DeepAPP: A Deep Reinforcement Learning Framework for Mobile Application Usage Prediction

Presentation by Millie

Introduction

- Predicting the applications (apps) that a mobile user may use in next time slot can provide many benefits: app pre-loading ,content pre-fetching and resource scheduling.

- For instance, by knowing the apps a user may open in next 5 minutes, we can pre-load the apps in memory slightly in advance and improve user experience with minimized launch time.

- Most existing app prediction works can only provide limited prediction accuracy for some reasons.

- We develop a Deep Reinforcement Learning (DRL) framework, named as DeepAPP, to learn a data-driven model-free neural network, which takes the environment context as input and predicts the apps that will be opened next.

MOTIVATION

- Need for app prediction
  - 76.63 % thought it takes a long time from clicking on an application icon to start using the application; 90.77 % are willing to use a software to reduce waiting time of application loading.
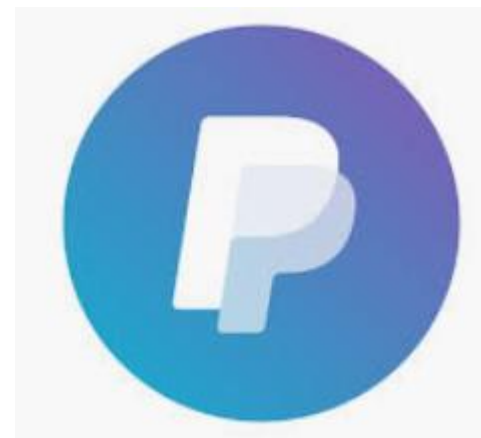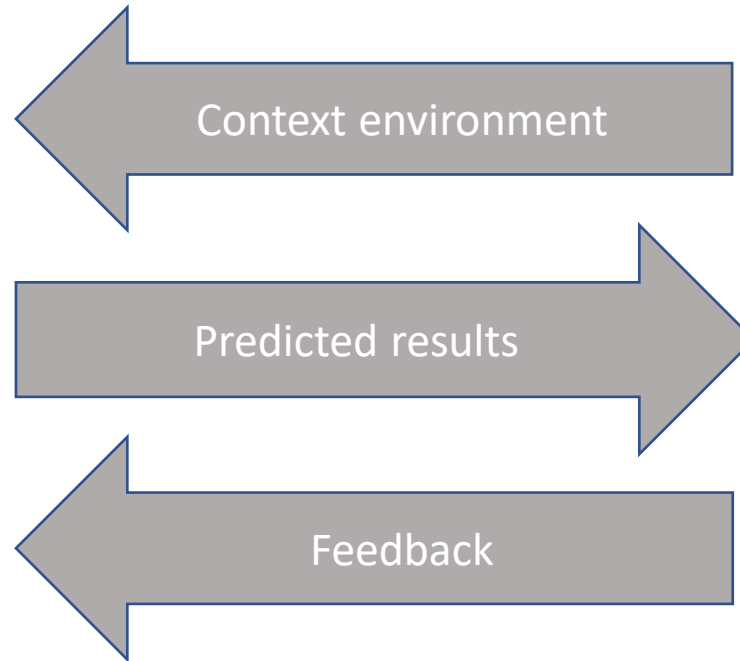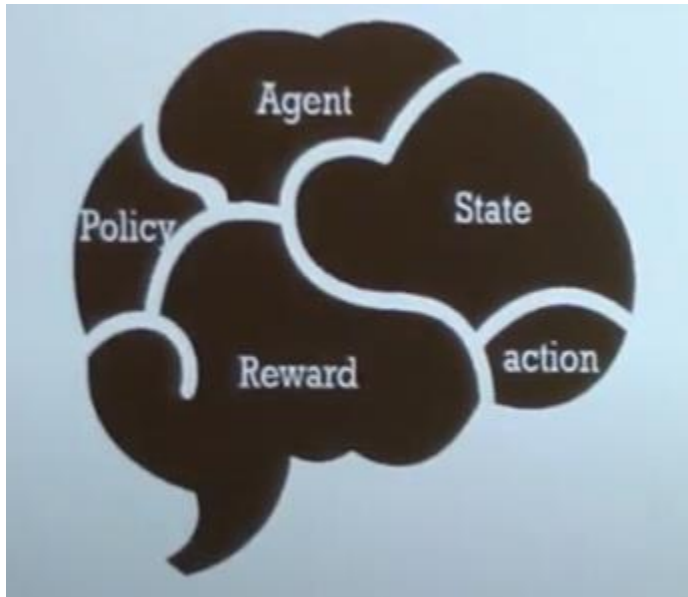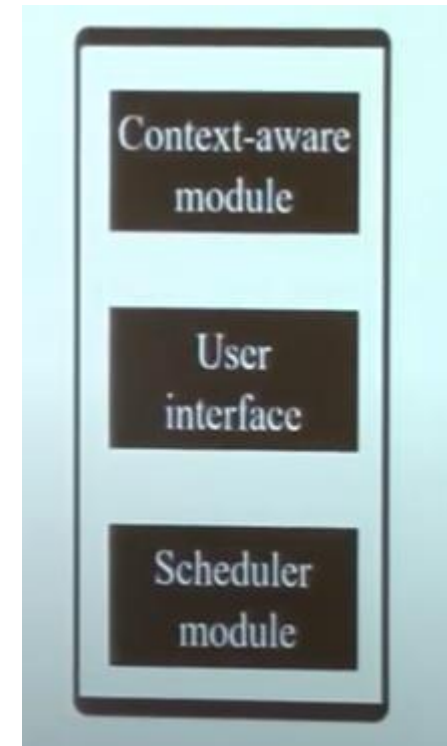
Deep Reinforcement Learning (DRL)
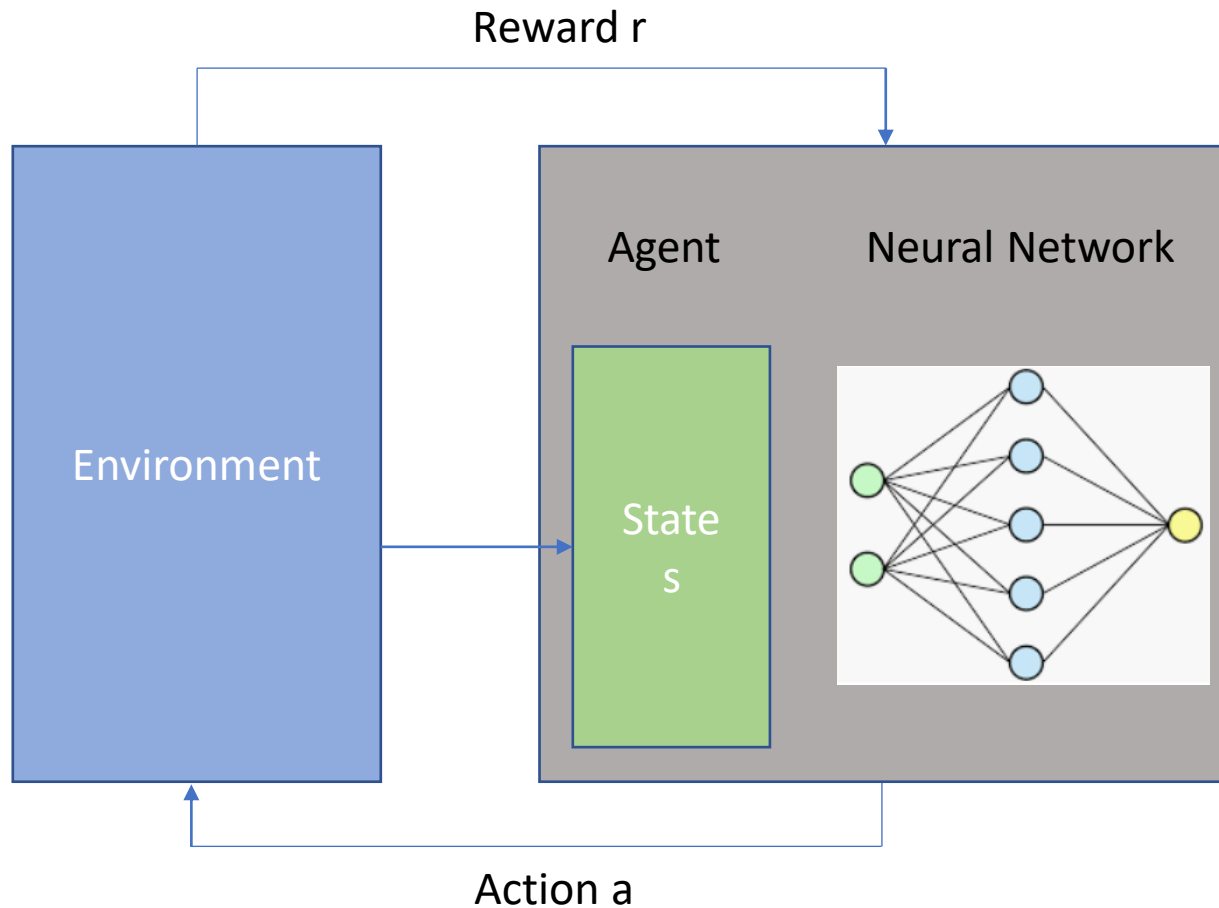
- **State**: current app, context and time
- **Action**: a combination of multiple apps
- **Policy**: a mapping from the state space to the action space

