Microservice-tailored Generation of Session-based Workload Models for Representative Load Testing

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Representative Load Testing Lacks in Support for Microservices
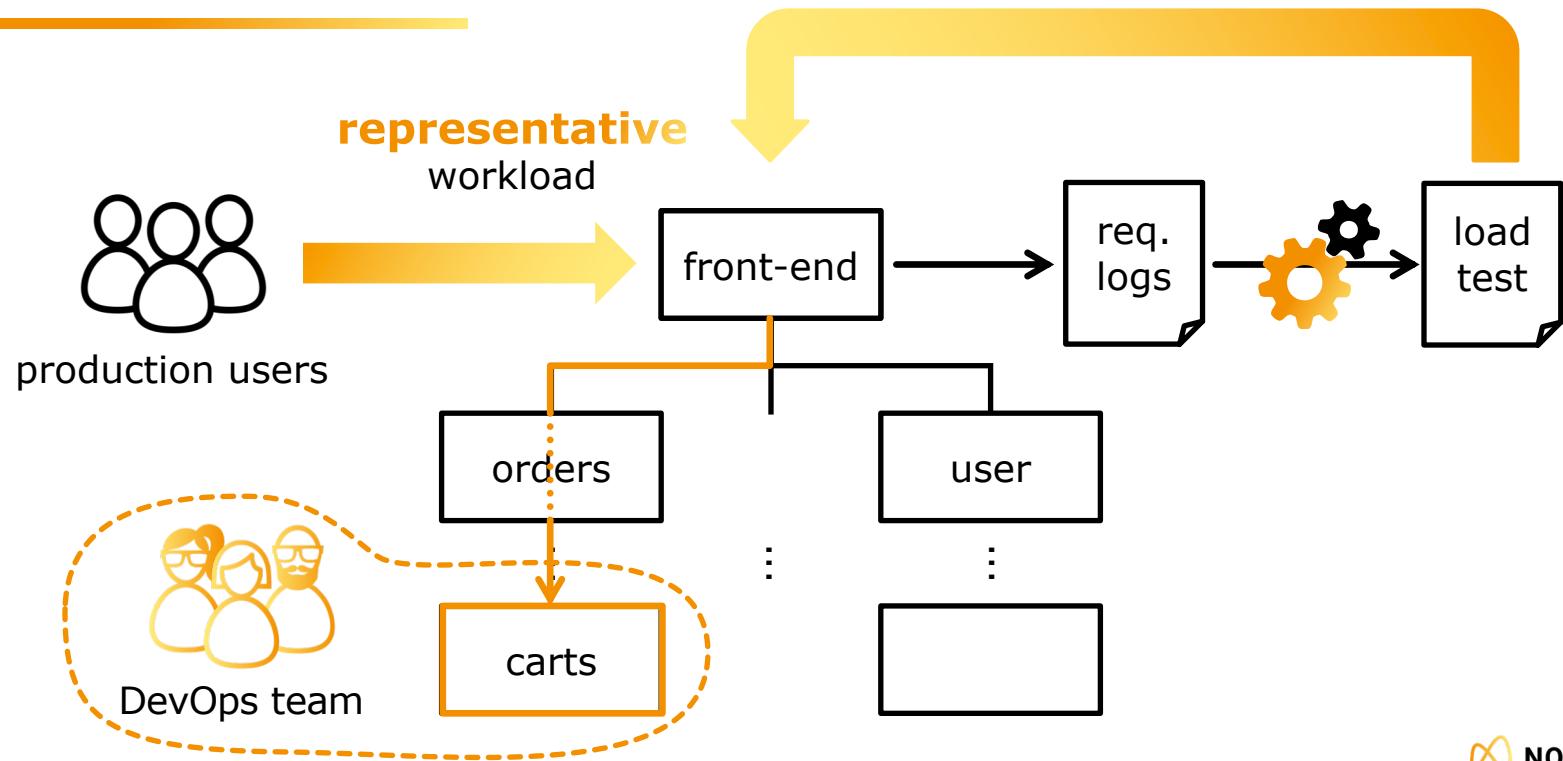
Session-based Workload
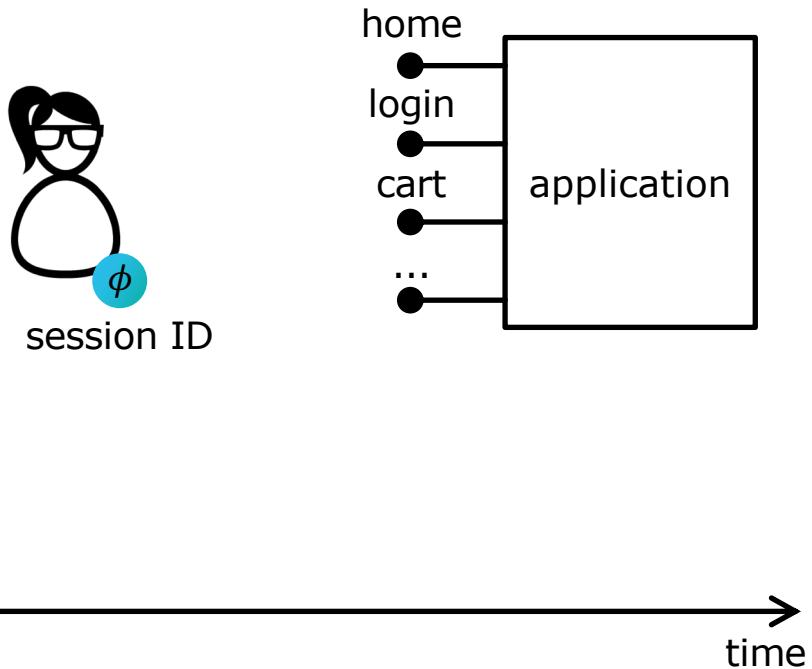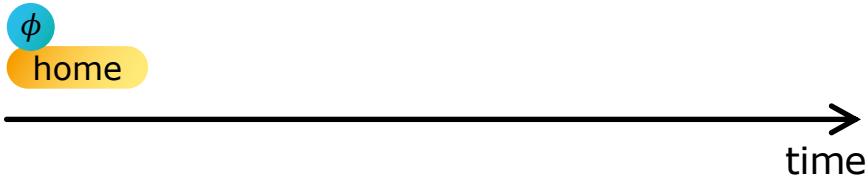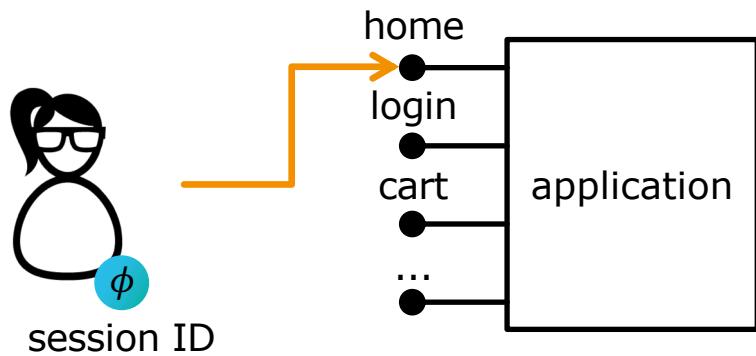
home

