# AVD-Net: Attention Value Decomposition Network For Deep Multi-Agent Reinforcement Learning

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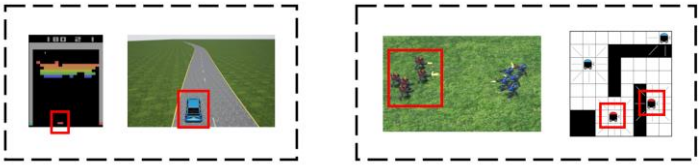
## Background

Multi-agent reinforcement learning (MARL) is of importance for variable real-world applications but remains more challenges like stationarity and scalability. MARL) is intrinsically difficult than the single-agent settings because of some multiagent pathologies such as the environment non-stationary problem, curse of dimensionality, credit assignment problem.

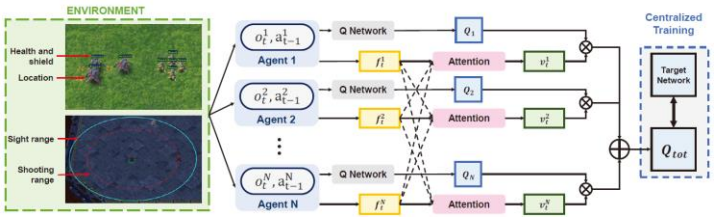



The main contributions of our work:

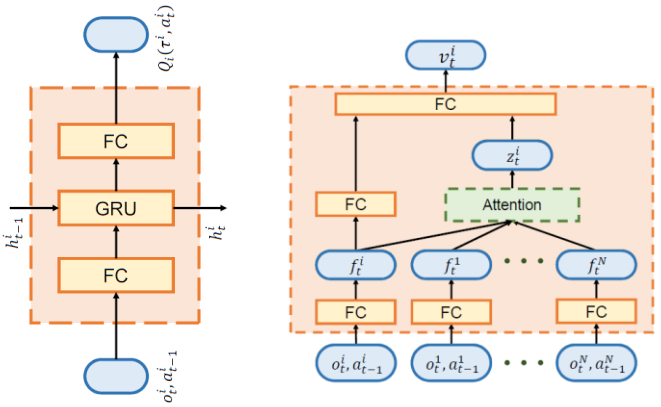
- We propose a value-based architecture which factorizes the joint value function with only the partial observations and actions of local agents.
- We adopt attention mechanism to learn the correlations between agents and compute the decomposition weight of each agent's action-value function.
- Our proposal effectively exploits the information in multiagent system and achieves state-of-the-art performance in different cooperative MARL environments.

## Our Method

- Overall structure of AVD-Net




- For each agent, there is an action-value network, which adopts the DRQNs structure and receives the current agent observation $o_t^i$ and the last action $a_{t-1}^i$ as input at each time step.
- Use an attention based policy architecture computing the $Q_{tot}$ which learns the correlations between agents.




## Related Works

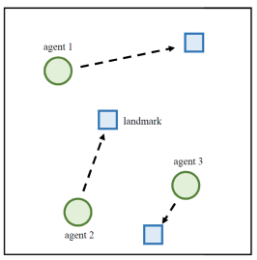
- Value Decomposition Network(VDN)
  - VDN algorithm learns a joint action-value function $Q_{tot}(\boldsymbol{\tau}, \boldsymbol{a})$ represented by the sum of individual value functions $Q_i(\tau^i, a^i; \theta^i)$

$$Q_{tot}(\boldsymbol{\tau}, \boldsymbol{a}) = \sum_{i=1}^{N} Q_i(\tau^i, a^i; \theta^i)$$

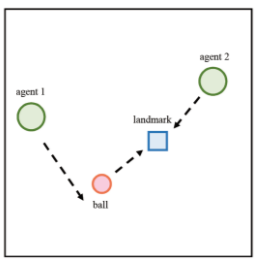
- QMIX
  - QMIX transforms the centralized state information into the weight of the agent's local action-value $Q_i$ though deep neural networks. It structurally enforces that the joint-action value is monotonic in the per-agent values and the extra state information on the mixing network performs an essential role.

## Experiments

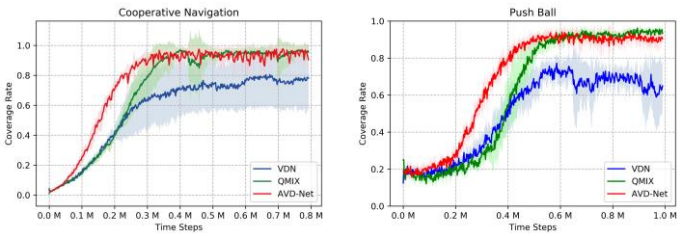
- Multi-Agent Particle Environment(MPE)




Cooperative Navigation

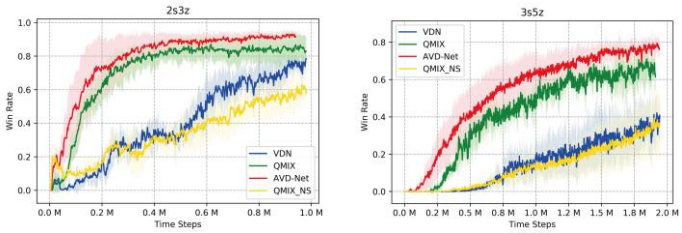



Push Ball




Performance in MPE

- StarCraft Multi-Agent Challenge(SMAC)




Performance in SMAC