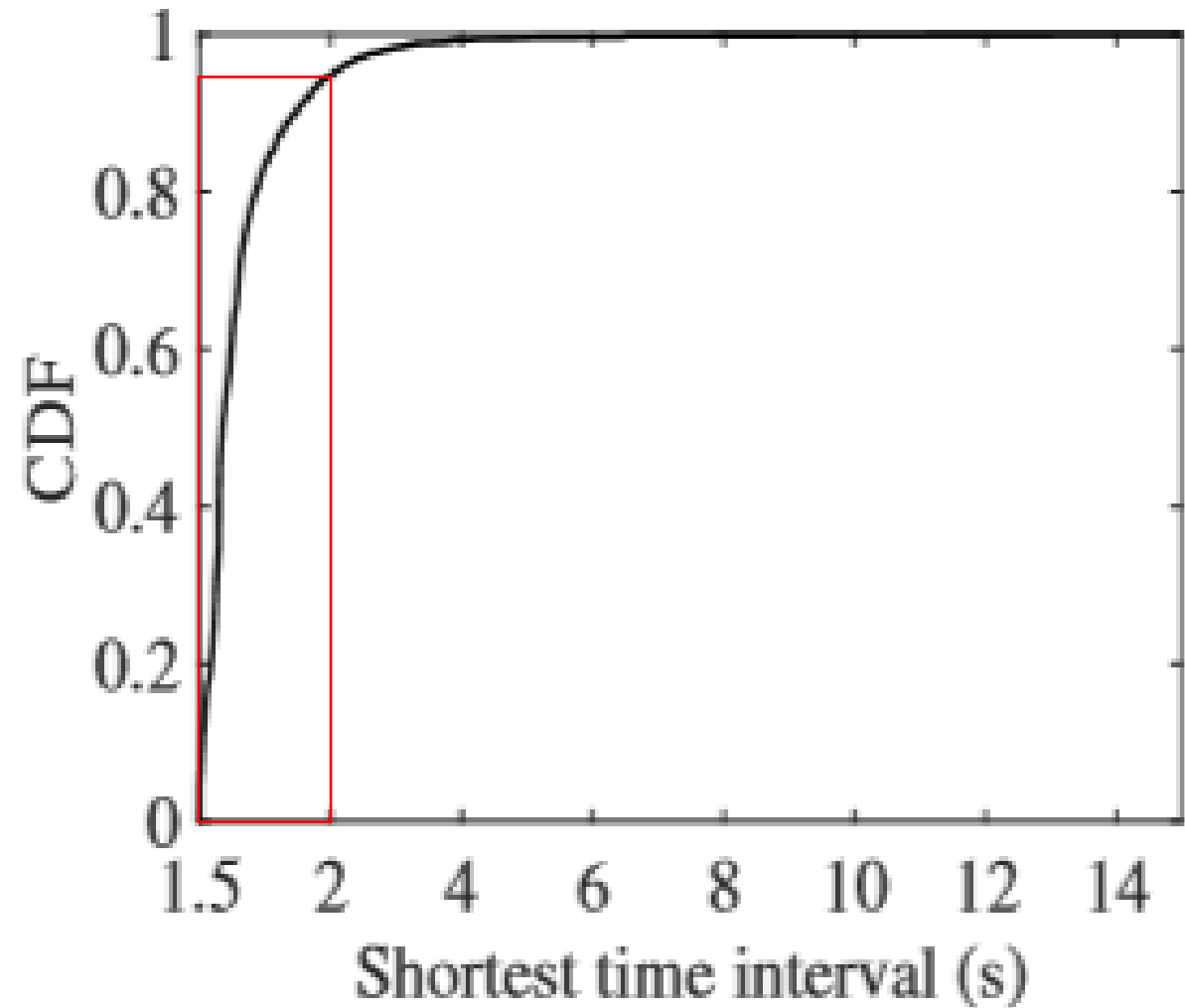# Workflow of DeepAPP

App prediction agent

Mobile Phones
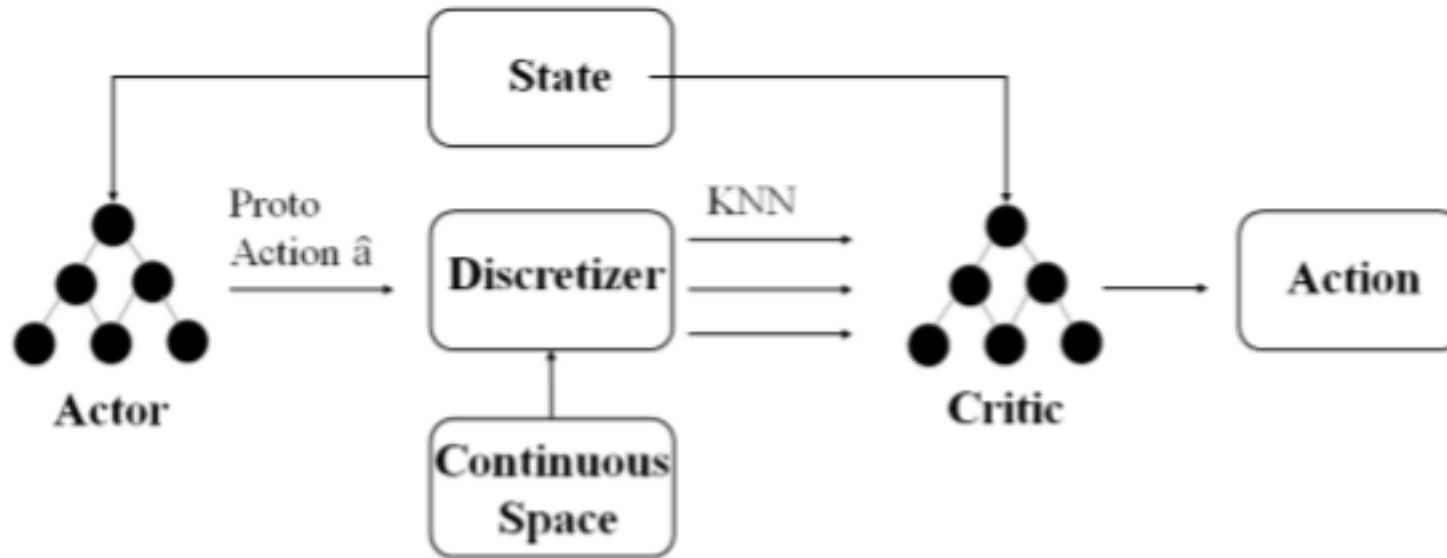

