工作进度报告

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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做了什么?

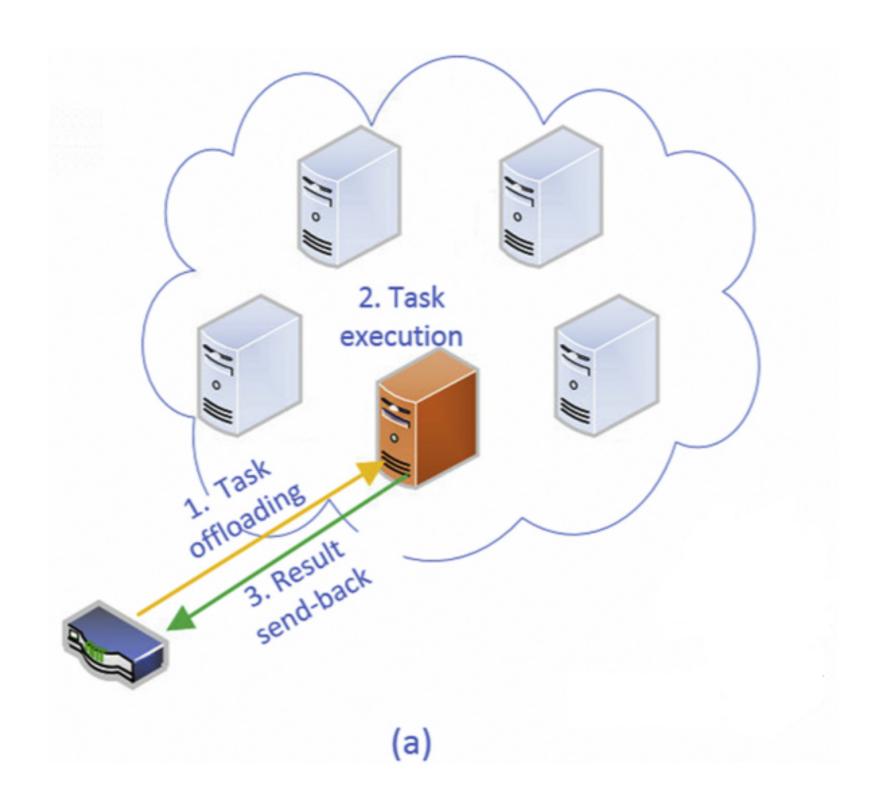
- 1. 调查20几篇DRL+任务卸载的论文
- 2. 编写完成基本的实验框架,包含
 - 1. 边缘计算任务卸载的模拟环境
 - 2. 使用较先进的DRL算法: T3C、SAC、PPO进行调度

