The Drunk Generals Problem

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Abstract

We pose the Drunk Generals Problem (DGP), a game where a player attempts to discern and replace adversarial nodes apart from normal nodes (each behaving probabilistically) in a distributed system. Making some simplifying assumptions, we determine Nash equilibria (NE) via hypothesis testing.

1 Background

Byzantine tolerance is the standard bearer in the field of fault tolerance in distributed systems. Since seminal work by Lamport [3], most of the focus has been centered around various modifications around that of (i) fault models, (e.g., the type of adversary a system could be dealing with), (ii) more restrictive/relaxed environments (e.g., synchronicity, network errors/lossy messages vs. node failures), and (iii) more efficient protocols (reduce communication complexity). However, these models often omit two real world concerns.

1.1 Byzantine versus Random errors

Systems, even non-adversarial ones, can suffer from faults simply due to chance or bad luck. This could be due to interference in communication channels, your cat tripping over your power supply or sheer bad luck. Here, we refer to *random errors* as one-off events which happens purely due to chance. Specifically, this precludes adversarial behavior as well as (permanent) hardware damage which will never recover. This modelling assumption is in fact the standard choice in the case of hardware failure, e.g., disk failures.

While Byzantine faults are a strict superset of random faults, mitigation strategies are notoriously heavy-handed, cost more in both monetary and implementation workload, and require stricter assumptions (e.g., there being no more than k faulty machines). It is tempting for system designers to go overboard in designing Byzantine tolerant systems. Indeed, in his monologue *The Saddest Moment*, James Mickens from Harvard University laments:

"I do not blame my fellow researchers for trying to publish in this area, in the same limited sense that I do not blame crackheads for wanting to acquire and then consume cocaine. The desire to