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Computer Systems
Quiz 4

Question 1

Which statement is wrong (assuming $f < n/2$)?

   a) Correct-range validity implies all-same validity.

   b) All-same validity implies correct-range validity.

   c) Median validity implies correct-range validity.

   d) Correct-input validity implies correct-range validity.

Question 2

If there are n nodes, what is the maximum number of byzantine failures f that any approximate agreement algorithm can tolerate?

   a) $f < n/4$.

   b) $f < n/3$.

   c) $f < n/2$.

   d) $f < n$.

Question 3

In Algorithm 21.5 ("Synchronous Approximate Agreement"), we store the received messages R_i as a set instead of a multi-set. If the set T_i is empty after removing the f largest and smallest values, x_i is not updated. Which statement is wrong?

   a) ε-agreement still holds.

   b) Termination still holds.

   c) Range-validity still holds.

   d) The set T_i can only become smaller.

Question 4

Suppose $n = 120$. What is the maximum number of byzantine failures that Algorithm 21.10 ("Asynchronous Approximate Agreement: Naive Attempt") can handle?

   a) $f = 30$.

   b) $f = 29$.

   c) $f = 24$.

   d) $f = 23$.

Question 5

The "witness technique" (Algorithm 21.12)...

    a) ... alerts other nodes whenever u suspects v of byzantine behavior.

    b) ... informs other nodes that no byzantine behavior was observed.

    c) ... shares a sufficiently large list of nodes that one received messages from.

    d) ... shares a sufficiently large list of nodes that one sent messages to.

Question 6

Suppose n nodes get their input values from a set S of possibly unbounded cardinality. Which statement holds true?

    a) Approximate agreement with $\varepsilon = 1/2^{|S|} > 0$ implies byzantine agreement.

    b) Approximate agreement with $\varepsilon = \inf_{x,y \in S}\{|x - y|\} > 0$ implies byzantine agreement.

    c) There exists $\varepsilon > 0$ small enough such that for any set S approximate agreement implies byzantine agreement.
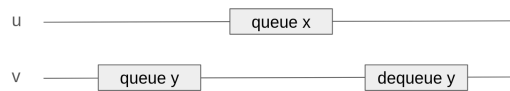
    d) The three previous statements are wrong.

Figure 1: Execution for Question 7.

Question 7

Consider a LIFO (Last-In-First-Out) queue shared between two processes. Which statement about the execution depicted in Figure 1 is true?

    a) It is sequentially consistent, but not quiescent consistent.

    b) It is quiescent consistent, but not sequentially consistent.

    c) It is neither sequentially nor quiescent consistent.

    d) It is both sequentially and quiescent consistent.
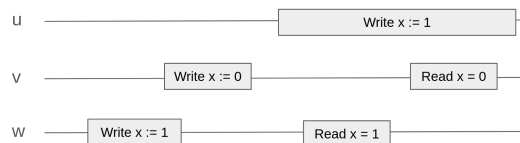

Figure 2: Execution for Question 8.

Question 8

Consider the execution depicted in Figure 2. Which statement is wrong?

a) It is sequentially consistent.

b) It is quiescent consistent.

c) It is linearizable.

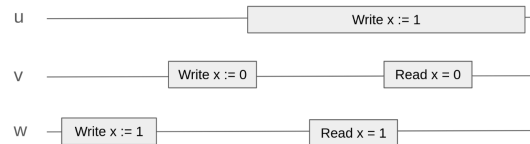**d)** It is happened-before consistent.

Figure 3: Execution for Question 9.

Question 9

Consider the execution depicted in Figure 3. Which statement is true?

a) It is sequentially consistent.

b) It is quiescent consistent.

c) It is linearizable.

d) All of the above.

Question 10

In Algorithm 22.26 ("Vector clocks"), we replace line 4 with $c_u[v] = \max(d[v], c_u[v]) + 1$ for all v. Which statement is true?

a) It is both a logical clock and a strong one.

b) It is a logical clock but not a strong one.

c) It is not a logical clock but it is a strong one.

d) It is neither a logical clock nor a strong one.

Question 11

In Algorithm 22.26 ("Vector clocks"), we replace line 2 with $c_u[u] = c_u[u] + 2$. Which statement is true?

a) It is both a logical clock and a strong one.

b) It is a logical clock but not a strong one.

c) It is not a logical clock but it is a strong one.

d) It is neither a logical clock nor a strong one.

Question 12

In Algorithm 22.26 ("Vector clocks") line 3, we first include c_u as d in the message, and then increment $c_u[u] = c_u[u] + 1$. Which statement is true?

a) It is both a logical clock and a strong one.

b) It is a logical clock but not a strong one.

c) It is not a logical clock but it is a strong one.

d) It is neither a logical clock nor a strong one.

Question 13

In Algorithm 22.31 ("Distributed Snapshot Algorithm"), we remove the forwarding of messages without snap tag in line 4. Which statement is true?

a) The algorithm collects a consistent snapshot.

b) The algorithm collects a snapshot, but it is not necessarily consistant.

c) The algorithm collects a consistent cut.

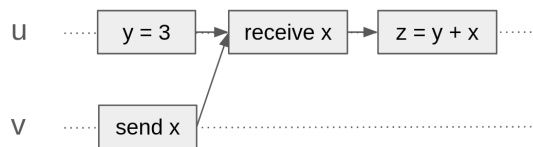**d)** The algorithm collects a cut, but it is not necessarily consistent.

Figure 4: Execution for Question 14.

Question 14

What is the measure of concurrency of the execution depicted in Figure 4?

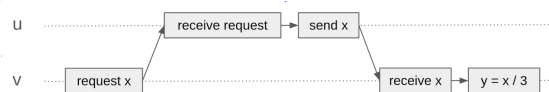**a)** 1/5

b) 2/5

c) 1/3

d) 2/3

Figure 5: Execution for Question 15.

Question 15

What is the number of consistent cuts in the execution depicted in Figure 5?