Greedy Cheating Liars and the Fools who Believe Them

Overview

University of Bologna – Dept. of Computer Science
Stefano Arteconi and David Hales

SLACER Algorithm

SLACER is an evolutionary algorithm inspired from “tag systems”, able to build an artificial social network with high level of cooperation between peer-to-peer network nodes.
While performing the application task periodically each node tries to improve its own utility by copying better-performing node through the SLACER basic step:

- Compare utility with a randomly chosen node
- Lower-utility node copies view and strategy of the higher-strategy one
- With low probability nodes randomly change links (link to a single random node) and strategy.

SLACER algorithm has been shown to posses many attractive emergent properties such as self-organised cooperation and coordination, on the other hand it relies on the honest reporting of node utilities, behaviours and links [2].
But what if a node does not follow the specified protocol and attempt to subvert it for its own selfish ends?
We examine the robustness of this approach to two kinds of cheating behaviour in the nodes.

Prisoners' Dilemma

To capture the contradiction between cooperation and selfishness typical of open systems as peer-to-peer networks, Prisoner dilemma (PD) has been used (see Figure 1)

Constraints: T>R>P>S and 2R>T+S

P2 \ P1	C	D
C	R, R	S, T
D	T, S	P, P

Figure 1: Prisoners' Dilemma payoff table.

In SLACER each node adopts some pure strategy (always C or always D) and periodically plays a single round with a randomly chosen neighbor.
Utility value is given by the average payoff obtained in past interactions.

Greedy Cheating Liars

Greedy Cheating Liar (GCL) nodes want to maximize their own utility with no respect for other nodes. In PD the maximum possible utility is achieved by a D player versus a C player.
GCL nodes surround themselves with nodes playing C in the following way:

- Always play D
- Always report playing C (lying)
- Always report high utility (lying)

Nihilists

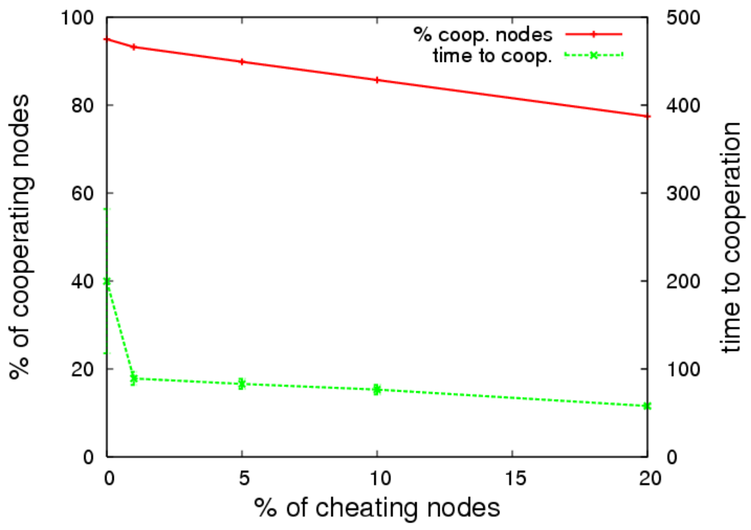
Nihilists (NIH) nodes aim is to destroy the network bringing down cooperation with no interest in their own utility.
To achieve this NIH nodes do the following:

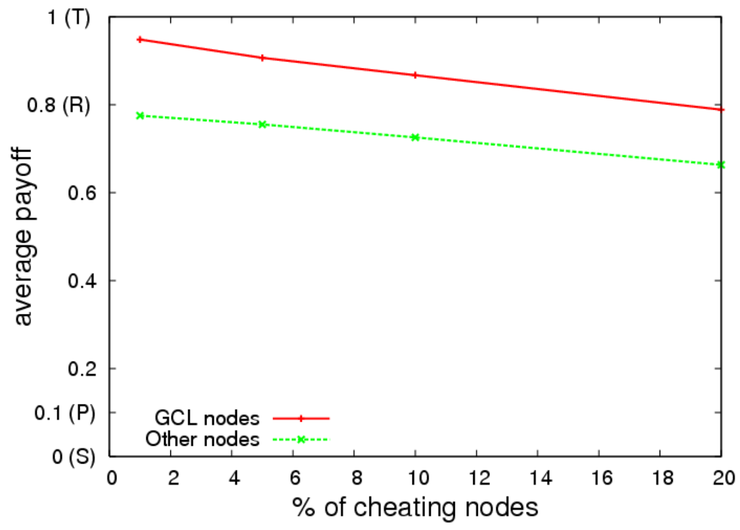
- Always play D
- Always report playing D
- Always report high utility (lying)

This way a GCL node will force other nodes to copy itself hence to play D strategy.

Simulation

Many scenarios with different proportion and kinds of cheating nodes have been analyzed[1], here are illustrated their effect on cooperation level, time needed to achieve it, and average utiliies for different kinds of node.





Conclusions

Looking at GCL nodes effects, they basically bring to cooperation all non-cheating nodes, and speed up the process of cooperation formation. Regarding the utilities GCL are able to get high utility while non-cheating nodes average utility is only slightly decreased. Moreover increasing the number of GCL nodes leads to a *graceful degradation* of utility.
GCL nodes even benefit the system (faster cooperation) in exchange of some slight lower utility for non-cheating nodes.
NIH nodes are able to destroy network cooperation by lowering it and requiring more time to let it emerge. A relatively large number of them is needed to actually destroy the system (about 20% of cheating nodes to lower cooperation under 50%).

These results suggests a provocative idea: maybe in open systems the best strategy for dealing with cheating nodes is not trying to detect and stop them, but to let them act freely yet turn their misbehaving into a social benefit for the whole system while trying to minimize their damage. Perhaps those who believe what greedy cheating liars tell them are not such fools after all!

References

[1] S. Arteconi and D. Hales.
Greedy cheating liars and the fools who believe them.
Technical Report UBLCS-2005-21, University of Bologna, Dept. of Computer Science.
Also available at: http://www.cs.unibo.it/pub/TR/UBLCS/2005/2005-21.pdf.
[2] D. Hales and S. Arteconi.
Slacer: A self-organizing protocol for coordination in peer-to-peer networks.
IEEE Intelligent Systems, 21(2):29–35, Mar/Apr 2006.

Contact
University of Bologna
Stefano Arteconi
Mura Anteo Zamboni 7
40127, Bologna, Italy
Fax: +39 051 209 45 16
Phone: +39 051 209 45 15
E-Mail: arteconi@cs.unibo.it
URL: www.cs.unibo.it/~arteconi

Additional Authors
University of Bologna
David Hales
Mura Anteo Zamboni 7
40127, Bologna, Italy
Fax: +39 051 209 45 16
Phone: +39 051 209 45 15
E-Mail: hales@cs.unibo.it
URL: www.davidhales.com

DELIS: Integrated European Project founded by the "Complex Systems" Proactive Initiative within the Sixth Framework Programm