

MAD 6306 COMPLEX NETWORKS - SPRING 2024
HOMEWORK 1

INSTRUCTOR: JIA LIU

- DUE on 002/02/2025 11:59pm C.T.
- You can write on the separate work sheet or type your quiz. (Word or Latex or similar)
- If you use the handwriting, Solutions must be neat,clear and legible.
- If you need to scan you quiz, save it as a PDF file. Do not use jpeg, png, jpg etc. Do not submit more than one file.
- Please check your scanned file before submission. Make sure it is readable, correct order, properly oriented. Make sure it does include all pages.
- Please name your file as follows: *LastnameInitials – MAD6306hw1.pdf*. If your name is Alan David Roberts, file name is *RobertsAD – MAD6306hw1.pdf*.
- Try to keep the file size less than 4MB.
- You can resubmit the quiz if you want. Please specify which one is the one to be graded. Otherwise I will grade the most recent version.
- DO NOT EMAIL me the quiz. All quizzes are submitted via Canvas.

- (1) Consider the following adjacency matrix of a network

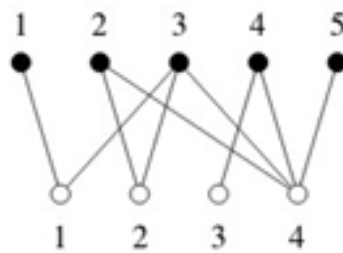
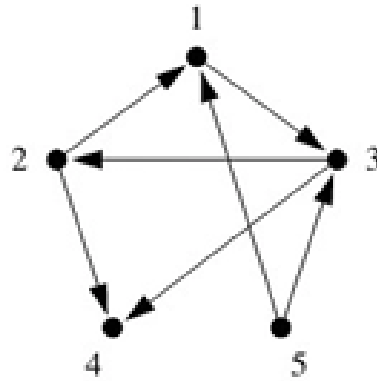
$$A = \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \end{bmatrix}$$

- (a) Is the network directed or undirected? (Explain why).
(b) Draw the network.

- (2) Given the set of node V with $|V| = 6$ in which each node i is labelled by a natural number between 1 and 6, $i = 1, 2, 3, 4, 5, 6$, consider the directed network $G = (V, E)$ where each link from node j to node i indicates that j is a multiple of i .

- (a) Draw the network.
(b) Write down the adjacency matrix of the network.

- (3) Consider the following two networks: Network(a) is directed and Network (b) is undirected but bipartite. Find the following:



- (a) Find the adjacency matrix of network (a)
(b) Find the incidence matrix of network (b)

- (4) Which word or words from the following list describe each of the five networks below: *directed*, *undirected*, *cyclic*, *acyclic*, *approximately acyclic*, *planar*, *approximately planar*, *tree*, *approximate tree*.
- (a) The internet, at the level of autonomous systems
 - (b) A food web
 - (c) The stem and branches of a plant
 - (d) A spider web
 - (e) A complete clique of four nodes

- (5) A simple network consists of n nodes in a single component. What is the maximum possible number of edges it could have? What is the minimum possible number of edges it could have?