# CPSC 441 COMPUTER NETWORKS

## MIDTERM EXAM

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This is a CLOSED BOOK exam. Textbooks, notes, laptops, personal digital assistants, tablets, and cellular phones are NOT allowed. However, **calculators are permitted**.

It is a 50 minute exam, with a total of 50 marks. There are 12 questions, and 7 pages (including this cover page). Please read each question carefully, and write your answers legibly in the space provided. You may do the questions in any order you wish, but please USE YOUR TIME WISELY.

When you are finished, please hand in your exam paper and sign out. Good luck!

Student Name: \_\_\_\_\_

Score: \_\_\_\_\_ /  $50 = ____ \%$ 

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#### **Multiple Choice**

Choose the best answer for each of the following 8 questions, for a total of 8 marks.

- 1 1. Historically, the "big three" applications in the early days of the Internet were:
  - (a) remote login, World Wide Web, and illegal file sharing
  - (b) remote login, file transfer, and gopher
  - (c) secure shell, video streaming, and electronic mail
  - (d) file transfer, remote login, and electronic mail
  - (e) file transfer, Twitter, and Facebook
- 1 2. The Domain Name Service (DNS) is an example of a:
  - (a) transaction-oriented application-layer protocol
  - (b) session-oriented application-layer protocol
  - (c) transaction-oriented transport-layer protocol
  - (d) session-oriented transport-layer protocol
  - (e) all of the above
- 1 3. The Simple Mail Transfer Protocol (SMTP) is an example of a:
  - (a) transaction-oriented application-layer protocol
  - (b) session-oriented application-layer protocol
  - (c) transaction-oriented transport-layer protocol
  - (d) session-oriented transport-layer protocol
  - (e) all of the above
- 1 4. The primary advantage of a persistent HTTP connection is:
  - (a) a larger version number (1.1) than non-persistent HTTP (1.0)
  - (b) additional RTT's when obtaining multiple Web objects from the same Web server
  - (c) re-using an existing TCP connection for a Web transfer when it is possible to do so
  - (d) eliminating the need for state information at the application layer
  - (e) extra funding support from Google

- 1 5. The transmission time for a 1200-byte packet on a classic 10 Mbps (Megabits per second) Ethernet LAN would be approximately:
  - (a) 1 millisecond
  - (b) 2 milliseconds
  - (c) 10 milliseconds
  - (d) 20 milliseconds
  - (e) 50 milliseconds
- 6. The one-way propagation delay for a single bit of information traveling at the speed of light (3 x  $10^8$  meters per second) over a fiber-optic cable from Vancouver to Halifax (6000 kilometers) would be approximately:
  - (a) 1 millisecond
  - (b) 2 milliseconds
  - (c) 10 milliseconds
  - (d) 20 milliseconds
  - (e) 50 milliseconds
- 1 7. The underlying control principle in TCP's congestion avoidance algorithm is:
  - (a) Additive Increase, Multiplicative Decrease
  - (b) Exponential Increase, Multiplicative Decrease
  - (c) Additive Increase, Exponential Increase
  - (d) Additive Decrease, Multiplicative Increase
  - (e) Additive Increase, Additive Decrease
- 1 8. In general, the throughput achieved by TCP for a file transfer is:
  - (a) inversely proportional to the average window size used during the transfer
  - (b) inversely proportional to the round trip time of the network path
  - (c) inversely proportional to the TCP segment size used for the transfer
  - (d) inversely proportional to the file size
  - (e) all of the above

#### **Internet Protocol Stack**

10 9. Use your knowledge of the Internet's TCP/IP protocol stack to complete the following fill-in-the-blank sentences and paragraphs. (20 blanks to fill in, each worth 0.5 marks)

The Internet Protocol Stack has \_\_\_\_\_ layers. The top-most layer is called the \_\_\_\_\_ layer. The logical units of data exchanged at this layer are called \_\_\_\_\_. Two examples of protocols at this layer are \_\_\_\_\_ and \_\_\_\_\_. The next lower layer is called the \_\_\_\_\_ layer. The logical units of data exchanged here are called \_\_\_\_\_. Two services provided at this layer are \_\_\_\_\_ and \_\_\_\_\_. On the Internet, the two protocols to choose from at this layer are \_\_\_\_\_ and \_\_\_\_\_. Layer 3 of the Internet Protocol Stack is called the Network Layer. It deals with logical data units called \_\_\_\_\_. The most prominent protocol at this layer on the Internet is \_\_\_\_\_. Immediately beneath the Network Layer is the \_\_\_\_\_ layer. It deals with logical data units called \_\_\_\_\_, which are exchanged on a hop-by-hop basis over network links. One example of a widely-used protocol at this layer is \_\_\_\_\_. The lowest layer of the Internet Protocol Stack is the \_\_\_\_\_ layer. The most basic unit of data exchange at this layer is called a \_\_\_\_\_\_. Two examples of transmission media commonly used at this layer include \_\_\_\_\_.

#### Networking Concepts and Definitions

- 12 10. For each of the following pairs of technical terms, **define** each term, and **clarify** the key difference(s) between the two terms. Be clear and concise.
  - (a) (3 marks) "connection-oriented" and "connectionless"

(b) (3 marks) "encapsulation" and "decapsulation"

(c) (3 marks) "iterative DNS query" and "recursive DNS query"

(d) (3 marks) "go-back-N" and "selective repeat"

#### Reliable Data Transfer

- 10 11. In class, we discussed several versions of Reliable Data Transfer (RDT) protocols, and the mechanisms used to detect and recover from different types of errors that could occur in an unreliable network layer.
  - (a) (3 marks) One type of error is a **corrupted data segment**. What mechanism or mechanisms are needed in an RDT protocol to detect and recover from this type of error? How do they work?

(b) (3 marks) A second type of error is a **duplicate data segment**. What mechanism or mechanisms are needed in an RDT protocol to detect this type of error? In particular, what state variables are needed, and where do they reside?

(c) (4 marks) A third type of error is a **lost data segment**. What mechanism or mechanisms are needed in an RDT protocol to detect and recover from this type of error? What additional state information is needed, and where does it reside?

### Transmission Control Protocol (TCP)

10 12. The diagram below illustrates the generic segment structure used by the Transmission Control Protocol (TCP). Use your knowledge of TCP to answer the following questions.

Source	Port	Destination Port
Sequence Number		
Acknowledgement Number		
Length	Flags	Window
Checksum		Urgent Pointer
Options (optional)		
DATA (optional)		

- (a) (1 mark) What is the default size (in bytes) for a TCP segment header?
- (b) (2 marks) What is a Transport Level Endpoint (TLE)? Which field or fields are used to help convey this information?
- (c) (3 marks) Which field or fields are used in TCP's 3-way handshake to open a new connection? What information is conveyed during the handshake, and how?
- (d) (2 marks) What is the purpose of the **Window** field? How is it used?
- (e) (1 mark) What **Flags** field bit is used to abort a TCP connection that has encountered an unrecoverable error?
- (f) (1 mark) Which header fields (if any) are used by TCP's congestion control algorithms?

#### \*\*\* THE END \*\*\*