Context environment

Predicted results

Feedback

Challenge 1: Real-time prediction

- 443 random users

- 21 days

- 95% of users switched to another app in 2 seconds
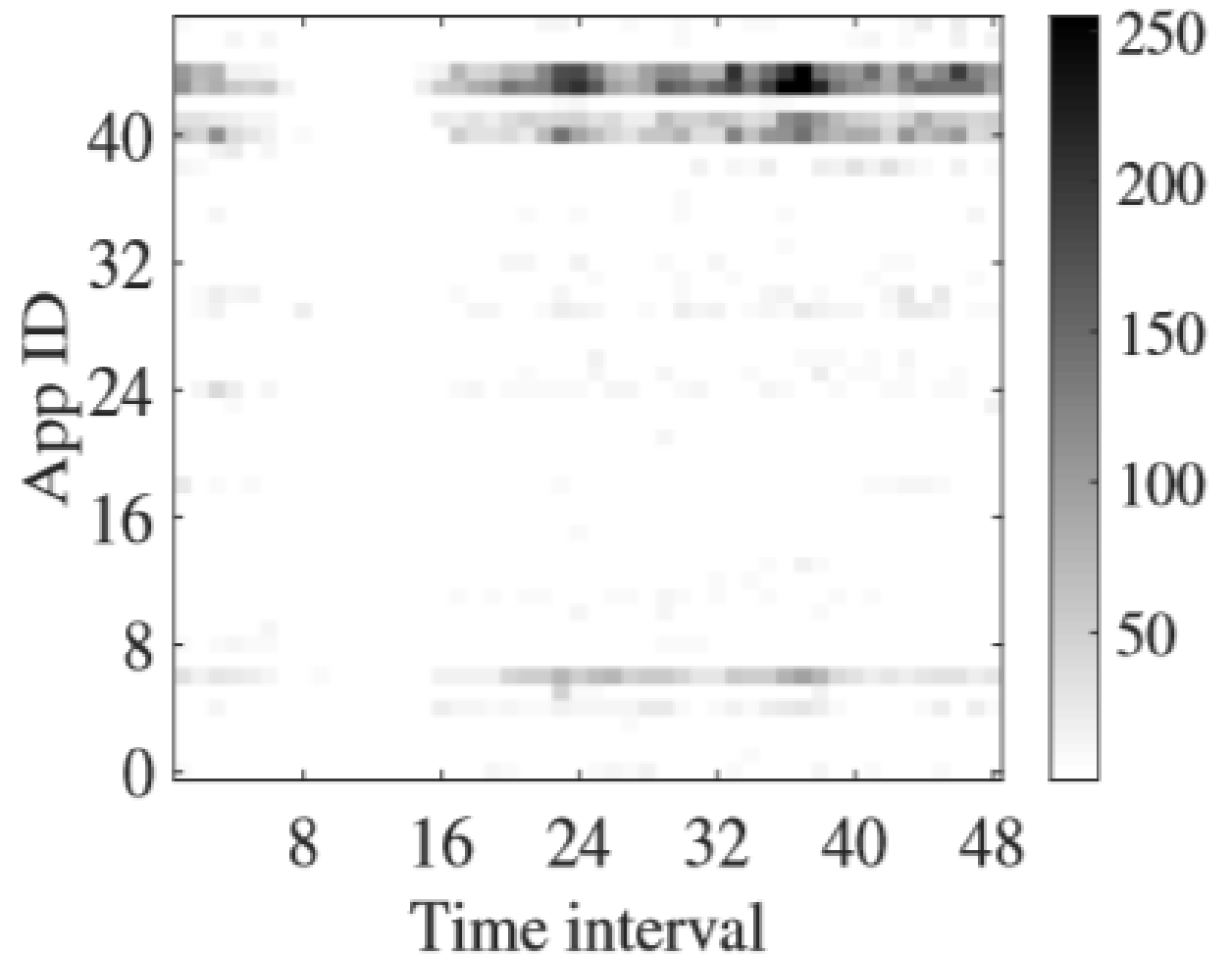
- --we need real-time prediction