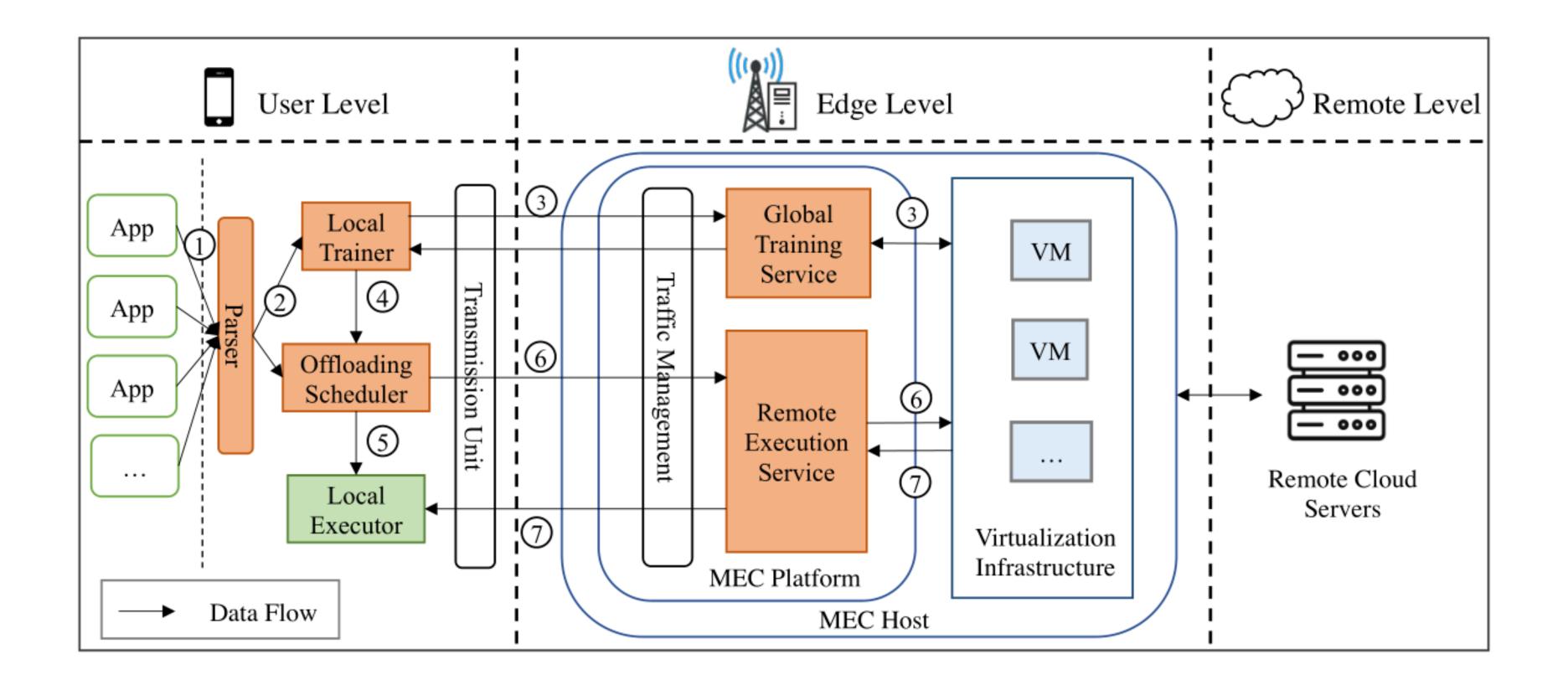
工作计划

- 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 2 week
 - 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 简介

- 1. 云计算的不足
- 2. 工厂、AR游戏...
- 3. 任务调度: 最优化问题
 - 1. 传统方式(凸优化、非凸优化)、遗传算法
- 4. game theory 3. 深度强化学习算法:速度快、泛化性强
- 5. $\min_{(\mathbf{a})} \quad Time + Battery, \ s.t. \quad a_i \in \{0,1\}, orall i \in \mathcal{M},$



