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Math 216 a note about last class

I just wanted to note that in one of the sections of last class, we made the following observation. If we have a linear system, then the eigenvalues can be determined in the manner outlined in the notes from last class. However, if your system is not linear, then you should think of your system as being "approximately linear" when you are close to that critical point. You should think of your eigenvalues as being obtained from the determinant of a matrix (and indeed they are!) in a continuous way. So right around your critical points your graph should behave as it would behave in the linear system unless the eigenvalues are special in the sense that a very very small shift will make their phase portrait look drastically different. The only special points like this are when the real value is zero, and the imaginary part non-zero, along with the case of repeated real roots. If you were to imagine a computer generating matrices at random, the it is highly unlikely that the compute would produce a matrix with either properties.

In the linear case, If your eigenvalues are complex, then you have that your guy is a spiral unless the real part is also zero. Also, in the case of repeated real roots, only nodes can occur.

However, in the nonlinear case, this is not the case. Repeated roots can give nodes or they can change into spirals, and we have no way of knowing which is happing unless extra information is given to us.

The most interesting rule we discussed however, is that if you have two complex eigenvalues with positive real part, then it IS true that your guy is a spiral, however, unlike in the linear case, if your eigenvalues are complex with real part zero, we can't say whether we have a spiral or a center without any additional information.