

- ▶ Define the Adjacency and Laplacian matrix. Define their normalized versions.
- ▶ The eigenvalues of the Laplacian are nonnegative. One of them is zero. Explain
- ▶ The eigenvectors the normalized adjacency and the normalized Laplacian are the same. Explain

- ▶ Define the diffusion sequence. Introduce its power series version and its recursive definition

- ▶ A graph convolutional filter is a linear combination of the elements of the diffusion sequence. Explain

- ▶ Explain a graph filter using a (graph) shift register.
- ▶ Explain a time filter using a (regular) shift register.
- ▶ Discuss similarities and differences.

- ▶ Implement a Pytorch class that creates filters of order  $K$  and given coefficients. It suffices to give the forward method that takes the graph signal  $x$  as an input. You can assume that  $S$ ,  $K$  and coefficients  $h_k$  have been initialized.
  
  
  
  
  
  
  
  
  
  
- ▶ You must use the diffusion sequence. Why?

- ▶ Define the graph Fourier transform (GFT) $x$  and write down a graph filter in the graph frequency domain. Show a proof of your result.

- ▶ Define the frequency response of a graph filter. Use it to write down the input-output relationship of a graph filter in the GFT domain.

- ▶ What is the role of a graph in the instantiation of a filter whose frequency response is  $h(\lambda)$ . Illustrate.