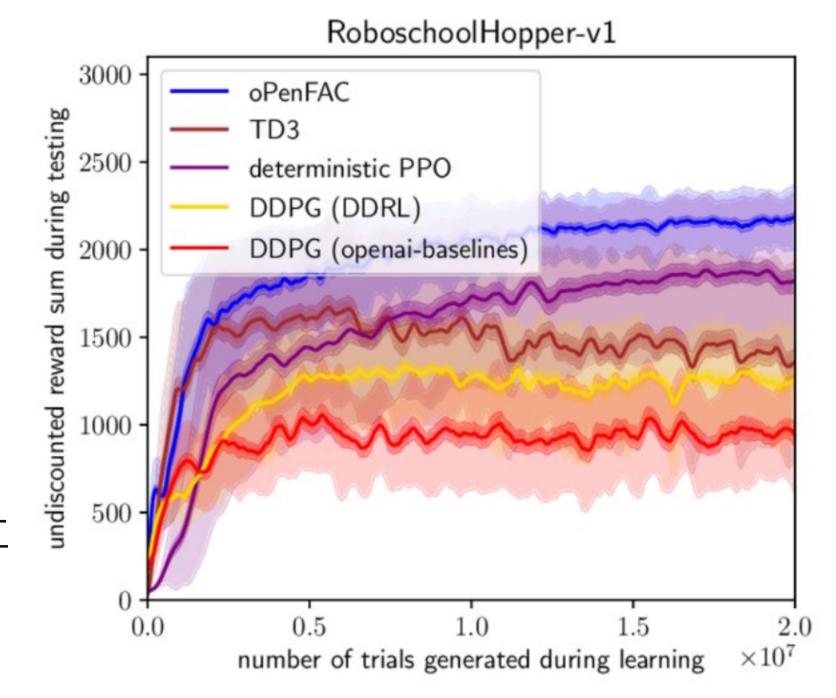


已读论文

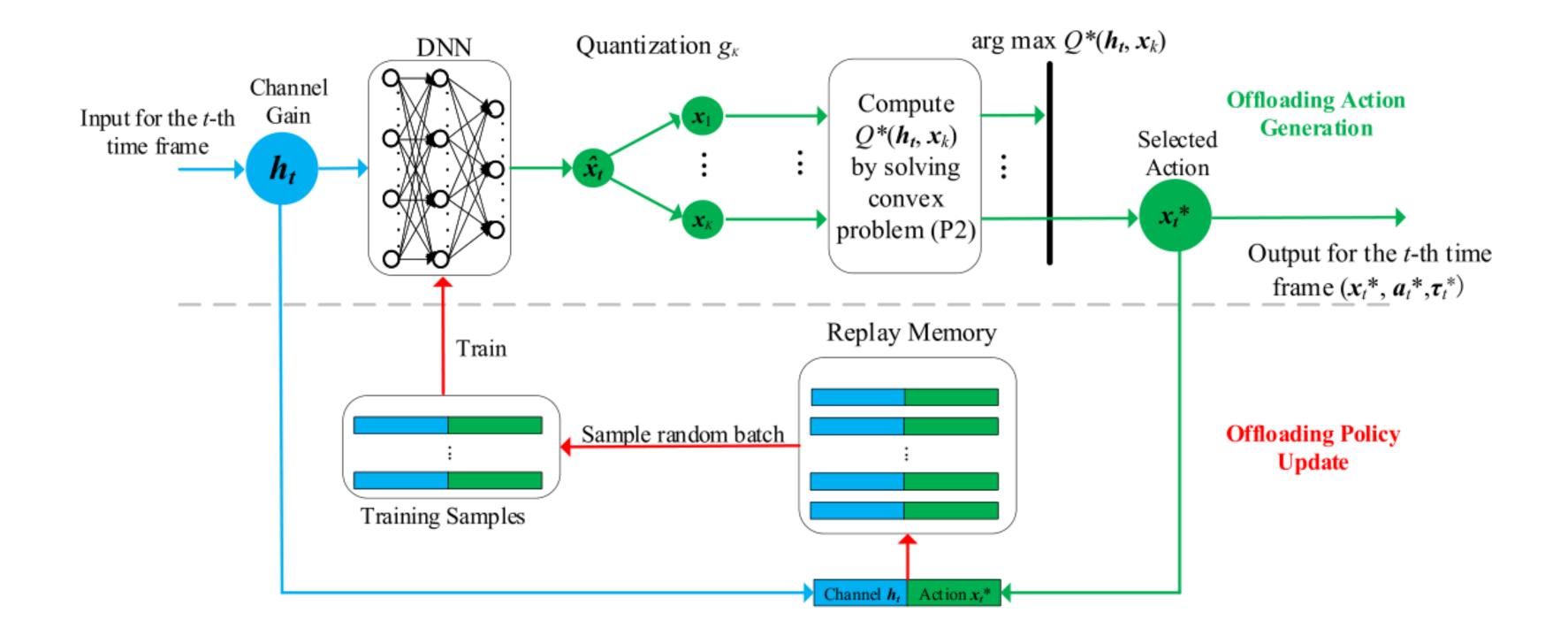
DRL + MEC offloading + Lyapunov + ...

- 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
- 4. 通过算法中的微调,lyapunuv 或 np-hard证明增加工作量

