Multi-Agent Game Abstraction via Graph Attention Neural Network

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The Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20)

introduction / Related works

- goal: simplifying MA learning process
- earlier work: game abstraction and data transfer
- some relationship is not needed

earlier work: mean-field MARL

interact with the agents in its vision

don’t fit to conplex environment

- requires prior knowledge
- can’t dynamically adjust to state transition

Attention mechanism:

mechanism to learn which vector input is important

- soft-attention
- hard-attention

Soft-attention

used in earlier work, but there are some problems.

- output is relative value: can’t model the relationship
- can’t reduce the agents number to interact
- nonzero agents weakens the attention to the significant agents.

hard-attention

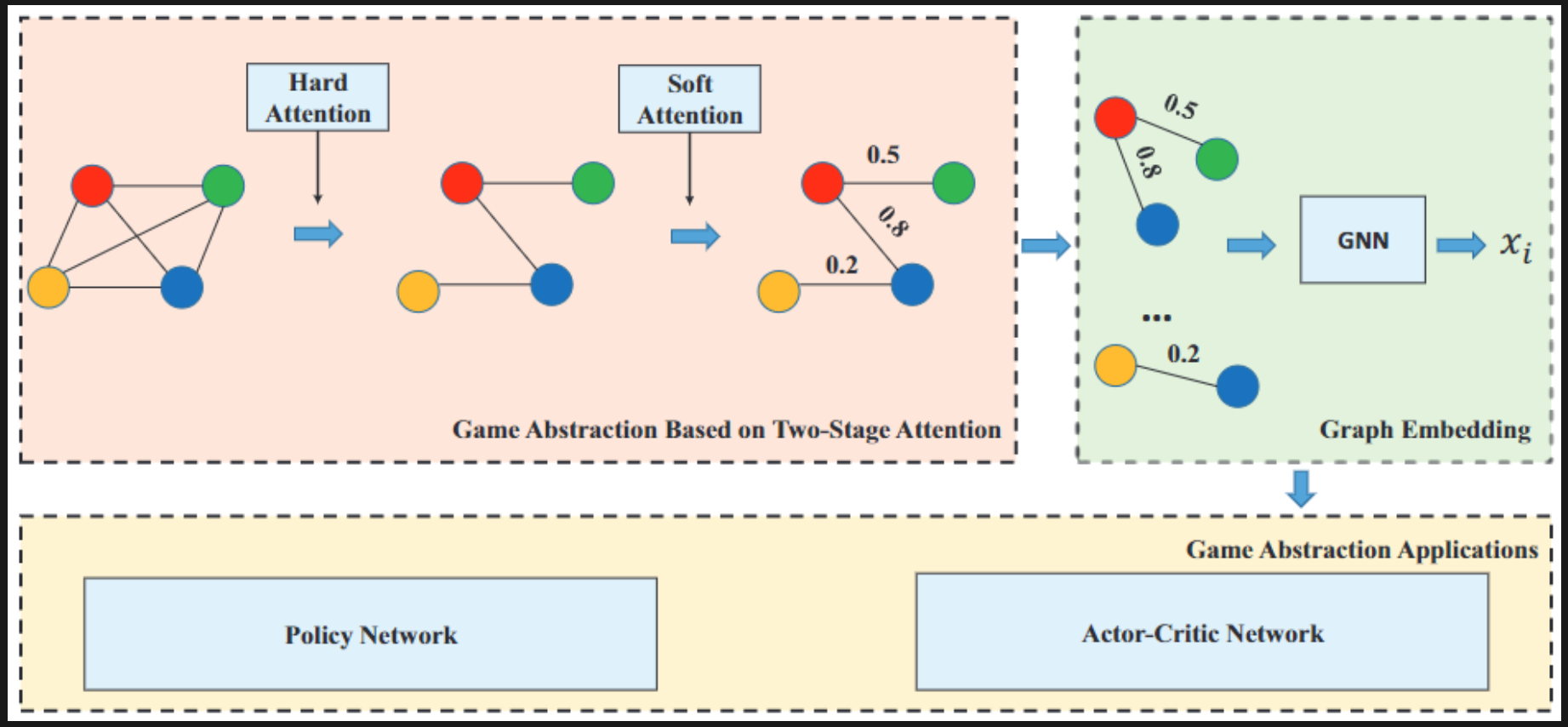
make zero attention

one-hot vector $[0, 0, 1, 0]$

Proposed Methods

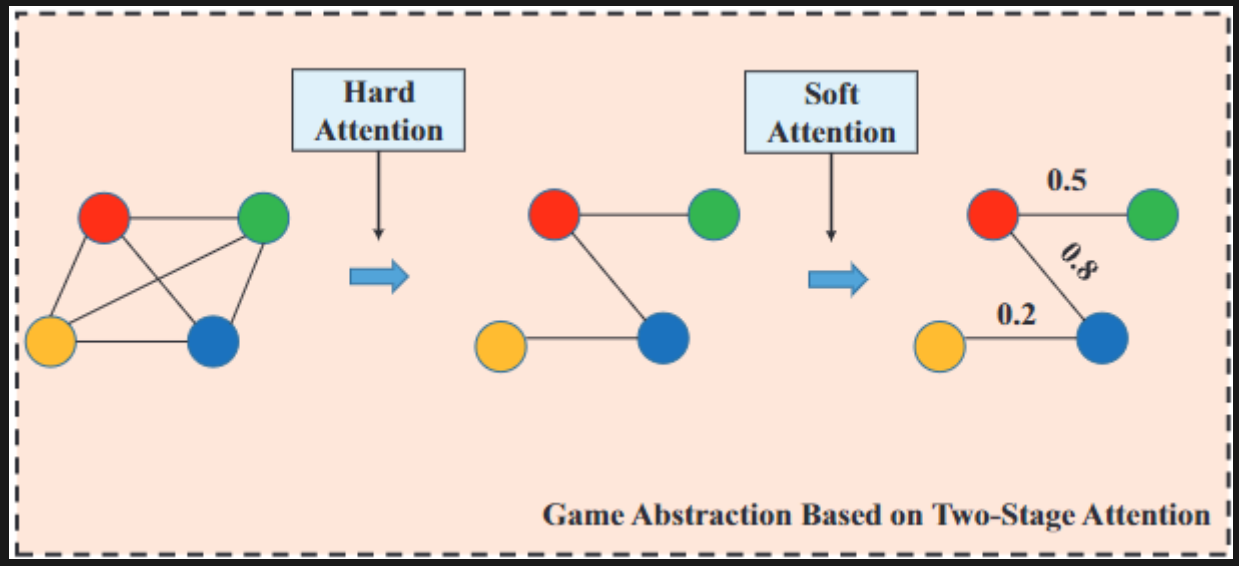
- Game abstraction: G2ANet
- Applied algorithm: GA-Comm and GA-AC

Overview


Hard Attention
Soft Attention
0.5
0.8
0.2
Game Abstraction Based on Two-Stage Attention
0.5
0.8
GNN
x_i
...
0.2
Graph Embedding
Game Abstraction Applications
Policy Network
Actor-Critic Network

