Computer Networks Quiz 2

Spring Semester 2018

Answer Sheet

Average Median Range
7.53 / 13 points 7 / 13 points 2 - 13 points

Total points distribution

ECDF of score
Q1: Select all true statements.

(a) The sliding window only moves when the left edge has been acknowledged.

(b) TCP uses a two-way handshake.

Solution: Wrong. It uses a three-way handshake.

(c) The TCP handshake includes communicating the receive window size to the sender, so that the receiver is not overwhelmed by traffic.

Q2: Select all true statements.

(a) There is no connection establishment in UDP.

(b) The UDP base header is smaller than the TCP base header.

(c) The objective of flow control is to not overwhelm the network.

Solution: Wrong. The objective of congestion control is to not overwhelm the network. The objective of flow control is to not overwhelm the hosts.
Q3: Select all true statements.

(a) A too low timeout value in TCP will result in excessive re-transmissions.

(b) During congestion avoidance in TCP, the successful acknowledgement of a segment results in the sender congestion window growing by one segment.

Solution: Wrong. In congestion avoidance, the sender congestion window grows with 1 segment per RTT.

(c) The Multiplicative-Increase-Multiplicative-Decrease (MIMD) approach described in the lecture slides always results in an unfair but efficient state.

Solution: Wrong. Might result in a fair state if the initial state was fair since it fluctuates along the equi-fairness line.
Q4: Select all true statements.

(a) In Additive-Increase-Multiplicative-Decrease (AIMD), as described in the lecture slides, an efficient state cannot be achieved since the congestion window is decreased more aggressively than increased.

**Solution:** Wrong. AIMD converges to fairness & efficiency.

(b) The ssthresh in TCP is used to estimate the achievable congestion window after a timeout.

(c) The sliding window can be advanced whenever a duplicate acknowledgement is received.

**Solution:** Wrong. The sliding window is only advanced once the first packet sent in this window is acknowledged.

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Q5: The Maximum Segment Size (MSS) of TCP is equal to...

(a) .. the Maximum Transmission Unit (MTU) of IP packets (MSS = MTU)

(b) .. the MTU of IP minus both IP and TCP headers size (MSS = MTU - header(IP) - header(TCP))

(c) .. the MTU of IP plus IP, TCP and Application Layer headers size (MSS = MTU + header(IP) + header(TCP) + header(APP))

(d) .. the MTU of IP minus IP, TCP and Application Layer headers size (MSS = MTU - header(IP) - header(TCP) - header(APP))

(e) .. the MTU of IP minus IP header size plus TCP header size (MSS = MTU - header(IP) + header(TCP))
Q6: Which of the following statements concerning sockets is/are true?

(a) UDP sockets type is SOCK_DGRAM while TCP sockets type is SOCK_STREAM

(b) A socket is a software abstraction by which an application process exchanges network messages with the MAC layer in the operating system

(c) For a SOCK_DGRAM, an operating system stores both local and remote IP address

(d) For a SOCK_STREAM, an operating system stores both local and remote port

(e) The socket ID is a part of the standard TCP header

Q7: Given a directed graph G(V,E), with |V| and |E| being the numbers of vertices and edges, how many variables do you need for the max-flow LP formulation discussed in class?
(a) $O(|E|)$
(b) $O(|V|)$
(c) $O(|V| + |E|)$
(d) $O(|V|^2)$

Q8: For load balancing requests across many servers, what drawbacks does the “Query load on all responsive servers; pick least loaded” approach have? (Select all true statements).

(a) If there are multiple load balancers, they may make synchronized choices, causing overload at the chosen server.
(b) Querying load at every server can be inefficient across large pools of servers.
(c) Failure of a server results in its entire workload being shifted to another server.
(d) Unless we maintain state about which session was allocated to which server, ensuring session continuity is challenging.
Q9: For the “Query load on \( k \) random servers; pick lesser loaded approach”, going from \( k = 1 \) to \( k = 2 \), the expected load on the most loaded server decreases

(a) linearly
(b) exponentially
(c) quadratically
(d) multiplicatively

Q10: For the “Query load on \( k \) random servers; pick lesser loaded approach”, going from \( k = 2 \) to \( k = 3 \), the expected load on the most loaded server decreases

(a) linearly

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\(^1\)It’s clear that question 10 was worded ambiguously; we’ll make every attempt to make the exam questions clearer. Nevertheless, such ambiguities are always corrected for in grading.
Q11: For the balls and bins analysis, if indicator variables $X_{ij}$ are used to denote collisions, being able to write the expectation of the number of collisions, $E[\Sigma X_{ij}]$ as $\Sigma P[X_{ij} = 1]$ requires that all $X_{ij}$ are independent of each other. True or false?

**Solution:** False. The linearity of expectation does not depend on independence of random variables.

Q12: With $m$ balls being thrown into $n$ bins (uniform independently at random), what is the probability that balls $i$ and $j$ land in the same bin?
Q13: After \( n \) insertions into a Bloom filter with \( m \) bits of memory using \( k \) hash functions per insertion, what is the probability that a particular bit is still 0?

(a) \( (1 - \frac{1}{mk})^{k+n} \)
(b) \( (1 - \frac{1}{m})^{kn} \)
(c) \( (1 - \frac{1}{mk})^n \)
(d) \( (1 - \frac{1}{k})^{mn} \)