SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2018
ENSC 427: COMMUNICATION NETWORKS

Final Examination
Saturday, April 21, 2018

Duration: 180 minutes. Attempt all problems. Questions are not equally weighted. Closed book and closed notes. Please provide detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted. Please write legibly. Illegible text will not be graded. Please use a pen (no pencils, please).

1. **Computer Networks and the Internet (20 points)**:

    (a) Name two reference models for communication networks and list their layers (5 points).
    (b) Provide examples of protocols used in each layer (5 points).
    (c) List names of data units in each layer (5 points).
    (d) List layers present in: server, client, router, bridge, and link (5 points).

2. **The Network Layer: Control Plane (35 points)**:
   Consider two routing algorithms to find the shortest path between two nodes in a network.

    (a) Assume that path from node u to a neighboring node v has distances $D(v)$ and cost $c(u,v)$. Write the pseudo-code to find the shortest path from source node s to all destination nodes d using:
        i. Dijkstra algorithm (5 points)
        ii. Bellman-Ford algorithm (5 points).
    (b) Consider the network shown in Fig. 1. Assume that node 1 is the source node and that node 9 is the destination node. Use tables to show each step for each algorithm (2 x 10 points).
    (c) Draw the shortest path trees found by each algorithm (5 points).

3. **The Link Layer and LANs (15 points)**:

    (a) Briefly describe ALOHA and slotted ALOHA algorithms (5 points).
    (b) Expand the acronym and describe the CSMA/CD algorithm (5 points).
    (c) Provide details of the binary exponential backoff (5 points).

4. **Wireless and Mobile Networks (15 points)**:

    (a) List main differences between wireless and wired links (5 points).

    (b) List components of a cellular network and show a typical network topology (5 points).

    (c) List main differences between 2G, 3G, and 4G network architectures (5 points).

5. **Case Study: Data Mining and Machine Learning for Analysis of Network Traffic (15 points)**:

    (a) Describe two models used to characterize network traffic (4 points). What is self-similar traffic (1 point)?

    (b) Describe three families of graphs used to model network toplogies (3 points). What is currently a widely adopted model for the Internet topology (2 points)?

    (c) Briefly describe methodology used to classify Internet BGP anomalies (5 points).
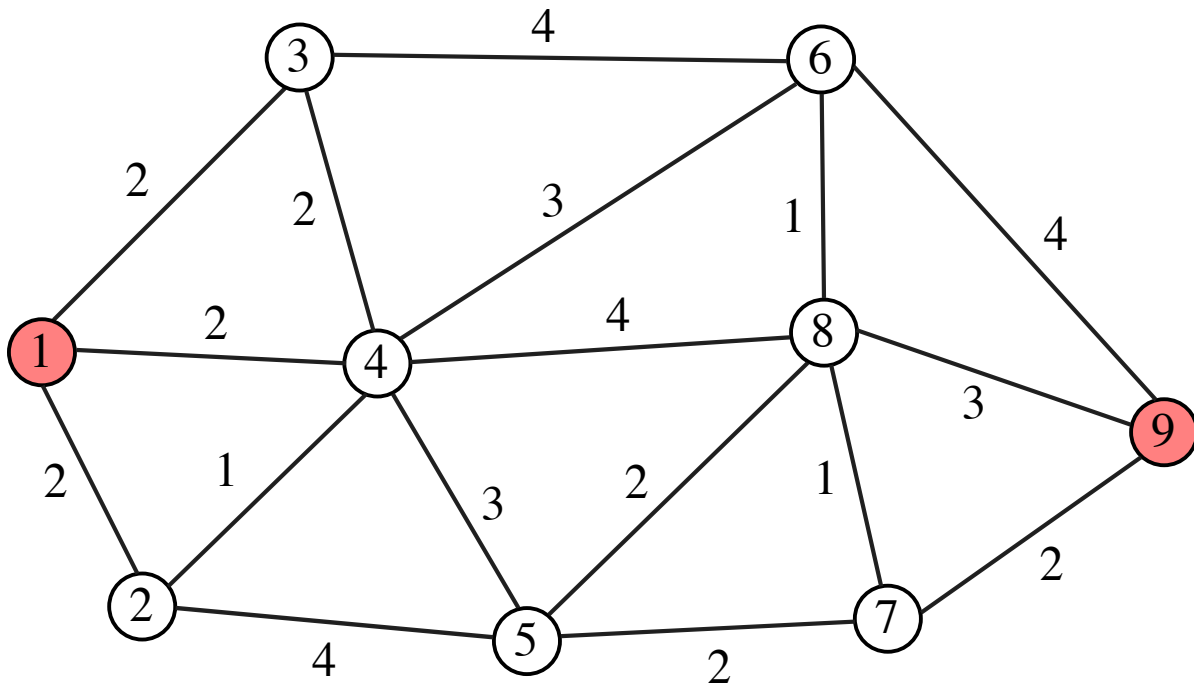

Figure 1: Apply Dijkstra and Bellman-Ford algorithms to find the shortest path in this network with nine nodes. Assume that node 1 is the source node and that node 9 is the destination node.