step1: G2ANet

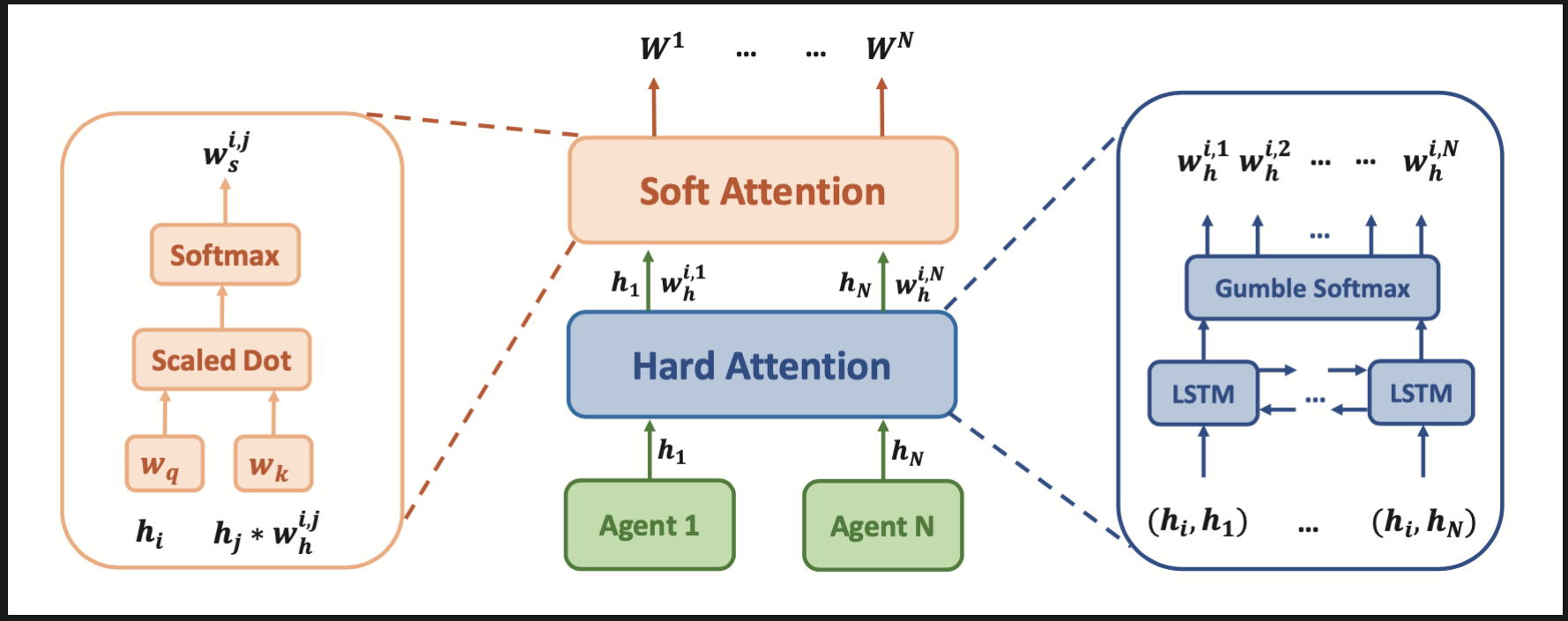
Game abstraction with Two-Stage Attention



