Intelligent Management using Collaborative Reinforcement Multi-agent System

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NMRG Meeting@IETF 99 – Prague
2017.07.20
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Reinforcement Learning

◆ One of the machine learning algorithm
◆ An agent can explore an environment with taking action and its current state toward destination
◆ The cumulative reward to find an optimal value by agents
◆ The policy from maximizing cumulative reward for learning process

\[ f(S_{k+1}, A_{k+1}) = \max_D(S_k, A_k) \]
\[ a = \arg\max(R(S_k, A_k)) \text{ where } a_k \in A \]
What is Motivation?

◆ General Motivation for Reinforcement Learning (RL)
  ✓ Reinforcement Learning (RL) is a system capable of autonomous acquisition and incorporation of knowledge

◆ Reinforcement Learning (RL) in networks (Intelligent Management)
  ✓ In terms of networking monitoring system, to achieve fair resource allocation for nodes within the wire or wireless mesh setting

◆ Motivation in our work
  ✓ Networking issues such as connectivity, traffic management, fast internet without latency and etc.
  ✓ ML-based mechanisms such as reinforcement learning [RL] will provide network solutions with multiple cases against human operating capacities
Proposed Method

- Multi-agent Reinforcement Learning process cycle
  - Reinforcement Learning (RL)
  - Action, State and Reward
  - Policy for Monitoring and Management
Proposed Method 1 (cont’d)

◆ Normal Process vs RL Learning Process

✓ Initial random exploration for learning process
✓ Random for the 1st processing
✓ Updated policy after random process
Proposed Method 1 (cont’d)

- Multi-agent Reinforcement Learning (RL) Technologies
  - Reinforcement Learning (RL)
  - Policy using Distance and Frequency
  - Distributed Computing Node

![Diagram of multi-agent RL system with centralized and distributed nodes, showing agent movement towards a goal through different terrains.](image-url)
Proposed Method 2

◆ Agent Sharing Information

✓ Agents should take actions and transfer the states to the global environment under reinforcement learning (RL), then it would share the information with other agents.
Proposed Method 2 (cont’d)

- **Agent Sharing Information**
  - Effect of sharing information vs not sharing information
  - Initially Random process for the 1st trial
  - Efficient performance with shared information between agents

![Graph showing the comparison between sharing and not sharing information](graph.png)
With Possible Network Scenario with RL

◆ Autonomous Driving System
  ✔ Self-automotive driving without human supervision depending on optimized trust region policy

◆ Wireless Sensor Network (WSN)
  ✔ RL in WSNs has been applied in a wide range of schemes such as cooperative communication, routing and rate control for intelligent monitoring and management

◆ Routing Enhancement
  ✔ Routers in the multicast routing protocol are determined to discover optimal route with a predicted reward, and then the routers create the optimal path with multicast transmissions to reduce the overhead
On-going work

- Adaptive Networking model on Routing using RL
Next Step

- We create adaptive intelligent networking management Model with RL
- We also set up RL scenario and preprocessing for Dataset
Thank you

Comment or Question?

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