



Faculty of Electronics and Telecommunication

Study course: RAE 411

WEEK 12: CRITICAL REVIEW

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CRITICAL REVIEW

Main message

The purpose of the article is to present a new software module in the network environment, a toolbox that will allow to validate and compare uniformly different systems, different networks and the performance of reinforcement learning.

The ns-3 network simulator integrates an RL framework such as OpenAI Gym and allows the development and comparison of reinforcement learning to improve the solutions offered thanks to its own experience. Through a single platform and tool, researchers will be able to work together to develop the open source project and make reinforcement learning more effective.

To make the prototyping of a new network faster, the tools must be scalable, requiring little hardware resources, while facilitating the conversion of old systems to the new environment.

Methods

First of all, the implementation of a generic interface between OpenAI Gym and ns-3 in order to launch the simulations, to follow the evolution of the treatment of the actions. We can then import and initialize the libraries to work with OpenAI GYM. The developer will define the different classes to meet his needs.

The framework collects the state of the environment using 4 functions: GetObservation, GetReward, GetGameOver, GetExtraInfo. These functions respectively allow the values of the parameters and variables of the different nodes of the network to be collected and for each protocol, to measure the reward obtained during the last step, if a condition is predefined in game-over, to obtain more information concerning the state of the environment.

The ns-3 simulation scripts can be simulated in generic environments, custom environments or emulated by Linux protocols. The sn3-gym tool can be developed in C++ or Python, the API will take care of the mapping to establish in an invisible way for the user the exchange of information between 2 modules.

Results

The results of this tool are very surprising and promising for the field of networks. Indeed, in the case of random access control in an IEEE 802.11 mesh, radio resources are disputed between the various nodes of the network. The use of ns-3 and the RL agent has improved the system to receive the same CWmin/CWMax value on all nodes.

Another example, when using a neural network, shows that after 80 episodes and therefore training, it can perfectly predict the state of the next channel.

Critical review

For my part, I think that having a single tool in common will make it easier to move forward in the network environment and solve the various problems encountered. The community using the Open Source tool, researchers and companies will be able to bring content and solutions to various areas of improvement. In addition to being able to simulate different environments, if this tool respects its design principles, namely scalability, low entry overhead, fast prototyping, easy maintenance, then ns3-gym is a sustainable solution for the development and validation of reinforcement learning algorithms.