# Platform-Agnostic Lightweight Deep Learning for Garbage Collection Scheduling in SSDs

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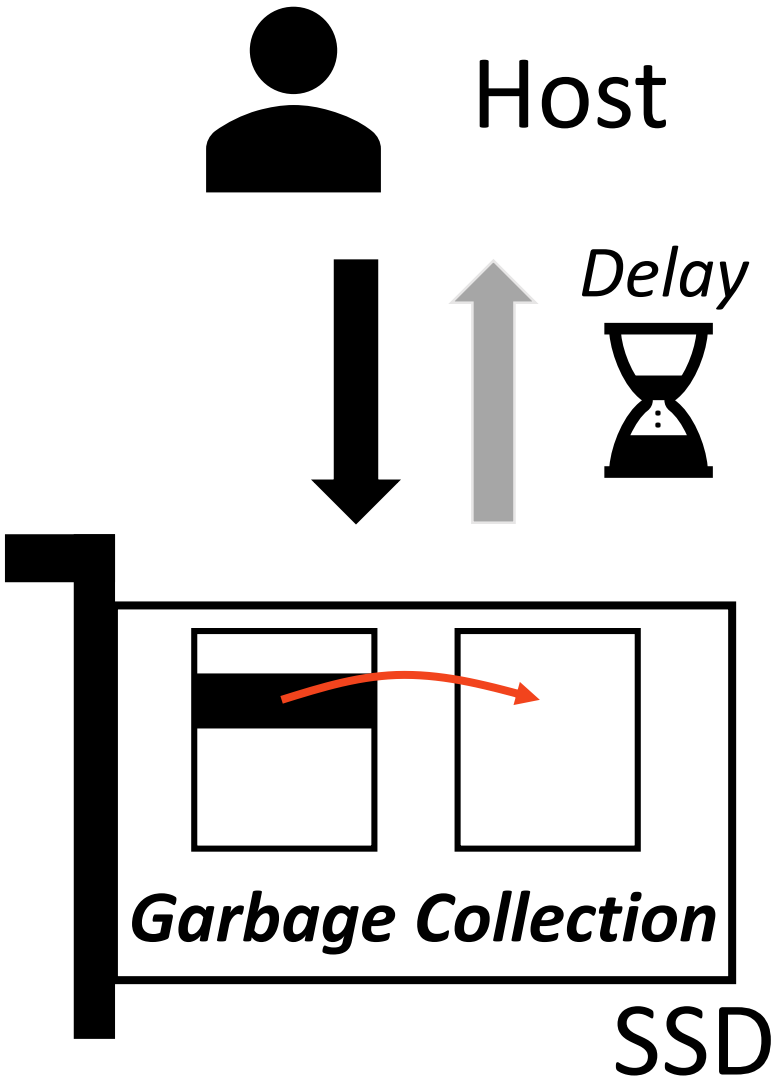
# Motivation




NAND Flash density
(pages / block)

