PHY 232: Modern Physics

Linear Algebra Supplement

Oct 6, 2017

Since some of you may not have found eigenvalues and eigenvectors before, I thought it might be helpful to provide a supplement.

Task: find the eigenvalues and eigenvectors of the matrix M =

Step 1: get the eigenvalues. You want to solve the equation det [M –  I] = 0

We see from this that  = ±1 are the two eigenvalues of the matrix.

Step 2: get the eigenvectors. You want to solve the equation [M - I] v = 0

First let’s take 1 = 1.

The top line tells us 0 v1 + 0 v2 = 0, which is unhelpful. The bottom line is better, telling us 2v1 - 2v2 = 0. Thus v1 = v2 = a, where a is some complex constant. Our first eigenvector is

Next, let’s take 2 = -1

In this case, both lines tell us 2v1 + 0v2 = 0. This means that v1 = 0 and thus v2 = b, where b is some complex constant. Our second eigenvector is

Step 3: Checking.

When a matrix multiplies its eigenvector, we get back the eigenvalue times that eigenvector. Let’s see if that works. Looking at the first eigenvector,

Yup that works. I even included a gratuitous factor of 1 to point out the eigenvalue.

Now for the second eigenvector

and again we see that it works.