近期工作汇报

使用深度强化学习算法优化边缘计算任务卸载问题

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工作概要

- 1. 调查20几篇DRL+任务卸载的论文
- 2. 完成基本的实验框架,包含
 - 1. 边缘计算任务卸载的模拟环境
 - 2. 使用较先进的DRL算法: T3C、SAC、PPO进行调度

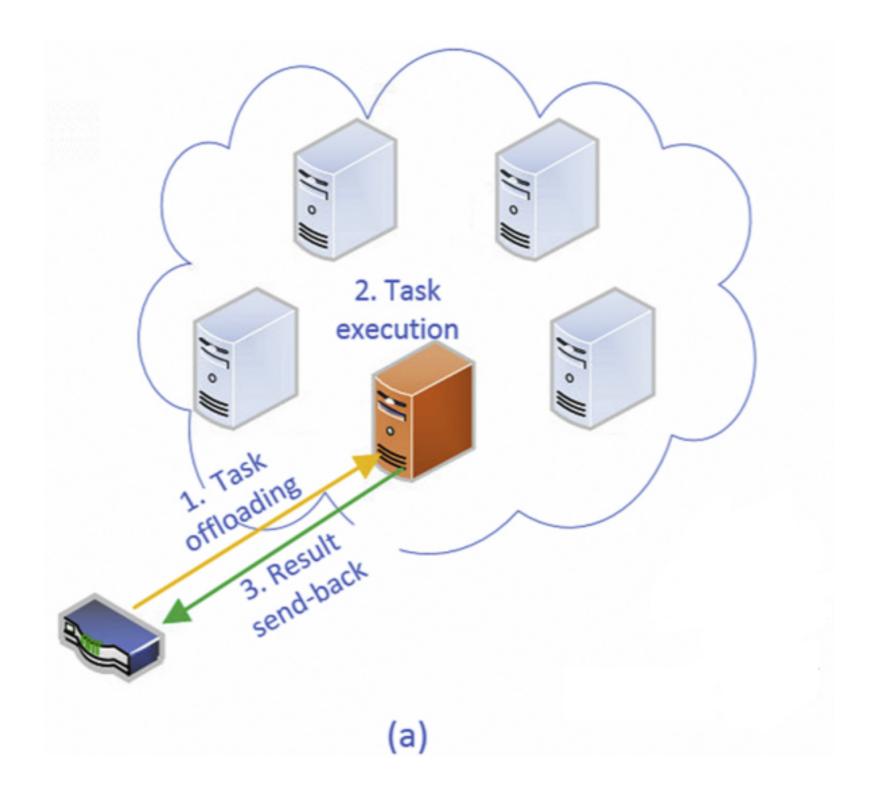
后续工作

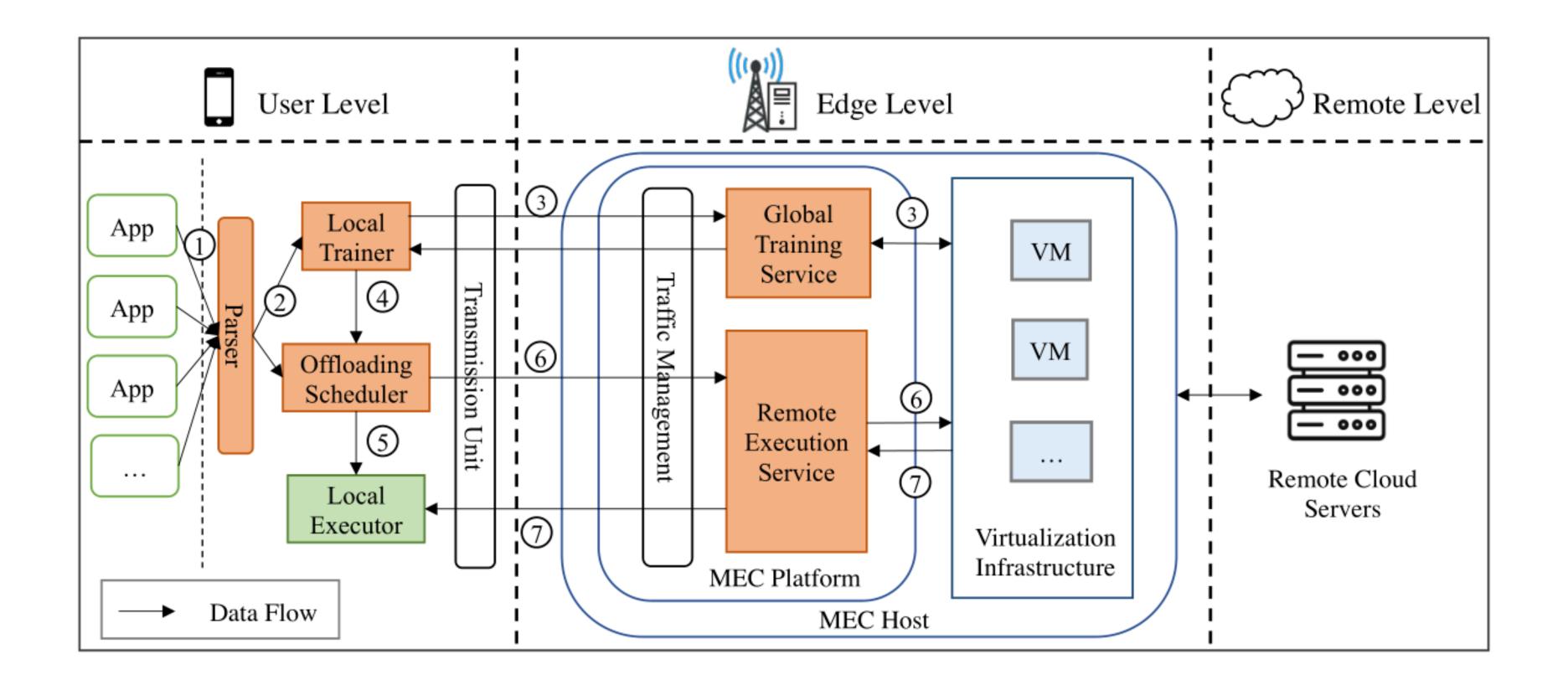
- 1. 对现有的论文进行较详细的排查,找到比较好的优化目标
 - 1. 优化现有的环境和算法
 - 2. 调参
- 2. 整合discrete action的DRL算法
- 3. 实现baseline: 贪心、穷举、无调度、线性松弛、DQN

MEC offloading

- 1. 相对于云计算
- 2. 工厂、AR游戏...
- 3. 任务调度: 最优化问题
 - 1. 传统方式、遗传算法
 - 2. 强化学习算法

4.
$$\min_{(\mathbf{a})}$$
 电量 $+$ 速度, $\mathbf{s.t.}$ $a_i \in \{0,1\}, orall i \in \mathcal{M},$



