

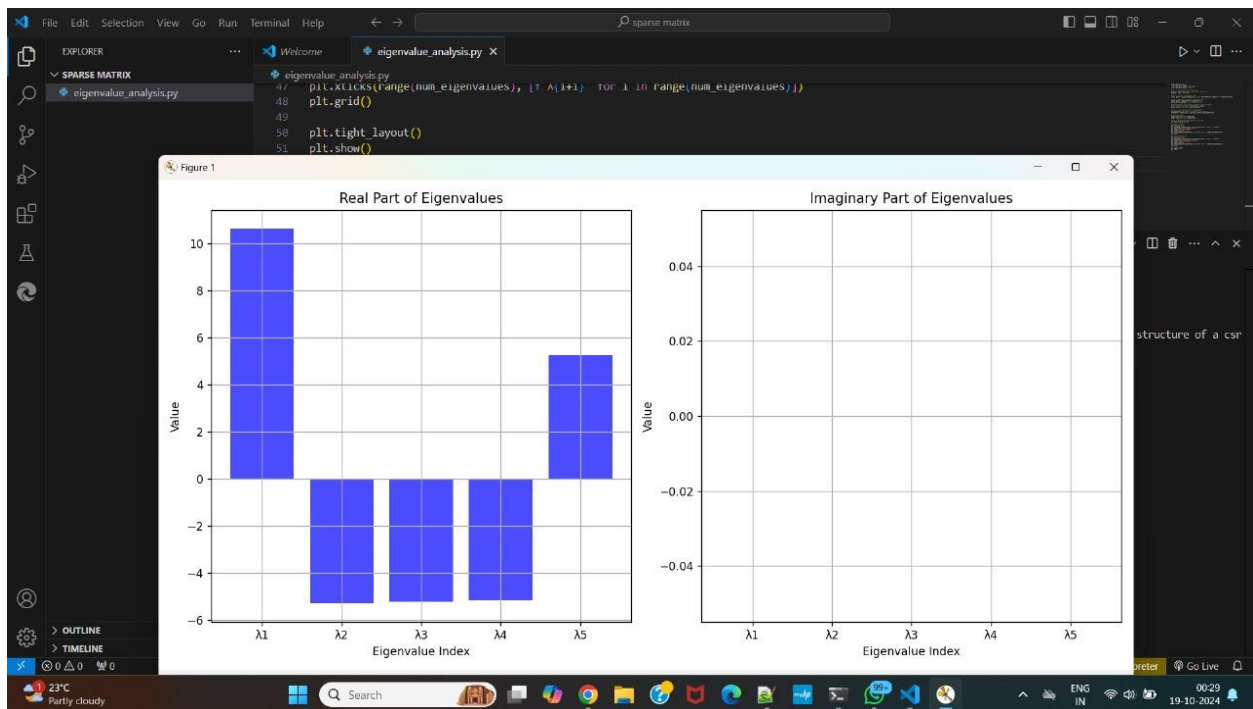
# 1. Task Description

Task : Statistical analysis

Calculate the eigenvalues and eigenvectors of a large sparse matrix using numpy's sparse matrix handling.

# 2. Task Output Screenshot

```
[-0.03495906+0.j  0.0133459 +0.j -0.00791298+0.j -0.02600424+0.j
 0.01598778+0.j]]
PS C:\Users\krupa\Desktop\sparse matrix> python eigenvalue_analysis.py
>>
C:\Users\krupa\AppData\Local\Programs\Python\Python312\Lib\site-packages\scipy\sparse\_index.py:145: SparseEfficiencyWarning: Changing the sparsity structure of a csr
_matrix is expensive. lil_matrix is more efficient.
  self._set_arrayxarray(i, j, x)
Sparse Matrix Shape: (1000, 1000)
Non-zero entries: 20884
Eigenvalues:
[10.6243259 +0.j -5.2940303 +0.j -5.23127347+0.j -5.16794678+0.j
 5.25200719+0.j]
Eigenvectors:
[[ 3.11772559e-02+0.j  1.08384110e-02+0.j  1.52785081e-02+0.j
  1.60048117e-02+0.j  2.65588160e-02+0.j]
 [ 1.46461167e-02+0.j -4.78207459e-05+0.j  9.28504093e-03+0.j
  1.78483530e-03+0.j  3.93291282e-03+0.j]
 [ 4.31403028e-02+0.j  3.45773857e-02+0.j -6.82039451e-02+0.j
 -1.11627240e-02+0.j  1.31368729e-02+0.j]
 ...
 [ 1.66892296e-02+0.j  3.08877547e-03+0.j  4.46272212e-03+0.j
  4.01865796e-03+0.j -8.60765428e-03+0.j]
 [ 5.27168019e-02+0.j -3.84291978e-02+0.j -3.94402568e-02+0.j
 -8.90522845e-02+0.j -8.46805461e-02+0.j]
 [ 2.94553181e-02+0.j  1.27983104e-02+0.j  3.18357825e-02+0.j
 -2.69644967e-02+0.j -1.88997460e-02+0.j]]
PS C:\Users\krupa\Desktop\sparse matrix>
```



### 3. Algorithms Used In Task :

#### Sparse Matrix Creation:

- Library: `scipy.sparse`
- Function: `sparse.random()`
- Description: Generates a large sparse matrix with specified dimensions and density. This ensures that the matrix remains memory-efficient while having a large number of rows and columns.

#### Eigenvalue and Eigenvector Calculation:

- Library: `scipy.sparse.linalg`
- Function: `eigs()`
- Parameters:
  - The sparse matrix.
  - The number of eigenvalues to compute (k).
- Description: Computes a specified number of eigenvalues and their corresponding eigenvectors from the sparse matrix.

#### Data Visualization:

- Library: `matplotlib.pyplot`
- Function: `plt.bar()`
- Description: Used to create bar graphs that visualize the real and imaginary parts of the calculated eigenvalues.