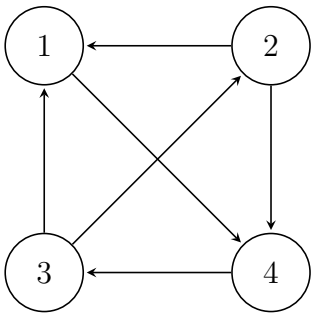
CS 549: Performance Analysis of Computer Networks
Theory Assignment 3

Assigned: April 1, 2025 *Due*: April 7, 2025

Write your answers by hand on plain paper, scan and submit on Moodle. Descriptive answers must be written in your own words, copying verbatim from the textbook will not fetch you any marks.

1. The connectivity digraph of a wireless multi-hop network is given below. Write the graph theoretic representation $G(\mathcal{N}, \mathcal{E})$ of this network, giving the nodes and the edges. Divide the edges into maximally independent sets that can be used for link scheduling, and give the underlying link activation constraints.



2. You are required to design experiments to analyse the performance of the IIT Mandi transport network in the Mandi-South Campus-North Campus route. Suppose the Institute is the *system* and the students are the *users*.

   (a) Identify 4 factors and list the associated levels against each factor.

   (b) Identify 3 system-oriented metrics and 3 user-oriented metrics. Against each metric indicate if it as "Higher is better" or a "Lower is better" metric.

   (c) Of the six metrics identified above, choose four appropriate metrics and draw Kiviat charts for the cases given below:

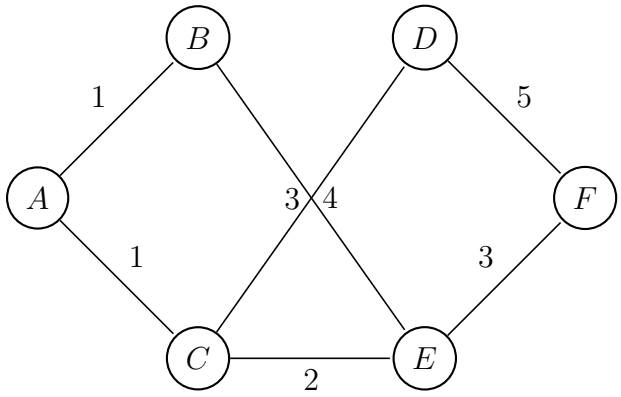
      i. Good performance from the perspective of the user and the system.

      ii. Good performance from user perspective, mediocre performance from system perspective.

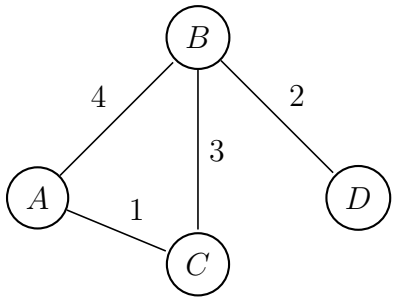
3. A study was conducted to evaluate the performance of Electronic Voting Machines supplied by 3 different manufacturers. Each voting machine was used to record a total of 1 milion votes, and the number of erroneous votes recorded was counted. This experiment was repeated 4 times. The readings obtained were as shown in the table below. Compute the sum of squares of response, means, effects and errors. Use these to compute the total variation in the response.

Expt no.	Manufacturer X	Manufacturer Y	Manufacturer Z
1	140	103	152
2	156	174	147
3	148	123	149
4	137	142	141

4. For the following network, hand-simulate Dijkstra's algorithm for node A. For each iteration show the update in distance and predecessor for each node. Give the shortest path from A to every node in the network.



5. For the following network, work out the iterations of the Distance Vector algorithm. Show the table in each node after each iteration until convergence.



6. Three graphs G, $\hat{G}$ and $\tilde{G}$ that are identical except for the costs of the links. Graph G has cost c_i assigned to each link $i \in E$, and

   (a) graph $\hat{G}$ has cost $k + c_i$, for all $i \in E$, where $k > 0$.

   (b) graph $\tilde{G}$ has cost $k \times c_i$, for all $i \in E$, where $k > 0$.

   Are the shortest paths between any two nodes in $\hat{G}$ and $\tilde{G}$ identical to that in G? Justify your answer.