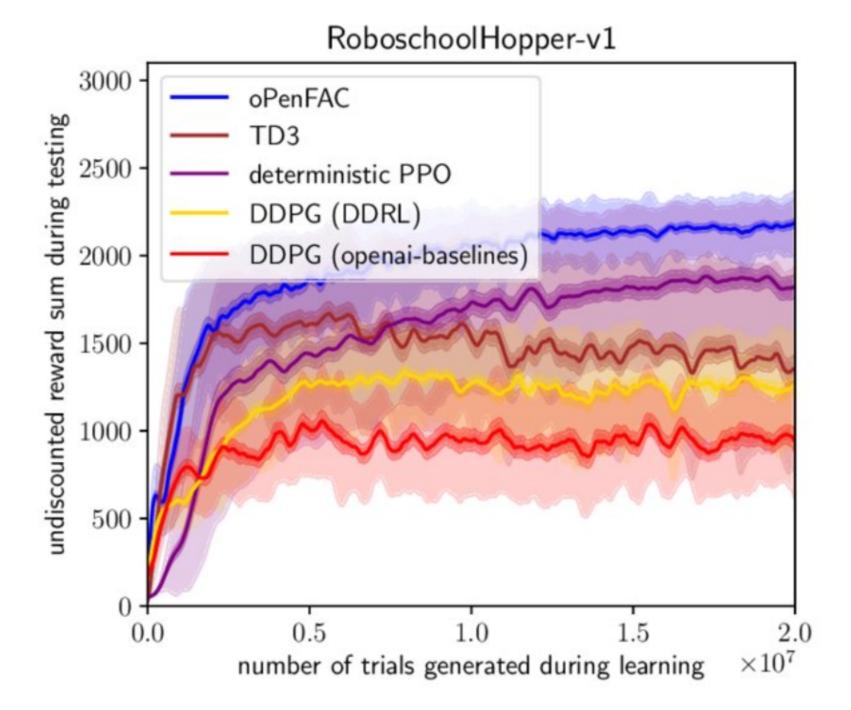


论文调查

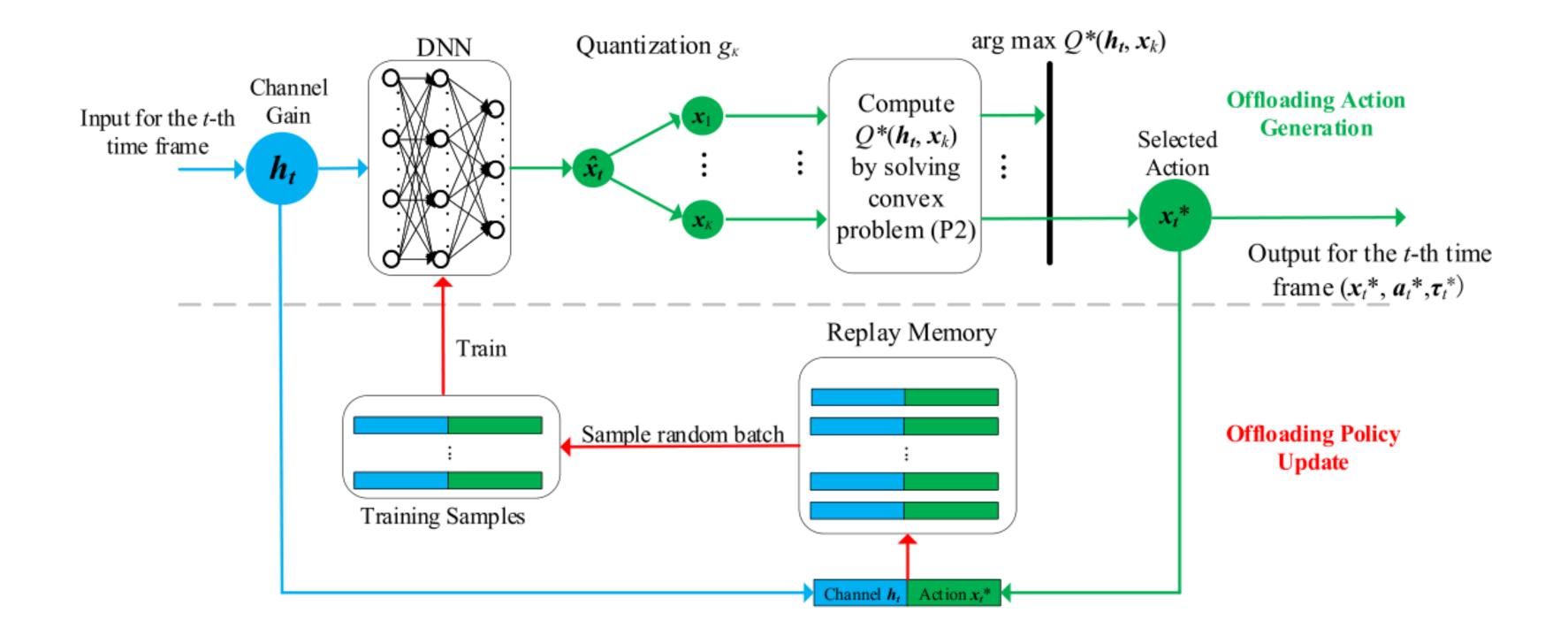
DRL + MEC offloading + Lyapunov + ...

