Designing Distributed Algorithms

Quiz 4:

A. Which of these two diagrams is better for regression testing? Why?

B. If something like (b) were chosen to support user feedback during a long operation (like fetching files from the network), what modification could be introduced to support multiple UIs?

Remember to put your name & lab section at the top.
Distributor Algorithm Problem 1:

![Diagram of two generals communicating through messengers near an enemy camp.]

Two generals problem
- Each assess the situation (attack or not?) 1 or 0
- Communicate through messengers — can be captured
- At the end of the message exchange:
  AGREEMENT: Both reach the same decision.
  VALIDITY: The final decision must be among the initial assessments.
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Ideas:
1. Send lots of messages
2. Put a sequence # on each message
3. Encrypt the messages — assume can tell (discard) if a message is corrupted
4. Use timeouts to send again when not getting a response
Theorem: The 2-generals problem is unsolvable. There is no protocol.

Proof: Assume there exists some protocol.

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Decide 0  Decide 0

Disagree!!
**Issue:** Completely asynchronous. Don't know when other side has knowledge.

**Assume:** Stronger comm. model: Time bound $\Delta t$ on delivery.

Common knowledge: "Everybody knows that everybody knows"
Problem 2: Byzantine Generals Problem

- An number $n$ processes.
- Of these $n$, up to $f \leq n$ may be faulty:
  - Stop sending messages (crash failure)
  - Skip over messages (omission failure)
  - Can lie to disrupt the system (Byzantine failure) (can collude)

Suppose $n = 2$ and $f = 1$

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Agreement:
- All non-faulty agree.

Validity:
- Final value was initial value of some $n-f$ process.

Wrong
What if $n=3$ and $f=1$?

Idea: Vote (Default 0)

initial 0 → 1 → 110 : 1

001 : 0

Agreement:
- All non-faulty agree.

Validity:
- Final value was initial value of some $n$-f process.