

Department of Computer Science

PURDUE
UNIVERSITY

CS505: Written Assignment 2

Agreement

Consensus

1. Devise a *multi-valued* (i.e., processes can propose any values, not just 0 or 1) *non-uniform* consensus with P , tolerating more than a majority of failures. Argue for its correctness.

Follow the specification of slide 5 in lecture 10 on Consensus.

Hint: you may use ordering *among processes* (identifiers) to break ties

2. Is it possible to extend the previous algorithm to achieve *uniform* agreement? If yes, how? If no, why not?

3. Can you devise a multi-valued *uniform* consensus using P without relying on an ordering of process identifiers?

▶ Hint: you may use an ordering among *proposed values* to break ties.

Failure Detectors

4. Consider the following failure detector (see slides 6 and 7 of lecture 7 on FDs for the definitions):

- **Perpetual Completeness:** Every faulty process is permanently suspected by every correct process.
 - $\forall t \in T, \forall p_i \in \text{crashed}(F), \forall p_j \in \text{correct}(F): p_i \in H(p_j, t)$
- **Perpetual Accuracy:** No process is suspected unless it crashes.
 - $\forall t \in T, \forall p_i, p_j \in \text{correct}(F): p_j \notin H(p_i, t)$

a. Give a similar formal description of the perfect FD P

b. Compare the above FD with P

c. Formulate a property precluding any FD looking into the future (cf. θ)

Group Membership (Crash-stop Model)

5. Describe an algorithm to implement Group Membership with properties (A)...(D) outlined on the next slide.

GM involves a primitive *install(V)* - used to deliver updated membership information in the form of a *view V*. A view V^i is a tuple (i, M) where i is a unique view identifier and M is the set of processes that belong to the view.

- (A) Monotonicity:** If a process installs view $V^j = (j, M_j)$ after installing $V^i = (i, M_i)$, then $j > i$ and $M_j \subset M_i$
- (B) Uniform Agreement:** If two processes install views $V^i = (i, M)$ and $V^{j'} = (j', M')$ then $M = M'$
- (C) Completeness:** If a process p crashes, then eventually every correct process installs view $V^i = (i, M_i)$ where $p \notin M_i$
- (D) Accuracy:** If some process installs view $V^i = (i, M_i)$ and $q \notin M_i$ then q has crashed.