- 1. 现有论文中使用的DRL算法比较落后: REINFORCE、DDPG、A3C、DQN
- 2. 算法框架基本一样, 都是简单的模拟环境+DRL算法
- 3. 优化目标(公平性、效率、安全性、电量)、考虑的环境(多agent、连续、离散、时间分配方式)各有不同

目前先实现基本的框架,根据具体目标进行微调



Modeling method	Centralized/ distributed	Scalability	Static/ dynamic	Achieved objectives
(Non)convex optimization	Centralized	Not scalable	Static	Global offloading optimization
MDP	Centralized/ distributed	Not scalable	Dynamic	Local offloading optimization
Game theory	Distributed	Scalable	Dynamic	Nash equilibrium
Lyapunov optimization	Centralized	Relatively scalable	Static	Offloading optimization Lyapunov drift
Machine learning	Centralized	Scalable	Dynamic	Intelligent decision



模拟实现

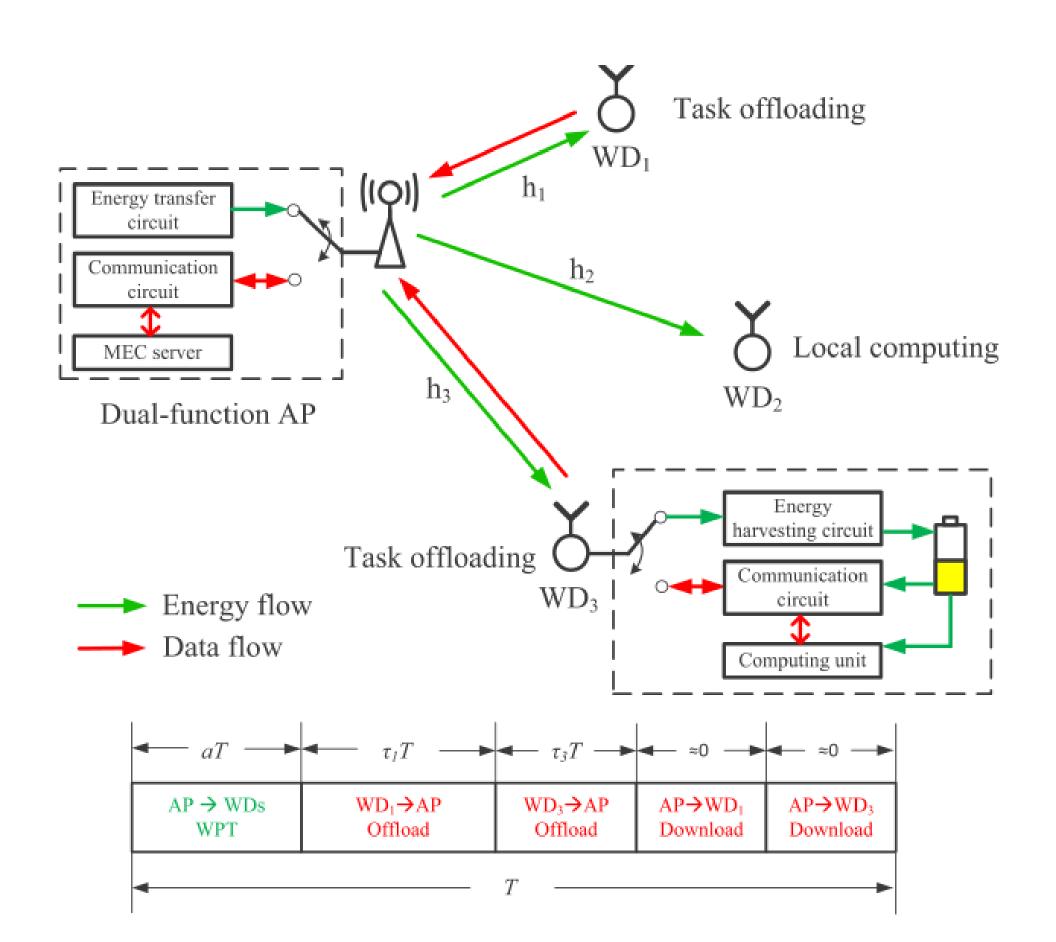
1063 line

已经包含

- 1. 电量消耗
- 2. 处理速度
- 3. 任务缓冲
- 4. 数据传输
- 5. 信道占用

可添加:

- 1. 虚拟机配置
- 2. 位置移动
- 3. 多server



DRL算法

大概1000 line

已包含大部分连续动作空间算法:

■ TD3、PPO、SAC、DDPG

拟实现其他离散空间算法:

■ D3QN、D4PG(连续)

