Self-Aggregation Algorithms for Autonomic Systems

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Self-Aggregation Algorithms

A Self-Aggregation algorithm is defined as an algorithm capable of enabling a spontaneous formation of groups of *compatible* nodes.

- **Clustering:**
  - Nodes are compatible if they have the same type.

- **Reverse Clustering:**
  - Nodes are compatible if they have different types.
Possible Applications

• Load-balancing problems:
  – System nodes are specialized in executing particular tasks.
  – Jobs coming to an overloaded node should be passed to another node that is able to execute the same task.
  – Nodes should be able to self-reorganize their limited knowledge about the environment.

• Overlay Self-Organization in Publish-Subscribe middleware:
  – Rewire the broker connections in order to minimize network load.
  – Group together subscribers interested on the same topics.
Clustering Algorithm Idea (Saffre et al, 2006)

1. Initiator Self-Election;
2. Initiator chooses a Matchmaker node among its neighbors;
3. The matchmaker node connects the initiator to one of its neighbors that are compatible to the initiator and then removes its link to the chosen node.
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The Concept of Algorithm “noise”

- The **noise** in clustering algorithms is defined as the number of algorithm iterations that do not increase the system homogeneity.
- An example of iteration that contributes to algorithm noise:

![Diagram showing an example of noise in clustering algorithms](image)
New Algorithms

- **Noise reduction:**  **FAST ALGORITHM**
  - More constrained: removal of links between compatible nodes is not permitted.
  - Faster convergence, less messages, lower accuracy.

- **Noise increase:**  **ACCURATE ALGORITHM**
  - Less constrained: addition of links between non-compatible nodes is permitted only if another link between non-compatible nodes is removed.
  - Slower convergence, more messages, higher accuracy.

- **ADAPTIVE ALGORITHM**
Performance Analysis: optimality and messages

Nodes=100, Links=4 per node, Types=5, Random topology, Clustering

Simulation time (ms) vs. Average of optimality

Simulation time (ms) vs. Average of the number of messages
Conclusions

• We have proposed self-aggregation algorithms
  – able to apply global properties to a distributed system …
  – using simple local rules without centralized control.

• The algorithms have been simulated in order to identify strengths and weaknesses in different situations.

• Future Work
  – Study how to tailor the adaptive approach.
  – Create self-similarity groups using a fuzzy compatibility function.
  – Improve the strategies used for algorithm initialization and distributed termination detection.