Set 9: Fault Tolerant Consensus

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Spring 2014 Prof. Jennifer Welch

Consensus Problem

- Every processor has an input.
- Termination: Eventually every nonfaulty processor must decide on a value.
 - decision is irrevocable!
- Agreement: All decisions by nonfaulty processors must be the same.
- Validity: If all inputs are the same, then the decision of a nonfaulty processor must equal the common input.

Examples of Consensus

□ Binary inputs:

- input vector 1,1,1,1,1
 - decision must be 1
- input vector 0,0,0,0,0
 - decision must be 0
- input vector 1,0,0,1,0
 - decision can be either 0 or 1
- Multi-valued inputs:
 - input vector 1,2,3,2,1
 - decision can be 1 or 2 or 3

Overview of Consensus Results

- □ *Impossible* in asynchronous case.
- Even if we only want to tolerate a single crash failure.

Consensus Algorithm for Crash Failures

Code for each processor:

v := my input

at each round 1 through f+1:

if I have not yet sent v then send v to all
wait to receive messages for this round
v := minimum among all received values and
current value of v

if this is round f+1 then decide on v