login

cart

...

application

ϕ

session ID

time

Session-based Workload

Session-based Workload

home

login

cart

...

application

session ID

home

login

time

Session-based Workload

Session-based Workload

Session-based Workload

home

login

cart

...

application

session ID

think time

ϕ home   ϕ login   ϕ cart   ϕ ...
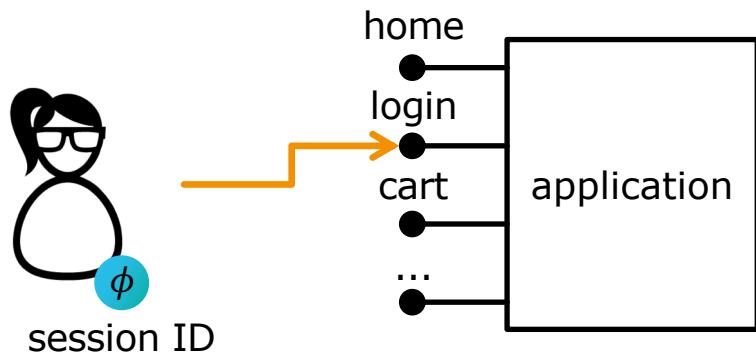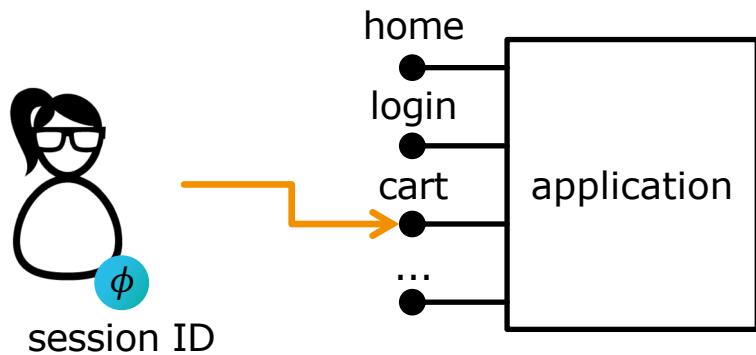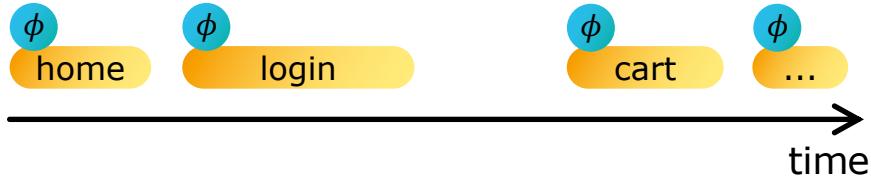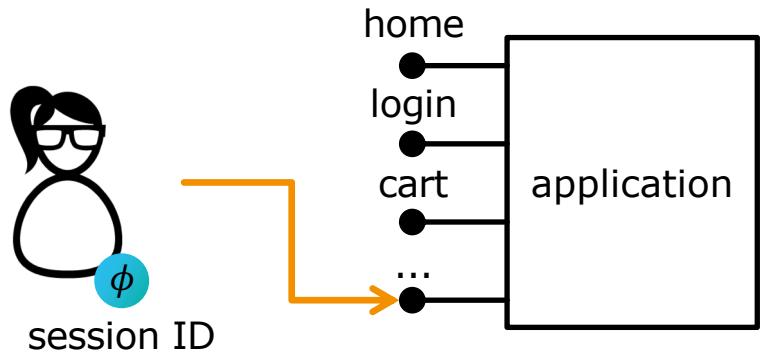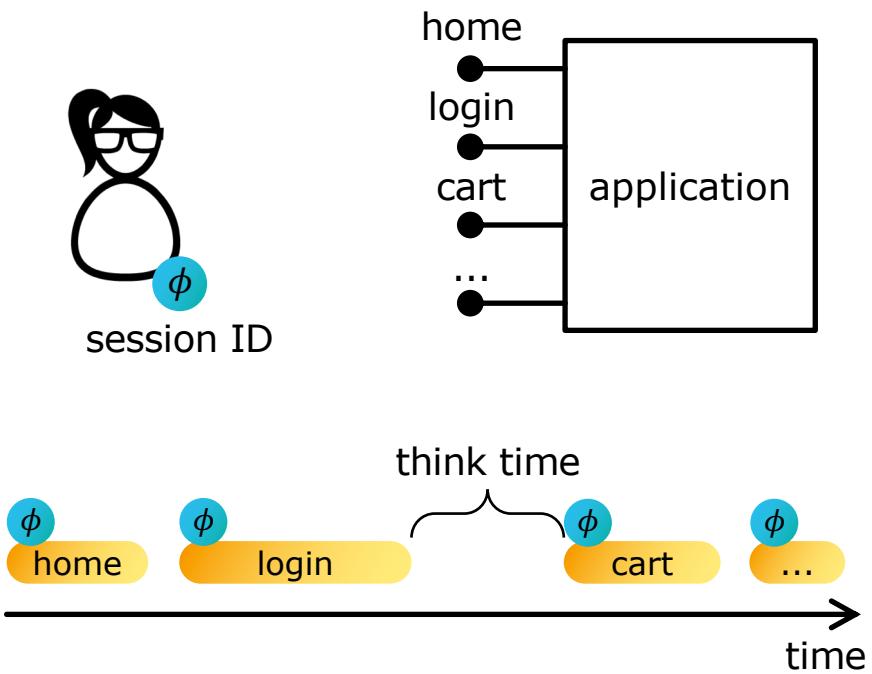
time

