



# LTAT.06.007 Distributed Systems

## Practical Seminar 12

Farooq Ayoub

TEACHING ASSISTANT

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# Recap



- **Fault Tolerance**

- Get acquaintance with the concept of Fault Tolerance
- Differences between a Fault, Error and a Failure
- Implement the Program to show fault tolerance and failure.

# Agenda



- **Goal: Consensus in faulty systems with arbitrary failures**
- **Content:**
  - Reaching consensus in a fault-tolerant process group in which  $k$  members can fail assuming arbitrary failures.
  - We need at least  $3k + 1$  members to reach consensus under these failure assumptions.
  - Byzantine agreement
  - Requirements for Byzantine Agreement.
- **Quiz**

# Session Content



## Description

- In this seminar, we take a look at how to reach a consensus in a fault-tolerant process group in which  $k$  members can fail assuming arbitrary failures.
- We will also show that we need at least  $3k + 1$  members to reach consensus under these failure assumptions.

## Observation

Instructions to complete this practical session can be found in the course website: <https://courses.cs.ut.ee/2021/ds/spring/Main/Instructions8>

# Consensus in faulty systems with arbitrary failures

Consider a process group consisting of  $n$  members, of which one has been designated to be the primary,  $P$ , and the remaining  $n - 1$  to be the backups  $B_1, \dots, B_{n-1}$ .

## Assumptions:

- A client sends a value  $v \in \{T, F\}$  to the primary, where  $v$  stands for either True or False.
- Messages may be lost, but this can be detected.
- Messages cannot be corrupted without that being detected (and thus subsequently ignored).
- A receiver of a message can reliably detect its sender.

# Requirements for Byzantine Agreement

**BA1:** Every nonfaulty backup process stores the same value.

**BA2:** If the primary is non faulty then every nonfaulty backup process stores exactly what the primary had sent.

**Note:** If the primary is faulty, BA1 tells us that the backups may store the same, but different (and thus wrong) value than the one initially sent by the client. Furthermore, it should be clear that if the primary is not faulty, satisfying BA2 implies that BA1 is also satisfied.

Session Instructions and examples  
explained at Course Page

# Quiz



## Content

- Lecture – **Fault Tolerance II**
- Two attempts
  - One in Seminar Session
  - Next available until Monday 23:59 (Deadline)
- Open Quiz in Moodle
- Total Quiz Points = 100

## Observation

Quiz review is available after the quiz is closed





# Questions?

E-mail: [farooq.ayoub.dar@ut.ee](mailto:farooq.ayoub.dar@ut.ee)