Assignment 10

John Platig
Computational Biology II
Due on April 30, 2025

Introduction

Here we'll explore some of the properties of the adjacency matrix and node centrality.

Question 1

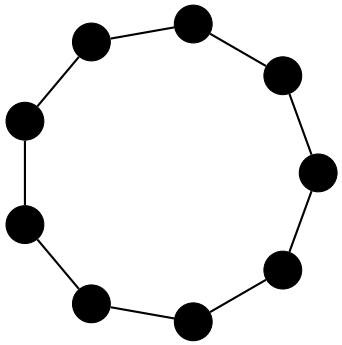
Recall from lecture that the closeness centrality of a node i is given by the following formula:

$$C_i = \frac{1}{l_i} = \frac{n}{\sum_j d_{ij}}$$

where d_{ij} is the shortest path between nodes i and j.

If the number of nodes, n, in a ring graph (example below) is odd, what is the closeness centrality of a node as a function of n? Be sure to show all of your work. (*4 point*)

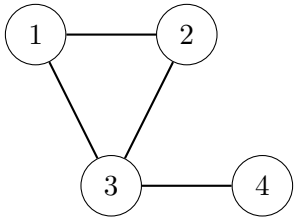
> *Note*: All nodes have the same closeness centrality. Also, fun fact: $1 + 2 + 3 + ... + p = \frac{p(p+1)}{2}$ for every positive integer p.
>
> *Hint:* If you get stuck, calculate the closeness centrality for ring graphs with different numbers of nodes (e.g., $n = 5$, 7, 9, etc.) to get a sense of the pattern.



Example: Ring Graph with 9 Nodes

Question 2.1

For the network shown below, write down the adjacency matrix, **A**. (*2 point*)



Question 2.2

Using the adjacency matrix from Q2.1, calculate $\mathbf{A}^2$. (*2 point*)

Question 2.3

What do the elements $[\mathbf{A}^2]_{ij}$ represent, where $[...]_{ij}$ denotes the ijth element of the matrix? (*2 point*)