PHY106: Assignment 4

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February 10

Submit programs files (soft copies) by **Wednesday Feb 15**. Create programs using the any editor, eg SPYDER. Name your files thus: `(your-name)_assignment(number)_prob(number).py`. Example: Sushmita will save her assignment 1, promblem 2, as `Sushmita_assigment1_prob2.py`

Submit over email to `tobias.toll@snu.edu.in` and `rs190@snu.edu.in`

1. The Power Methods

a) Write a program which uses the power method for finding eigenvalue with the largest modulus (furthest from zero) and its corresponding eigenvector.

b) Write a program which uses the inverse power method for finding an eigenvalue *closest to* a shift *s*, and its corresponding eigenvector. (If there is no shift (*s*=0) this method will find the smallest eigenvalue and its corresponding eigenvector.)

c) Use the programs to find *all three* eigenvectors and eigenvalues for the matrix:

$$\mathbf{A} = \begin{bmatrix} 1/3 & -1/3 & 0 \\ -1/3 & 4/3 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

2. Example of Eigenvalue Problem

Imagine a set of springs, all with the same spring constant *k* connecting a set of masses *m* between two walls. The positions of the masses are $x_1, x_2, x_3, \ldots, x_n$, which can be represented by a vector $\vec{x}$, and they obey Newton's second law:

$$\frac{\mathrm{d}^2}{\mathrm{d}t^2}\vec{x} = K\vec{x},$$

where *K* is a symmetric matrix containing all the forces. Use the ansatz $\vec{x}(t) = \vec{x}_0\cos(\omega t)$ to write down an eigenvector equation for the system.

Use the programs from **1** to solve the equation and find the largest and smallest eigenvalues for *n=10,* and *n=21* , and find the corresponding eigen-frequencies of the system.

Interpret the result.

Note: This is a combined paper/programming assignment, so you should hand in both the equations and interpretations as well as the program.