CPSC 441
COMPUTER COMMUNICATIONS

MIDTERM EXAM

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University of Calgary
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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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Student ID: _____

Multiple Choice

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

1 1. Historically, the design philosophy for the network core of the Internet has always been:

(a) simple best-effort datagram service model

(b) connection-oriented virtual circuits to end systems

(c) complex signalling protocol with resource reservations

(d) charge users based on the Quality of Service (QoS) provided

(e) none of the above

1 2. One of the early ancestors of TCP/IP in the 1970's was:

(a) ARPAnet

(b) NSFnet

(c) CERFnet

(d) NCP (Network Control Protocol)

(e) Wimbledon

1 3. Which of these network applications uses TCP as its default transport-layer protocol?

(a) remote login

(b) file transfer

(c) electronic mail

(d) World Wide Web

(e) all of the above

1 4. Which of these network applications uses UDP as its default transport-layer protocol?

(a) BitTorrent

(b) NNTP (Network News Transfer Protocol)

(c) DNS (Domain Name Service)

(d) World Wide Web

(e) none of the above

1 5. What significant event had a major effect on the Internet in the mid-1980's?

(a) the creation of the World Wide Web

(b) the rise of peer-to-peer file sharing

(c) TCP congestion collapse

(d) mid-life crisis

(e) none of the above

1 6. The congestion avoidance and control mechanisms in TCP were initially designed by:

(a) Vinton Cerf

(b) Robert Kahn

(c) Van Jacobson

(d) Tim Berners-Lee

(e) Carey Williamson

1 7. The underlying control principle in TCP's congestion control can be described as:

(a) speed up slowly, and back off quickly

(b) speed up quickly, and back off slowly

(c) speed up quickly, and back off quickly

(d) speed up slowly, and back off slowly

(e) grab everything you can get, and run away

1 8. In general, the throughput achieved by a file transfer using TCP depends on:

(a) the size of the file being transfered

(b) the round trip time of the network path

(c) the packet loss rate of the network

(d) the version of TCP being used

(e) all of the above

Networking Concepts and Definitions

12 9. 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) "positive ACK" and "negative ACK"

(b) (3 marks) "cumulative ACK" and "selective ACK"

(c) (3 marks) "`SOCK_DGM`" and "`SOCK_STREAM`"

(d) (3 marks) "Round Trip Time (RTT)" and "Retransmit Timeout (RTO)"

Reliable Data Transfer Protocols

10 10. In class, we discussed a simple One-Bit Sliding Window Protocol (OBSWP).

(a) (4 marks) What were the key elements of **state information** maintained by OBSWP? Where did the state information reside, and why?

(b) (2 marks) Would OBSWP be suitable for general-purpose data transfer on the wide-area Internet? Why or why not?

(c) (4 marks) What additional features are needed to generalize OBSWP effectively to a WAN environment? What additional state information is required to support these features, and where would this state information reside?

Transmission Control Protocol (TCP)

10 11. 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.

<table>
<tr><td colspan="2">Source Port</td><td>Destination Port</td></tr>
<tr><td colspan="3">Sequence Number</td></tr>
<tr><td colspan="3">Acknowledgement Number</td></tr>
<tr><td>Length</td><td>Flags</td><td>Window</td></tr>
<tr><td colspan="2">Checksum</td><td>Urgent Pointer</td></tr>
<tr><td colspan="3">Options</td></tr>
<tr><td colspan="3">DATA</td></tr>
</table>

(a) (1 mark) Does TCP support simplex, half-duplex, or full-duplex data transfers?

(b) (2 marks) Describe precisely what information is carried in the *Sequence Number* field.

(c) (2 marks) Describe precisely the information carried by the *Acknowledgement Number*.

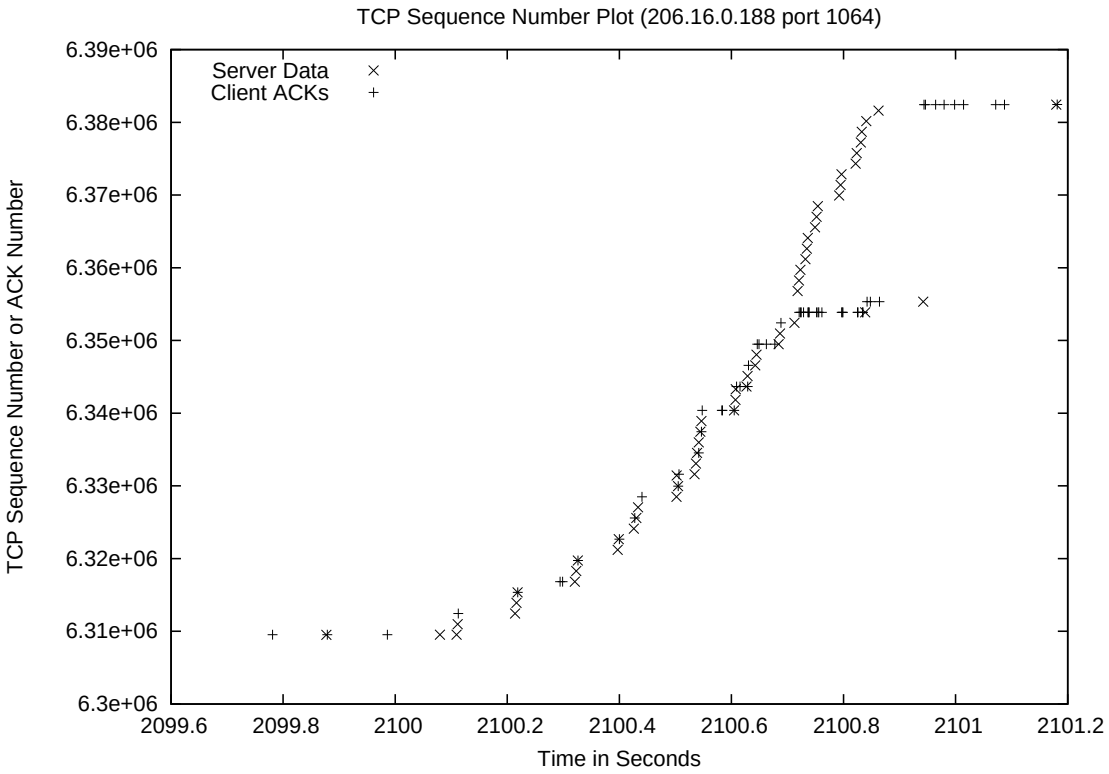
(d) (3 marks) Give 3 examples of *Flags* field bits used to convey TCP state information.

(e) (1 mark) Does the *Window* field represent the Sender Window (W_S), the Receiver Window (W_R), or the Congestion Window (`cwnd`)?

(f) (1 mark) Give one example of a *TCP Option* that could be negotiated during an opening 3-way handshake.

TCP Performance

10 12. The graph below shows one of the TCP sequence number plots that we discussed in class. Using lines, arrows, circles, and handwritten text as appropriate, **annotate the graph** to show **at least 5 features** of the TCP transport-layer protocol, and/or any unusual performance anomalies that occur during this particular TCP connection. You may write directly upon the graph, or in the white space around it. Up to 2 marks are available for each **distinct and relevant feature** that is correctly identified and explained.



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