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Lecture 27.ns19

Exercises

Course: **Complex Networks Analysis and Visualization**
Sub-Module: **NetSci**

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Exercise 1

What is the minimal diameter in a connected graph of N nodes? What is the maximal diameter instead?

Exercise 2

Consider the adjacency matrix A = [[0,1,1,0]; [1,0,0,0]; [1,0,0,1]; [0,0,1,0]]

- Draw the graph
- Is the graph connected?
- What is the in-out degree of each node?
- What is the clustering coefficient of each node?

Exercise 3

Consider an ER random graph with n nodes and connecting probability equal to p. What is the expected number of edges?

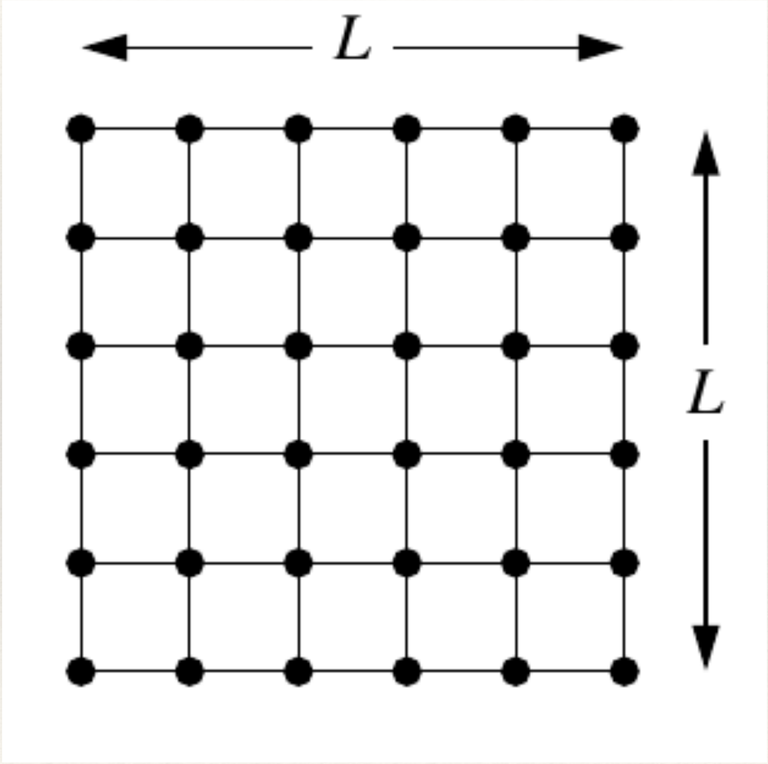
Exercise 4

Suppose an ER has n = 1000 and L = 300 edges: do you expect the graph to be connected? What if it has L = 1000 edges?

Exercise 5

Consider a finite square lattice as the one in the figure. Which of the following assertions are correct?

- All nodes have the same degree
- It is undirected
- It has a high clustering coefficient
- It is a complex network
- It is small world
- It verifies the friendship paradox



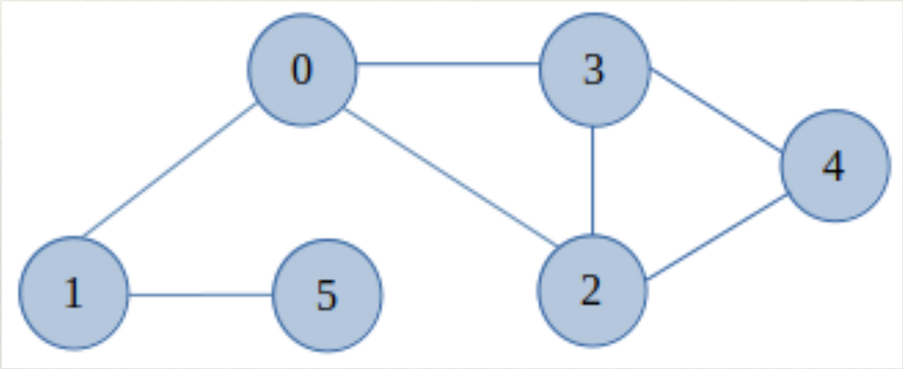
Exercise 6

Consider the following graph:
A = [[0,0,1,1,0]; [0,0,1,1,0]; [1,1,0,1,1]; [1,1,1,0,0]; [0,0,1,0,0]].

What is its diameter?

Exercise 7

Consider the following network. Would you define the edge (1,0) as a strong or a weak tie? What about the edge (3,2)?



Exercise 8

What type of network is this? What is its average clustering coefficient?

A = [[1,2], [1,4], [2,3], [3,4], [3,6], [4,5], [6,7]]

Exercise 9

A professor receives two candidatures from two students (A, B) with a cover letter. A has higher marks than B, but B's cover letter was written by a friend of the professor's. Basing on a network theory perspective, who do you think the professor will hire and why? What is the name of the underlying process?

Exercise 10

Define

* A fully connected graph
* A subgraph
* A clique

Exercise 11

What is the advantage of the edge list graph representation with respect to the adjacency matrix representation? Why is it particularly relevant for real world graphs?

Exercise 12

True or False: the diameter of a graph is always smaller than the number of nodes

Exercise 13

A d-regular graph is a graph in which all nodes have the same degree. Show that the degree vector is an eigenvector of the adjacency matrix of this graph with eigenvalue equal to d. What is the largest eigenvalue of of the adjacency matrix of a fully connected graph?

Exercise 14

What is the maximal number of edges in a network of size n? What is the minimal number of edges in connected graph of size n? What is the average clustering coefficient in these two cases?