A Survey on Byzantine Gathering of Mobile Agents

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Outline

Introduction

- Gathering means meeting of two or more mobile agents starting from different positions in some topology.
- Termed as Rendezvous in case only two mobile agents are there.

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- Gathering means meeting of two or more mobile agents starting from different positions in some topology.
- Termed as Rendezvous in case only two mobile agents are there.
- Motivation:
  - How quickly two friends can meet in an unknown city.
  - Software agents collecting data from a computer network.

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- Inconsistency and faults are unavoidable in real life. Distributed computing for mobile agents on networks are no different.

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- Inconsistency and faults are unavoidable in real life. Distributed computing for mobile agents on networks are no different.
- Usually, two types of faults are considered:
  - **Crash Faults:** Similar to hardware failure[8].
  - **Byzantine faults:** May not obey the algorithm. Controlled by some adversary [4].
    - Weak Byzantine
    - Strong Byzantine

The Problem

***f*-Weak Byzantine Gathering:** k mobile agents are dispersed on an anonymous port-labelled undirected graph G having n nodes. At most f agents among those k agents are weak Byzantine. The agents know n but do not know f, k or the ID range. The adversary wakes up at least one good agent. All the good agents need to gather at some node of the graph and terminate.

Literature Survey

	Input	Byzantine	Condition of # Byzantine agents	Startup delay	Simultaneous termination	Time complexity
[Dieudonné et al.(2014)]	n	Weak	$f+1 \leq k$	Possible	Possible	$O(n^4 \cdot \lvert L \rvert \cdot X(n))$
[Dieudonné et al.(2014)]	f	Weak	$2f+2 \leq k$	Possible	Possible	Poly. of n and $\lvert L \rvert$
[Bouchard et al.(2016)]	n, f	Strong	$2f+1 \leq k$	Possible	Possible	Exp. of n and $\lvert L \rvert$
[Bouchard et al.(2016)]	f	Strong	$2f+2 \leq k$	Possible	Possible	Exp. of n and $\lvert L \rvert$
[Hirose et al.(2021)]	N	Weak	$4f^2+9f+4 \leq k$	Possible	No guarantee	$O((f+\lvert L \rvert) \cdot X(N))$
[Hirose et al.(2021)]	N	Weak	$4f^2+9f+4 \leq k$	Possible	Possible	$O((f+\lvert \overline{L} \rvert) \cdot X(N))$
[Hirose et al.(2022)]	N	Weak	$9f+8 \leq k$	Impossible	No guarantee	$O(f \cdot \lvert L \rvert \cdot X(N))$
[Saxena and Mondal(2024)]	n	Weak	$f^2+5f+9 \leq k$	Possible	Possible	$O(k^2 \cdot \lvert L \rvert \cdot X(n))$

Table 1: An overview of synchronous Byzantine gathering algorithms with unique IDs. Here n is the number of nodes, N is the upper bound of n, l is the smallest ID among non-Byzantine agents, $|L|$ is the length of the largest ID among non-Byzantine agents, $|\overline{L}|$ is the length of the largest ID among agents, k is the number of agents, $X(n)$ is the number of rounds required to explore any network composed of n nodes, and f is the number of Byzantine agents.

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$[1, 2, 7, 10, 11, 5, 6, 3, 9]$.