

Papers We Love Chattanooga

September 6, 2016

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Physical Impossibility of Consensus of Death in the Mind of Someone Faulty

Terms

⋮

Informal Proof

⋮

Discussion

The Physical Impossibility of Death in the Mind of Someone Living



Tiger shark, glass, steel, 5% formaldehyde solution, 213 x 518 x 213 cm.



Impossibility of Distributed Consensus with One Faulty Process



Journal of the Association for Computing Machinery, Vol. 32, No. 2, April 1985, pp. 374-382.

Death





Terms

Asynchronous

Time doesn't (shouldn't) matter

Distributed

> 1 Process

Process

Something that does computation and messaging

Consensus

A decisive vote among processes that allows them to reach a final state

Fault

Death (or something equivalent)



Terms 2

Valid consensus

The vote must only be about something a process has proposed

Final state

All, and at least one, non-faulty process(es) agree on the result of a vote

Distributed Systems



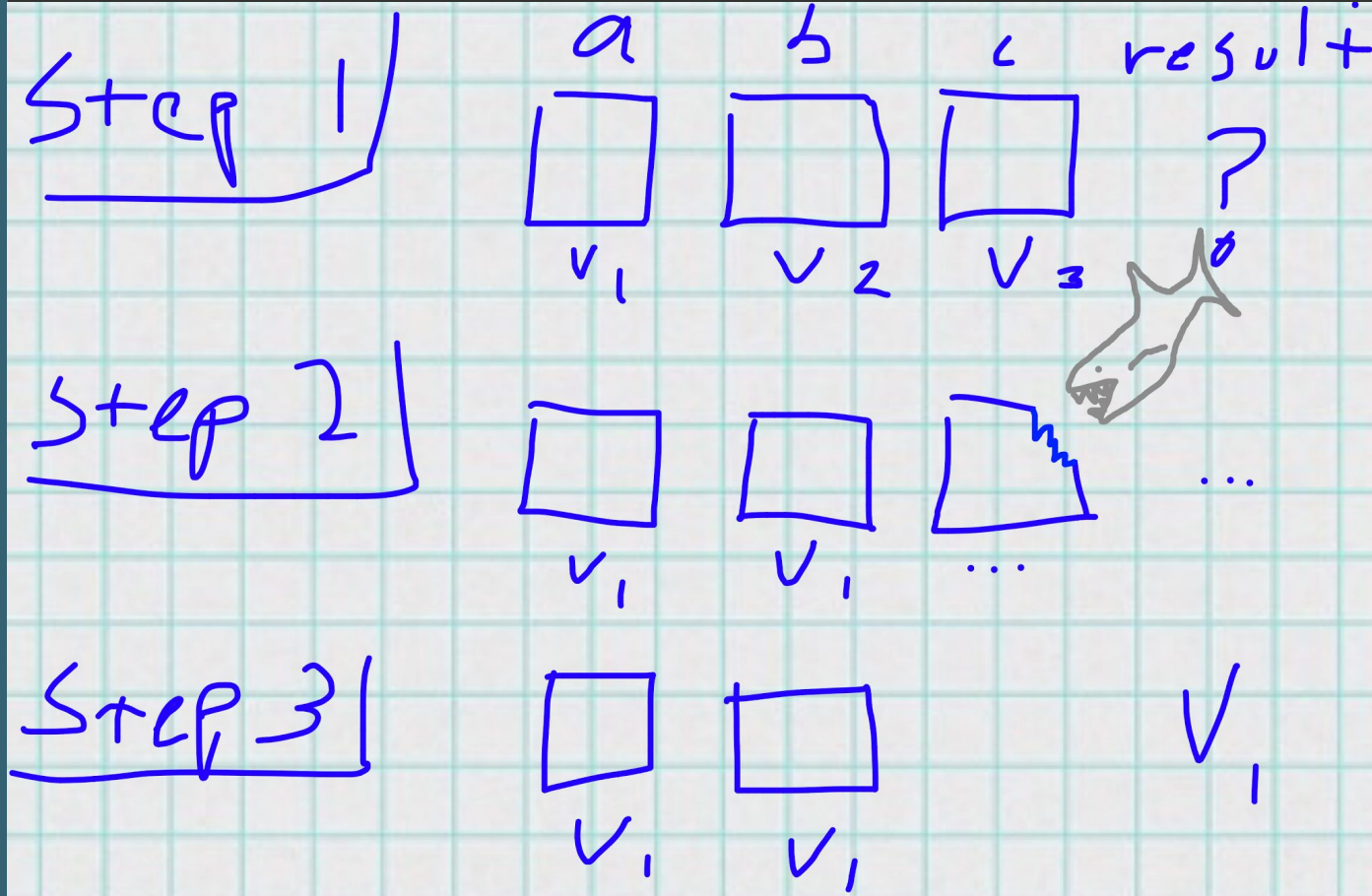


Lemma 1

***P* has a bivalent initial configuration.**



Synchronous Consensus Proof (informal)





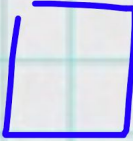
Asynchronous Processes

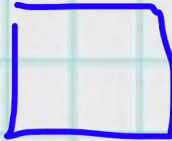




Asynchronous Unknown System

Step 1


a

 v_1

b

 v_2

c result
?
...

Step 2


 v_1

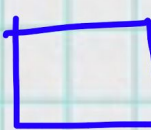

 v_1


...



Step 3


 v_1


 v_1

~
.