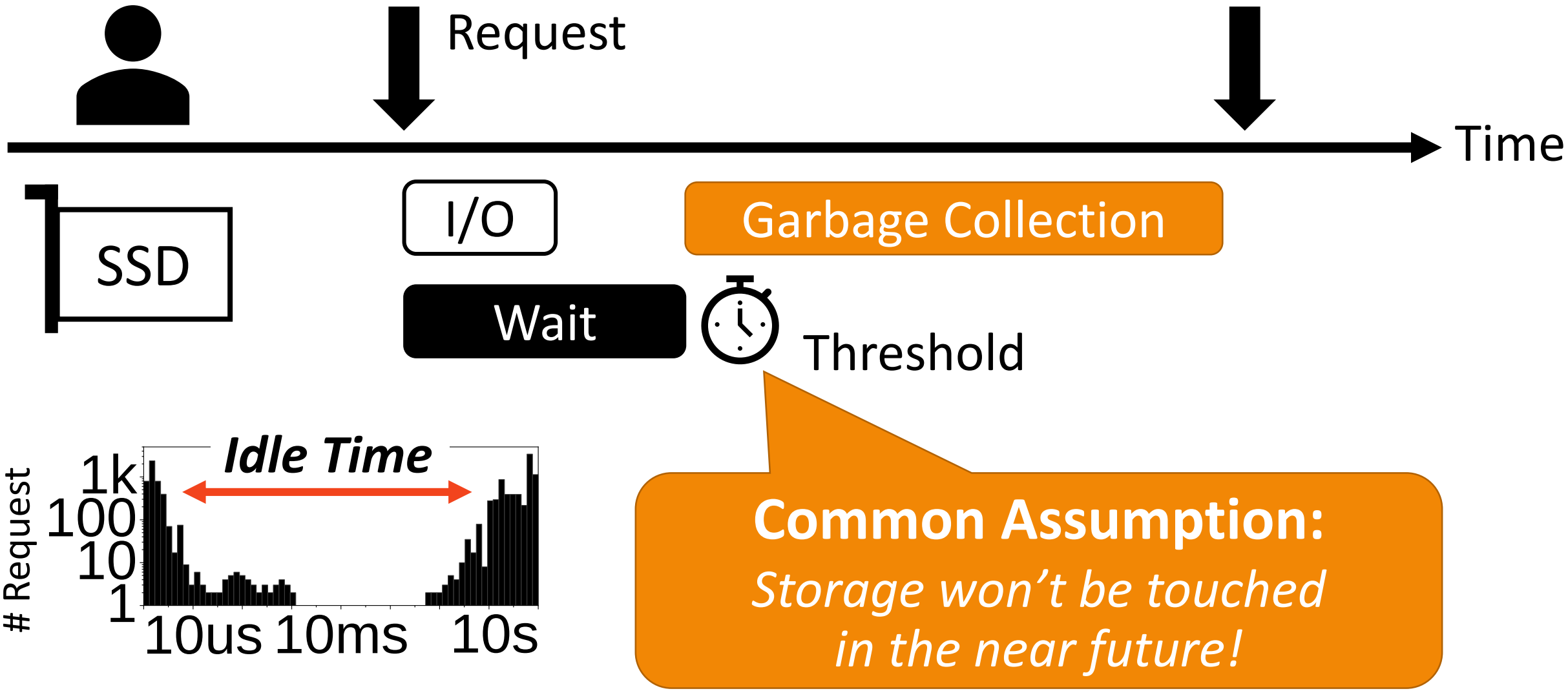
More GC overhead

How to hide GC latency?

- Let's perform GCs at user idle times!

