How Network Security Aspects Shape Rational Behavior in Games [MSc]

1 Topic

The fundamental task of computer networks is to move information from one location to another (e.g. from a Google server to your mobile phone). The value of computer networks lies in the value of the information that can be transmitted: If no one has any valuable information to transmit, computer networks would be obsolete. The value of transmitted information therefore stems from they way in which the information can affect the receiver (e.g. a notification of an imminent tsunami is extremely valuable as it may save someone's life, thereby making indirectly the network connection from the tsunami-sensor-network to a citizen's mobile phone very valuable). We would like to study how network security aspects such as Denial-of-Service (DoS) can affect the behavior of rational entities that make use of the computer network.

2 Task

Concretely, we want to study how rational behavior in multi-agent games (such as Pong) is affected by network security aspects. To that end we use multi-agent reinforcement learning to train smart agents to act in a networked environment. By modulating environment parameters such as network jitter, packet loss, latency, and throughput, we can measure how the optimal strategies (and expected performance) of intelligent agents change. By enabling agents to themselves perform DoS attacks (and/or protect against DoS) we can discover novel strategic solutions to existing well-studied scenarios. This is a first step towards designing and tuning network security systems based on the rational behavior of network entities.

3 Methods

The task is mostly reinforcement-learning related. You will be designing multiple simulation environments in the form of Markov Decision Processes (MDPs) and train smart agents to perform in these environments. By studying the resulting optimal policies and comparing the performance of agents in different environments we can quantify how valuable certain security aspects, such as DoS prevention, are to rational entities.

4 Prerequisites

Required: Machine Learning, C++, Computer Networks Nice to have: Reinforcement Learning, Game Theory

5 Contact

If you are interested, write to francesco.dadalt@inf.ethz.ch. Please attach your CV, transcript of records, and a brief reasoning for why you would like this project.