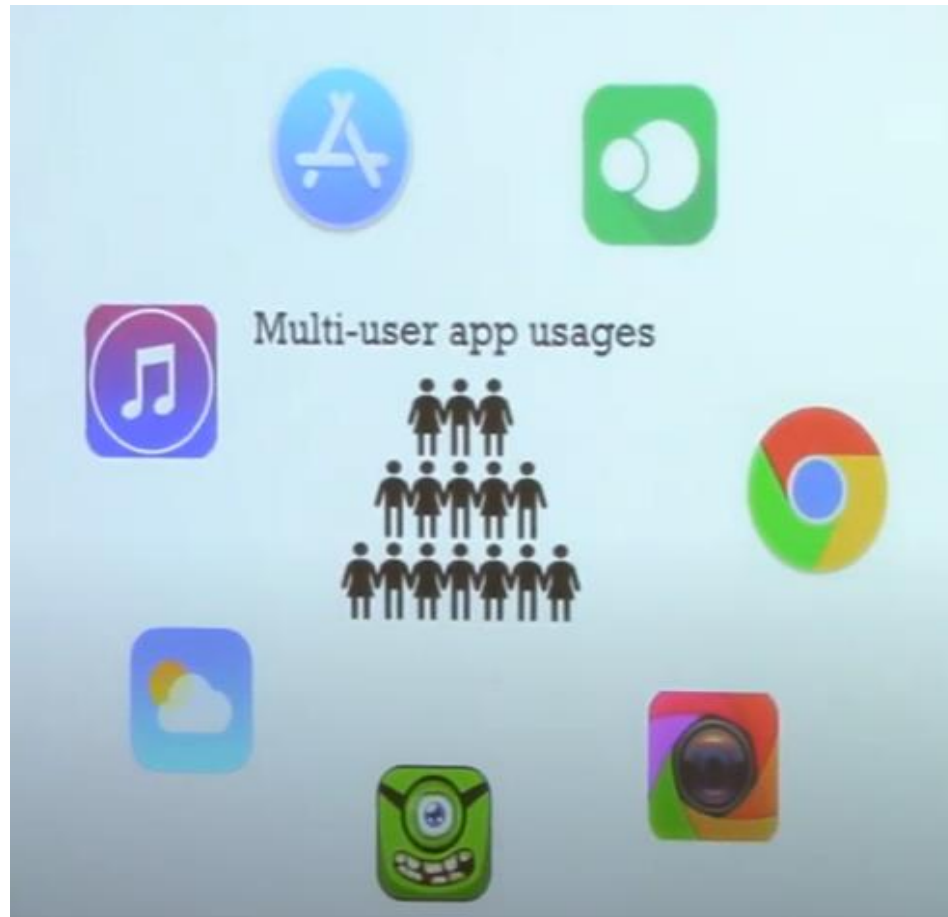
Solution – Fast Prediction
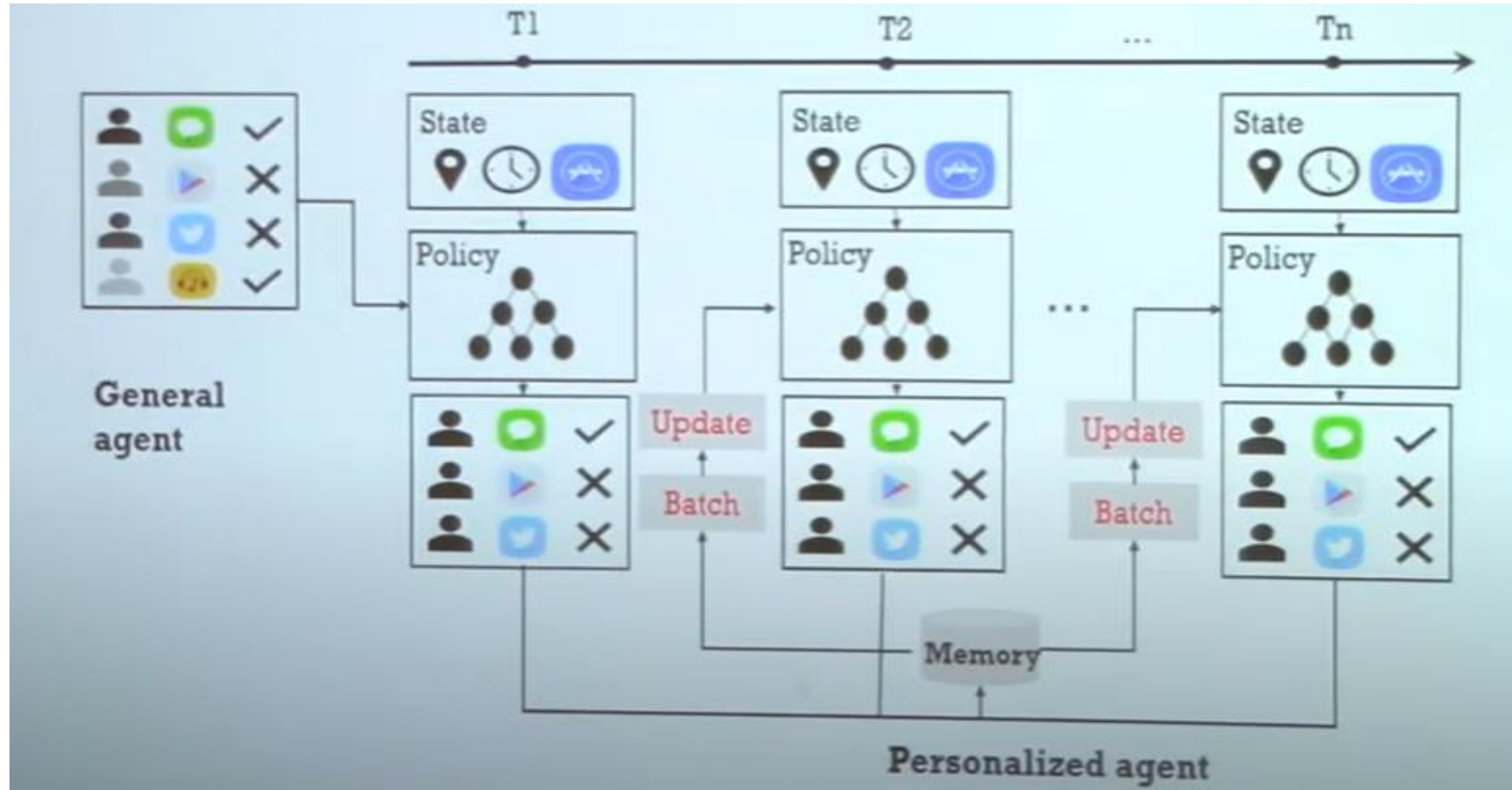
Challenge 2: sparse app usage