***How long will be the user idle times?***

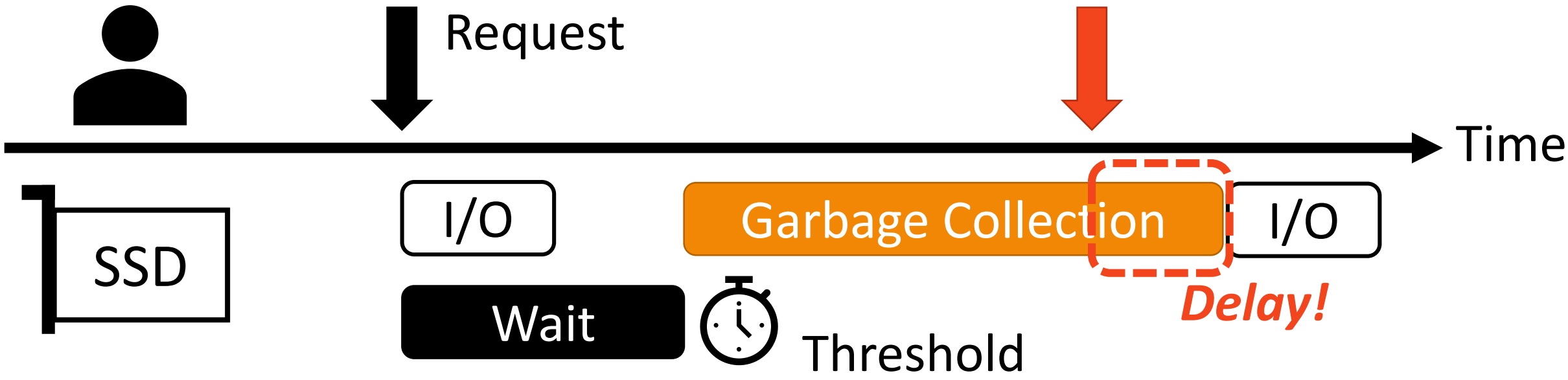
# Hiding GC latency : Background GC

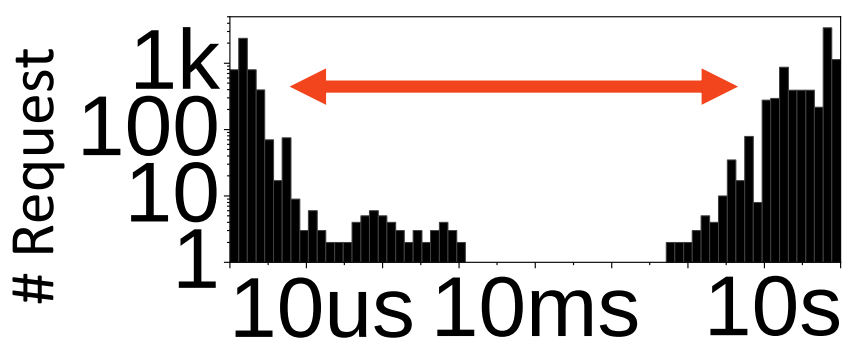



**Common Assumption:**

*Storage won't be touched in the near future!*

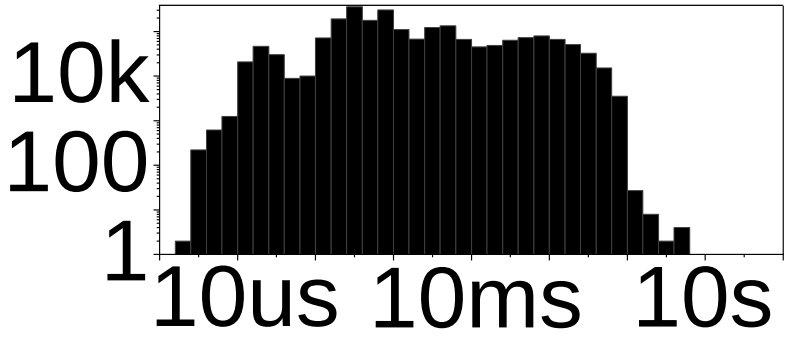
# Hiding GC latency : Background GC




Assumption

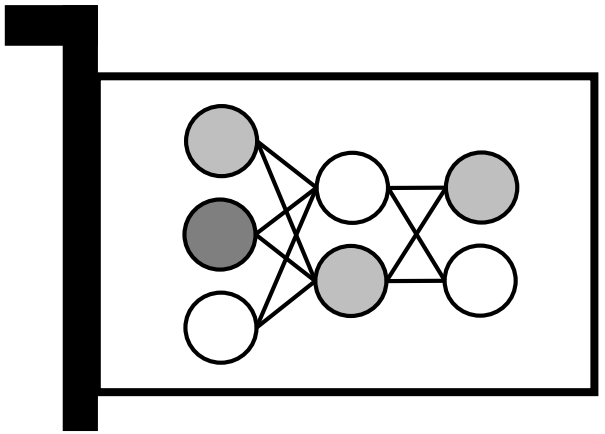
≠




Real workload*

*Real workload from MS Production Server (https://trace.camelab.org/)

