Paper Review Assignment (CS-565)

The following questions are based on the paper *Deep Reinforcement Learning Based Resource Allocation Strategy in Cloud-Edge Computing System*. Kindly review the paper beforehand. Write your responses in the space provided.

Paper Weblink: <https://www.frontiersin.org/articles/10.3389/fbioe.2022.908056/full>

**Q1.** Consider the resource allocation problem where a client submits the following demands in three consecutive time slots:

|  |  |
| --- | --- |
| Time-Slot | Demand |
| 1 | (30, 2) |
| 2 | (10, 1) |
| 3 | (20, 2) |

where represents the number of VMs requested and represents the duration of service request. Assume that time slot (1) is the starting slot such that no VMs have been allocated a priori. There are 80 VMs available at the edge node.

**(a)** ***Resource allocation using private cloud***: Suppose that we have our own private cloud and a policy has been deployed to allocate VMs as per client demands which outputs the following actions at each timeslot:

|  |  |
| --- | --- |
| Time-Slot | Policy Action |
| 1 | 0.4 |
| 2 | 0.7 |
| 3 | 0.8 |

The action represents the ratio of VMs allocated from the private cloud to the total VMs requested by client at time slot t. The remaining VMs are allocated from the edge node.

Calculate the cost of collaborative cloud side computing in the given private cloud setting at each of the three time slots. Also, find out the number of VMs that will be available at the edge node at the beginning of fourth time slot.

Given Constants:

|  |  |
| --- | --- |
| Constant | Value |
| Stand-by cost of a VM at the edge node ) | 0.03 |
| Computing cost of a VM at the edge node ) | 0.20 |
| Computing cost of a private cloud ) | 3.00 |

**(b)** ***Resource allocation using public cloud***: Assume that we have replaced the private cloud with a public cloud setting with a new policy that outputs the following actions at each timeslot:

|  |  |
| --- | --- |
| Time-Slot | Policy Action |
| 1 | (1, 0.4) |
| 2 | (0, 0.7) |
| 3 | (2, 0.8) |

where represents the type of public cloud instance that was allocated. Calculate the cost of collaborative cloud side computing in the given public cloud setting at each of the three time slot. Assume that the same demands were made by client as in part (a) and that no customization is performed on reserved instances.

Additional Constants:

|  |  |
| --- | --- |
| Constant | Value |
| Unit price of on-demand instance in public cloud ) | 3.0 |
| Unit price of reserved instance in public cloud ) | 1.5 |
| Customization price of reserved instance ) | 800 |
| Unit price of spot instance in public cloud ) | 1.0 |

**Q2.**

**(a)** Why do the authors choose to apply P-DQN in the case of public cloud resource allocation as opposed to DDPG as in the case of private cloud resource allocation?

**(b)** How is the exploration-v/s-exploitation managed in P-DQN given that there are parameterized actions?

**Q3.** Suppose that we want to extend the resource allocation model to a new setting where there are multiple edge nodes, each having a fixed amount of available VMs. The computation and stand-by cost of VMs may vary across different edge nodes. Reformulate the resource allocation problem with new cost functions in the multi-edge setting. Suggest an appropriate action space for a policy in this new multi-edge setting. *Hint: exercise your creativity.*