

CSCI 1320 Day 15 : Roff Edge Cases

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# To day

Raft Concluded

- \* Top Hat Questions
- \* log safety
- \* Cloudflare Bug

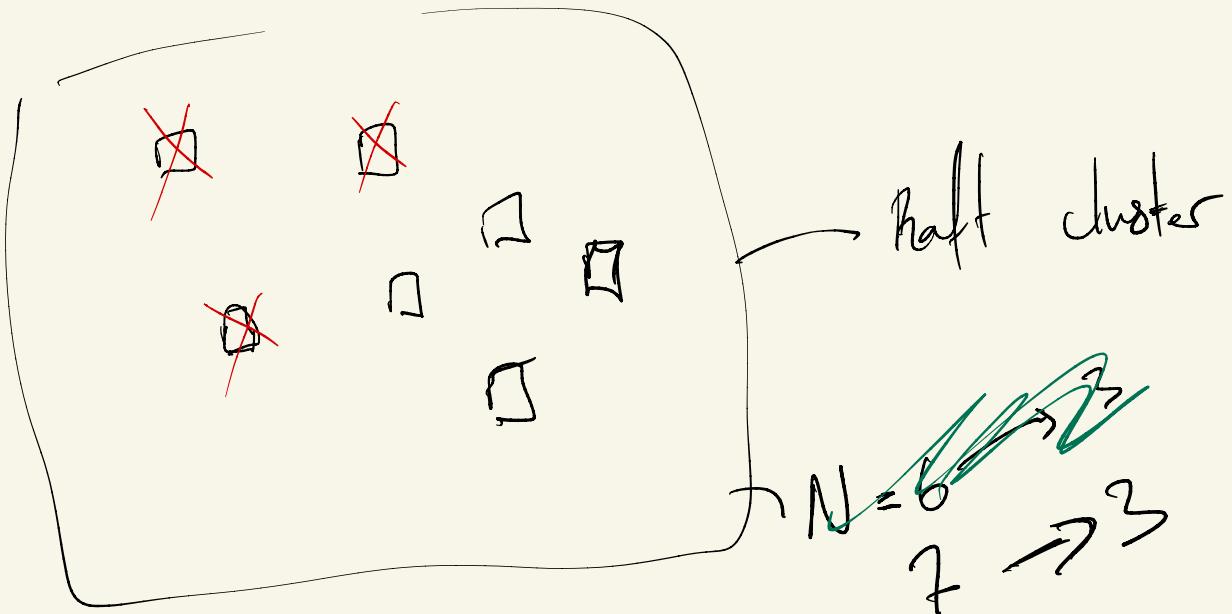
"Raft cluster" is  
essentially all of the  
RM participating in  
the Raft Protocol!

Lazy Replication

- \* Motivation
- \* Gossip
- \* Lazy replication protocol

$$F = 3 \quad \Rightarrow \quad N = 2F + 1 = 7$$

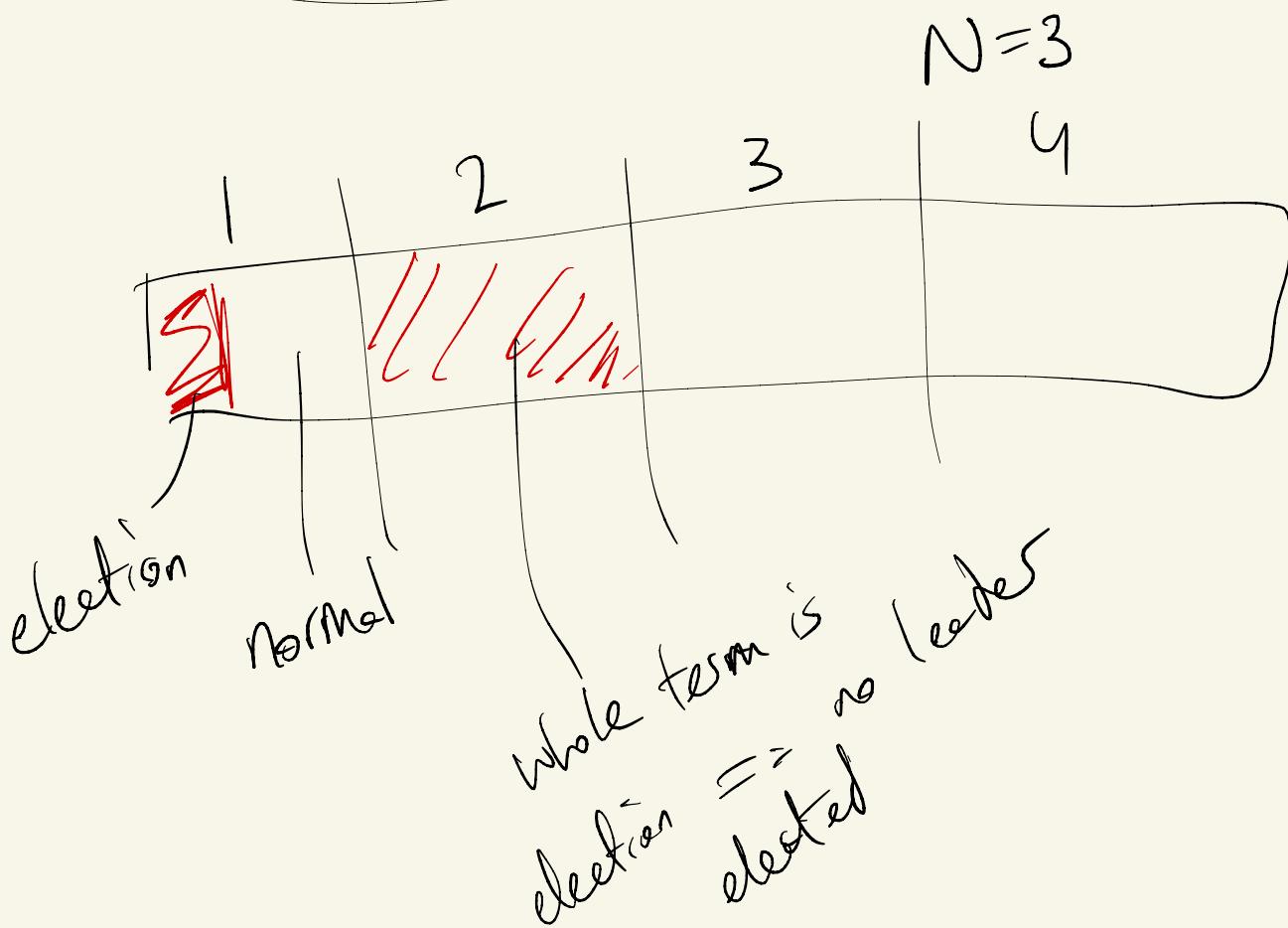
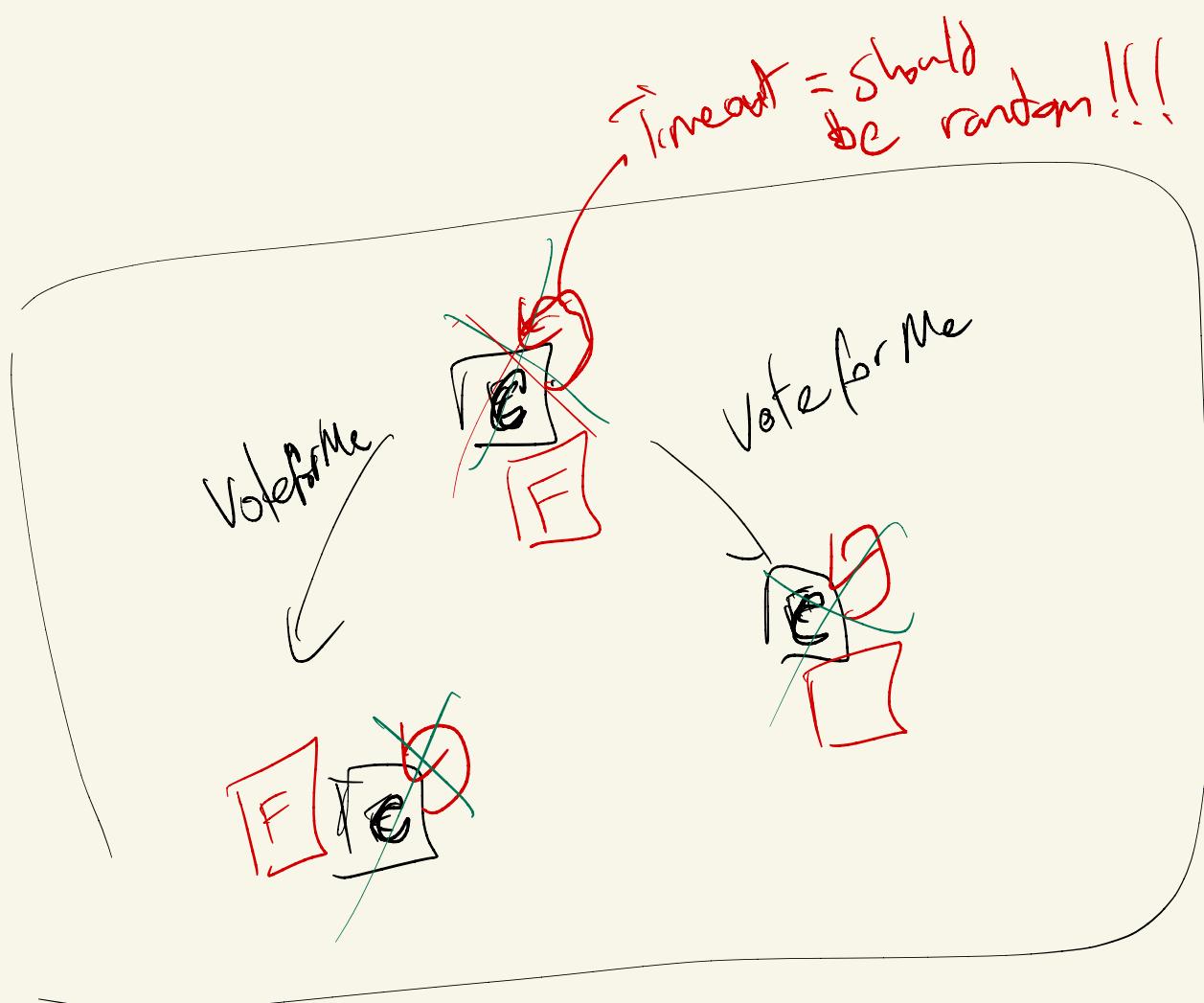
maximum # of  
node failures



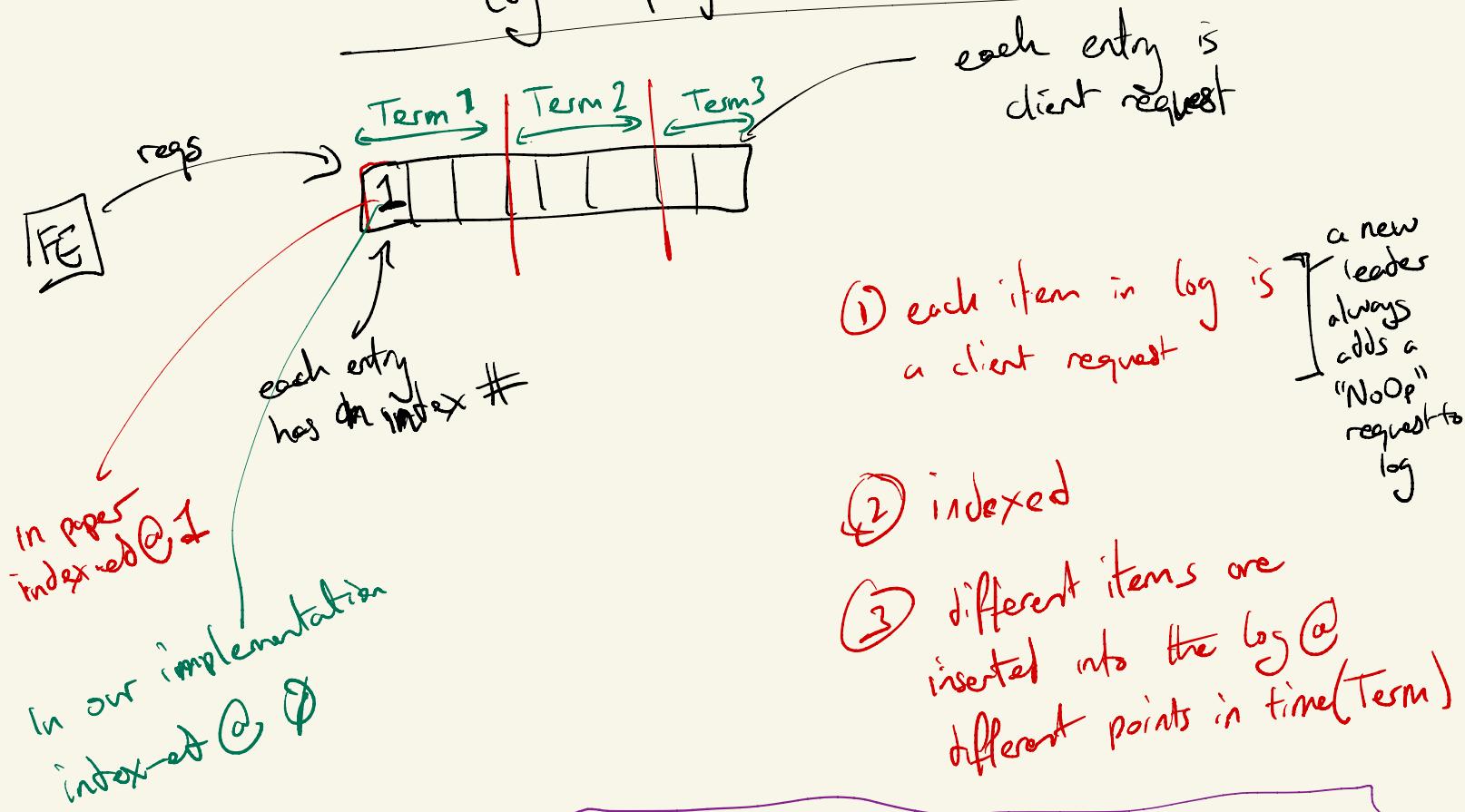
$N = 9$  → 2 or 3 nodes fail

Majority is always based on " $N$ "  
not on the # of active nodes

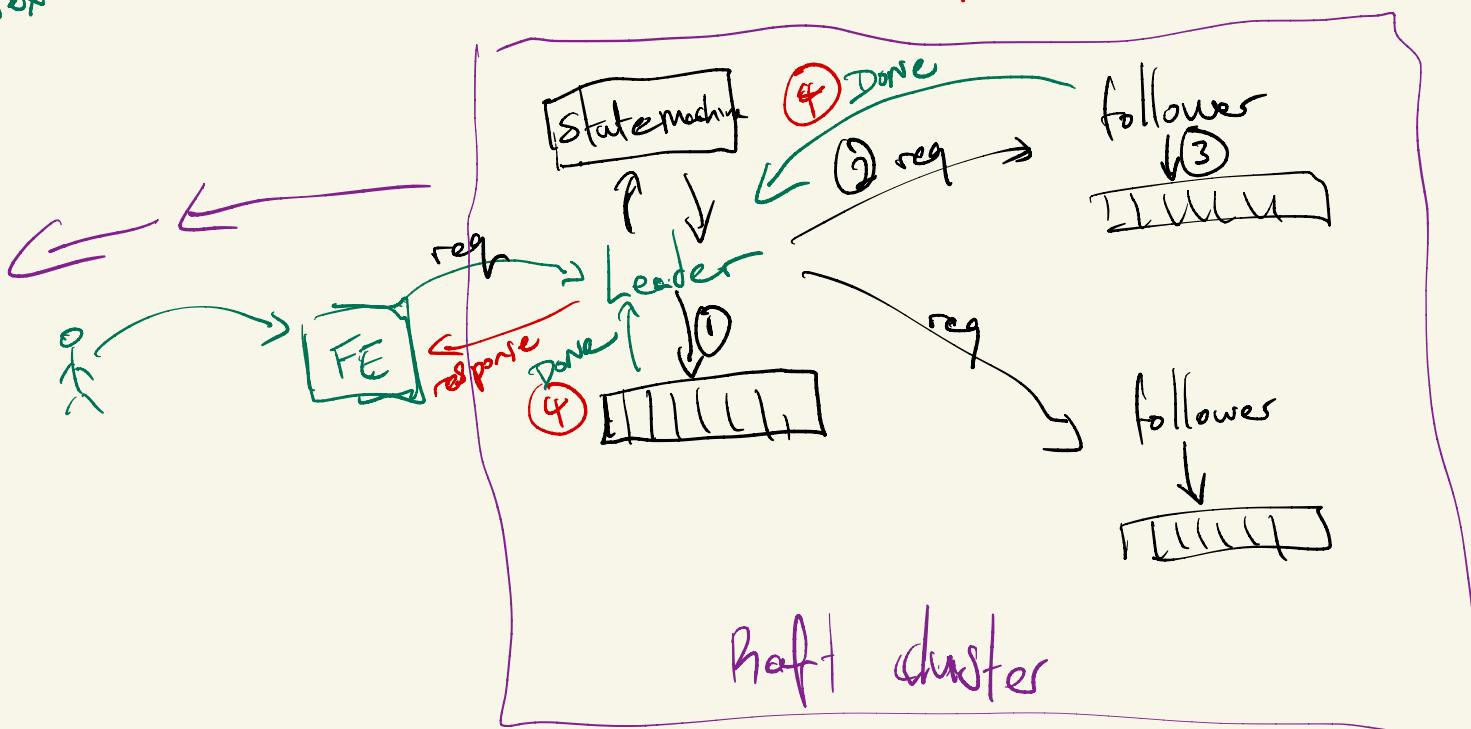
Config parameter



# Log Safety

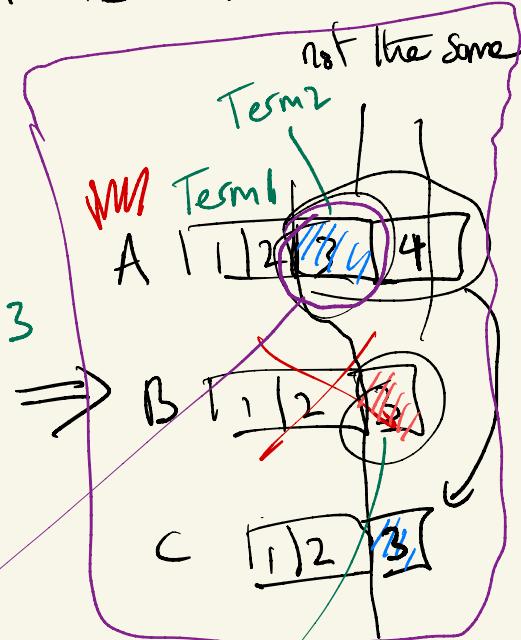
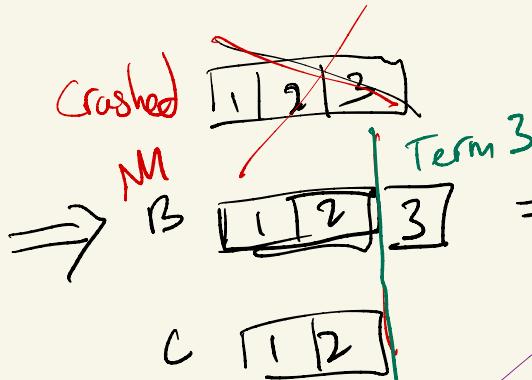
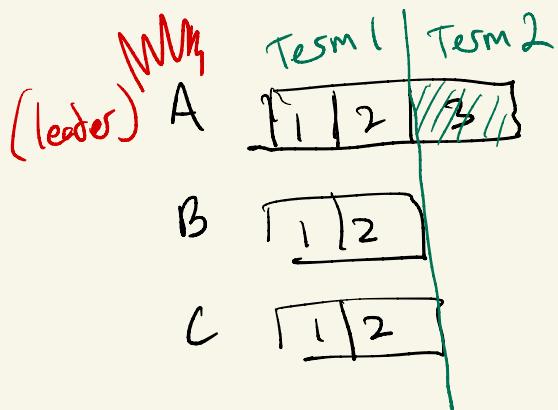


- ① each item in log is a client request
- ② indexed
- ③ different items are inserted into the log @ different points in time(Term)



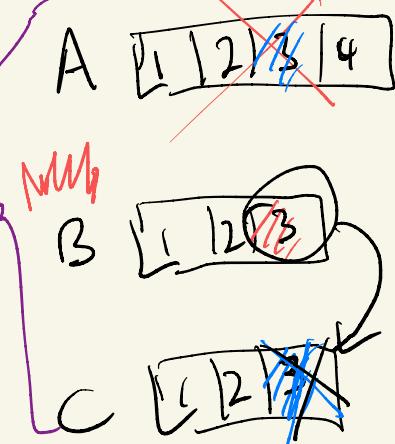
# Log Safety

if a leader claims that an entry is committed then all future leaders should agree that its committed



At this point A replicates index 3 to majority (itself + C) & it responded to FG/client with a response

But when B became leader index 3 was deleted from majority



try to make follower update with the leader

this when the leader corrects

Repairing logs

## log Commit

as a new leader before  
any index can be considered  
committed:

① you need a majority

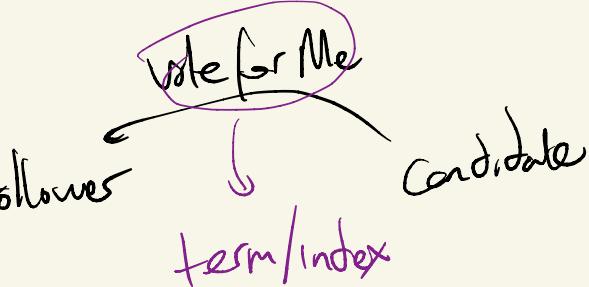
② you need to get up to  
at least one index in

current term

log repair

at least one index  
from current term  
where you are  
leader

↑  
or leader  
add NoOp  
that there's always  
one entry  
to ensure  
you



vote yes to first candidate  
where

Current  $\Rightarrow$  My term

or Current = My term

& Current  $\neq$  My Index

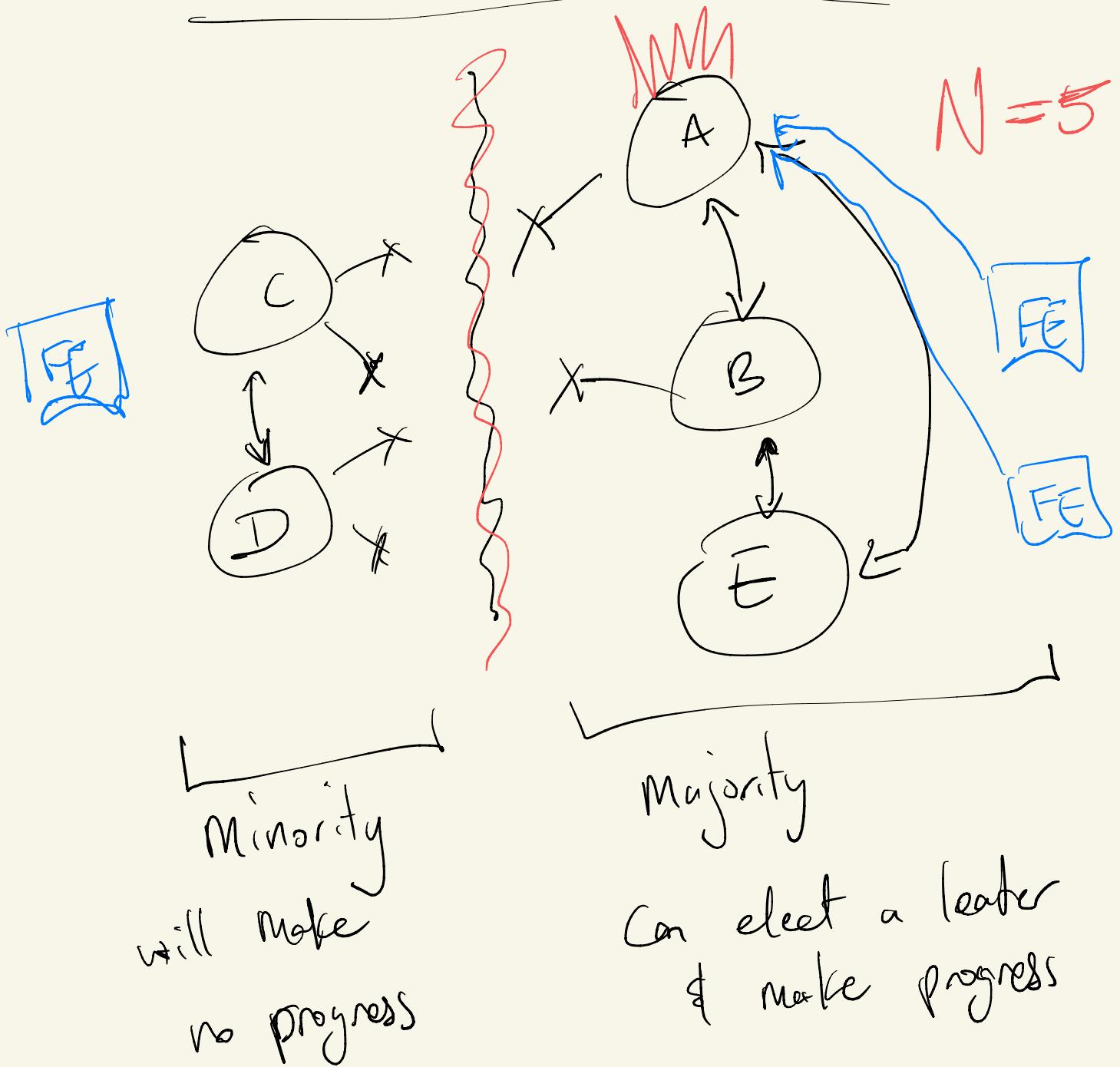
## leader election

old: majority  $\Rightarrow$  you win  
\* follower voted for 1st candidate

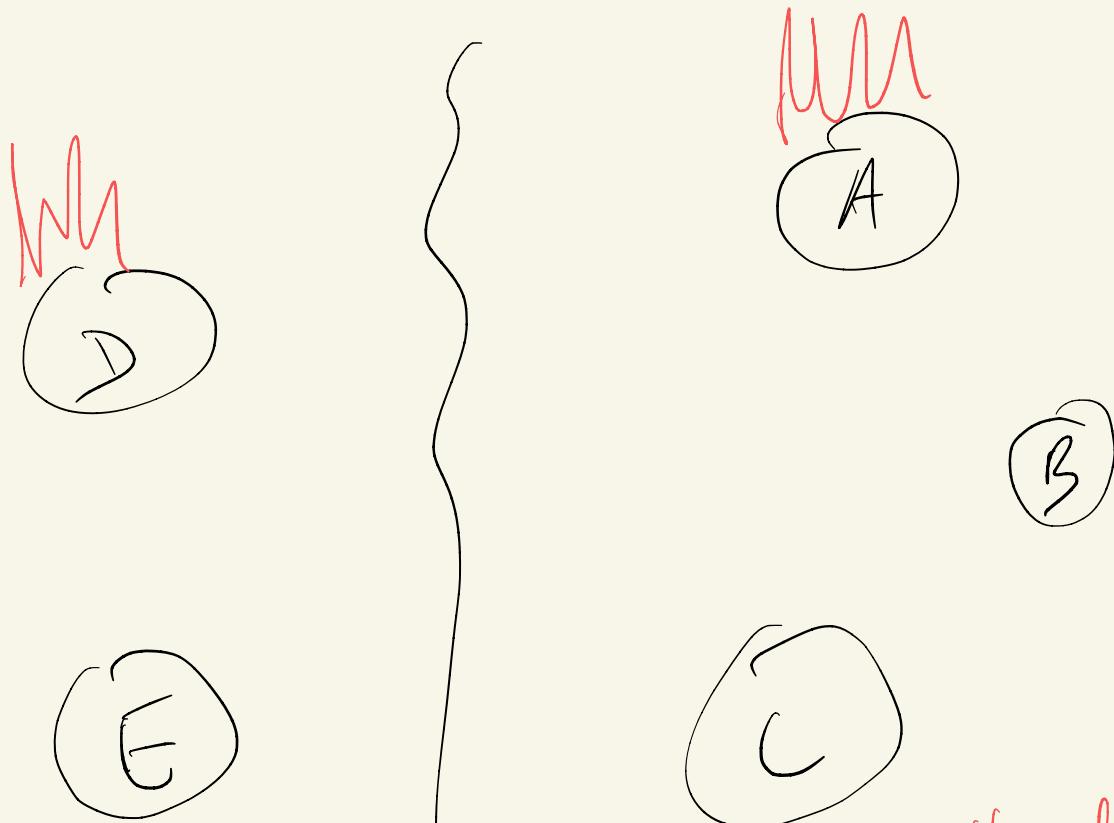
new: majority  $\Rightarrow$  you win

\* follower only vote for  
the 1st candidate that has  
more up to date log

# Network partitions



after partition disappears then leader  
repairs logs to get everyone up to date



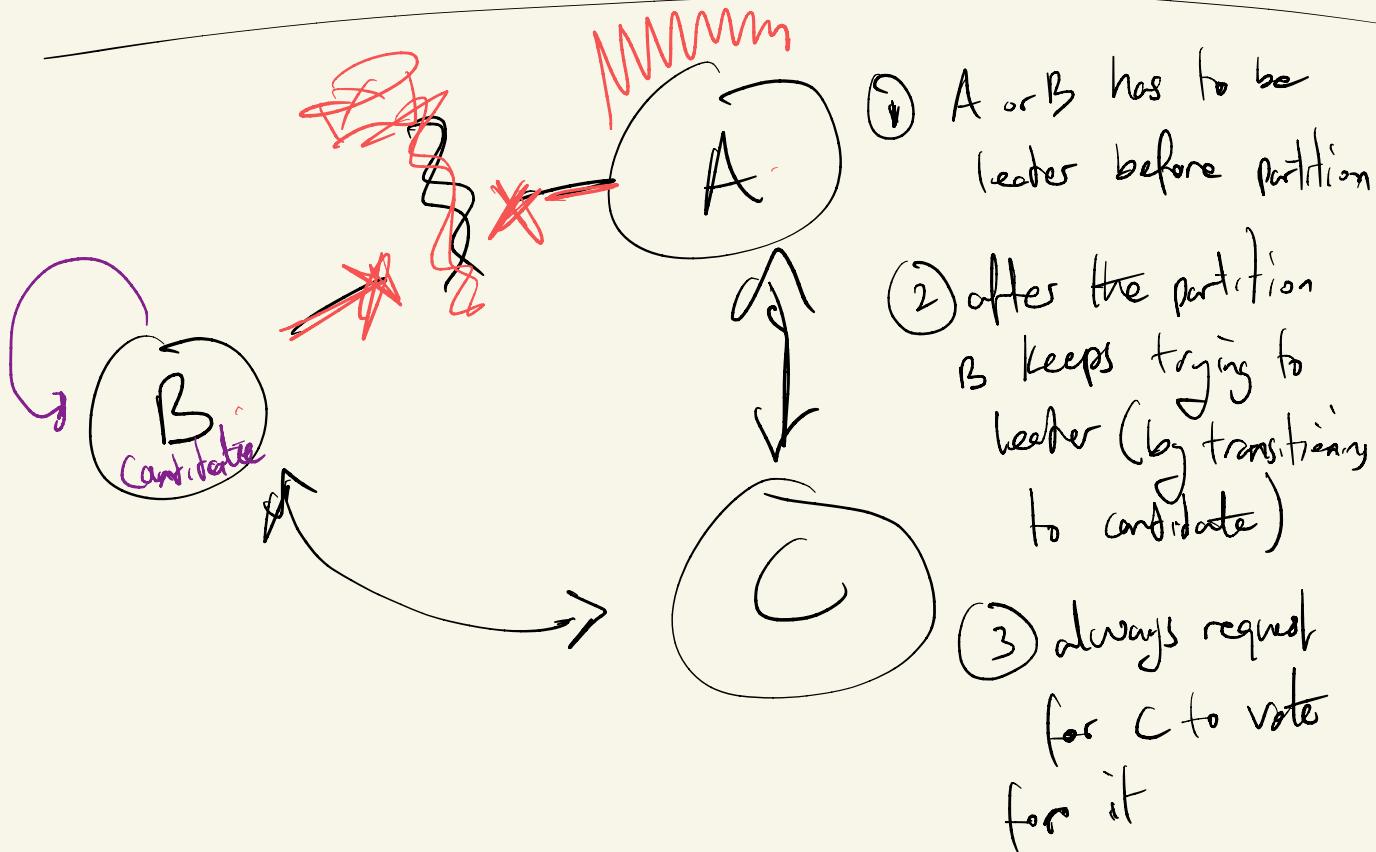
here the minority  
leader can not commit &  
can not process any update  
to the log

Majority will elect a  
new leader & move

There can only be one Viable leader

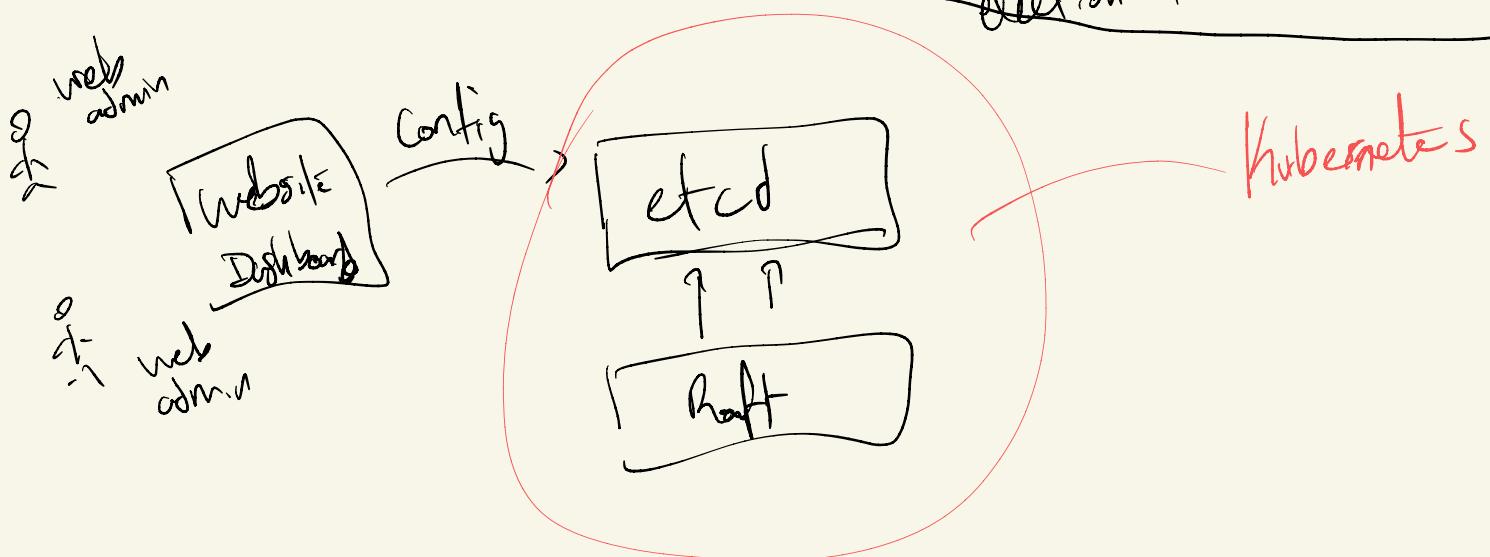
Minority Partition: followers keep transitioning to  
candidate & failing to win  
elections ~~but~~ their  
term keeps increasing

# Partial Partition (cloudflare)



live lock scenario  $\Rightarrow$  A is trying to commit

C is preoccupied with an election that never succeeds



# Raft

\* Edge Cases in the protocol

- (1) Partitions
- (2) log safety
- (3) livelock

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Lazy replication → prelude to DynamoDB

log index      1    2    3    4    5    6    7

term	1	1	5	6	6	6
$s_1$	1	1	5	6	6	6
$s_2$	1	1	5	6	7	7
$s_3$	1	1	5	5		
$s_4$	1	1	2	4		
$s_5$	1	1	2	2	3	3

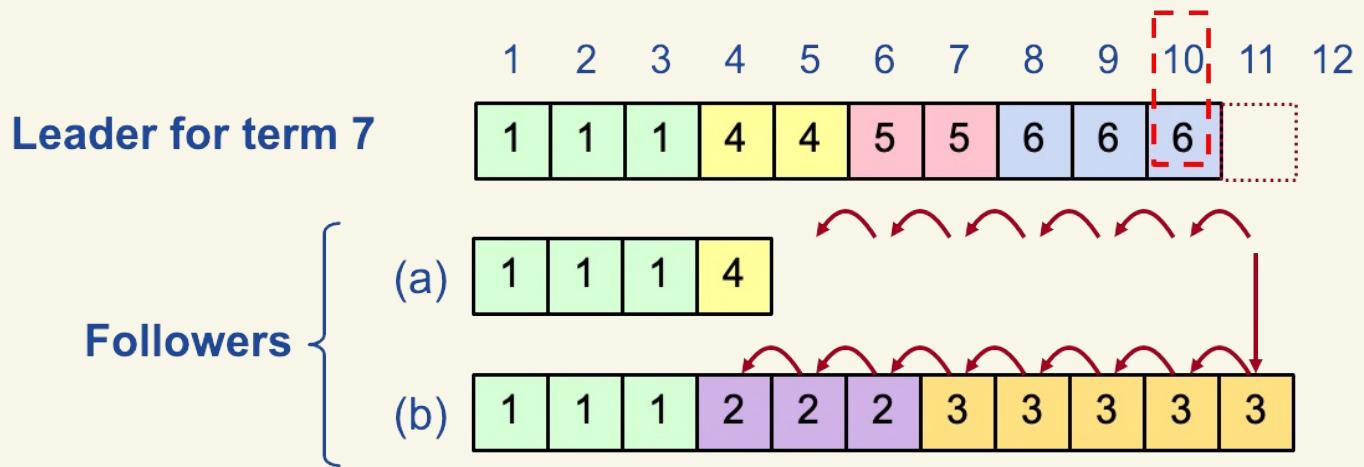
term      1    2    3    4    5    6    7    8      log index  
 command      add cmp ret mov jmp div shl sub      leader

1	1	1	2	3	3	3	3
add	cmp	ret	mov	jmp	div	shl	sub
1	1	1	2	3	3	3	3
add	cmp	ret	mov	jmp	div	shl	sub
1	1	1	2	3	3	3	3
add	cmp	ret	mov	jmp	div	shl	sub
1	1						
add	cmp						

followers

committed entries





	1	2	3	4	5
$s_1$	1	1	2	2	2
$s_2$	1	1	2	2	
$s_3$	1	1	2	2	
$s_4$	1	1	2		
$s_5$	1	1			

	1	2	3	4	5
$s_1$	1	1	2	4	
$s_2$	1	1	2		
$s_3$	1	1			
$s_4$	1	1			
$s_5$	1	1	3	3	3