# GC-Tutor

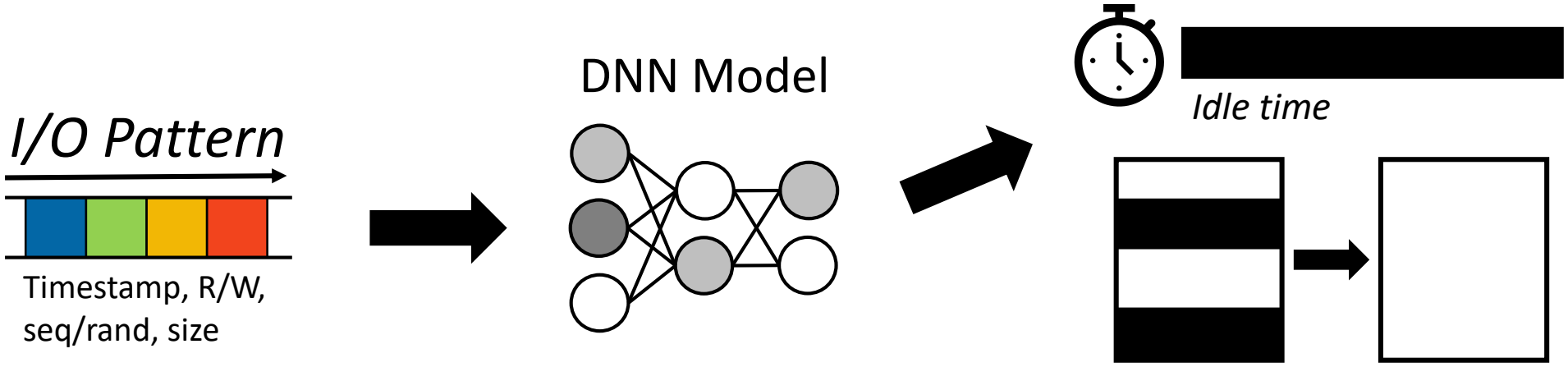


## *DNN-based GC scheduler*

- Precisely predict future request arrivals
- Schedules GC in user-invisible time

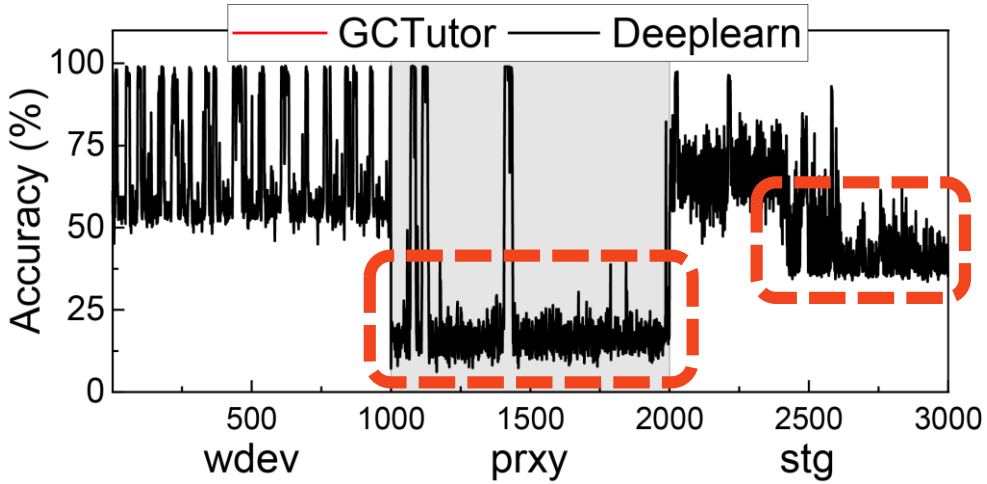
- Consistently accurate regardless of workload with lightweight online learning mechanism

# DNN-based GC Scheduling




DNN-based Idle Time Prediction

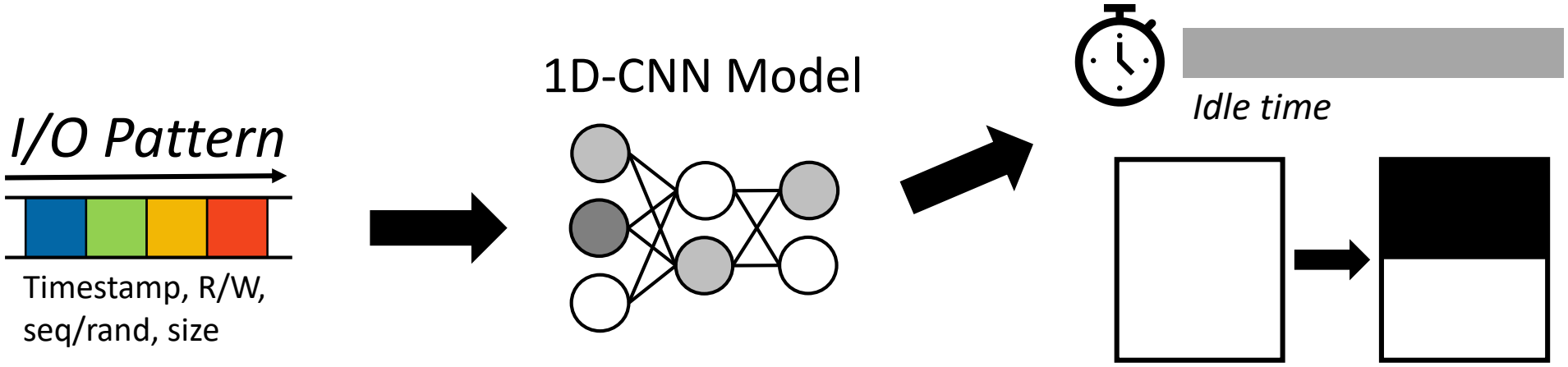
Background GC




Problem :

