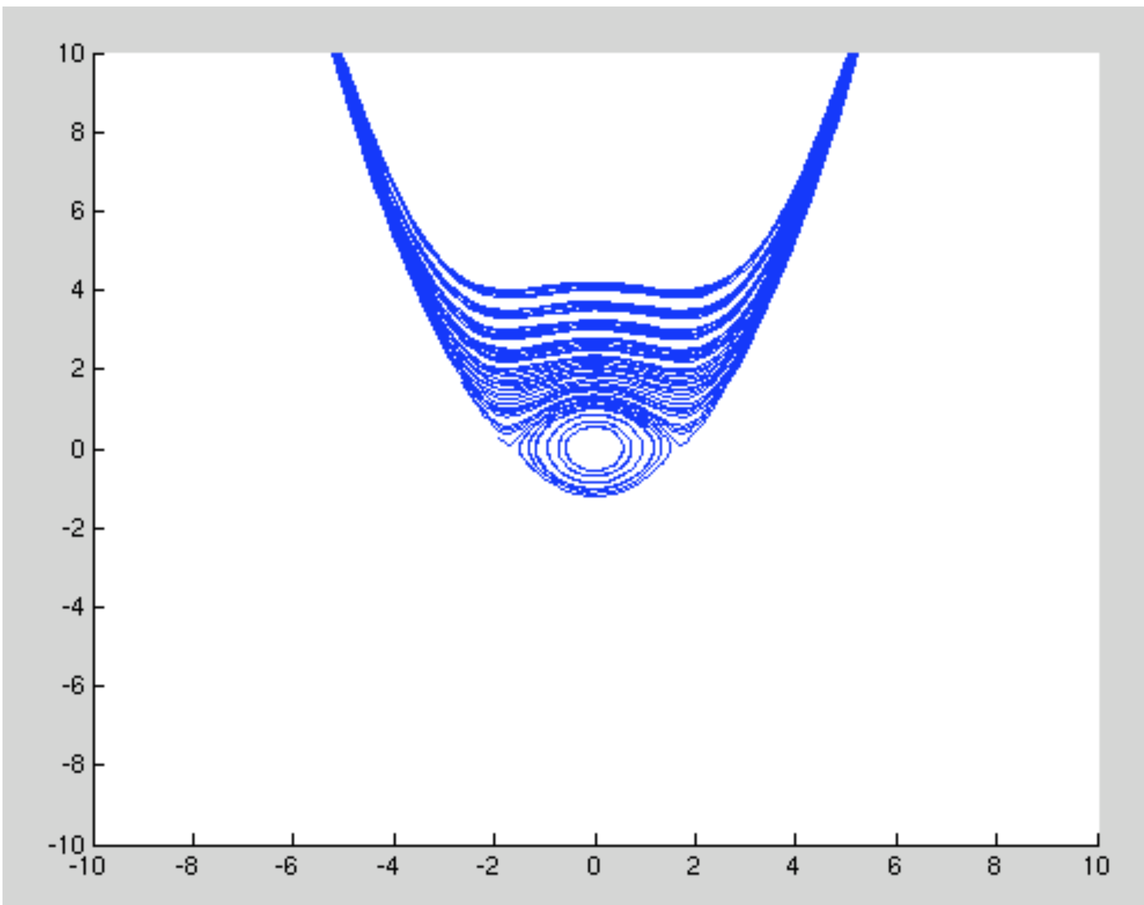
Math246

Extra Credit

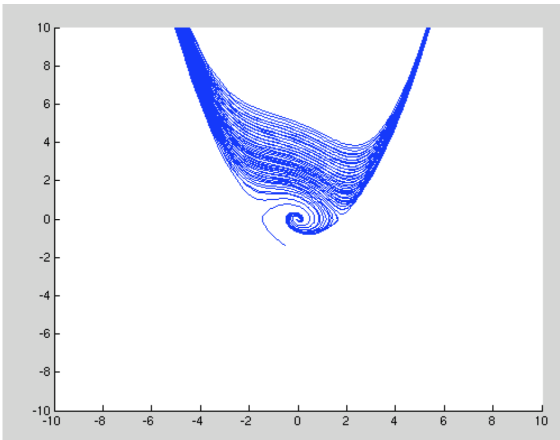
```
warning off all
f = @(t, x) [x(2); ...
   -0*x(2)-x(1)+(1/3)*x(1)^3];
figure; hold on
for a = 0.25:0.25:1.75
   for b = 0.5:0.5:4
      [t, xa] = ode45(f, [0 10], [a b]);
      plot(xa(:,1), xa(:,2))
      [t, xa] = ode45(f, [0 -5], [a b]);
      plot(xa(:,1), xa(:,2))
   end
end
axis([-10 10 -10 10])
```

b = 0



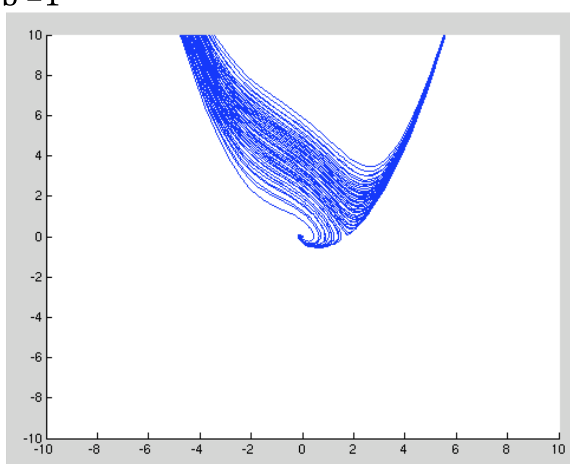
This is the phase diagram for x'' + bx' + x – (1/3) x^3 = 0. There are three critical points (0,0), (-3^(1/2),0), and (3^(1/2). There is a center at (0, 0) and the other two points are saddles. The center is stable and the other two are unstable. In order to plot this, I needed to convert the equation into a system of equations where Dx1=x2 and Dx2=-bx2-x1+(1/3)x1^3.

b=0.5



As b increases, the center point becomes a spiral. It is going in the clockwise direction into the origin, so it is becoming into a spiral sink. It is still table and attracting. Due to this direction, the right side appears to have a more defined asymptote.

b =1



b=1.5