

NAME	Uxxxxxx	GRADE
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Introduction to Networks Science (2025-2026)

————— MID-TERM EXAM —————

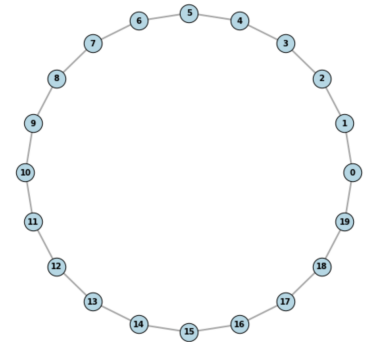
WRITE YOUR ANSWERS BRIEFLY and CLEARLY IN THE BLANK SPACES. PLEASE UNDERLINE KEY WORDS IN YOUR ANSWERS. PLEASE IF YOU INCLUDE INTERMEDIATE CALCULATIONS, CIRCLE THE FINAL RESULT. PLEASE USE ONLY CAPITAL LETTERS.

Problem 1

2.5 point

Consider this graph on the right.

1. Is this a particular type of graph? Which one? (0.5 pts)
2. Calculate its global clustering coefficient. (0.5 pts).
3. Does it have the small-world property? Why or why not? (0.5 pts)



4. If you consider this graph has not the small world property, make it more "small-world" by adding 4 links. Draw the new links on the graph. If, instead, you consider this graph has the small world property, make it less "small-world" by removing 4 links. Highlight the links you remove on the graph. (1 pt).

Problem 2

2 point

Consider the following undirected graph:

Nodes: A, B, C, D, E. *Edges:* (A,B), (A,C), (B,C), (B,D), (C,E), (D,E)

1. Write the adjacency matrix for this graph. (0.5 pts)
2. Calculate the average degree. (0.5 pts)

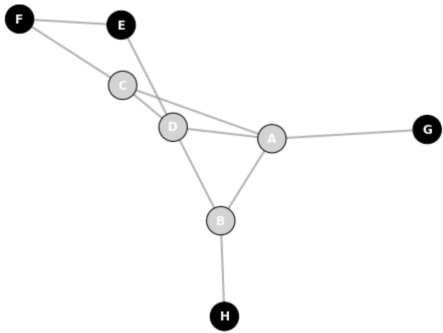
Consider that the edge (D,E) became a directed edge from D to E with weight equal to 5. The rest of the edges are bidirectional with a weight equal to 1.

1. How would the adjacency matrix change? (0.5 pts)
2. Calculate the out-strength of node D. (0.5 pts)

1. What does it mean that most real-world networks are *sparse*? (0.5 pts)
2. Consider an undirected graph with N nodes. The graph has two connected components. What is the maximum number of edges it can have? Explain your reasoning. (1.5 pts)

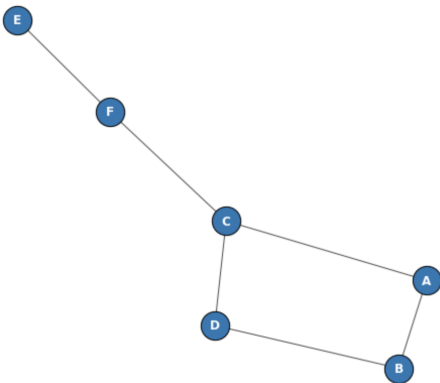
Consider this small graph on the right, composed of 4 black nodes (group B) and 4 white nodes (group W).

1. Compute the local clustering coefficient of each node. (0.5pts)
2. Compute the average degree of the nearest neighbors of each node. (1pt)
3. Compute the homophily score of both groups. (0.5pts)



Use the Brandes-Newman algorithm to compute the betweenness of the edge (C-F) in this graph. For each source node, write the contribution to the betweenness of the edge (C-F). Write the final edge betweenness of the edge (C-F).

Source node	Contribution
A	
B	
C	
D	
E	
F	



Betweenness of the edge (C-F):