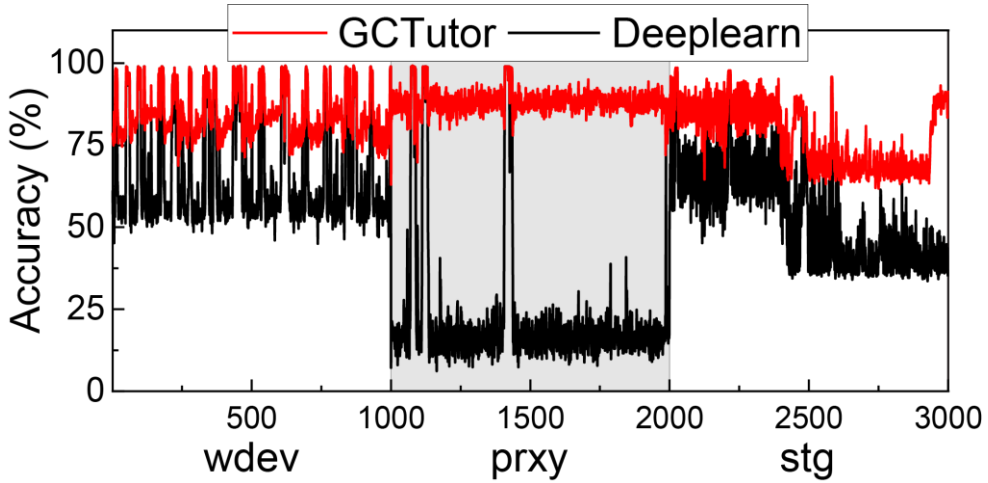
*A fixed DNN model fails to predict unseen workloads*

# DNN-based GC Scheduling




DNN-based Idle Time Prediction

Background GC



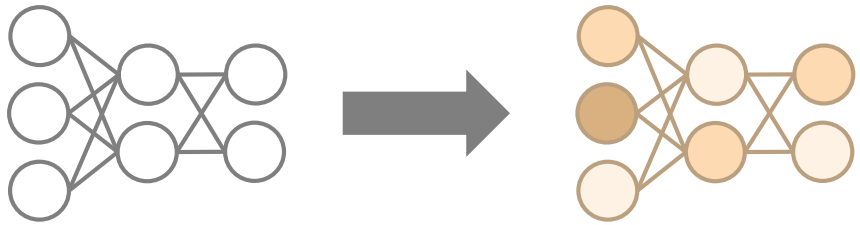

Problem :

