Universiteit Leiden

Master Computer Science

Title :Discovering quantum communication strategies with multi-agent reinforcement learning

Name: Athanasios Agrafiotis

Student ID: s2029413

Date:

Specialisation: Advanced Data Analytics

1st supervisor: Evert Van Nieuwenburg

2nd supervisor:

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Leiden Institute of Advanced Computer Science (LIACS)
Leiden University
Niels Bohrweg 1
2333 CA Leiden

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Abstract

Communication channel systems are easy to use; however, they are vulnerable to attacks by a third person. The third person can easily penetrate the channel and read or manipulate messages before reaching the receiver from the sender. For this purpose a number of protocols are recommended that can secure the communication between the two parties. Nowadays, quantum computing has been shown to get benefit from such scenarios and introduces protocols that can encrypt and decrypt a message. One of those protocols is the protocol of Bemett and Brassard. The purpose of this Master thesis is to present a simulation of a quantum communication channel using reinforcement learning algorithms. In more details it describes in details how the sender and the receiver exchange messages and how they verify the security of the channel with a secret key.

The main goal of this Master thesis is to simulate a Quantum key distribution process using artificial intelligence environment. In each episode the two agents are using a communication channel. The first agent reads a message and then sends it to second agent , the receiver verify the message correctness. In case the message has been transferred successful, the episode ends with the maximum reward in the other cases the reward is negative.

A number of reinforcement learning algorithms are implemented during the Master thesis project. Namely a Q-learning, deep q learning approach that solves artificial environment with optimal solutions. As a result the agent performs that actions that is required to communicate with each other avoiding any mistakes.

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