VPG. Vanilla Policy Gradient. 2000 AC. Actor-Critic Methods. 2000

Stochastic Policy

NPG. Natural Policy Gradient. 2002

Trust Region

TRPO. Trust Region Policy Optimization. 2015

GAE. Generalized Advantage Estimation. 2015

Advantage Function
A2C (Advantage Actor-Critic)

A3C. Asynchronous A2C. 2016

Trust Region (approximated, surrogate)
KL Penalty Coefficient

PPO. Proximal Policy Optimization. 2017

Planning (Model-based RL)

MBPO. Model Based PO. 2019
Auxiliary Task (on-policy, off-policy)

PPG. Proximal Policy Gradient. 2020

Energy-Based Policy

SQL. Soft Q-learning. 2017

Maximum Entropy

Automating Entropy Adjustment

SAC. Soft Actor-Critic. 2018

Q-learning. 1992

Q-table → Q net. Experience Replay

DQN. Deep Q Network. 2014

Q net. \rightarrow 2 Q net.

Double DQN. 2016 +Advantage Function

Dueling DQN. 2016

Deterministic Policy

DPG. Deterministic Policy Gradient. 2015

Taming the Noise via soft update. 2015

Greedy-Policy \rightarrow Policy Net.

DDPG. Deep DPG. 2016
D4PG(Distributed Distributional DDPG). 2017

2 Q net. → Twin Critic
Delay Target Update
Policy Smoothing (SPG in DPG)

TD3. Twin Delayed DDPG. 2018

Distributional Perspective

C51 DQN (Categorical 51 grids). 2017

Quantile Regression

QR-DQN. 2017

Prioritized sweeping. 1993 PER. Prioritized Experience Replay. 2016 HER. Hindsight Experience Replay. 2017

All DQN Variances

Rainbow DQN. 2017

Use Monte Carlo Tree Search 2006

AlphaGo. 2015

Without human knowledge

AlphaZero. 2017

Planning using Dynamics Model

Value Prediction Network. 2017

+Atari game (continuous state space)

MuZero. 2019 (Model-based RL)

Ape-X DQN. 2018

Ape-X DPG. 2018

IMPALA. 2018

Seed RL. 2020

后续工作

优化目标

将现有论文中的

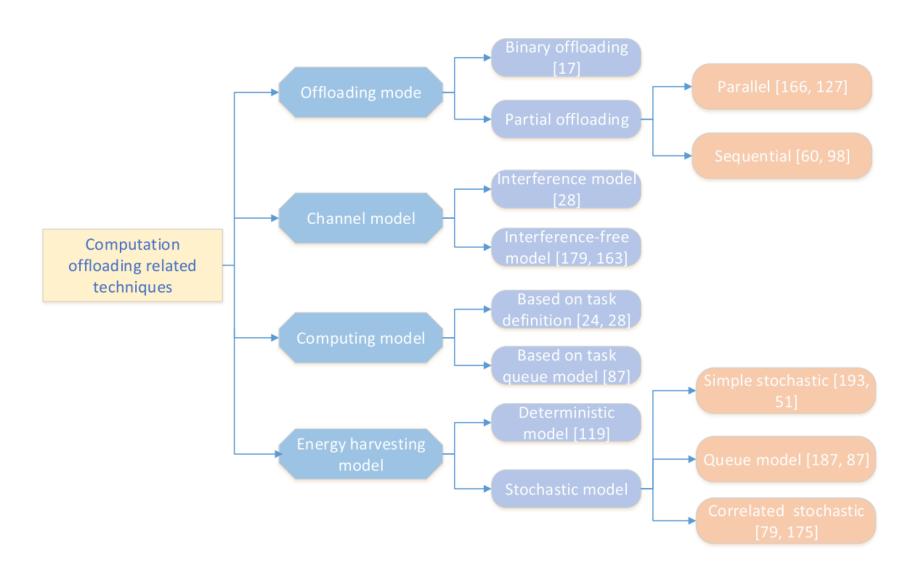
- 优化目标
- 考虑的要素
- 理论阐述
- 环境配置

进行总结找出比较好的优化目标进行微调

实验

■ baseline: 贪心、穷举、无调度、线性松弛、DQN

discrete: D3QN, Rainbow



总结

基本实现实验框架,包含模拟环境和调度算法

后续工作:

- 1. 选择更新颖的优化目标和环境设置
- 2. 调参、基线实验