CMPT 371: Data Communication and Networking Summer 2019 Final Exam (August 6, 2019)

First Name: Last Name: Student Number:

Instructions:

- 1. This is a closed book examination.
- 2. No electronic devices may be used.
- 3. Please write down your answers using a pen.
- 4. Exam duration is 90 minutes (7:00 8:30pm)
- 5. This exam includes 10 questions. Answer all the questions.
- 6. Answer each question in the space provided. You should not need more space.
- 7. The exam is eight (8) pages. Make sure you have all of the pages.

Question	Mark	Question	Mark
1 (10 points)		6 (10 points)	
2 (5 points)		7 (10 points)	
3 (5 points)		8 (15 points)	
4 (5 points)		9 (15 points)	
5 (5 points)		10 (20 points)	
Total (100)			

Q1 (10 points). Please clearly circle or underline true or false for each of the following statements. (1 point each)

- (a) IP routing is performed based on a unique IP address and forwarding table entries with longest prefix matching, whereas in MPLS the routing is performed based on a fixed-length label.
 (True / False)
- (b) An ARP query is sent in a broadcast frame because the querying host does not know which adapter address corresponds to the IP address in question. (True / False)
- (c) POP3 is capable of keeping the messages at the server side for the client to check any time desired. (True / False)
- (d) Consider an overlay network with N active peers, with each pair of peers having an active TCP connection. Additionally, suppose that the TCP connections pass through a total of M routers. There will be (N+1)(N+2)/2 edges in the overlay network.
 (True / False)
- (e) Hot potato routing chooses local gateway that has least intra-domain cost. (True / False)
- (f) If the distance between a Client and the Server is 4000 Km and the propagation speed through the medium is 2×10^8 m/s, then the propagation delay is 0.04 seconds. (True / False)
- (g) Routing is based on MAC address and forwarding is based on IP address. (True / False)
- (h) Address Resolution Protocol finds the MAC address that corresponds to a specific IP address. (True / False)
- (i) Using tunneling, IPv6 datagram can be carried as payload in IPv4 datagram among IPv4 routers. (True / False)
- (j) An OSPF router broadcasts its link-state information to all other routers in the autonomous system to which it belongs, not just to its neighboring routers.
 (True / False)

Q2 (5 points).

- (a) Explain a problem that might happen with two-way handshake. (3 points)
- (b) Explain how three-way handshake solves this problem. (1 point)
- (c) Which Transport layer protocol uses a three-way handshake? (1 point)

Q3 (5 points).

- (a) Explain how a proxy-server works. (2 points)
- (b) Provide three usage scenarios for a proxy server and briefly explain why proxy server works as a solution in these scenarios. (3 points)

Q4 (5 points).

- (a) What is a Content Distribution Network (CDN)? (1 point)
- (b) Name content distribution strategies and briefly mention their content placement? (4 points)

Q5 (5 points).

- (a) Explain briefly how bit parity works. (1 points)
- (b) Explain with an example how two-dimensional parity works? (1 point)
- (c) Can two-dimensional bit parity locate a bit flip? If yes, how? If no, why? (2 point) Are there any exceptions? (1 point)

Q6 (10 points).

- (a) What is network congestion and where does it happen? (1 point)
- (b) What are the challenges we have in addressing congestion? (1 points)
- (c) How do we implement congestion control in TCP? Describe the mechanism, its important elements, transition between the different states of congestion control, and the reason they are needed in the TCP congestion control. (8 points)

Q7 (10 points).

- (a) Explain Inter-AS and Intra-AS routing and their usage (2 points) and compare them based on policy, scale, and performance (3 points). Can you discuss OSPF and BGP in this context? (2 points)
- (b) What is centralized network control? (1 point) Provide one incentive (1 point), and one protocol and its usage (1 point) in the context of centralized control.

Q8 (15 points).

- (a) What is CSMA? (3 points) and where it is used? (3 point)
- (b) What is collision and why does it happen? (2 points)
- (c) What is binary backoff and how it is used in CSMA/CD? (2 points)
- (d) What are the alternatives to the CSMA mechanism (in the context of resource sharing)? And how do they compare? (5 points)

Q9 (15 points).

- (a) What is packet switching? (3 points)
- (b) What is circuit switching? (3 points)
- (c) Give one example of application needs and explain traffic situations that is appropriate for packet switching. (2 points)
- (d) Give one example of application needs and explain traffic situations that is appropriate for circuit switching. (2 points)
- (e) Suppose we have users that generate data at a rate of **100kbps** when they are busy. However, these users are busy generating data only **10%** of the time. Suppose we have a **1 Gbps** link between source and destination. What is the maximum number of users that can be supported simultaneously if we use circuit switching? (2 points)
- (f) Now consider packet switching and a user population of **M** users. What will be the formula for the probability that more than **N** users are sending data? (3 points)

Q10 (20 points). Please answer the following questions about Dijkstra's algorithm.

- (a) Explain Dijkstra's algorithm in detail (6 points).
- (b) Is it a Link State or a Distance Vector algorithm? (1 point) Why? (1 point)
- (c) Is it used in control, or forwarding plane? (1 point)
- (d) Is it used in the centralized/generalized model, or the traditional model? (1 point)
- (e) Run Dijkstra algorithm on the following network and find the least cost path from **u** to all other destinations. (10 points)

Note: List of least-cost paths without indicating the steps of the algorithm will not receive any points.