use both hard-attention and soft-attention
describe relation with graph

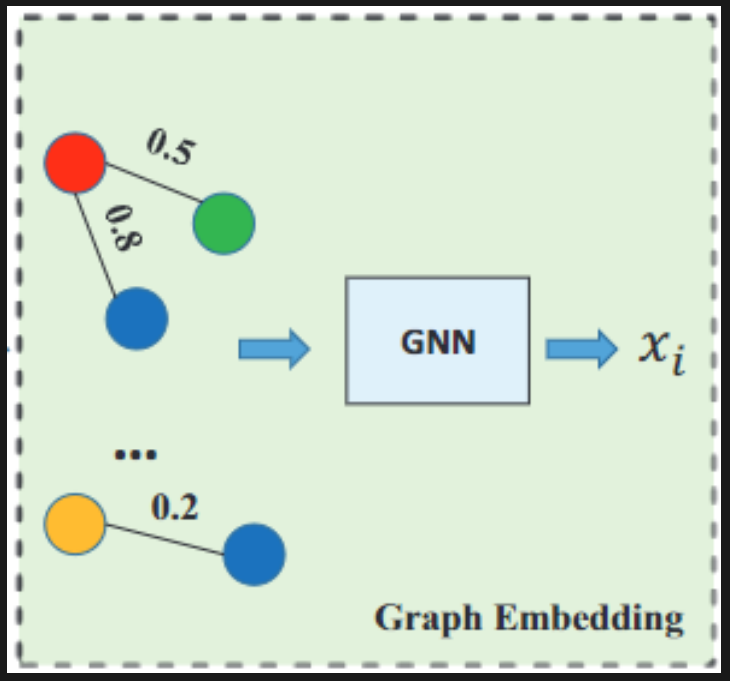
structure of Attentions

use LSTM(RNN) in hard-attention



step2: graph

GNN to obtain contribution from other agents



step3: 2 Learning algorithm based on Game Abstraction

- GA-Comm: Policy Network based on GA
- GA-AC: Actor-Critic based on GA

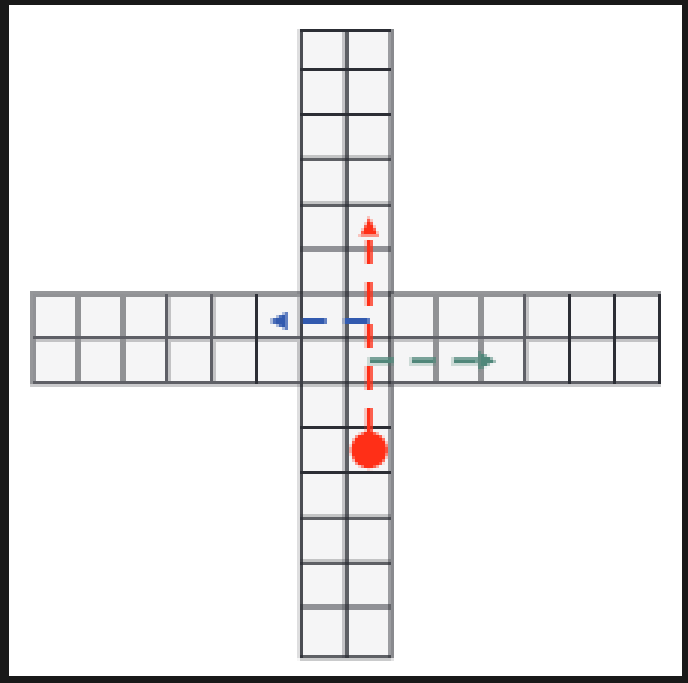
Experiments

They prepared two environments:

