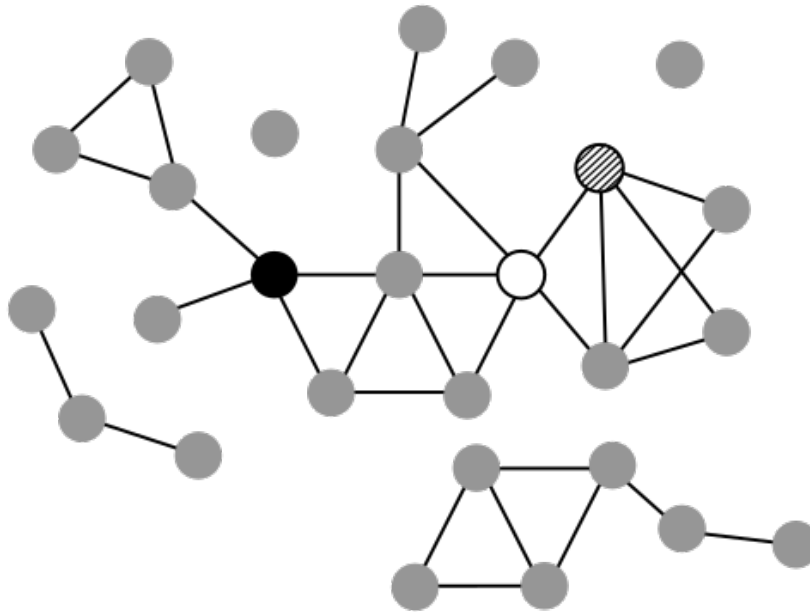


Part 1: Network characteristics

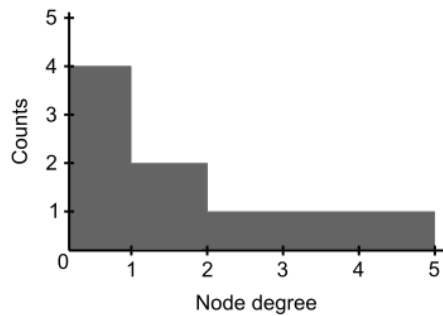
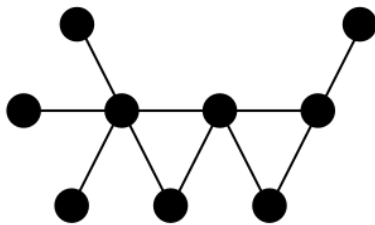
1) Please have a look at the following example network and answer the questions:

- a) What's the degree of the white node?
- b) What's the length of its shortest path from the striped to the black node?
- c) What's the clustering coefficient of the striped node?
- d) What's the size of the network's largest connected component?

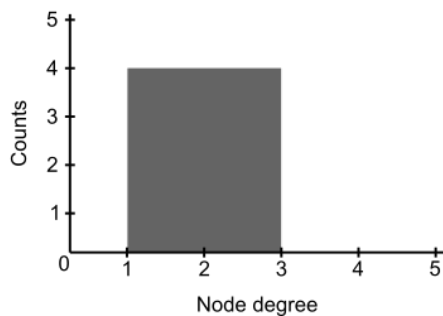
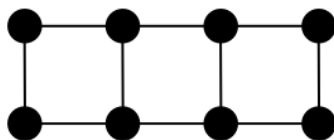


2) Consider the following two networks and their degree distributions. Which one is more likely to represent a complex system and why?

A



B



- 3) A network is specified by the following adjacency matrix A.
- Draw the network / Graph
 - Specify the link table and link list of the network
 - Determine the weighted in-degree and out-degree of each node.
 - Does the network contain cycles?

$$A = \begin{pmatrix} 0 & 0.5 & 0 & 0 \\ 0 & 0 & 1 & 0.2 \\ 0.7 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Part 2: A brief look behind the human integrated protein-protein interaction network (HIPPIE)

Download the current release of the HIPPIE database/network in tab format from <http://cbdm-01.zdv.uni-mainz.de/~mschaefer/hippie/download.php> and answer the following questions (hint: using R might be helpful for some questions):

- In which network format is the network saved (adjacency matrix, link table or link list)? Which amount of memory would you approximately need to store the network as adjacency matrix?
- Which type of network is it ((un)directed, weighted, bipartite)?
- Determine the following network characteristics:
 - Average node degree
 - Maximum node degree and the name of the protein with the highest node degree
 - Determine and plot the degree distribution of the network – do you recognize a specific network type described in the lecture?
- Choose two proteins of your interest: Can you determine the shortest path between these proteins?