KTH ROYAL INSTITUTE
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Paxos

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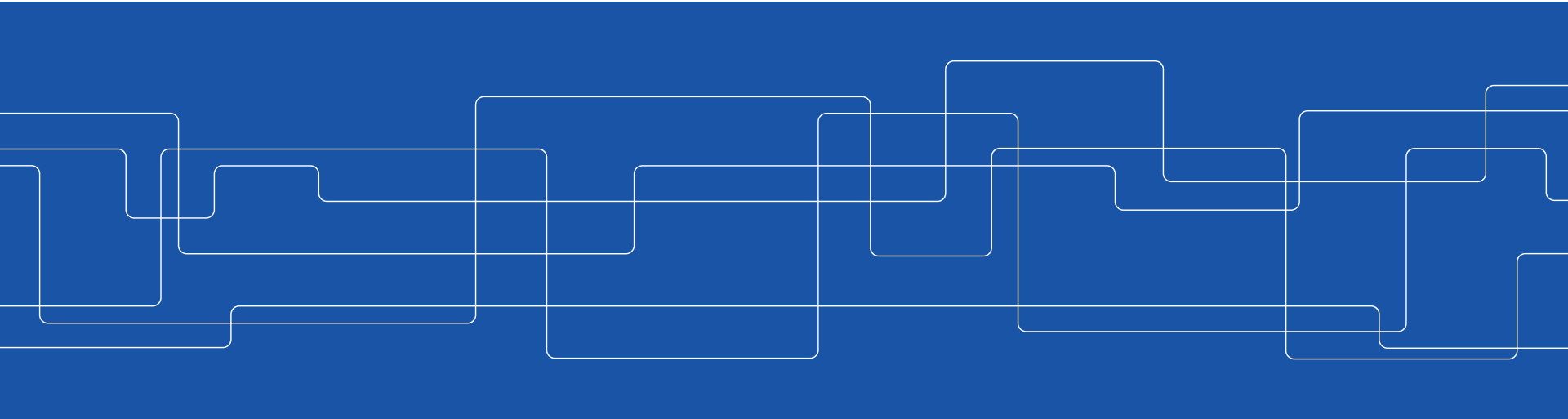

Paxos

- - or how to decide the price of olive oil.

The problem

How do we reach a consensus when:

- nodes can crash
- messages get lost
- we have no failure detectors

We might have failure detectors but we can not trust them completely.

The environment

Nodes can crash,

- but are restarted and
- will remember where in the protocol they were.

Messages can:

- take arbitrary long time to be delivered,
- get lost or get duplicated,
- but not corrupted.

Actors

Proposers:

- drive the execution
- want to find a consensus
- will inform the learners if consensus is reached

Acceptors:

- vote for proposals

Learners:

- wait for a consensus to be reached

Outline

Proposer:	sends request with ***unique sequence numbers***
Acceptors:	promise not to vote for a proposal with lower sequence number
Proposer:	collect promises and ***initiate a ballot*** with a proposal
Acceptors:	vote for the proposal ***unless they have promised not to vote in the sequence number***
Proposer:	collect votes and if a quorum vote for the proposal then we're done

The proposer

Operates in rounds, each round using a ***unique sequence number***.

In a round:

- send a request to all acceptors
- collect a quorum of promises
- ***keep information on the proposal with highest sequence number in all the promises it has collected***
- request votes for ***that proposal***
- if a quorum vote for the proposal, we have reached consensus

When you're tired of waiting you start a new round.

The acceptor

Keeps track of:

- a sequence number below which it has promised not to vote
- the ***accepted value*** with the highest sequence number that it has voted for

If requested to promise:

- promise and
- return ***accepted value and the sequence number of your vote***

If requested to vote for a proposal:

- vote, if not promised otherwise

Messages

Request to promise:

Please do not vote in any sequence number less than 42:a.

Promise:

Ok - but I have voted for €8 in sequence number 37:b.

Request to vote:

Please vote for €8 in sequence number 42:a.

Vote:

Ok - but I have voted for €8 in sequence number 37:b.

Failures

- An acceptors need never reply on anything; the protocol will never end in more than one value being selected by a quorum.
- A proposer can abort and restart anytime; must select unique sequence number.
- Any message can get lost; which also means that you can ignore any message.
- Progress is not guaranteed; two proposers can fight forever over a quorum.

If a consensus is reached, it is the only consensus that will ever be reached.

Why

Why does this work?

- Assume that one proposer has a quorum for 8€ and another proposer has a quorum for 10€.
- Prove that we have a contradiction.

- Assume that one proposer has gained a quorum for 8€ in sequence number *k*.
- Assume that each quorum formed in sequence numbers *k*, *k* + 1, .. *n* − 1 has also voted for 8€.
- Prove that if a quorum is formed in sequence number *n* it will also be for 8€.

hmm, sounds simple

40pt Let’s try.