SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2020
ENSC 427: COMMUNICATION NETWORKS

Midterm No. 2
Monday, March 23, 2020

Duration: 110 minutes. Attempt all problems. Questions are not equally weighted. Please provide detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Closed book and closed notes. 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).

Please sign your solution sheets before uploading the PDF file to Canvas. By signing and uploading your solutions, you agree to recognize your professional responsibility for ethical behavior in this course.

1. **The Network Layer: Data Plane (20 points)**:
   (a) Describe the role and list main functions of the network layer.
   (b) What are data and control planes and their functions?
   (c) List and describe four scheduling mechanisms.
2. **The Network Layer: Control Plane (15 points)**:
   (a) List two families of routing algorithms.
   (b) Write the pseudo code for:
      i. Dijkstra algorithm
      ii. Bellman-Ford algorithm
   (c) What is the maximum number of iterations required before the algorithms converge?
3. **The Network Layer: Control Plane (30 points)**:
   (a) Consider the network shown in Figure 1.
      i. With the indicated link costs, use Dijkstra's algorithm to compute the shortest path from z to all network nodes.
      ii. Show how the algorithm works by computing an appropriate table.
      iii. Draw the shortest path tree found by the algorithm.
   (b) Consider the network shown in Figure 2.
      i. Assume that each node initially knows the costs to each of its neighbors. Use Bellman-Ford algorithm and show the routing table entries at node z.

4. **The Link Layer and LANs (20 points)**:

   (a) List and describe three error detection techniques.

   (b) Describe CSMA, CSMA/CD, and CSMA/CA random access algorithms.

   (c) Describe the Ethernet CSMA/CD exponential back-off algorithm.

   (d) What is the maximum number of permitted collisions?

   (e) If $K = 100$, how long does the adapter wait after a collision for 10 Mbps and 100 Mbps broadcast channels?

5. **Case Study: Data Center Networking (15 points)**:

   (a) What are Data Center Networks (DCNs)?

   (b) Describe main advantages of DCNs.

   (c) Describe the main characteristics of Software Defined Networking (SDN).

   (d) Consider the network shown in Figure 3. Based on the available infrastructure network (left), select an assignment to embed a virtual network request (right).

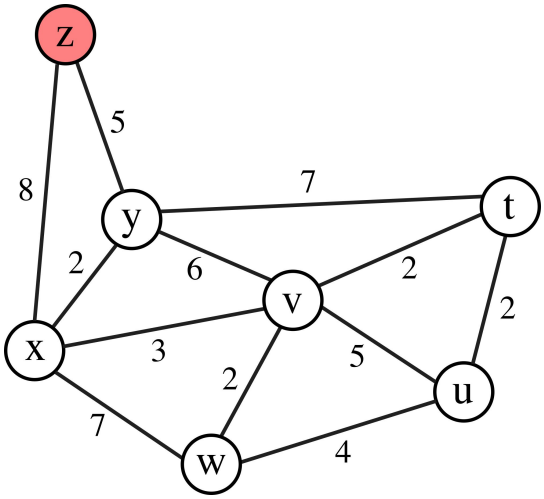

Figure 1: Apply Dijkstra's algorithm to find the shortest path from node z.

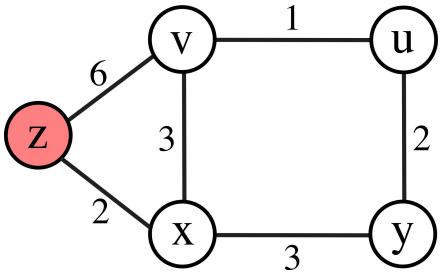

Figure 2: Apply Bellman-Ford algorithm to show the routing table entries at node z.

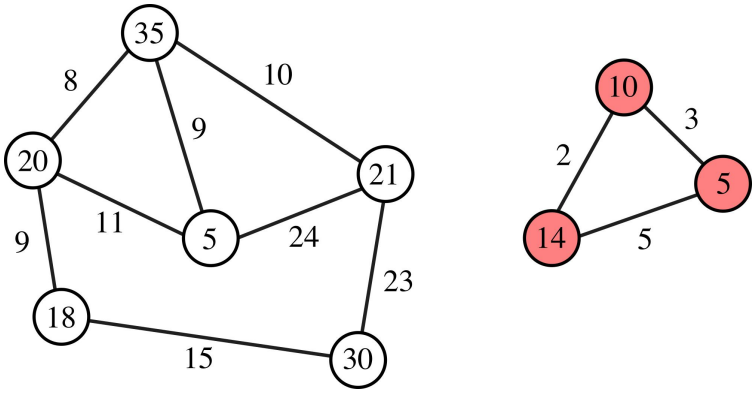

Figure 3: Infrastructure network (left) and a virtual network request (right).