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

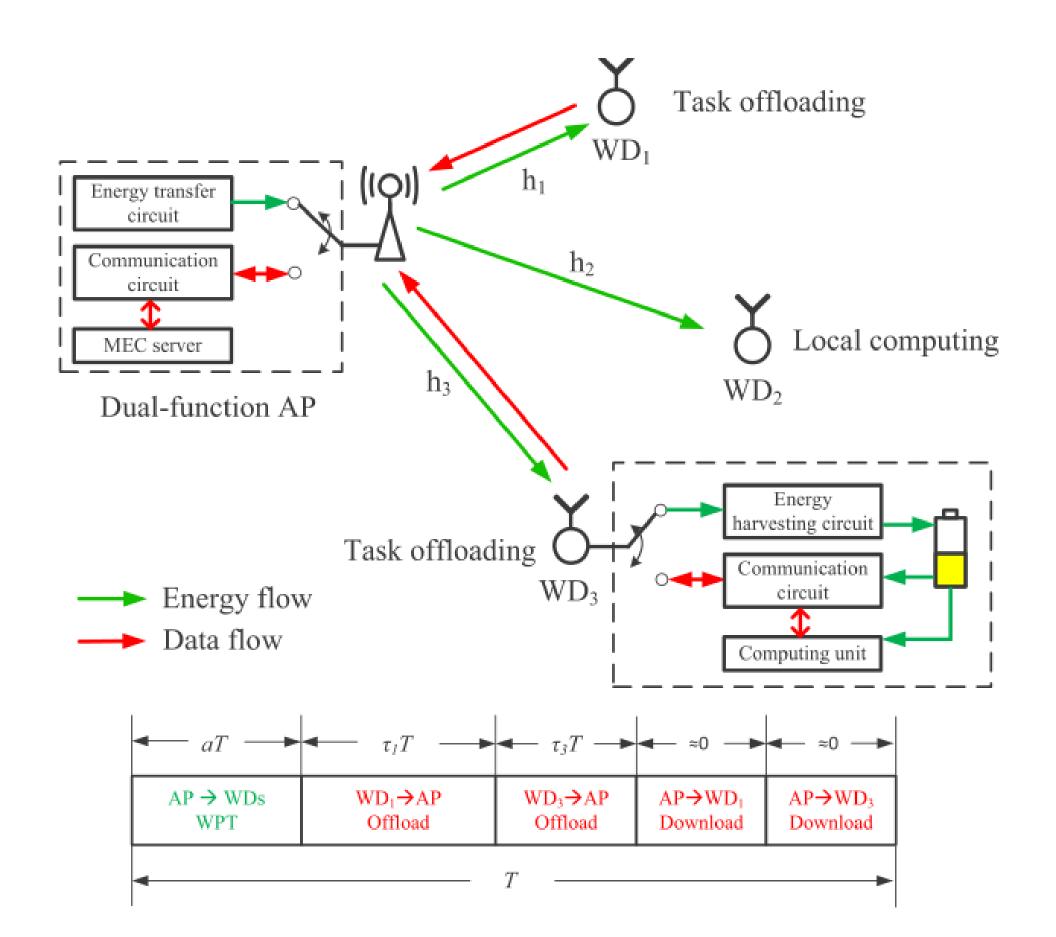
1063 line

已经包含功能特性

- 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

拟添加:

- 1. 虚拟机配置
- 2. 位置移动
- 3. 多server



DRL算法

~1000 line

已包含大部分连续动作空间算法:

■ TD3、PPO、SAC、DDPG

拟实现其他算法:

■ D3QN (离散)、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

后续工作计划

较新颖的优化目标

将现有论文中的

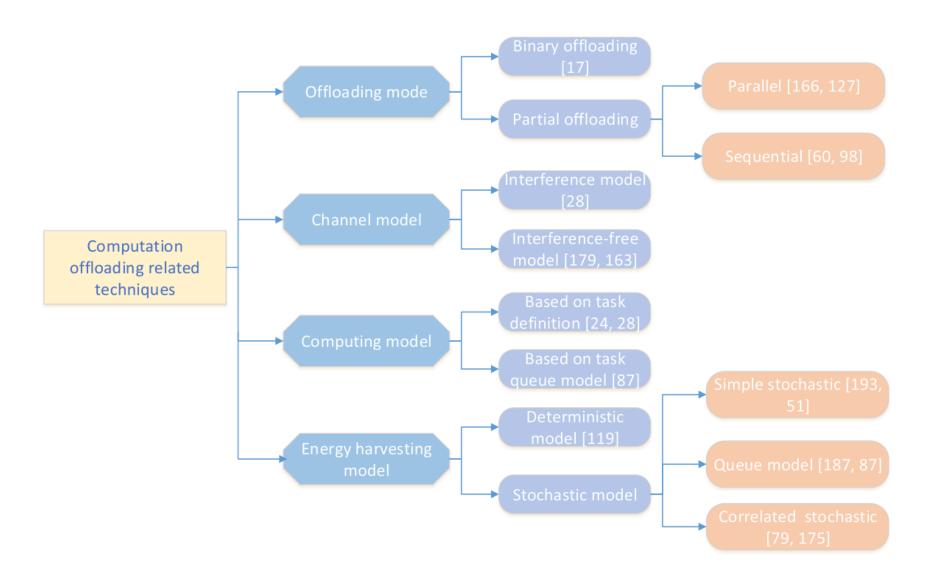
- 优化目标
- 特性(距离变化、连续时间片)
- 卸载模型
- 数学理论
- 环境配置

进行总结,找出比较好的优化目标,对现有算法进行调整

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

问题

- 1. 时间安排
- 2. Lyapunov + 高级算法 + 许多数学公式似乎质量不高