*A fixed DNN model fails to predict unseen workloads*

*Online Learning!*

# Lightweight Online Learning

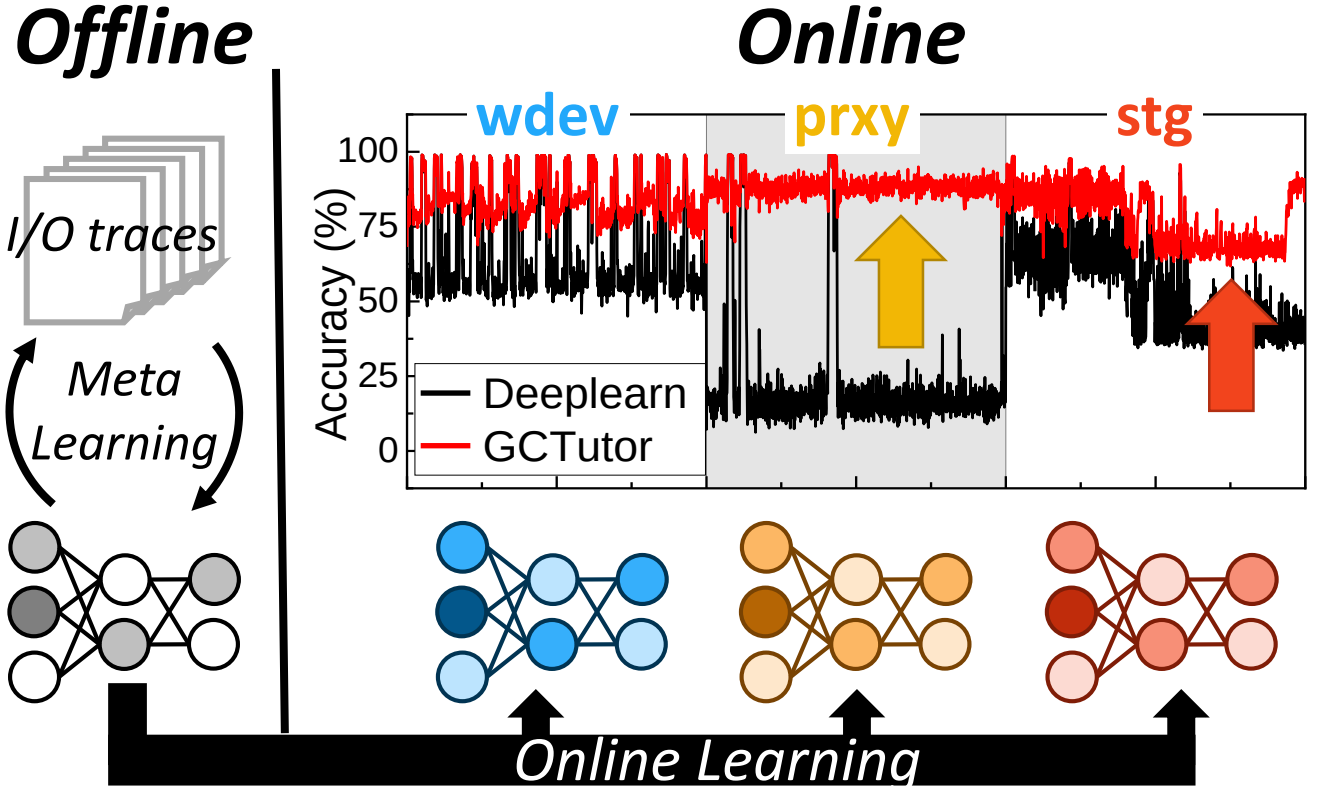
## *Naïve*



Takes more than a few hours

***Infeasible!***

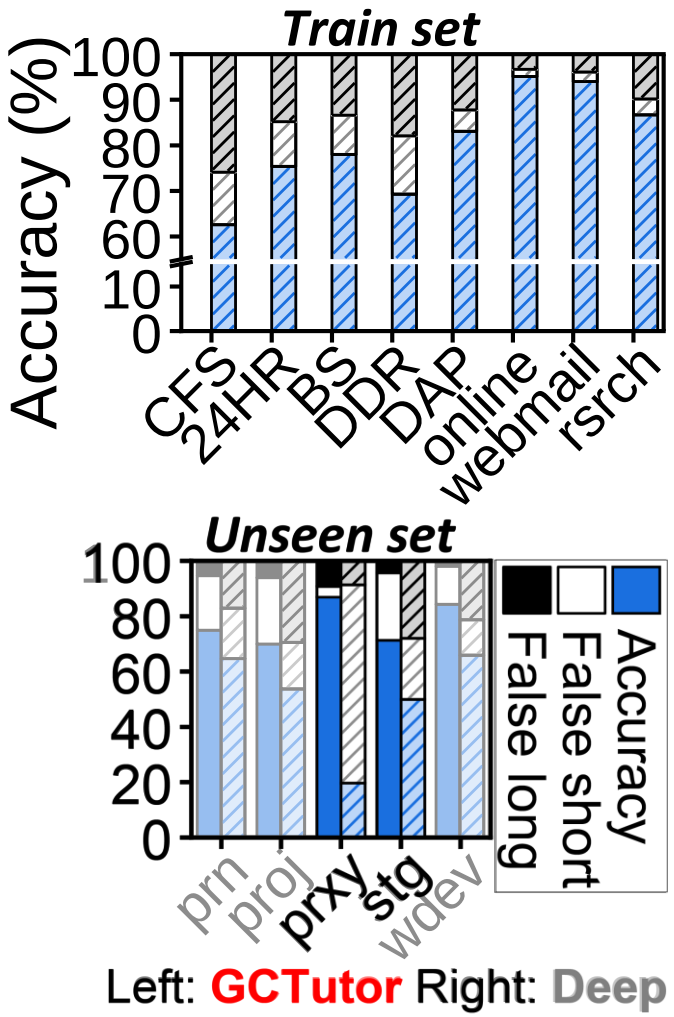
## *Meta Learning**





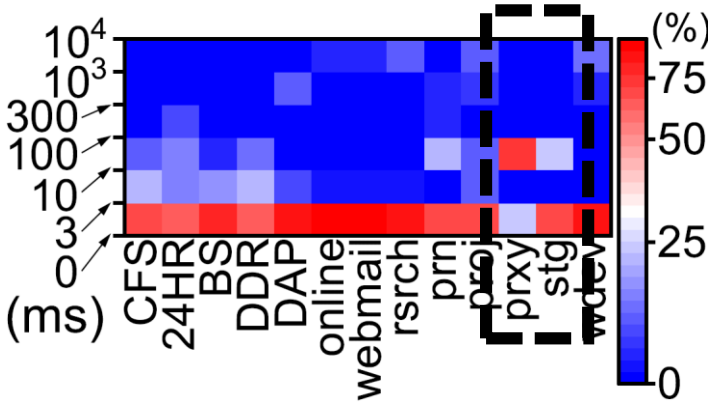

*Chelsea Finn, et al., Model Agnostic Meta Learning for Fast Adaptation of Deep Networks, ICML 2017

# Evaluation



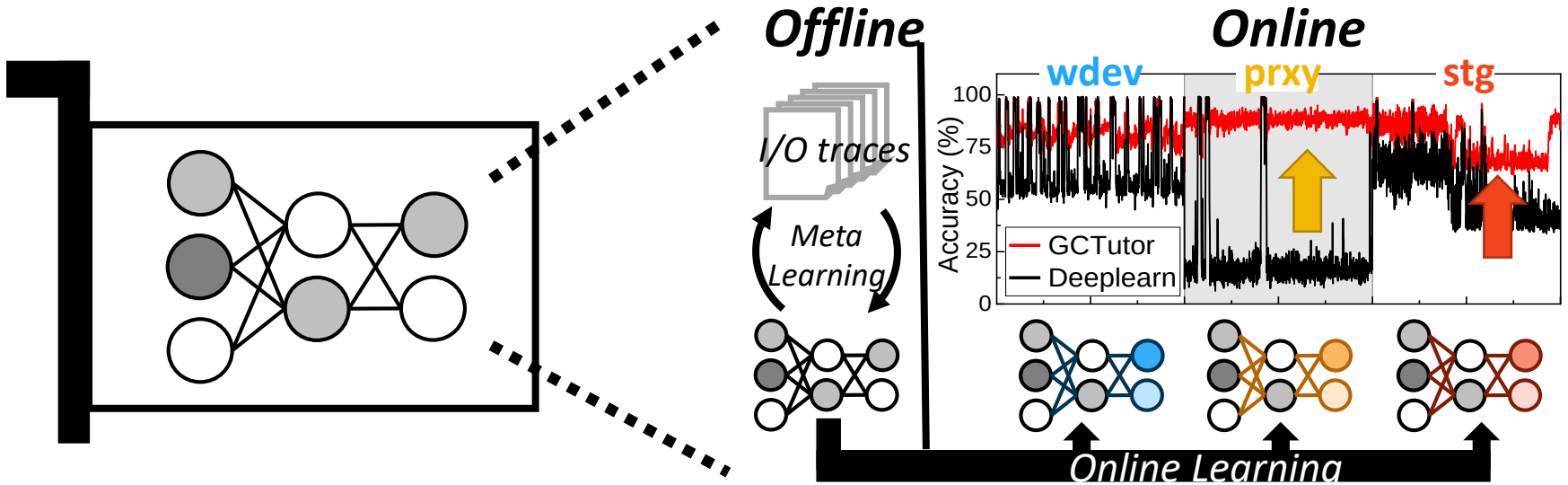

*GC-Tutor can accurately predict idle time*

- Consistently higher accuracy on trained workloads
- Significantly higher accuracy on unseen workloads
  - prxy, stg :
    Very different idle time distribution compared to trained workloads




*GC-Tutor can reduce GC-induced delays by 82.4%,*
on average, compared to rule-based GC scheduler

# Conclusion : GC-Tutor




DNN-based GC scheduler

- Accurate request arrival prediction using DNN model
- Meta learning-based light-weight online learning mechanism

***Making GC overhead invisible to users!***

# Thank you!

Junhyeok Jang

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