

---

# Project-I

---

Viviana Petrescu  
EPFL  
viviana.petrescu@epfl.ch

## 1 PageRank

### 1.1 Exercise1

i) After randomly initializing  $x_0$  and repeating the experiments. E has the eigenvalues

$$\begin{pmatrix} 1 \\ -0.5000 + 0.2887i \\ -0.5000 - 0.2887i \\ 0 \end{pmatrix}$$

two real and two complex values, the largest eigenvalue is 1. The sequence  $E^{15}x_0$  normalised using l2 norm, as the number of iterations increases tends to the largest eigenvector of E, the eigenvector corresponding to eigenvalue 1. eigenvector

$$\begin{pmatrix} 0.6447 \\ 0.2478 \\ 0.4154 \\ 0.5920 \end{pmatrix}$$

ii) Eigenvector

$$\begin{pmatrix} 0.2230 \\ 0.3755 \\ 0.4201 \\ 0.7955 \end{pmatrix}$$

Eigenvalues

$$\begin{pmatrix} 0 \\ 0.5614 \\ -0.2807 + 0.2640i \\ -0.2807 - 0.2640i \end{pmatrix}$$

The largest eigenvalue is 0.5614 and the sequence converges again to the largest eigenvector, up to a constant, -1 in my case.

iii) Eigenvalues of E

$$\begin{pmatrix} 1.0000 \\ -0.5000 + 0.2887i \\ -0.5000 - 0.2887i \\ -0.0000 \\ 1.0000 \\ -1.0000 \end{pmatrix}$$

There are two eigenvalues of 1. The sequence after 15 steps does not converge to the largest eigenvector (any of them)

$$\begin{pmatrix} 0.3500 \\ 0.1050 \\ 0.2099 \\ 0.3149 \\ 0.6848 \\ 0.5043 \end{pmatrix}$$

## 1.2 Exercise2

i) The eigenvectors are  $-0.6446 - 0.2887 + 0.5000i$   $-0.2887 - 0.5000i$   $0.5345 - 0.2478 - 0.4330 - 0.2500i$   $-0.4330 + 0.2500i$   $-0.8018 - 0.4154$   $0.5774$   $0.5774$   $0.0000$   $-0.5920$   $0.1443 - 0.2500i$   $0.1443 + 0.2500i$   $0.2673$  Eigenvalues are

$$\begin{pmatrix} 1.0000 \\ -0.4250 + 0.2454i \\ -0.4250 - 0.2454i \\ -0.0000 \end{pmatrix}$$

The convergence vector is

$$\begin{pmatrix} 0.6447 \\ 0.2478 \\ 0.4154 \\ 0.5920 \end{pmatrix}$$

ii) GREEN  $0.2769 - 0.3641 - 0.3761i$   $-0.3641 + 0.3761i$   $0.0044$   $0.3984$   $0.5959$   $0.5959$   $-0.1091$   $0.4548$   $-0.3506 + 0.2950i$   $-0.3506 - 0.2950i$   $-0.0657$   $0.7468$   $0.2363 + 0.3242i$   $0.2363 - 0.3242i$   $0.9918$  Eigenvalues are

$$\begin{pmatrix} 0.6618 \\ -0.2427 + 0.2257i \\ -0.2427 - 0.2257i \\ -0.0264 \end{pmatrix}$$

The convergence vector is

$$\begin{pmatrix} 0.2769 \\ 0.3984 \\ 0.4548 \\ 0.7468 \end{pmatrix}$$

iii) BLUE Eigenvector of M blue

$$\begin{pmatrix} 0.5351 \\ 0.2057 \\ 0.3449 \\ 0.4914 \\ 0.3943 \\ 0.3943 \end{pmatrix}$$

The eigenvalues are

$$\begin{pmatrix} 1.0000 \\ 0.8500 \\ -0.4250 + 0.2454i \\ -0.4250 - 0.2454i \\ 0.0000 \\ -0.8500 \end{pmatrix}$$

The convergence vector is

$$\begin{pmatrix} 0.5200 \\ 0.2012 \\ 0.3358 \\ 0.4778 \\ 0.4257 \\ 0.4085 \end{pmatrix}$$

## **2 Summary**

**Acknowledgments**

**References**