- 1 anonymized user

- 7 days

- No sufficient training data

- app usages are scattered over the time intervals. If we always predict those apps with higher frequency, this sometimes affects the performance

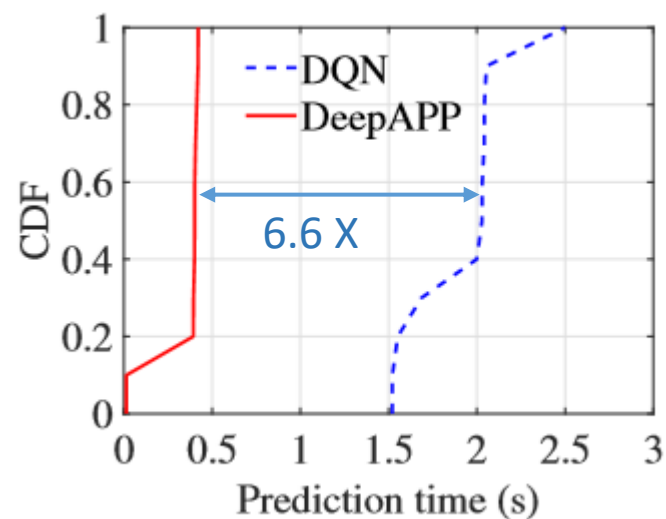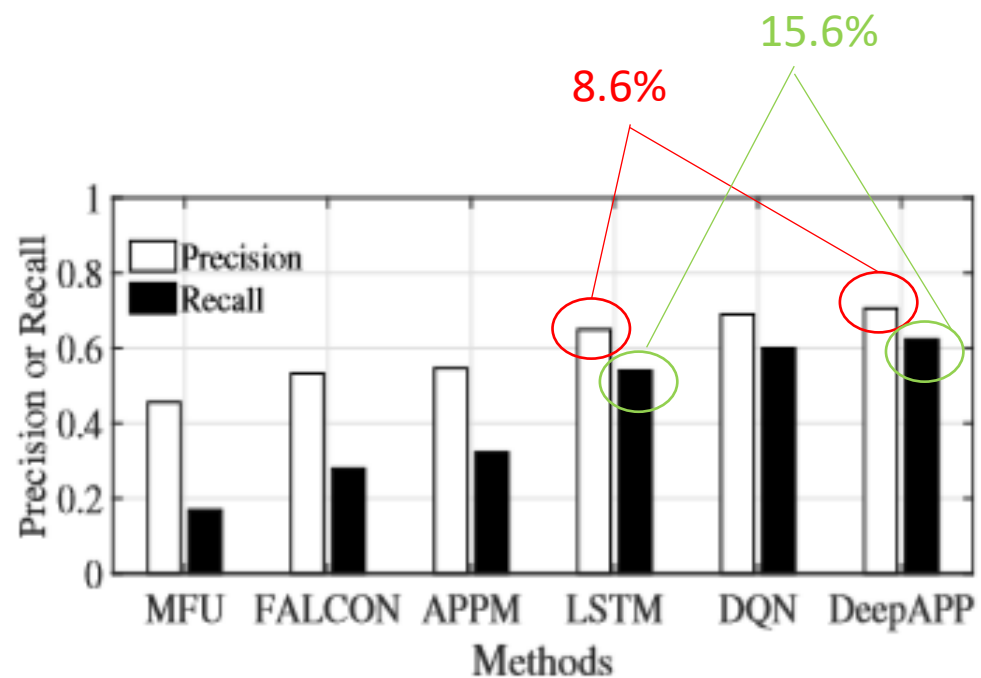# Solution – General &Personalized Agents