aggregation to Markov chains

probability: 0.7
think time: $\mathcal{N}(10,5)$

login

I → home

cart

... $

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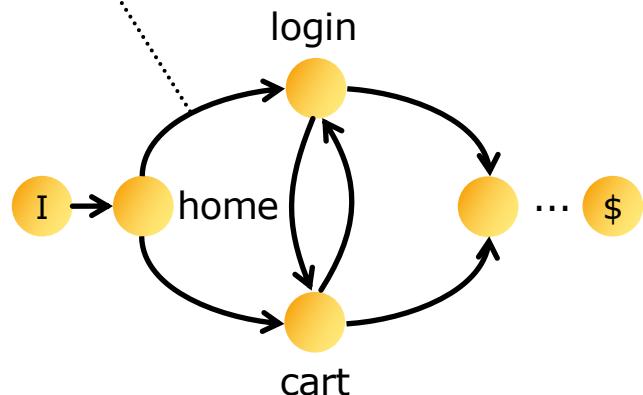
Related Work – Test Pyramid (Cohn, 2009)

system level

Ferrari, 1984   Menascé et al., 2002

Calzarossa et al., 2016   Ruffo et al., 2004

Vögele et al., 2018   Shams et al., 2006

session-based workload model extraction

Forced Flow Law
(Denning et al., 1978)

