

When evolution is mentioned, we recall Charles Darwin and his ideas of struggle for existence and natural selection of the fittest. Martin Nowak writes in Scientific American (7/2012) about the other aspect of evolution i.e. cooperation that appears among members of a group, species, between species and also on cell level.

The theory of evolution has had a lasting impact on philosophy, political, social and other fields of science. Game theory has been used to model the emergence of cooperation in a population. Classical studies look at the Prisoner's Dilemma in repeated rounds of the game and establish that the winning strategy in a population of players tends to be tit-for-tat. In tit-for-tat, players do not cheat or behave selfishly first and otherwise follow the opponent's moves. We say that players are ready for reciprocal altruism. More complex games can demonstrate how forgiveness may appear as a part of a player's strategy. This links evolution and strategies for survival to morality. Altruism is good for survival among players that meet often. Conversely, if a player knows that he is not going to meet the other player ever again, often cheating gives the highest benefit.

Among different species, humans are super cooperators. We use our natural perception to evaluate our partners, we gossip about people and we form an opinion of the character of the partners. A summary opinion of a character of a player is called reputation. The process of forming an opinion of the partner is a natural part of all interaction and communication with other people. Gossip helps in defeating a cheating strategy in hope of never seeing the opponent again.

Many technical systems exhibit characteristics of evolution. In the Internet there is a brutal competition among applications and protocols. For example an interesting development since about 2005 is the rapidly growing penetration of Unicode (UTF-8) as the character encoding in the web. Another historical experience is that protocols that are used by everyone tend to be developed to meet new requirements while protocols for a narrow set of users are easily forgotten over time. These are examples of the struggle for survival and selection of the fittest.

One can ask: how do the communication methods supported by the networks we use help us in the use and forming of reputation? In telephony, the network first helps to establish the willingness of the called person to communicate. Once the person-to-person communication is on the way, typically the communication channel limits the availability of non-verbal cues that in a face-to-face communication help to form an opinion of the partner.

The Internet uses a cooperative method of routing to establish the prerequisites to any communication: network nodes distribute reachability and routing information to other nodes and the nodes create routing tables based on this information. Curiously enough, the basic communication protocol, namely IP has no support whatsoever for cooperation: it just delivers the packets irrespective of whether the receiver wants them or not. The players in the Internet do not have stable identities nor does the network help to remember the collective opinion of the users on the reputation of the players. These weaknesses of the technology are used by some players for their selfish strategies such as gaining control of other user's computers using Trojans, spamming the users with unwanted e-mail, stealing sensitive information from other people's machines etc.

Over the years many new applications have appeared that help people cooperate. These include e-mail, the web, chat, many social networks such as Facebook, Twitter etc. New applications are being created for cooperation for particular types of groups or purpose.

For taking better care of the receiver, particularly a receiver that is using a wireless device, we have been developing protocols and algorithms for a collaborative firewall ([www.re2ee.org](http://www.re2ee.org)). Provided such edge devices were adopted, we could introduce a collective memory of reputation of hosts, ISPs, applications and users. This could be used to promote careful and “moral” behavior on the net.

More generically, network researchers are putting a lot of effort into developing methods of identifying selfish behavior of users and modeling the different strategies ISPs, hackers etc. are using or should be using. Examples of these directions are the techniques for deep packet inspection, intrusion detection or using game theory for network security modeling. As a result we hope to move towards a kinder, more secure and more user-friendly Internet that serves the increasing needs of the society in communications.