...

Theorem 1

No consensus protocol is totally correct in spite of one fault.

Theorem 1

**No consensus protocol is
totally correct in spite of
death.**

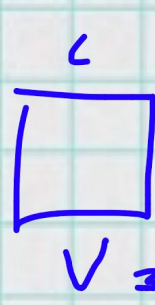
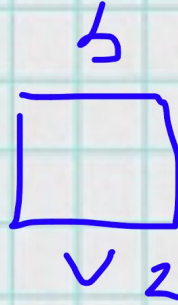
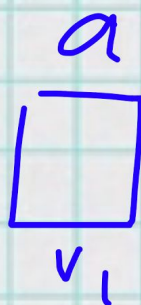
Lemma 2

Let C be a bivalent configuration of P , and let $e=(p,m)$ be an event that is applicable to C . Let \mathcal{C} be the set of configurations



Lemma 2 (informal)

Step 1



result

?

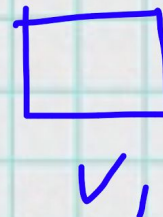


Step 2



...

Step 3



?

...

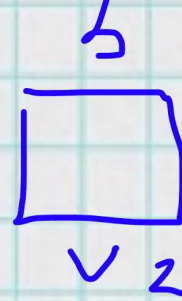
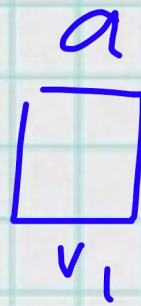
Theorem 2

There is a partially correct consensus protocol in which all non-faulty processes always reach a decision, provided no processes die during its execution and a strict majority of the processes are alive initially.



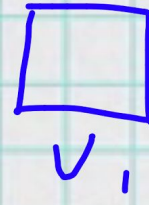
Theorem 2 (informal)

Step 1



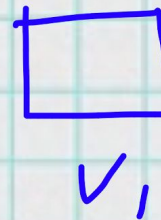
c result
?
...

Step 2

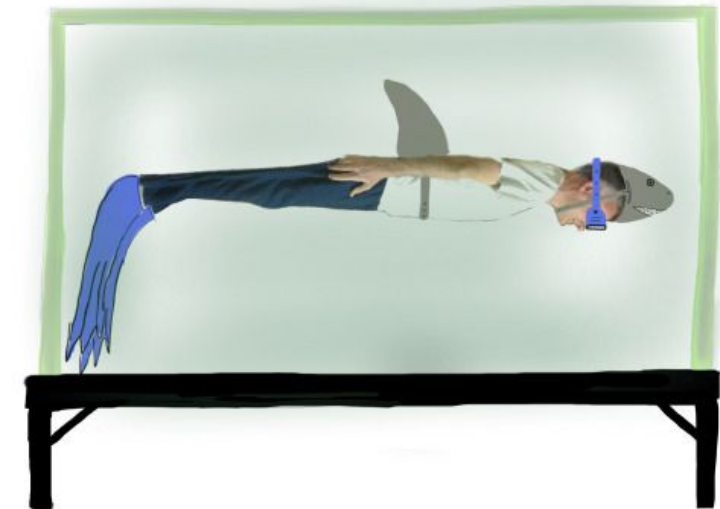


?
...

Step 3



v_1







Further Reading

2001 PODC Influential Paper Award

<http://www.podc.org/influential/2001-influential-paper/>

A Brief Tour of FLP Impossibility

<http://the-paper-trail.org/blog/a-brief-tour-of-flp-impossibility/>

Stumbling over consensus research: Misunderstandings and issues

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.174.8238&rep=rep1&type=pdf>

A Hundred Impossibility Proofs for Distributed Computing

<http://groups.csail.mit.edu/tds/papers/Lynch/MIT-LCS-TM-394.pdf>



FLP Proof (Marcos K. Aguilera)

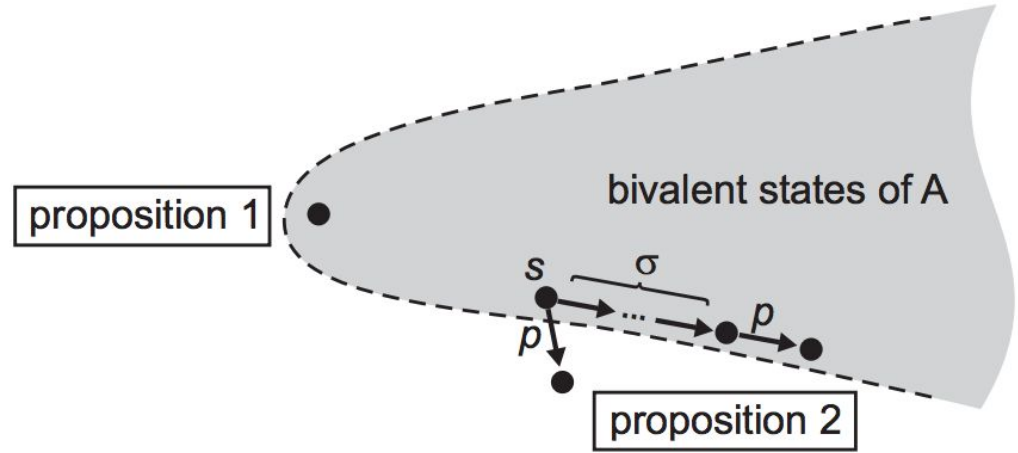


Fig. 1.1 Depiction of key propositions in the proof of impossibility of consensus.