Graf, 1987

Koziolek et al., 2008

Cortellessa et al., 2002

Bernardo et al., 2011

service / integration level

Baltas et al., 2012

Becker et al., 2008

Field et al., 2018

Versteeg et al., 2016

(workload) model transformation

our work

performance stubs

unit level

performance unit tests

Horky et al., 2015

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Two Possible Solutions

log-based tailoring
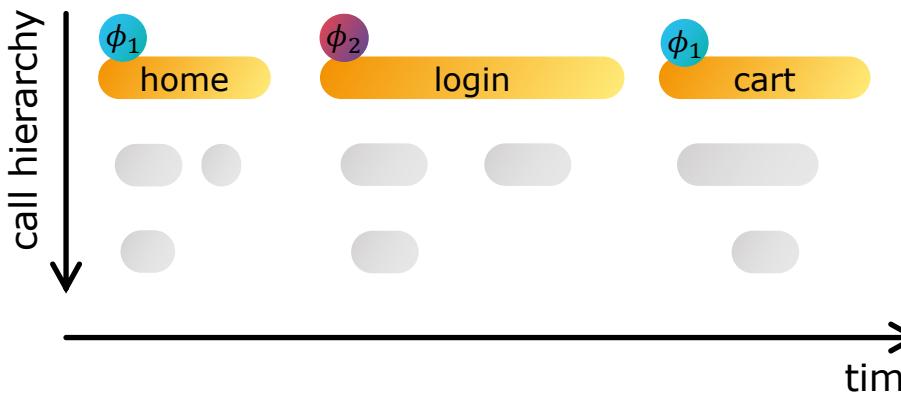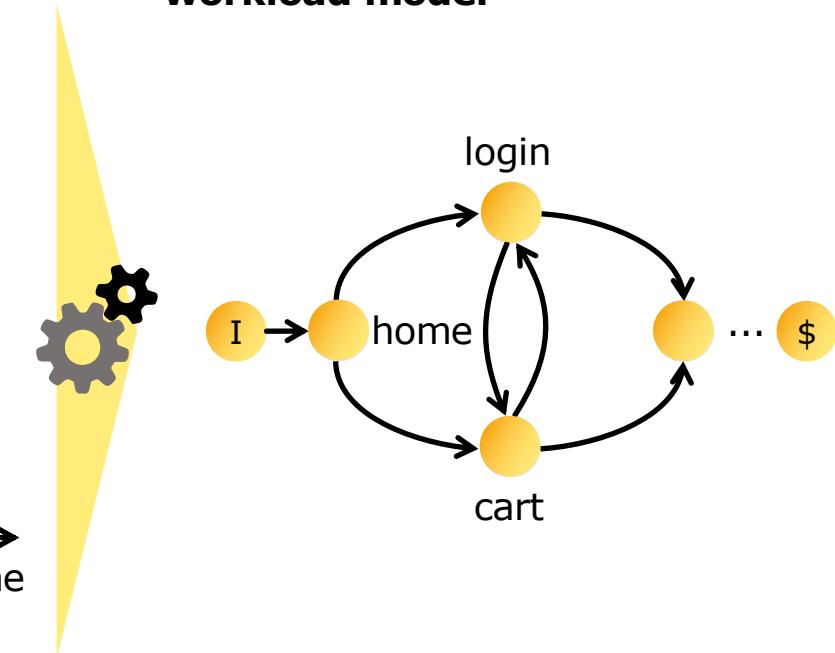
model-based tailoring

