



# [ME5470] Introduction to Parallel Scientific Computing

## Assignment 1

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### Question 1: Part A

Sol:

**Table 1:** Comparison of size of Files

format_flag	File Type	Size (MB)
0	ASCII	320
1	Binary	123

Comment: We see that size of ASCII file is significantly larger than Binary file.

### Question 1: Part B

Size of the array in memory :

$$\text{sizeof(double)} \times n^2 = 8 \times (4000)^2 = 128,000,000 \text{ bytes}$$
$$\approx 122 \text{ MB}$$

Comment: The size of binary file efficiently mirrors the in memory size while the size of ASCII file is significantly larger as it stores data in human readable format having adding overhead for character representation, space, commas, newlines.

For larger dataset binary format is better due its compactness and memory efficiency.

### Question 2

Methodology: An eigenvector must satisfy the following relation:

$$\mathbf{Ax} = \lambda \mathbf{x}$$

To compute  $\lambda$ , let:

$$\mathbf{y} = \mathbf{Ax}$$

Then,

$$\lambda_i = \frac{y_i}{x_i}$$

Here,  $\lambda = \{\lambda_1, \lambda_2, \dots, \lambda_n\}$ .

We check if  $\lambda_{\min} = \lambda_{\max}$ , which indicates that all  $\lambda$  are equal, so  $\mathbf{x}$  is an eigenvector.

## Results:

Input File	Is Eigenvector?	Eigenvalue
vec_000003_000001.in	Yes	-6.000000e+00
vec_000003_000002.in	Yes	-6.000000e+00
vec_000003_000003.in	Yes	-1.000000e+00
vec_000003_000004.in	Not an eigenvector	-

**Table 2:** Eigenvector Results, for  $n = 3$

Input File	Is Eigenvector?	Eigenvalue
vec_000005_000001.in	Yes	2.680981e-01
vec_000005_000002.in	Not an eigenvector	-
vec_000005_000003.in	Yes	9.868750e-01
vec_000005_000004.in	Yes	1.399039e+00

**Table 3:** Eigenvector Results, for  $n = 5$

Input File	Is Eigenvector?	Eigenvalue
vec_000050_000001.in	Not an eigenvector	-
vec_000050_000002.in	Yes	4.796282e-01
vec_000050_000003.in	Yes	1.337887e+00
vec_000050_000004.in	Not an eigenvector	-

**Table 4:** Eigenvector Results, for  $n = 50$

Input File	Is Eigenvector?	Eigenvalue
vec_000080_000001.in	Yes	3.330178e-01
vec_000080_000002.in	Yes	4.931420e-01
vec_000080_000003.in	Yes	9.392745e-01
vec_000080_000004.in	Not an eigenvector	-

**Table 5:** Eigenvector Results, for  $n = 80$