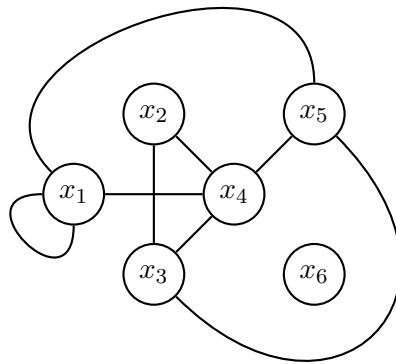


Math for Deep Learning - Homework 05

Name: _____

1. Count the number of vertices, and edges for Figure 1.

Figure 1: Graph 1.

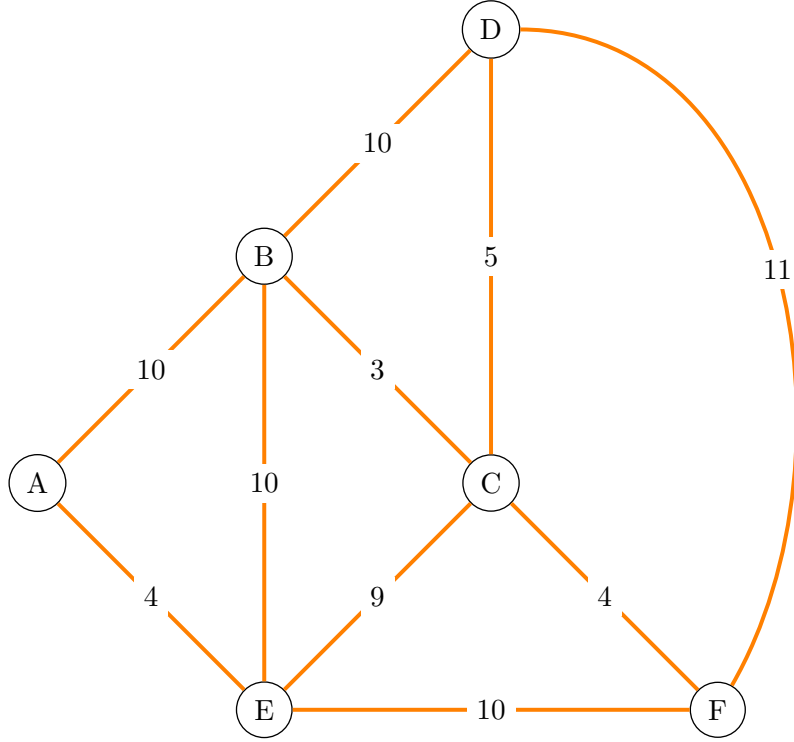


2. Verify $V - E + F = 2$ for the following: cube, a pyramid with a triangular base and a pyramid with a octagonal base. Does Euler's formula hold for each shape? If not why not?
3. For the graph in Figure 1, what is the adjacency matrix?
4. What is the adjacency matrix for the weighted graph in Figure 3.
5. Draw a **directed** graph with the following adjacency matrix.

$$\begin{bmatrix} 0 & 1 & 2 & 3 \\ 1 & 0 & 1 & 2 \\ 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

6. Compute the Laplacian for the graphs in Figure 1 and in Figure 3.

Figure 2: Weighted Graph



Graph Laplacian (used in spectral clustering)

$$L_{i,j} := \begin{cases} \deg(v_i) & \text{if } i = j \\ -1 & \text{if } i \neq j \text{ and } v_i \text{ is adjacent to } v_j \\ 0 & \text{otherwise,} \end{cases}$$

or equivalently by the matrix : $L = D - A$,

Where A is the adjacency matrix we have been using and D is the D is the degree matrix defined as

$$D_{i,j} := \begin{cases} \deg(v_i) & \text{if } i = j \\ 0 & \text{otherwise.} \end{cases}$$

7. The following tree graph is often used in Neural Networks (Figure 3).
What is its adjacency matrix?

Figure 3: Neural Network.