# Solution – Personalized agent updating

Data-Driven Evaluation

- Dataset:
  - 443 users
  - 3 weeks: 2 for training + 1 for validation
- Prediction accuracy
- Evolution of prediction accuracy over time
- Performance gain of the context-aware state

Evaluation

Field Study

- Participants:
  - 29 (13 females and 16 males)
  - Students, teachers, and employees
  - Aged from 19 to 49
  - Duration: 17 sep.2018 – 10 nov.2018
- Goals:
  - Measuring the in-field accuracy
  - Evaluating the real user experience
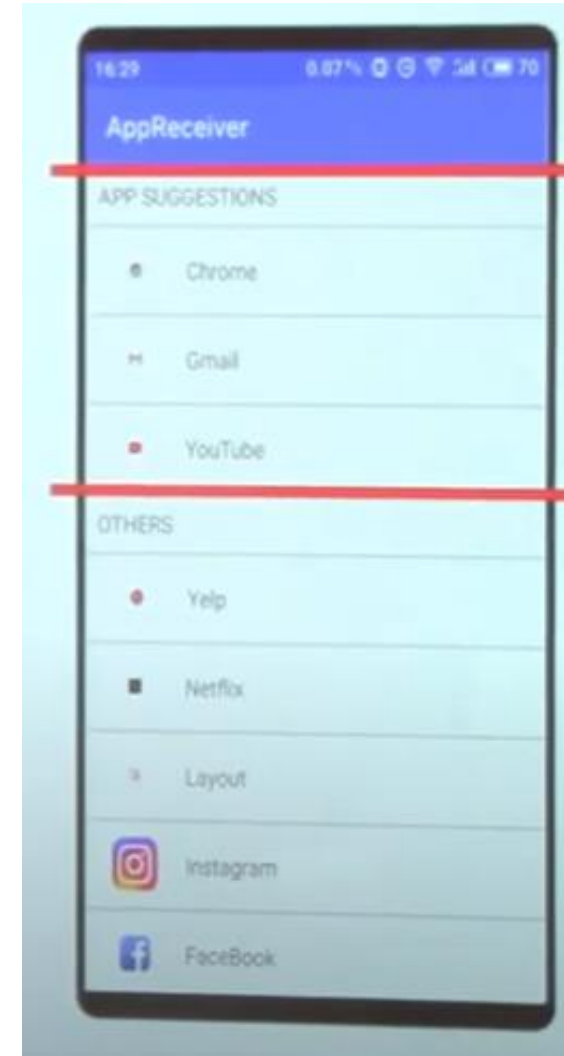
Results

- 87.51% of users are satisfied with our DeepApp prediction system
- 71.88% of participants agree that the DeepApp can save their time of launching apps by preloading our predicted apps into the memory.

Discussion

- Deployment cost
- Privacy issues

End

THANK YOU!