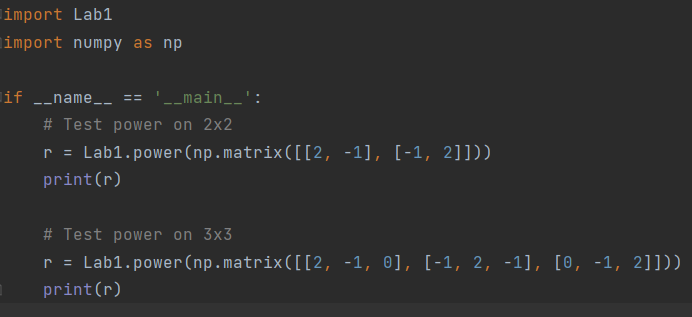
# **Lab 1 – EngSci 311 – Daniel Clark – 343733502**

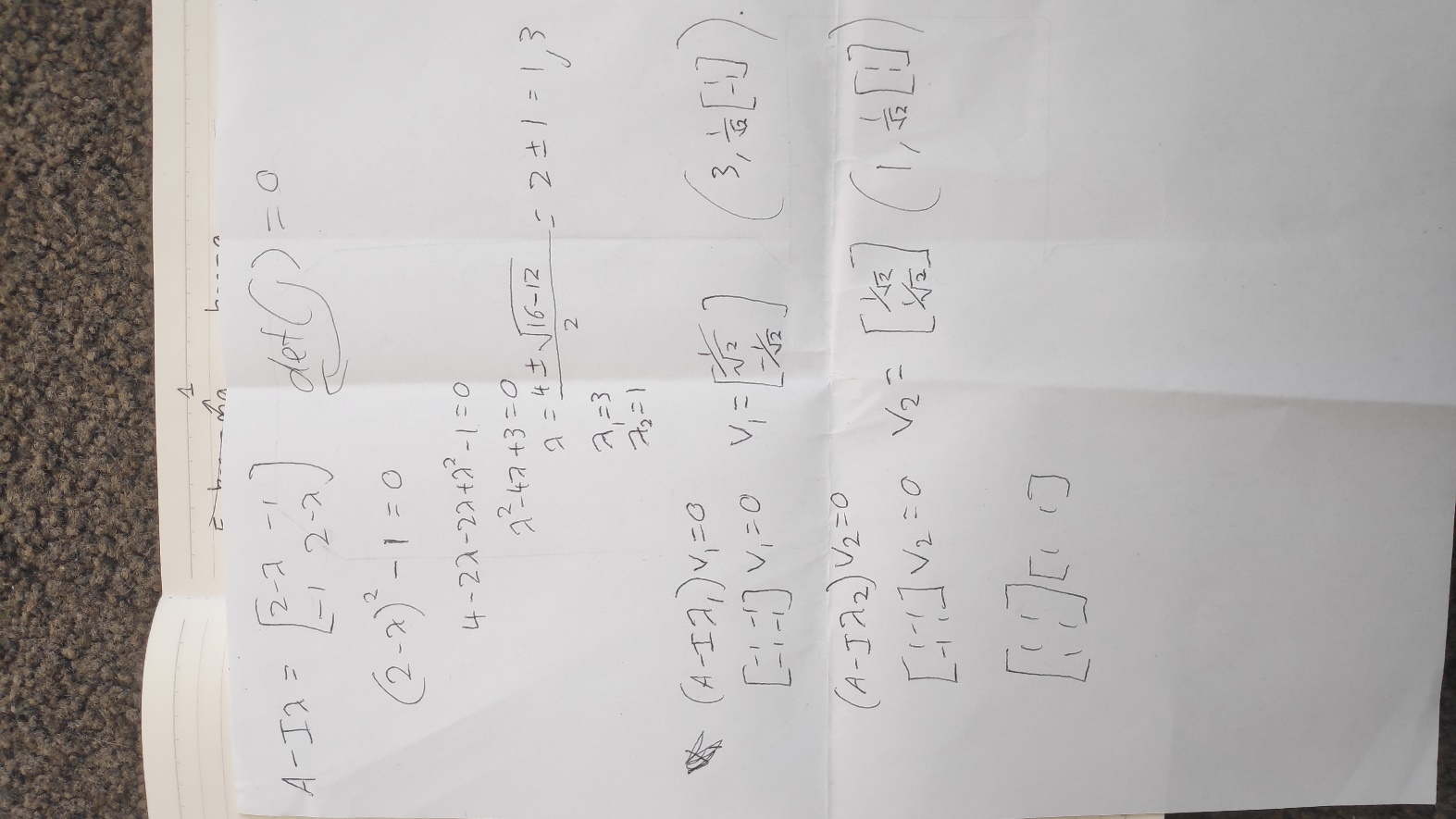
Output:

1. Verification of both the power and power\_w\_deflate scripts by on the matrix given in Question 1 and 3 ×3 symmetric positive definite (SPD) matrix with distinct eigenvalues. For the 3 ×3 use either analytic (pen and paper) methods or an independent eigenvalue/eigenvector solver such as numpy.linalg.eig. (I used wolfram alpha)

To Test my ‘power’ function, I created the following test module, to test it with the 2x2 matrix we were given, and a 3x3 SPD matrix which I found online.



To verify my results from the 2x2 matrix, I calculated the eigenvalues and eigenvectors by hand:



To verify my results from the 3x3 matrix, I used wolfram alpha:

A close-up of a logo

Description automatically generated

Which gave the following results:

A screenshot of a math equation

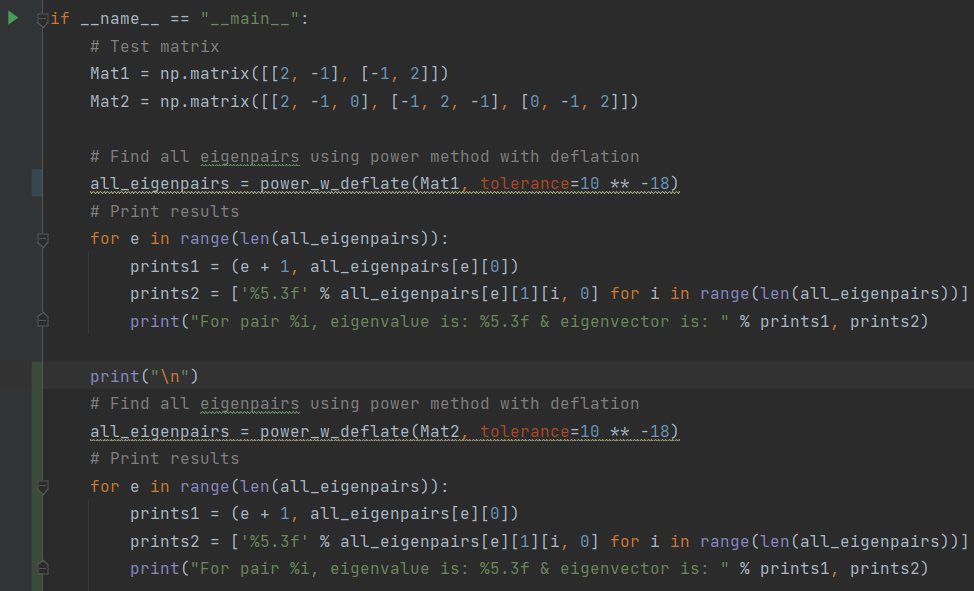
Description automatically generated

A computer screen shot of a code

Description automatically generated

The results for the 2x2 matrix are correct (aside from negligible numerical error) as the eigenvalue given is effectively equal to 3, and the vector is [-1/root(2),1/root(2)], which is simply -1 times the result I found by hand, so is also correct. The results for the 3x3 matrix are also correct, as 3.414=1+root(2), and[ 0.5, -1/root(2), 0.5] is the **normalised** version of eigenvector 1 given by wolfram alpha.

To test the power\_w\_deflate function, I used the following function call and output printing:



Which gave the following output:

A screen shot of a computer program

Description automatically generated

These results are all as expected from the earlier verification, so the functions are working correctly.

1. Display all the natural frequencies and eigenvectors for the case of N = 10 masses with all spring constants equal to 1 (i.e. K1 = K2 = ··· = K10, even though the code should handle arbitrary N and spring constants Ki).

Interpretation:

1. Use a graph to compare the natural frequencies from Question 3 using an independent eigenvalue solver such as numpy.linalg.eig with the natural frequencies you obtained using the power method & deflation for ∆ ∈ {1e−2,1e−4,1e−6,1e−8}, Comment on any trends (Hint: Consider what ∆ represents and also the order in which modes/frequencies are computed).
2. Write one paragraph explaining what the eigenvectors and eigenvalues found in Question 3 represent.

Appendices: