Byzantine General Problem

Murat Osmanoglu

Permissionless Blockchain

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- The ledger itself is public, readable, and writeable by anyone

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can also be dynamic, i.e. the initial set of nodes agree on a specific set of rules to accept new players

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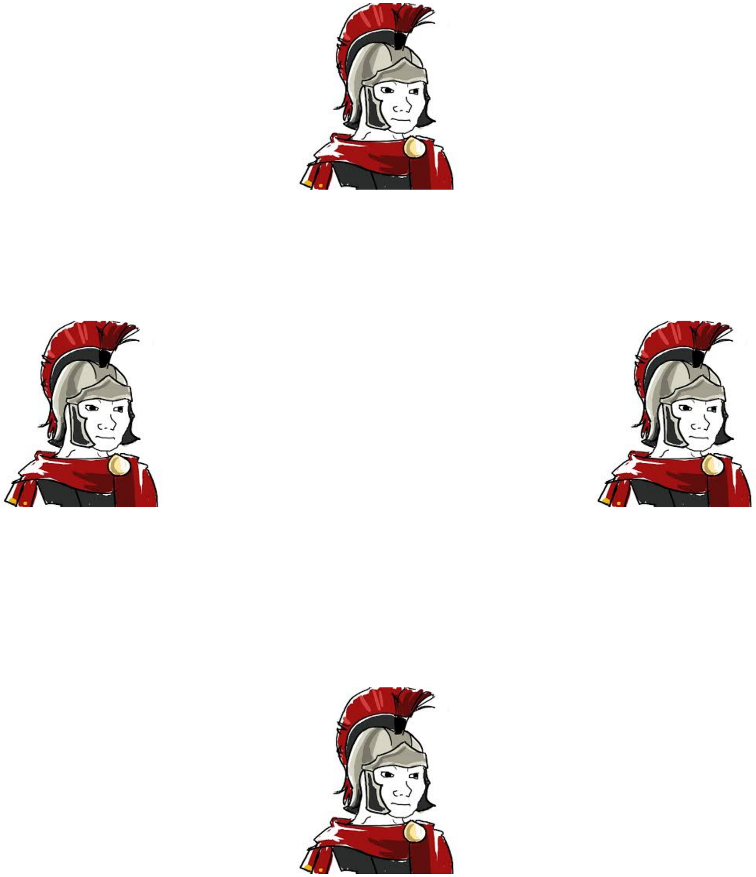
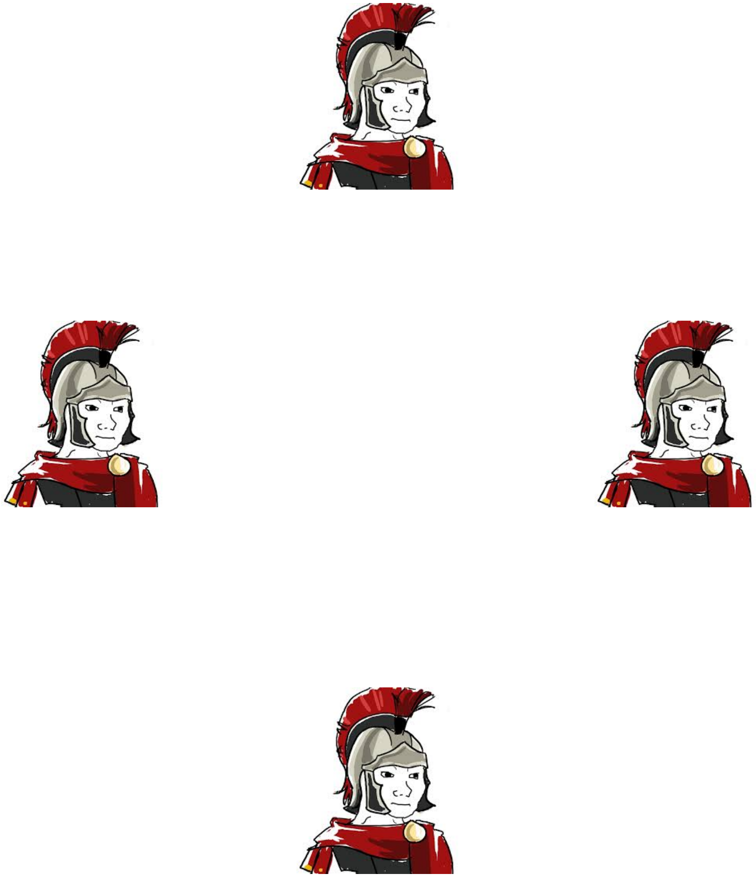
- Certificates need to be revoked in case that the corresponding secret keys become exposed

The Byzantine Generals Problem



The Byzantine Generals Problem



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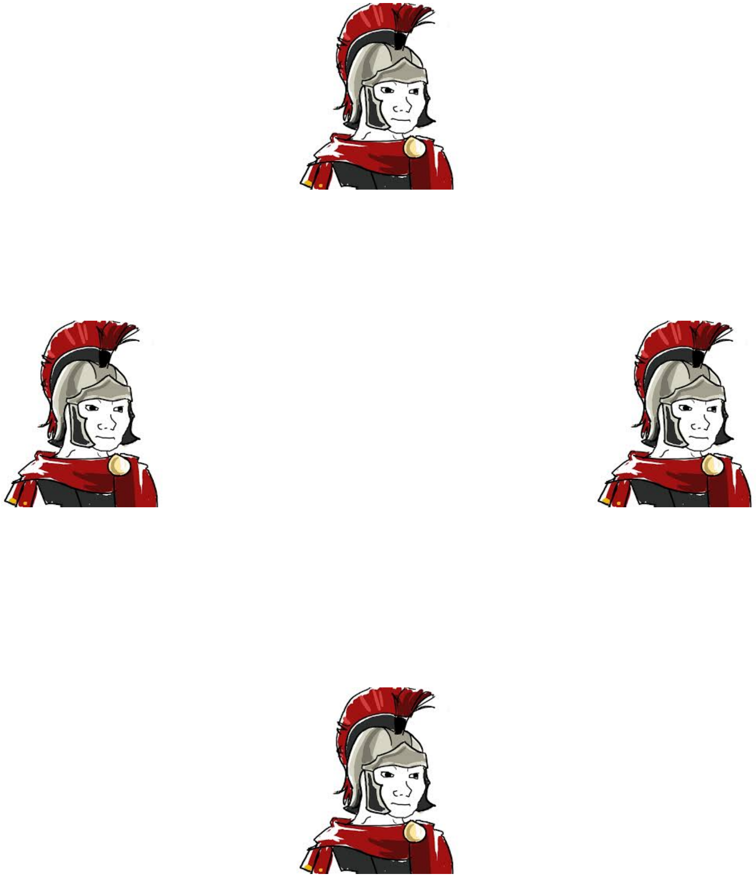

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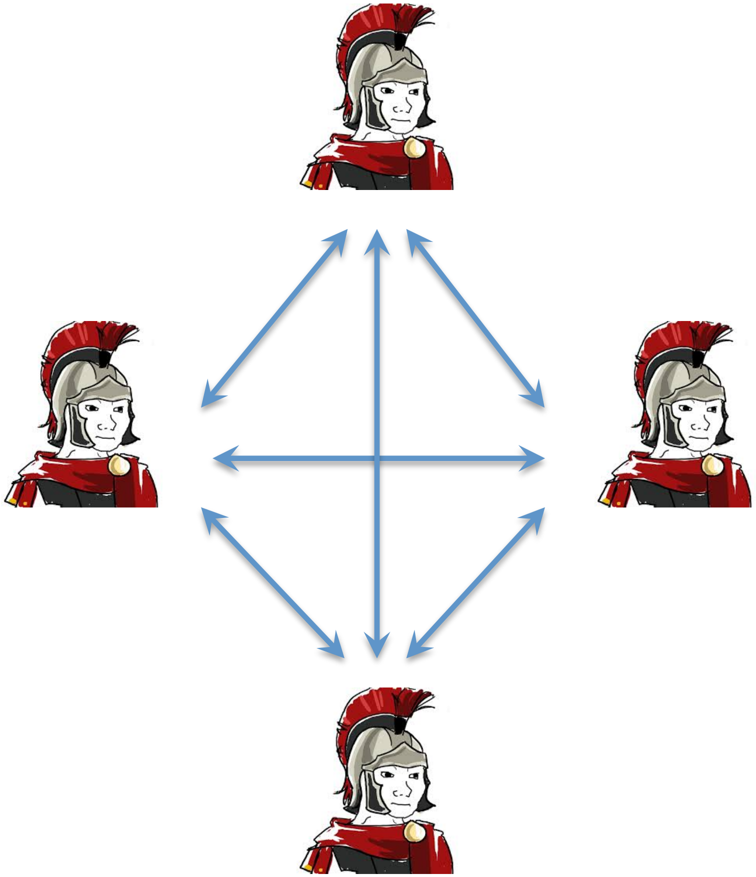

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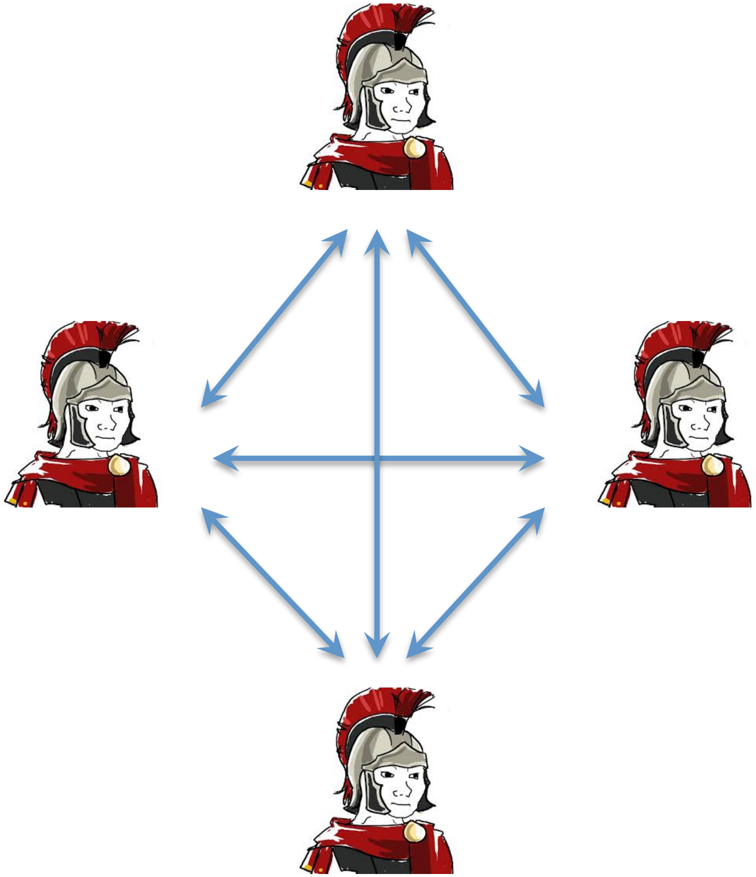
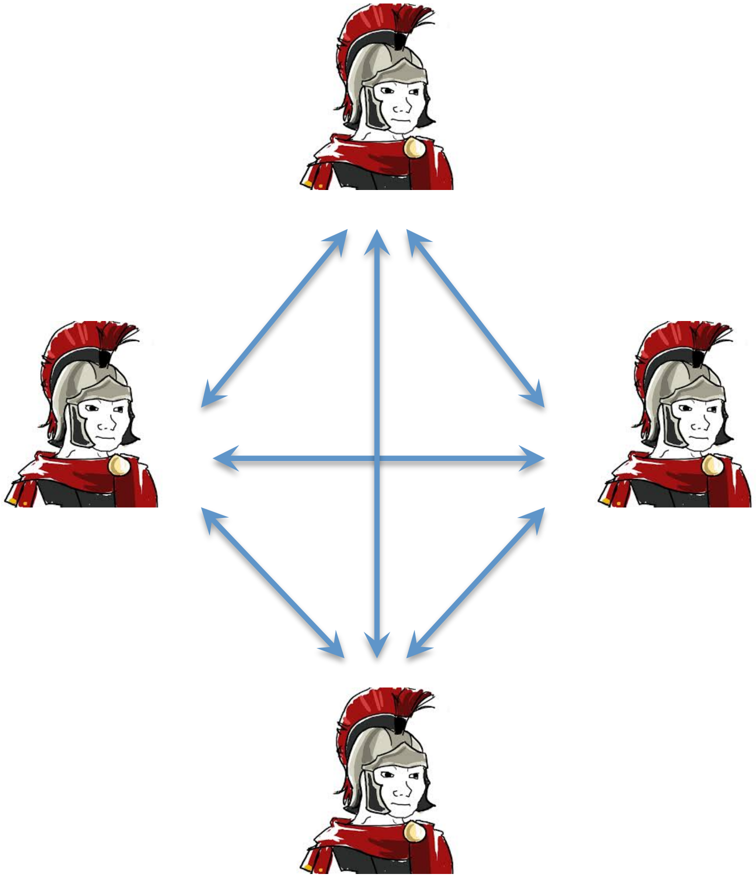


- several divisions of Byzantine army camped outside of an enemy city
- each of them commanded by a general
- generals communicate through messengers
- they try to reach an agreement on a common plan (retreat or attack) while some of them may be traitors that sabotage this process

The Byzantine Generals Problem



The generals must develop an algorithm guaranteeing that

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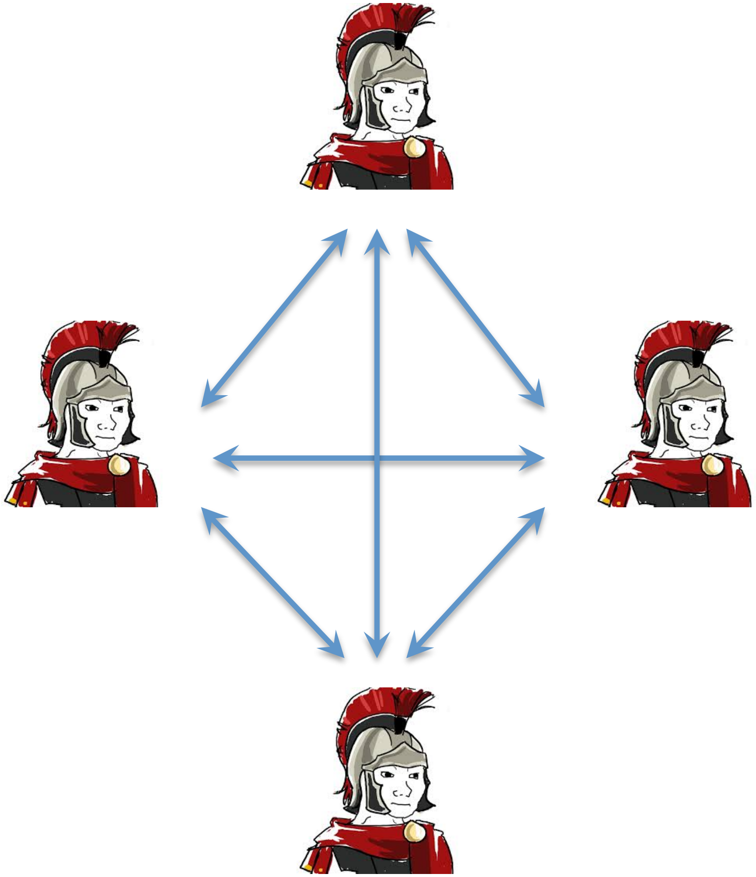

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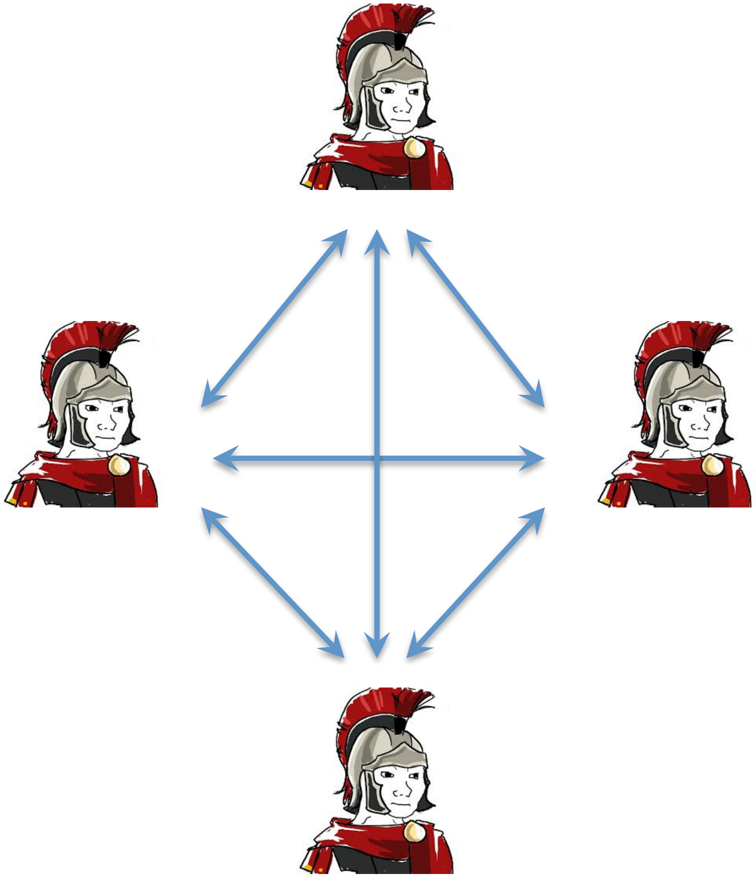

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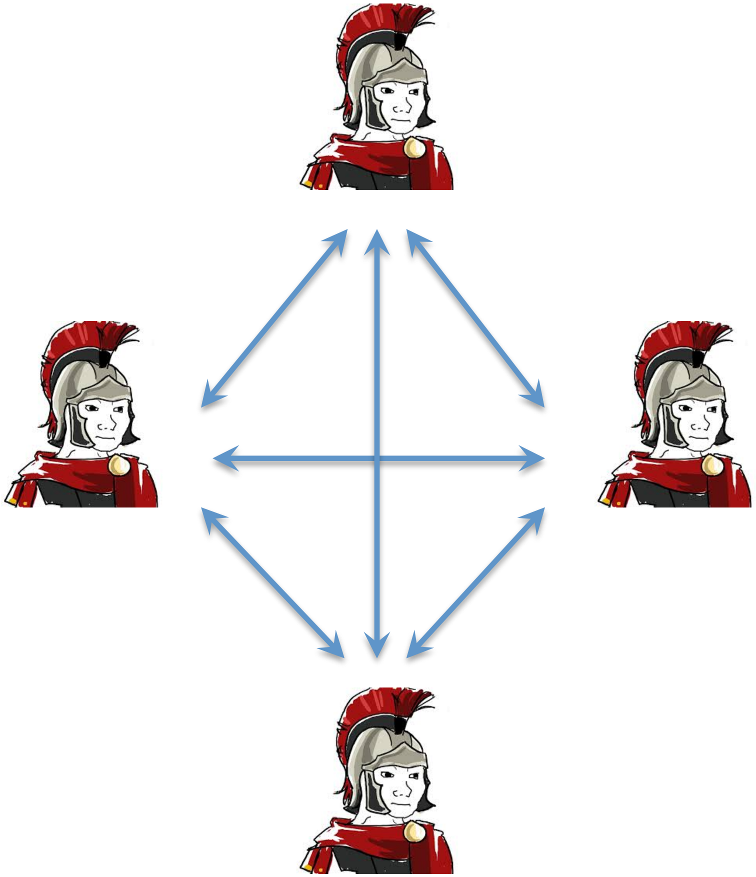

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- a small number cannot cause the loyal generals to adopt the wrong plan

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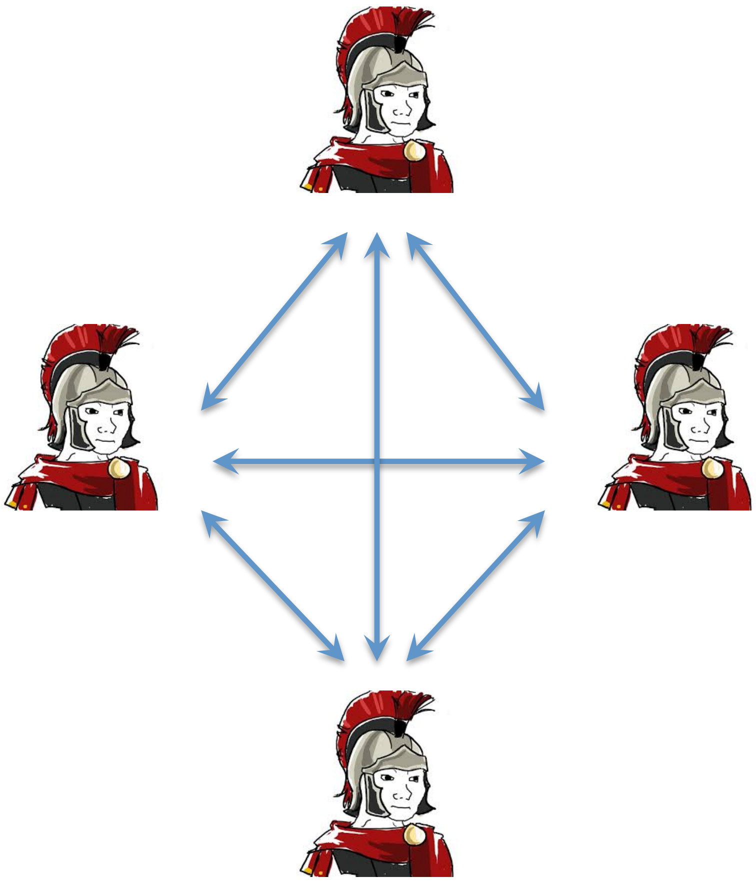

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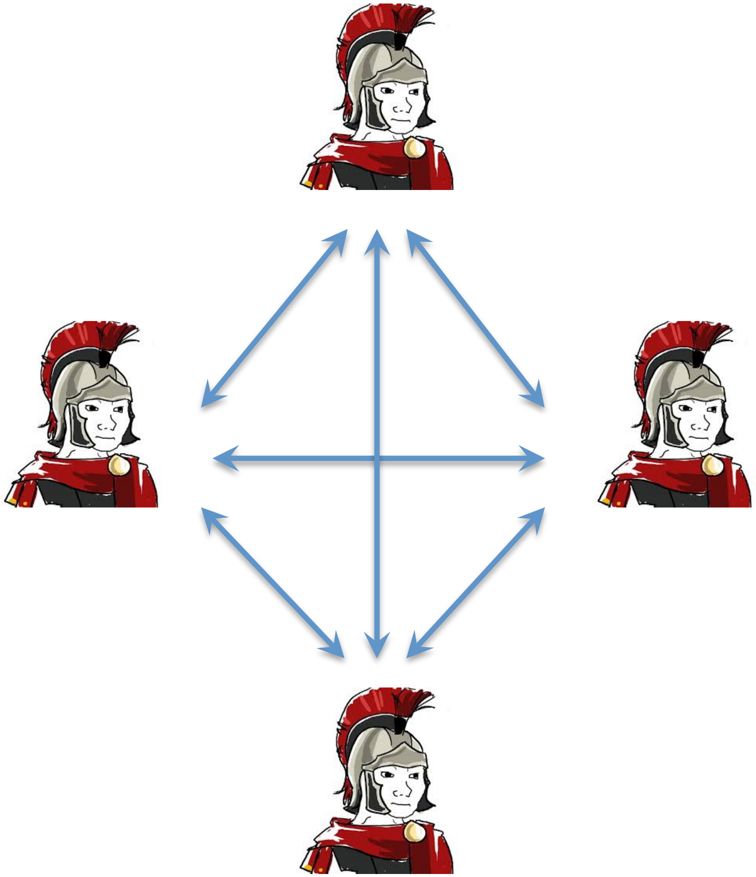

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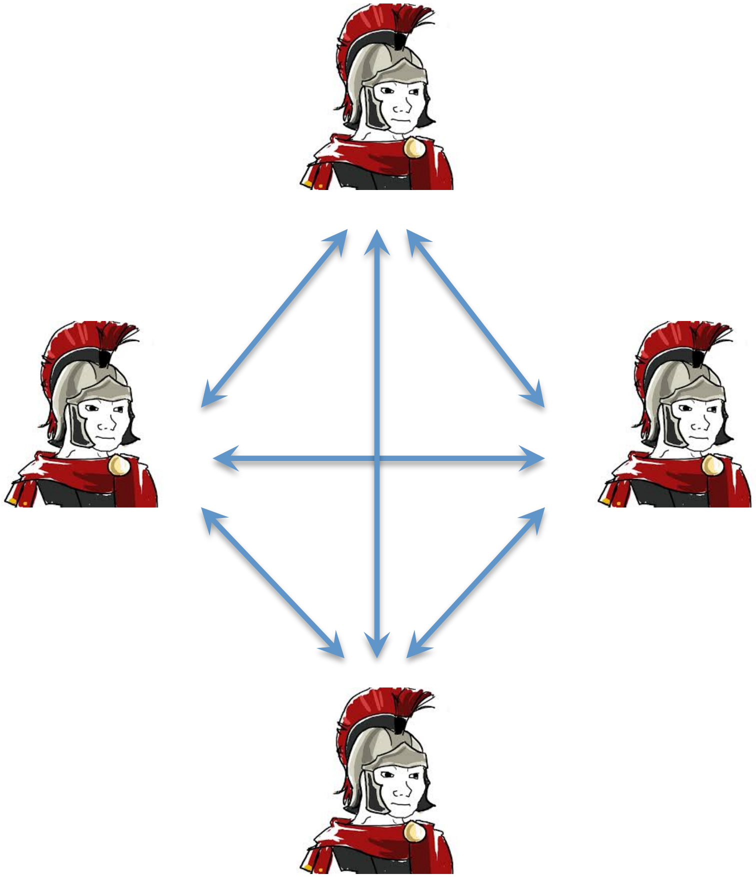

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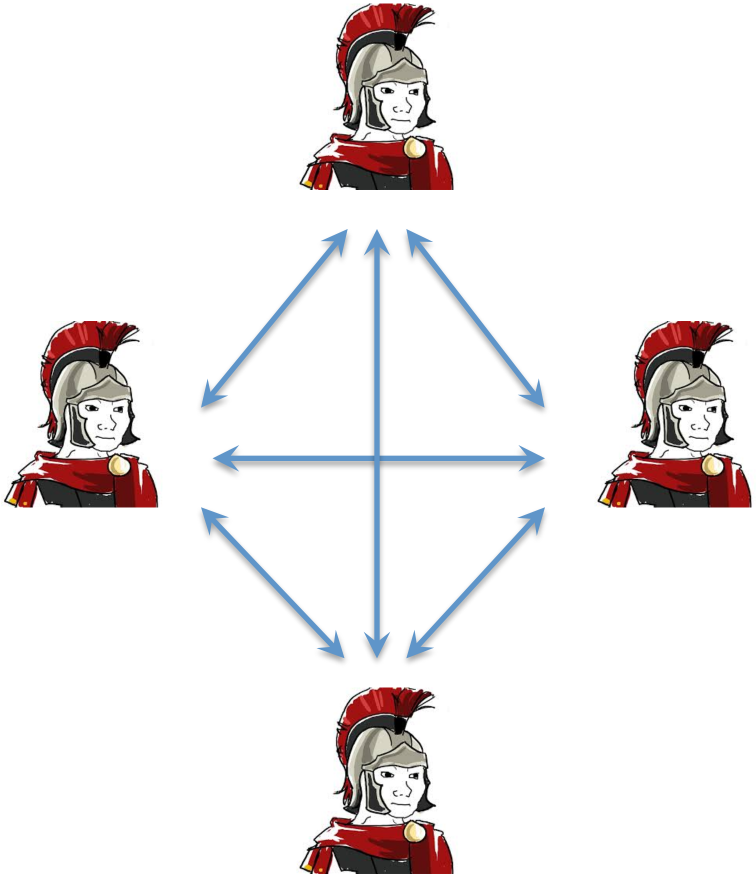

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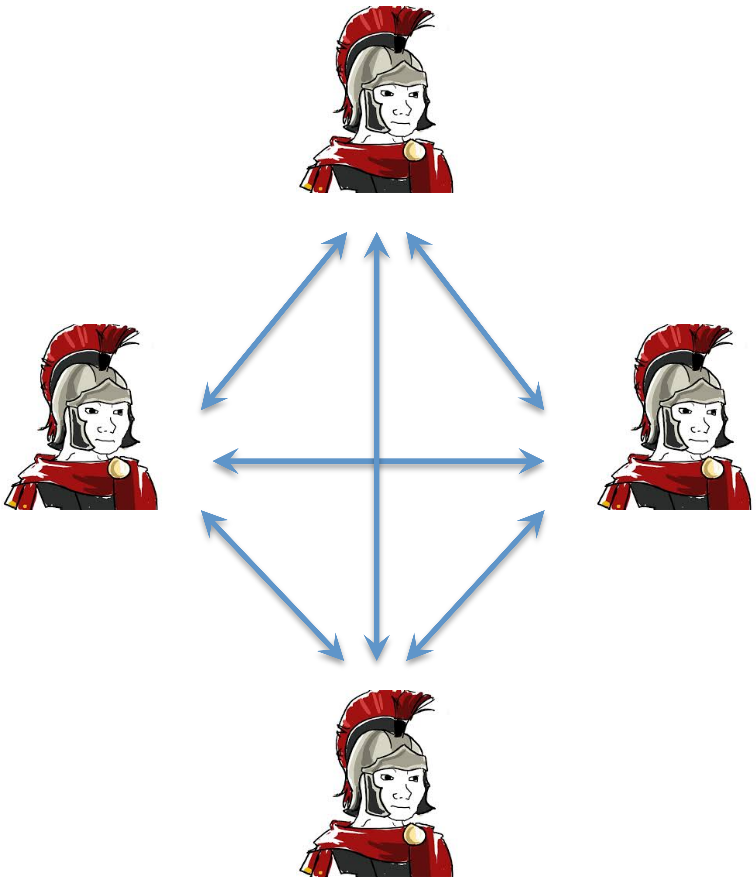

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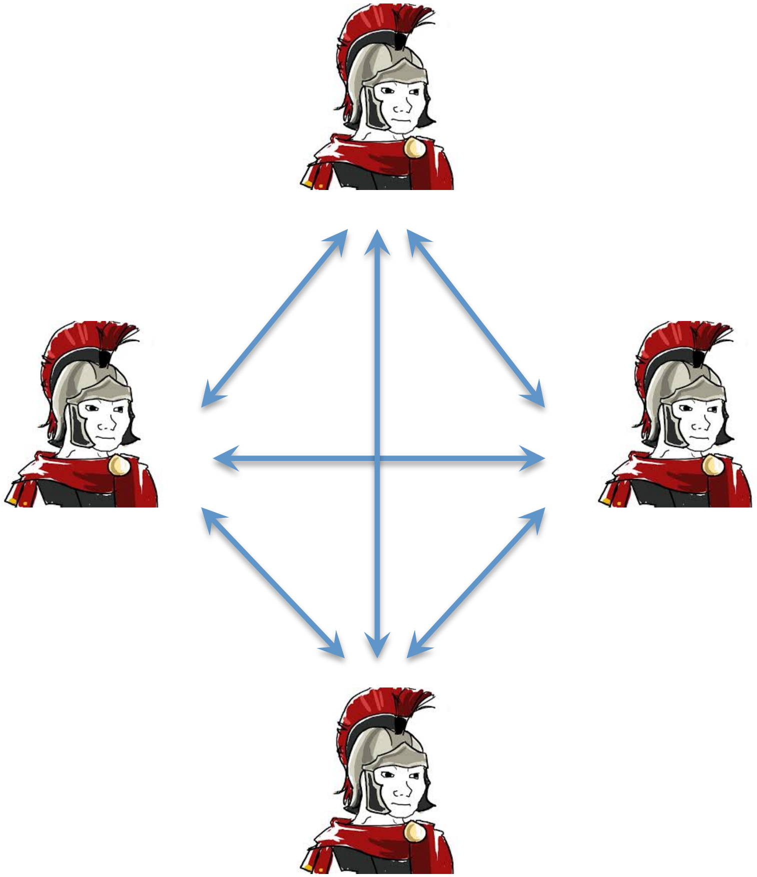

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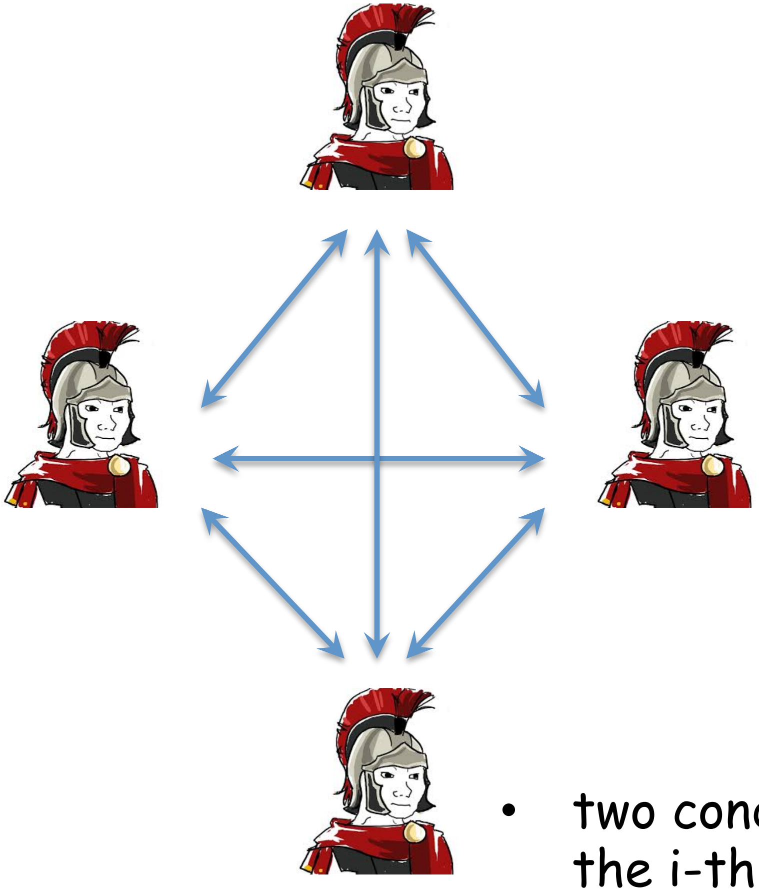

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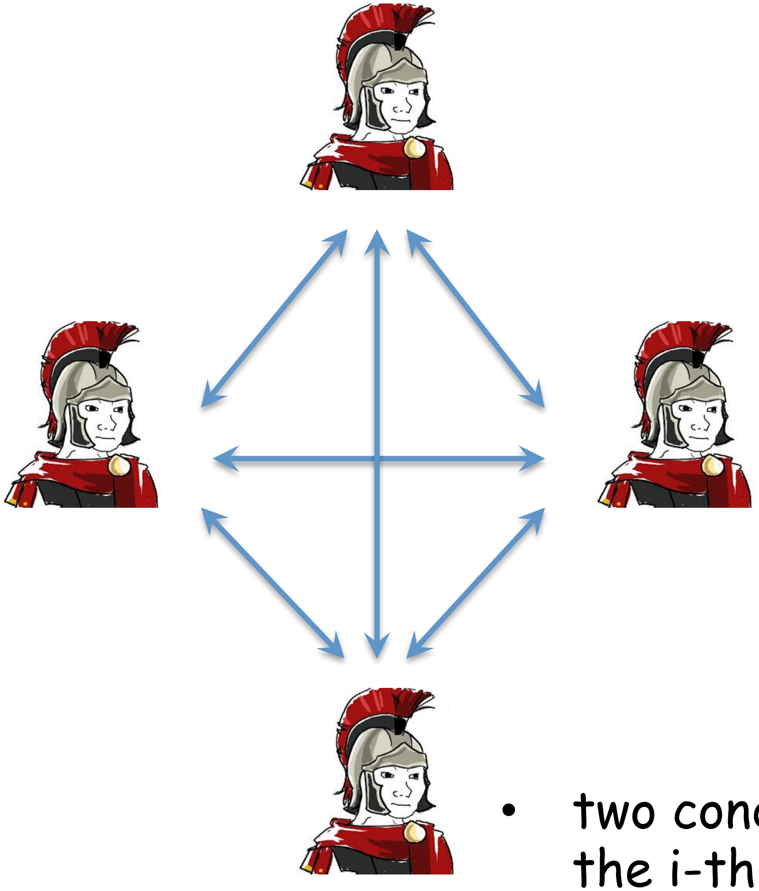

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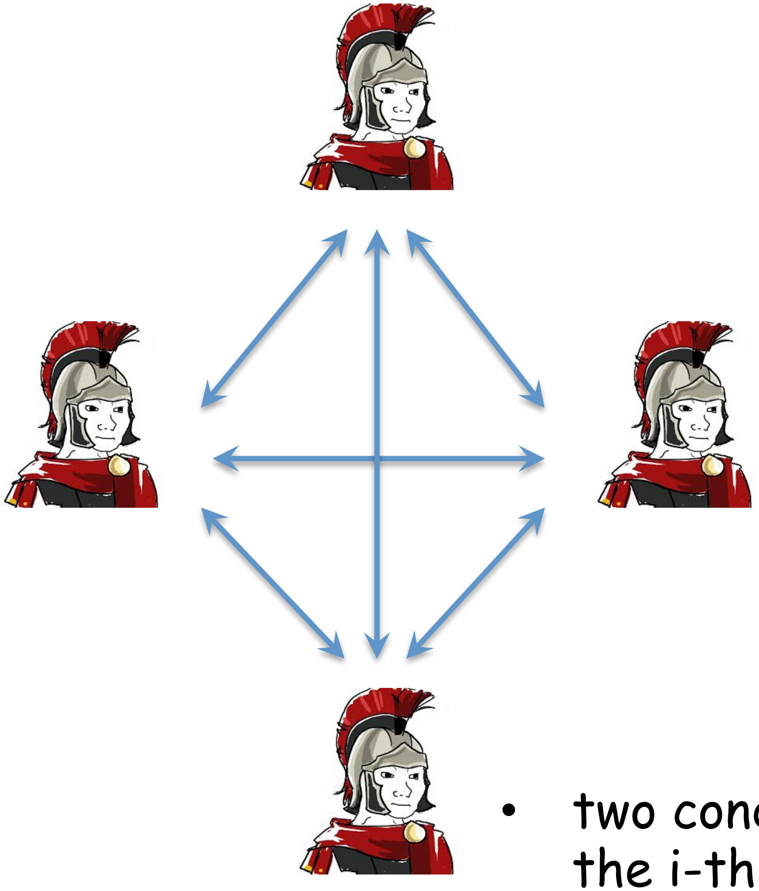

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- turn the problem into a simpler one:
  How a single general sends his value to the others ?

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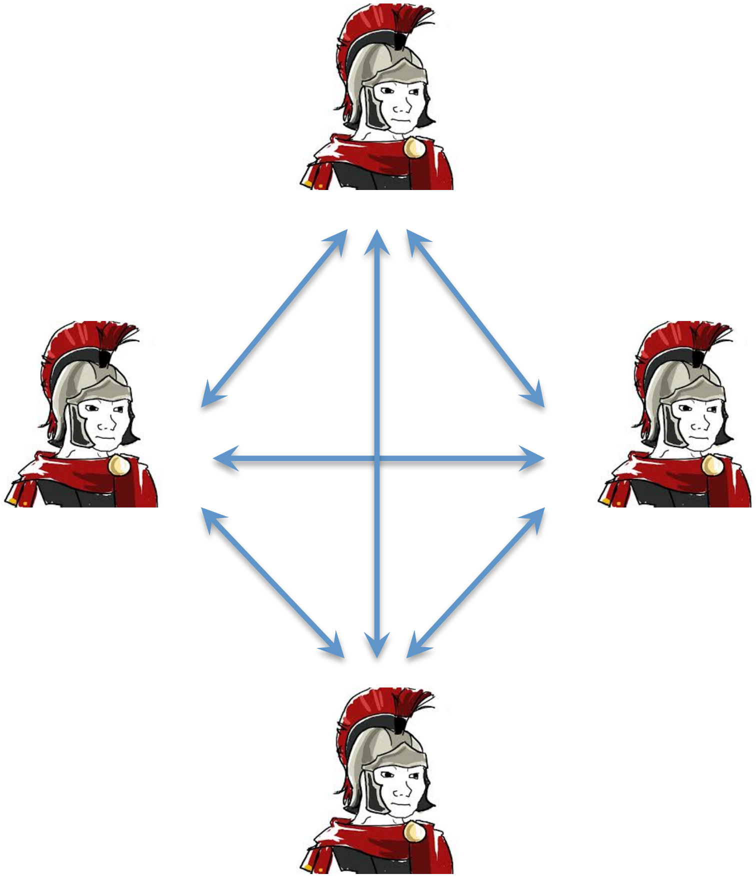

Definition

A general must send an order to his n – 1 lieutenant generals in a way that :

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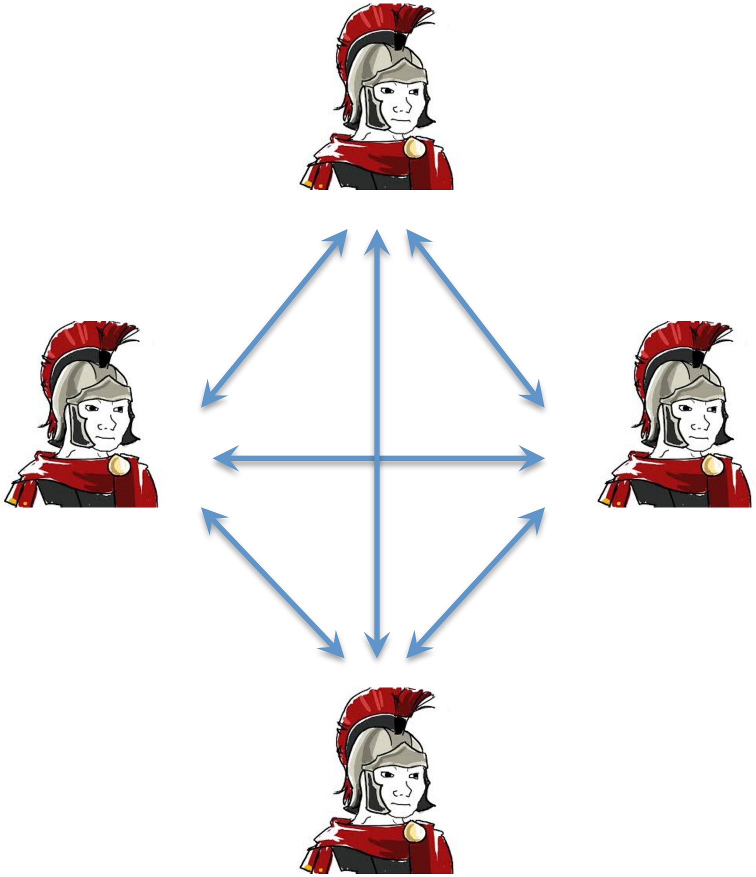

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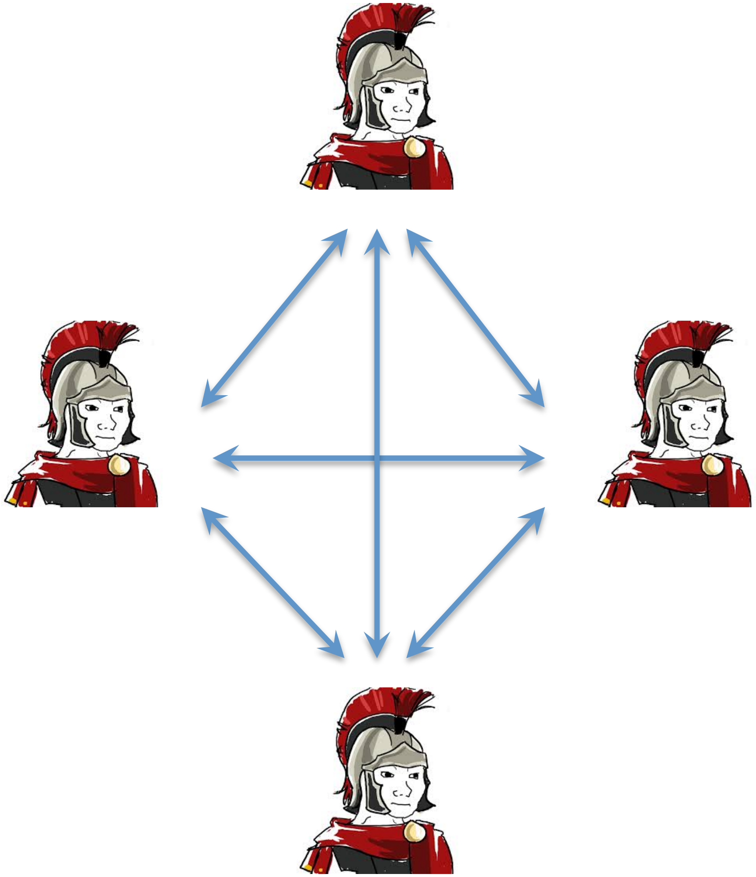

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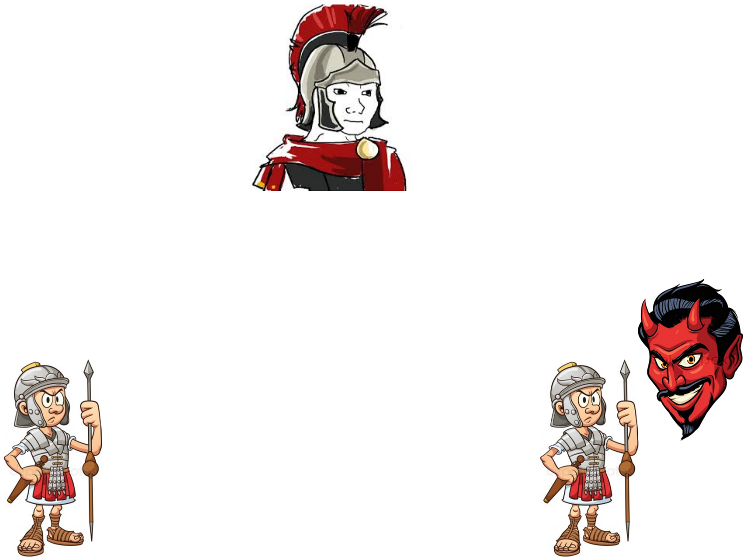

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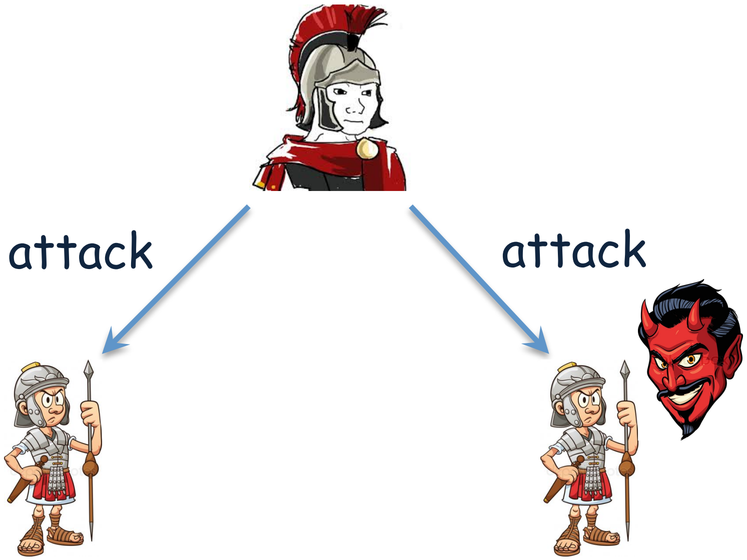

attack

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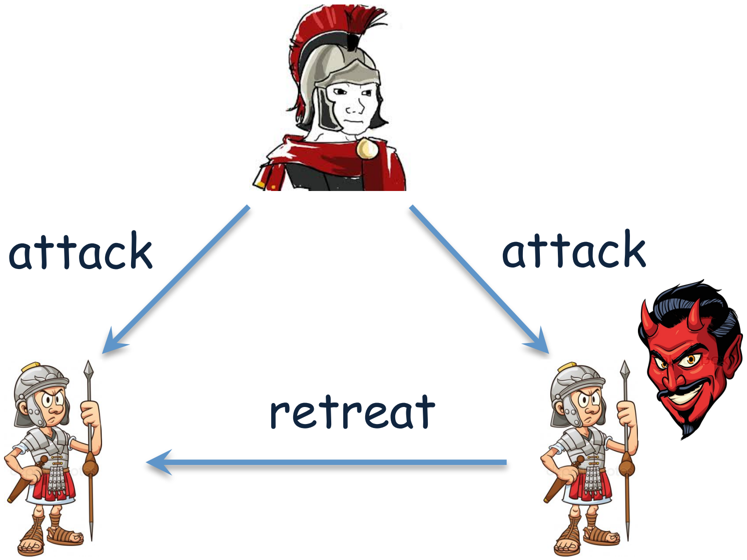

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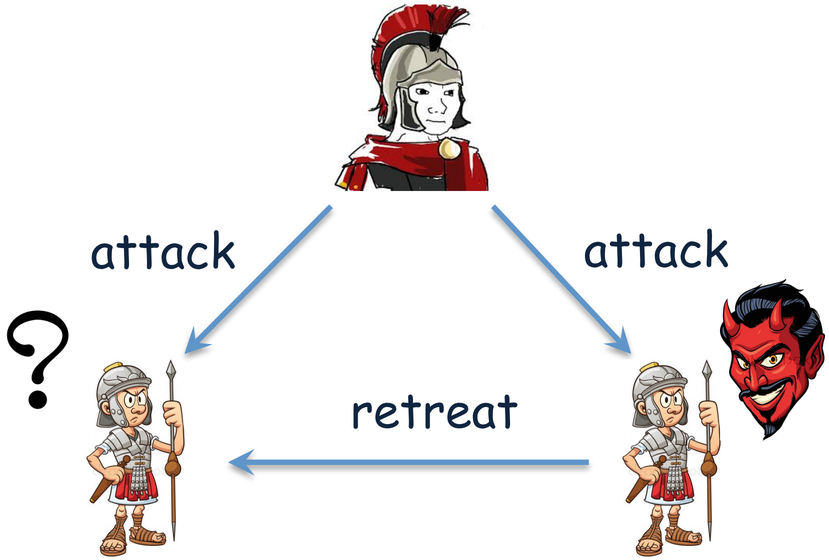

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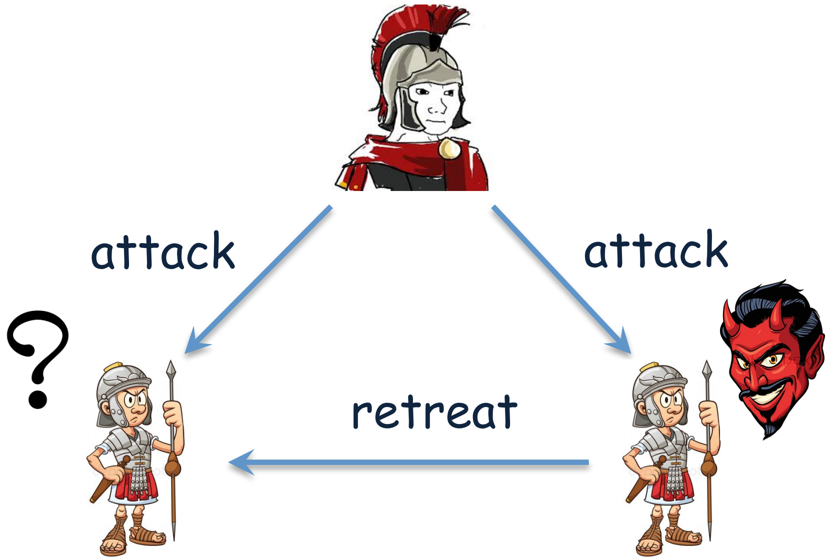

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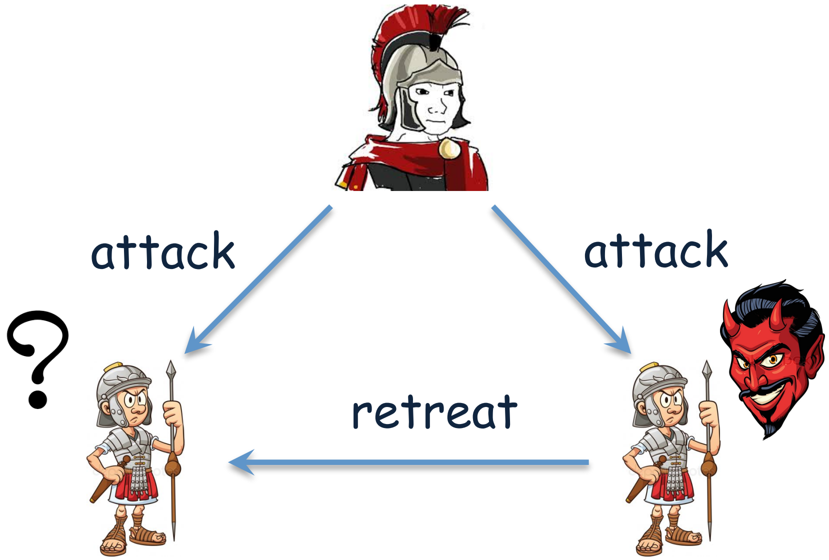
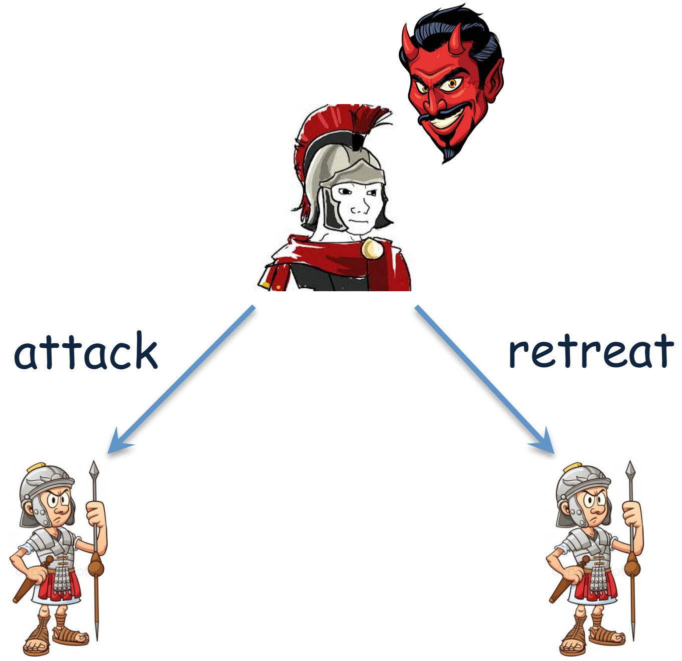


attack

attack

?

retreat



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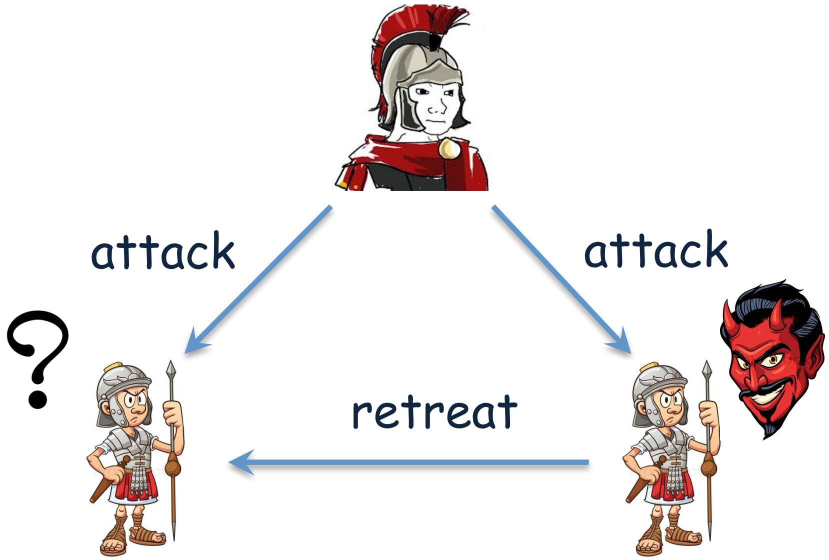

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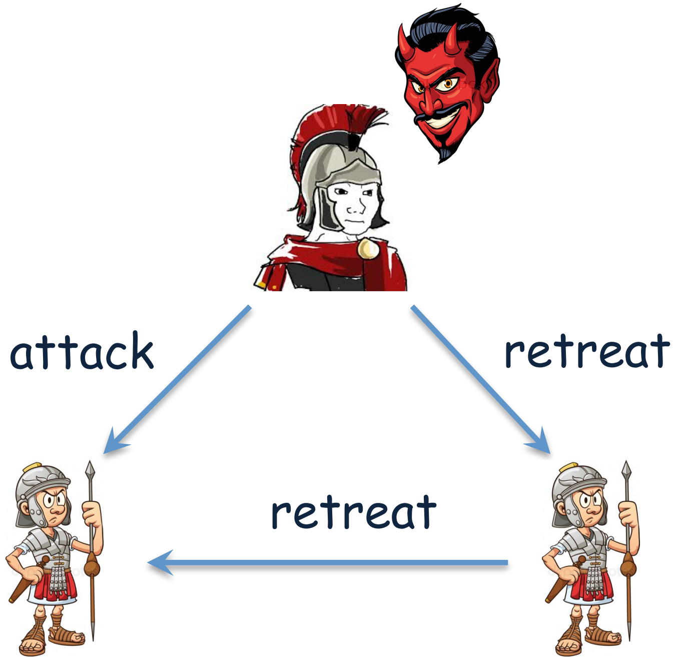

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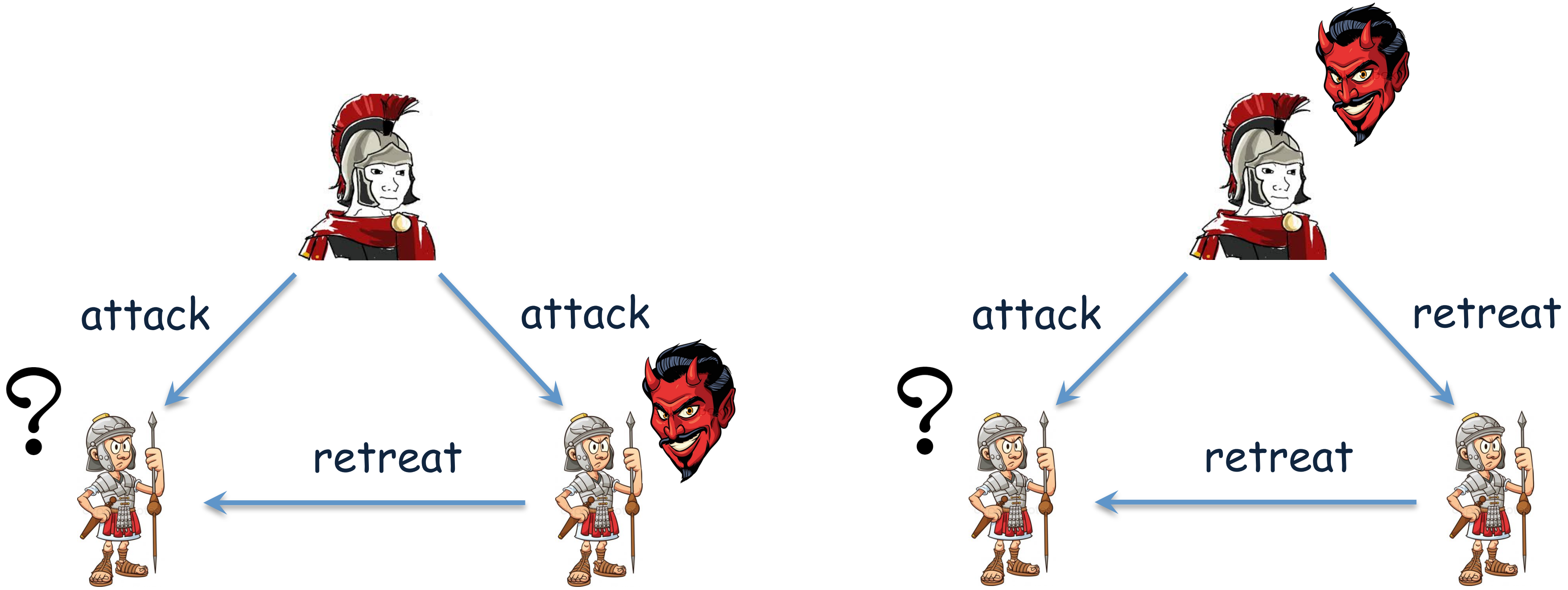

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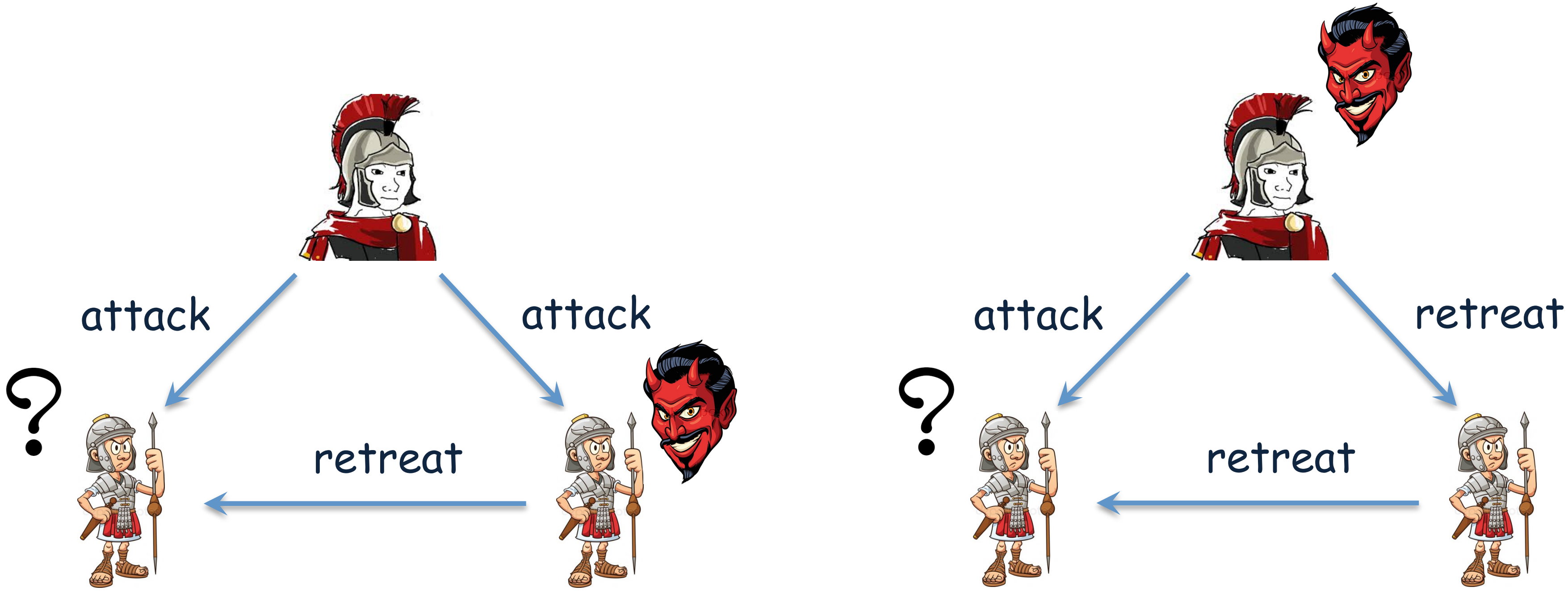

- no solution can work in the presence of a single traitor if there are only three generals

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- Lieutenant i computes the final decision as majority(v(1),…,v(n-1))

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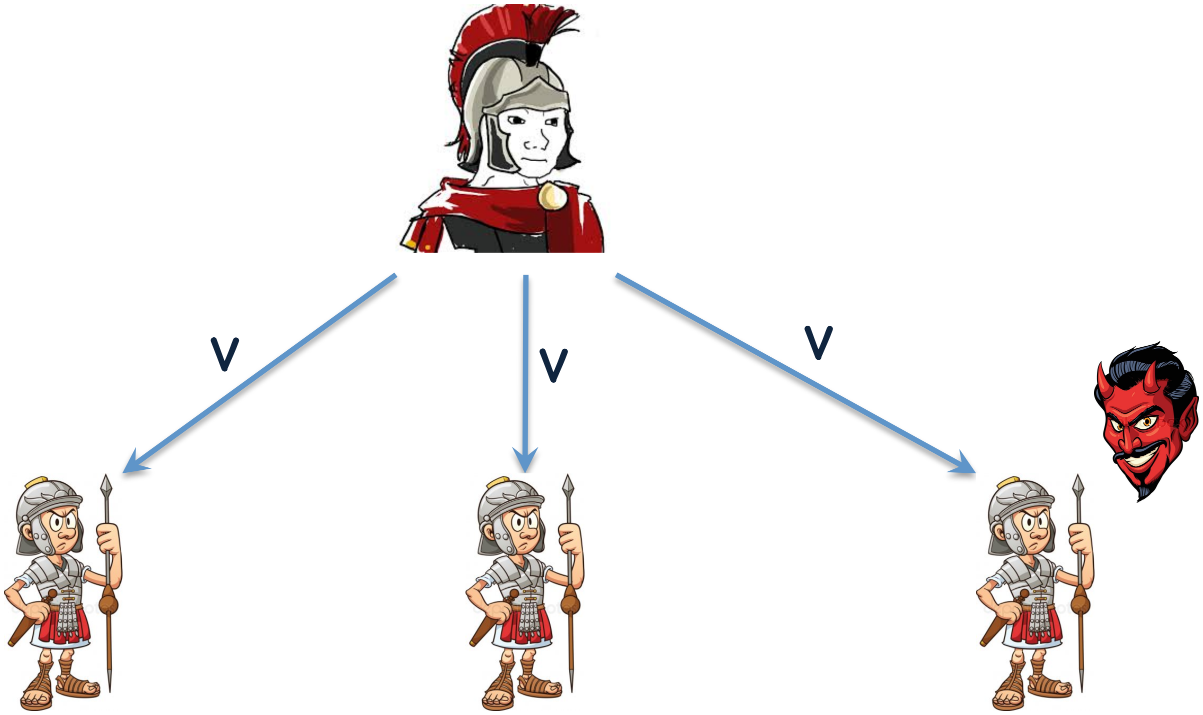

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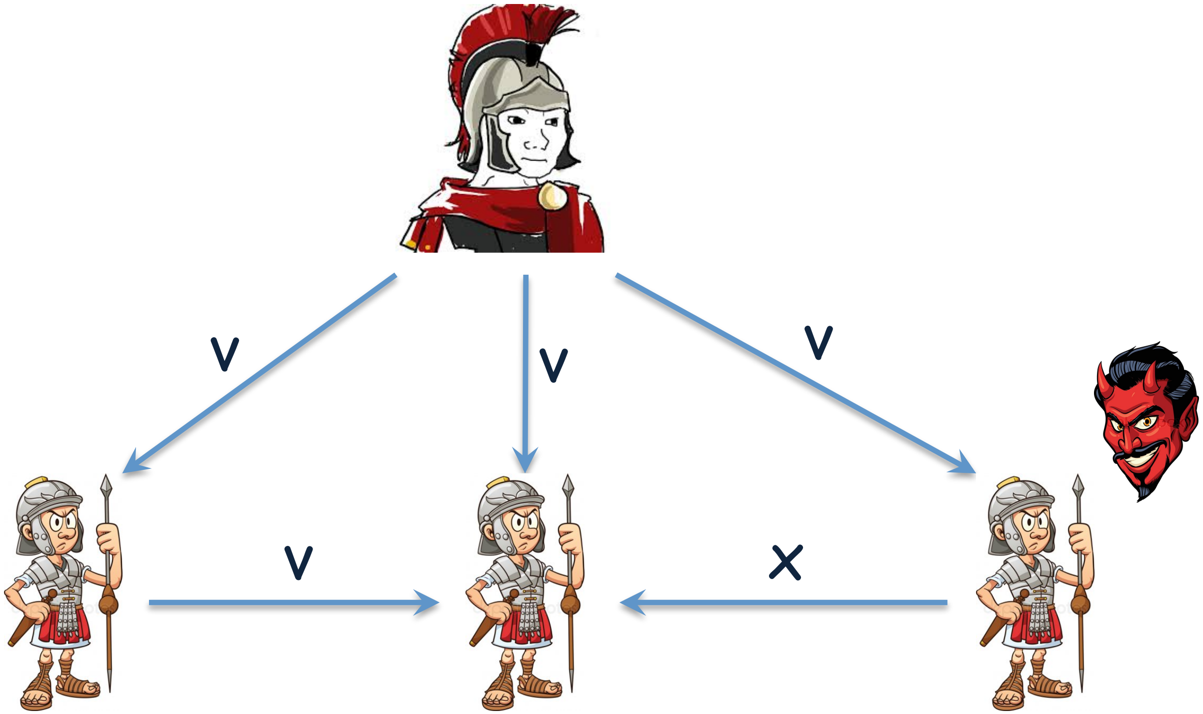

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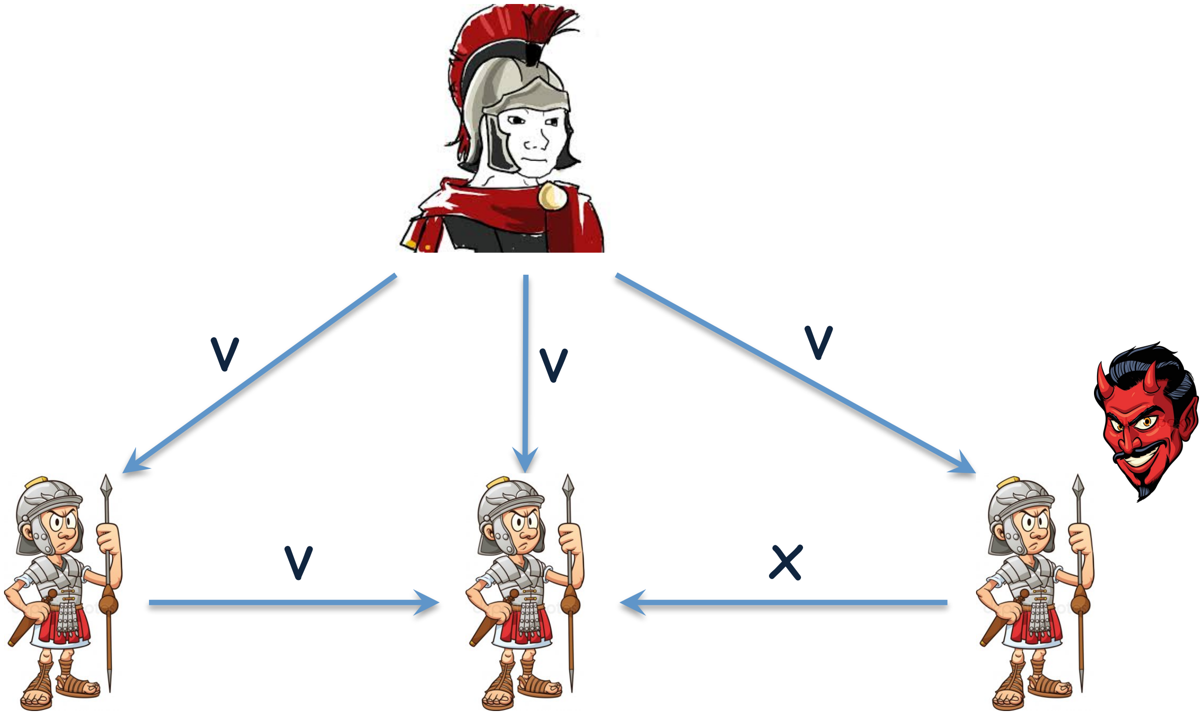

majority(v, v, x)

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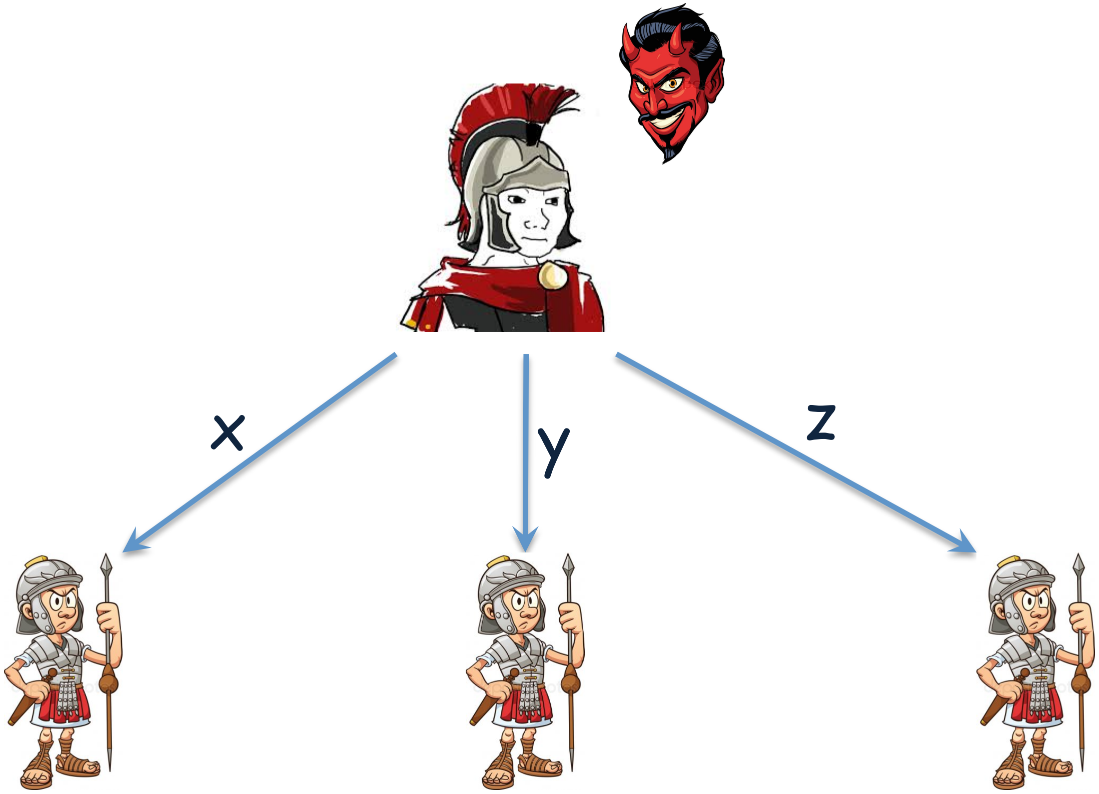

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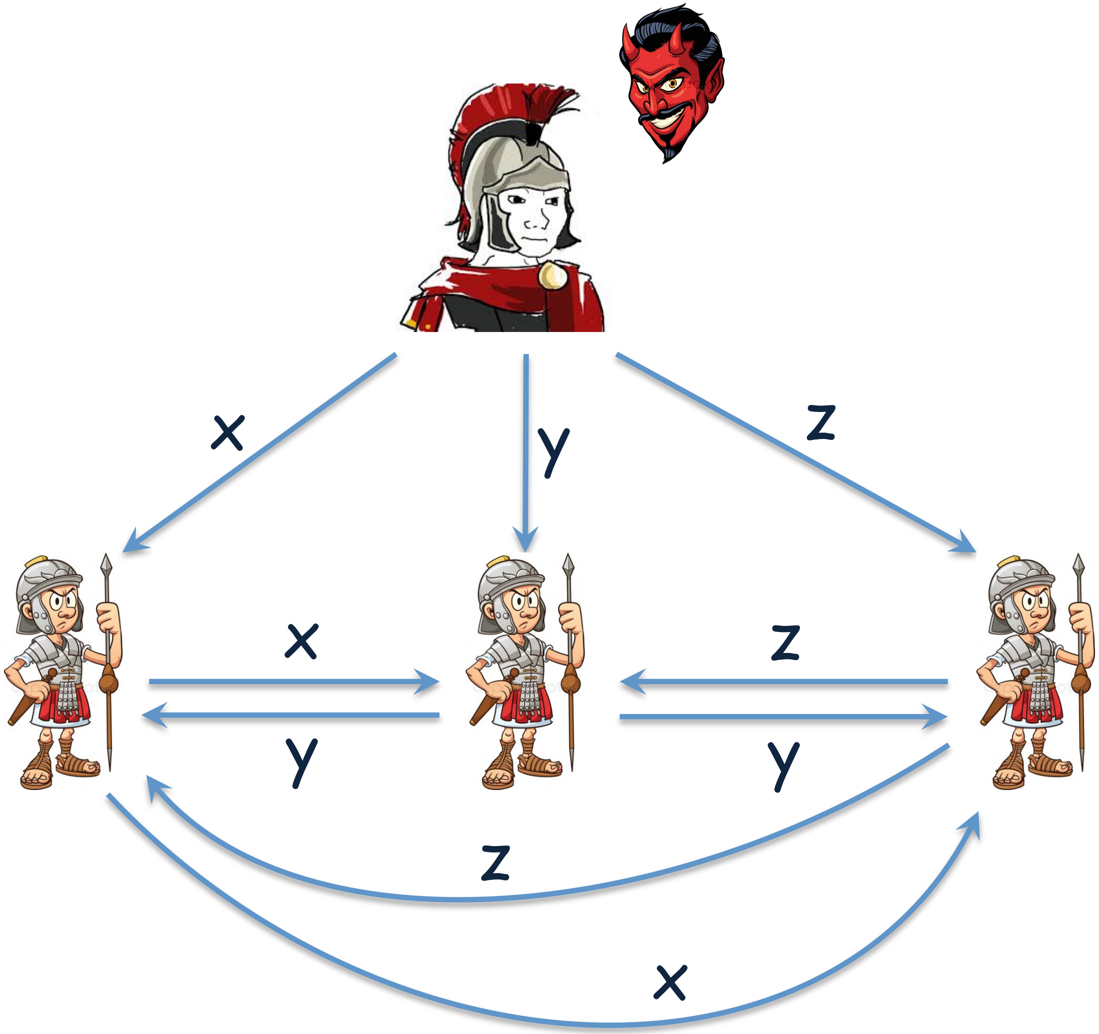

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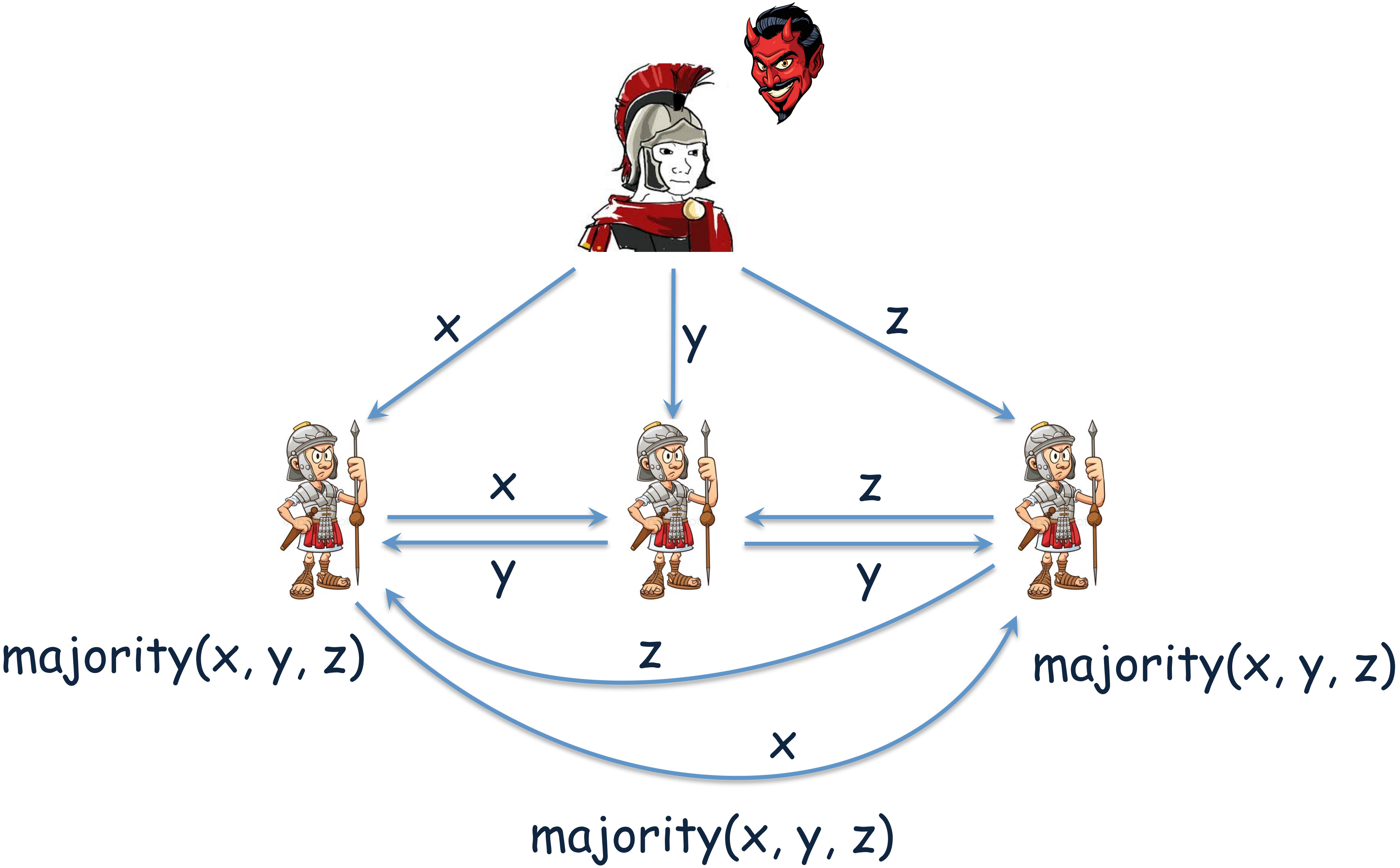

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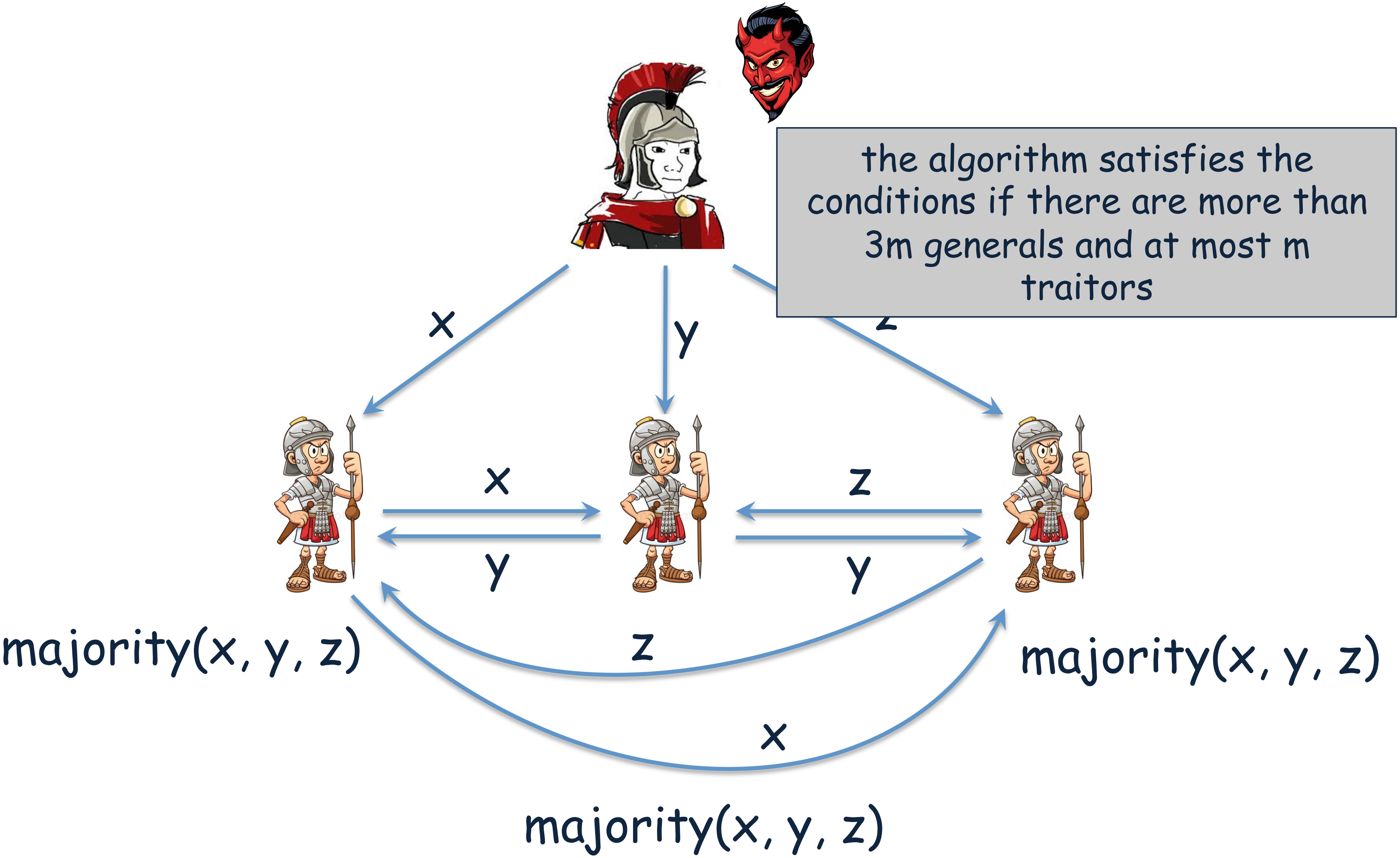

the algorithm satisfies the conditions if there are more than 3m generals and at most m traitors