



Computer Systems

Quiz 1

Question 1

Which of these greek islands appears in most distributed systems text books?

- a) Paros
- b) Patmos
- c) Paxos
- d) Naxos

Question 2

What is the minimum number of nodes for an asynchronous consensus algorithm that can tolerate f failures?

- a) $2f$
- b) $2f + 1$
- c) $3f$
- d) $3f + 1$

Question 3

What is the minimum number of rounds for a deterministic synchronous consensus algorithm that can tolerate f failures?

- a) $2f + 1$
- b) $3f + 1$
- c) $5f + 1$
- d) (None of the above.)

Question 4

In the Paxos protocol, if two clients each send a different command at the same time, what will the servers that receive both commands do?

- a) Accept both values and merge them.
- b) Accept only the value from the client with the higher proposal number.
- c) Reject both values due to the conflict.
- d) Wait for a tie-breaker value from the leader.

Question 5

With n servers, of which $c \leq n$ also act as clients and $f < \frac{n}{2}$ may fail. What is the worst-case time until Paxos decides on a value?

- a) $\mathcal{O}(c)$
- b) $\mathcal{O}(f)$
- c) $\mathcal{O}(n)$
- d) ∞

Question 6

What would be the main problem if in Paxos clients did not receive the previously stored commands when asking for tickets?

- a) Servers might end up deciding different values.
- b) A client could single-handedly decide the command.
- c) The clients would not learn the decided command.
- d) (None of the above.)

Question 7

In Paxos, could clients choose one of the previously stored commands arbitrarily for their proposal (instead of the one with the highest ticket number)?

- a) Yes, without any downside.
- b) Yes, but it decreases performance in practice.
- c) No, this would prevent termination.
- d) No, it could lead to breaking agreement.

Question 8

Assume the client receives tickets from ALL servers, only one of which contains a stored command. Would it be safe for the client to send any arbitrary command?

- a) Yes.
- b) No, it means one server already executed the stored command.
- c) No, some client may have already executed the stored command.
- d) No, it could still lead to two different commands being executed.

Question 9

Without the validity property of consensus...

- a) ...achieving agreement and termination would be trivial.
- b) ...achieving agreement and termination would be impossible.
- c) ...a single node may decide the final value.
- d) ...an additional round of communication would be required.

Question 10

Given any asynchronous consensus protocol, which of the following is easy to construct?

- a) Synchronous consensus protocol.
- b) State replication protocol.
- c) Asynchronous BINARY consensus protocol.
- d) (All of the above.)

Question 11

Which of the following is NOT a way to get around the impossibility of consensus?

- a) Use randomization.
- b) Assume (partial) synchrony.
- c) Assume at most one failure.
- d) (Any of the above enable consensus.)

Question 12

Consider a distributed database across 5 servers. We want to employ a consensus algorithm to provide state replication. The servers are connected with reserved network links with an upper bound on latency. Which of the following is TRUE? (NOTE: This question has been corrected).

- a) If 3 or more servers may fail, consensus is impossible.
- b) We can employ a consensus protocol with 3 rounds, regardless of the number of server failures.
- c) A randomized consensus algorithm is necessary.
- d) With up to 3 failures, a deterministic consensus protocol may take up to 4 rounds.

Question 13

What is the main disadvantage of using individual coins instead of a shared coin for randomized consensus?

- a) It decreases fault tolerance.
- b) It eliminates the need for synchrony.
- c) Termination takes longer.
- d) (None of the above.)

Question 14

Assume we run randomized consensus with biased individual coins instead of unbiased coins. Which of the following is FALSE?

- a) This increases time until termination in some instances.
- b) This decreases time until termination in some instances.
- c) If all individual coins are biased towards 1, the protocol may still decide 0.
- d) The protocol is no longer guaranteed to terminate.

Question 15

Assume a synchronous network with unidirectional latency of at most 200ms with a single client that does not crash. What is the upper bound on the time (in ms) from starting the Paxos protocol to execution of the decided command on ALL servers?