- traffic junction
- predator-prey

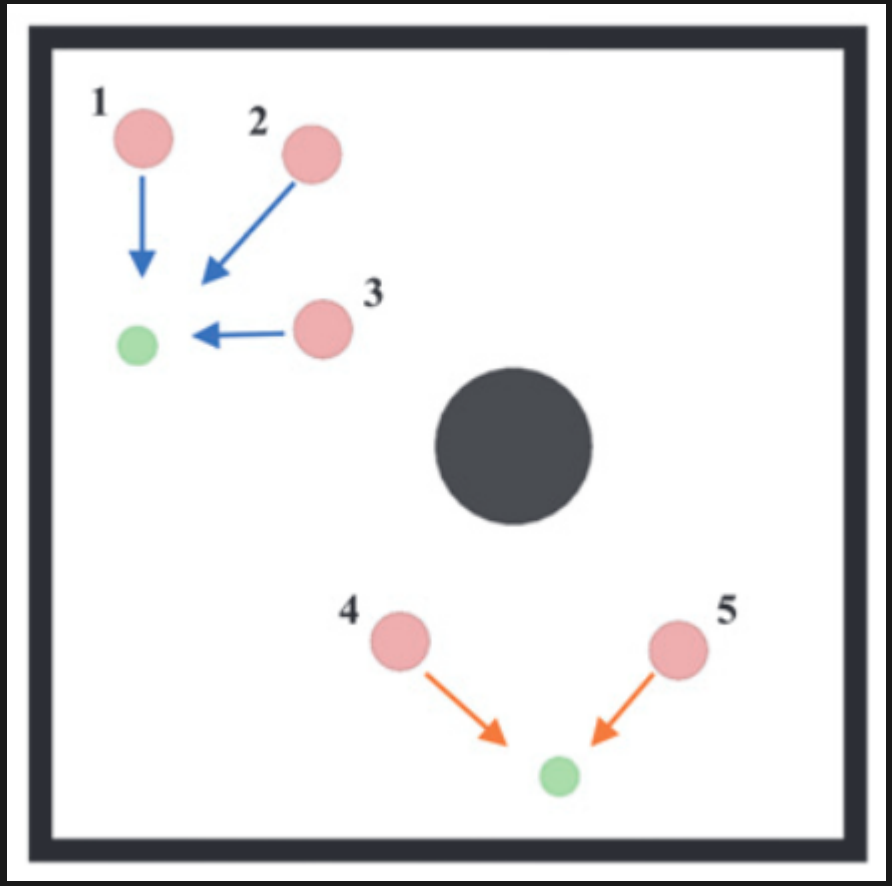
Traffic Junction

- car appears from entry point
- action
  - gas: move forward
  - brake: stop
- goal: avoid collision

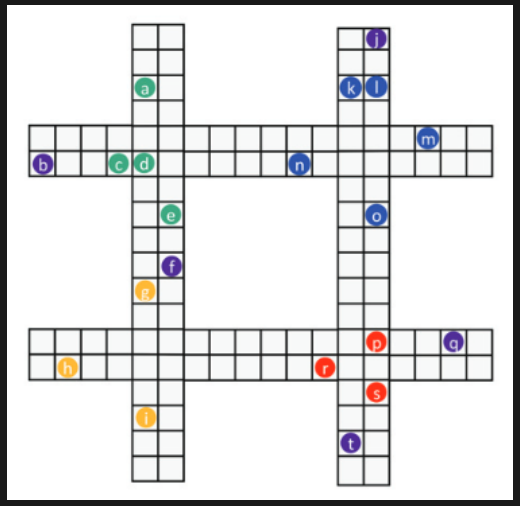


Predator-prey

- 2 Predators, 5 Preys and Obstacles
- predator will chase prey
- goal: catch prey



Results: GA-Comm (Traffic Junction)



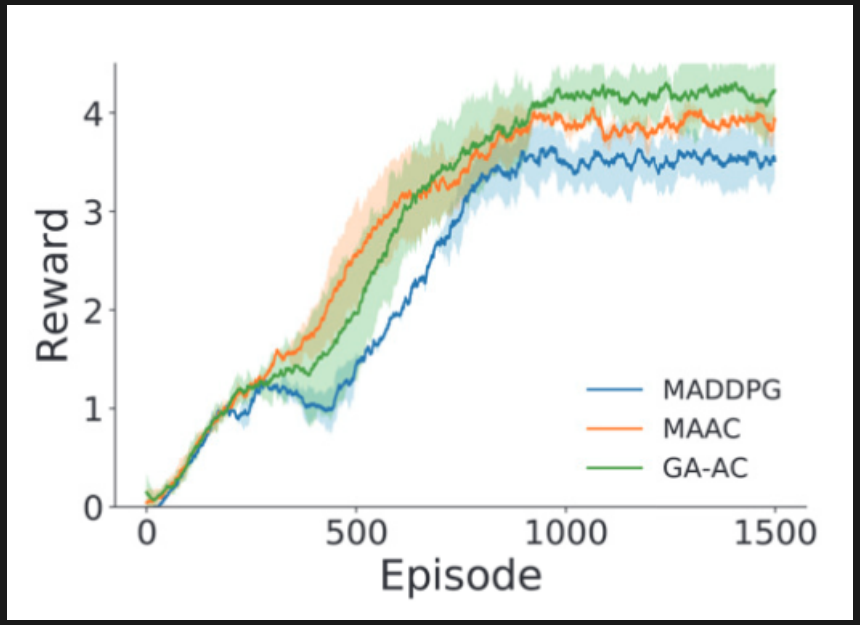
Algorithm	Easy	Medium	Hard
CommNet	93.5%	78.8%	6.5%
IC3Net	93.2%	90.8%	70.9%
GA-Comm	**99.7%**	**97.6%**	**82.3%**

Higher than other methods.

Results: GA-AC (predator-prey)

Achieved high reward

Learning is slow at beginning, but then grow rapidly



Conclusion

- they succeed to simplify 2 MARL by adapting G2ANet.
- it is adaptive to dynamic relation between agents.

Thank you for listening!