req./trace logs

session logs

work-load model

load test

application monitoring

session extraction

workload clustering

load test transformation

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Log-based Tailoring

request / trace logs

workload model

call hierarchy

ϕ_1 home

ϕ_2 login

ϕ_1 cart

time

I → home

login

cart

$\cdots$ $

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Log-based Tailoring

request / trace logs

workload model

Log-based Tailoring

request / trace logs

workload model

Log-based Tailoring

Model-based Tailoring

ϕ_1 login
ϕ_2 login
ϕ_3 login

login

I → home

cart

… $

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Model-based Tailoring

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Model-based Tailoring

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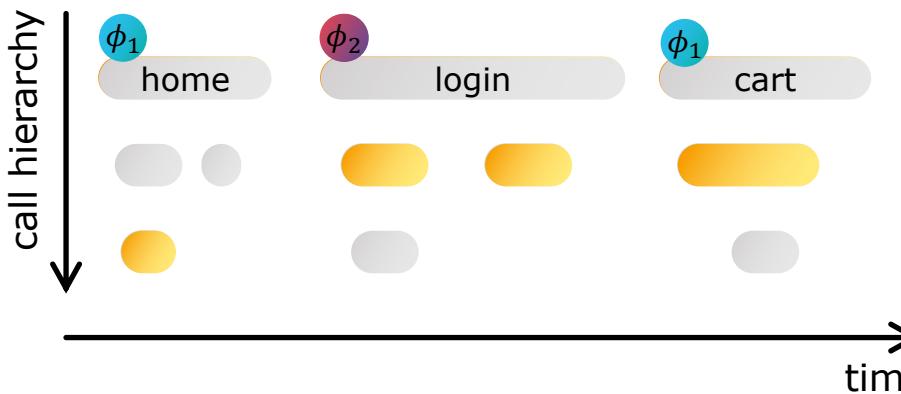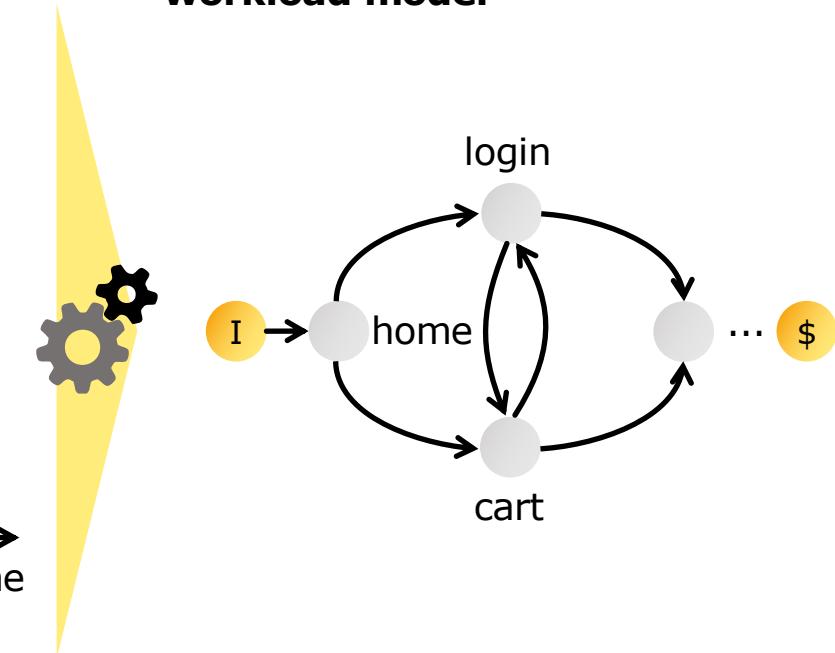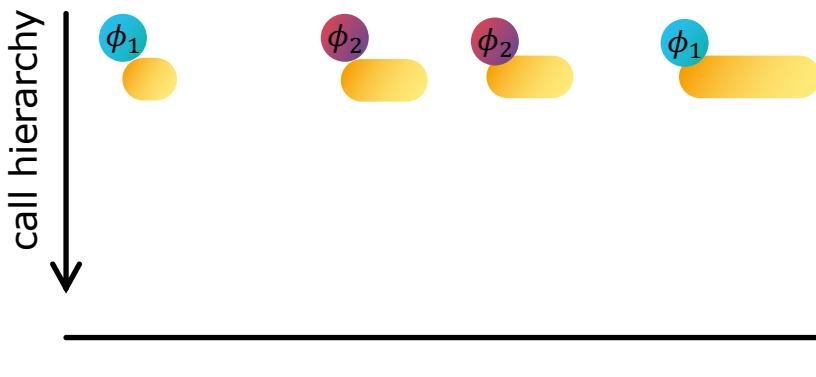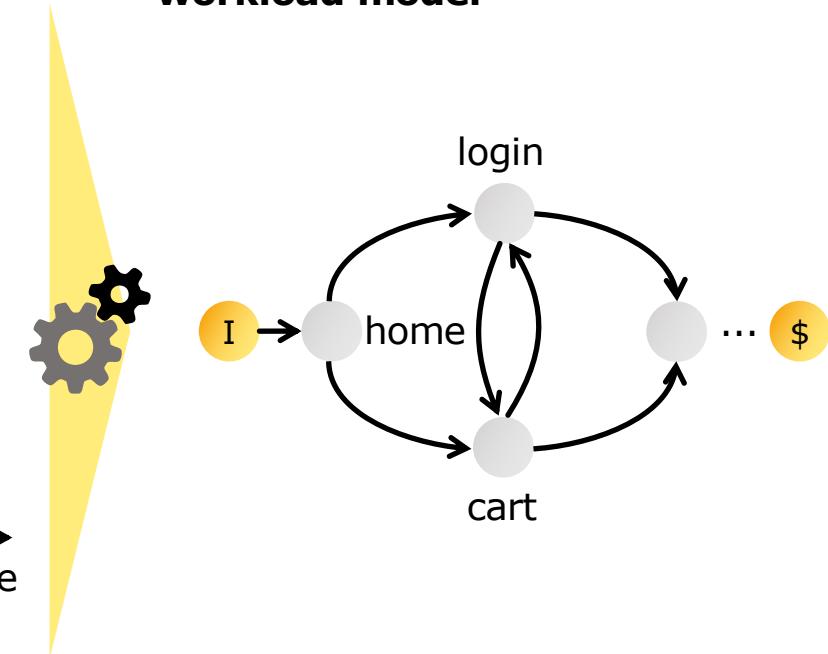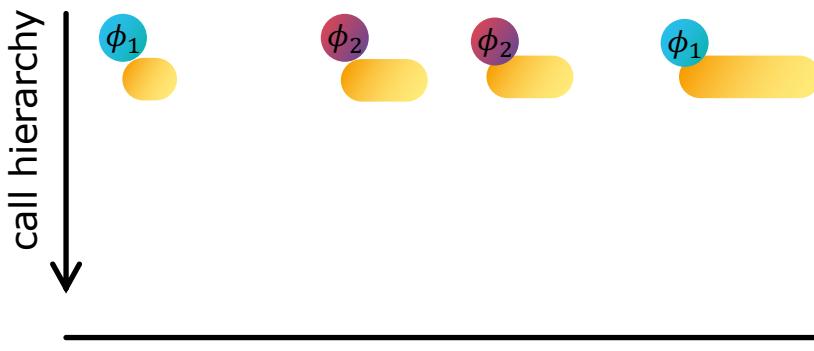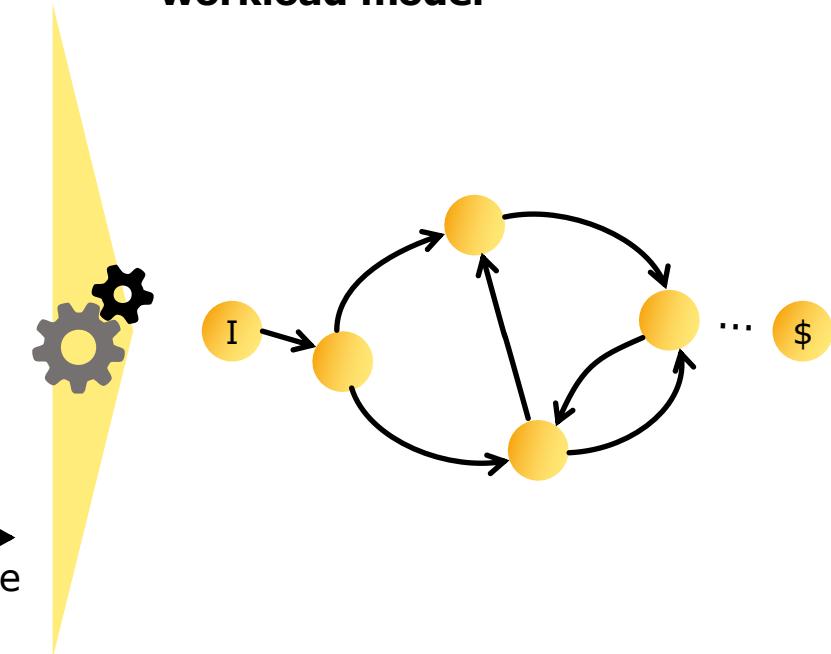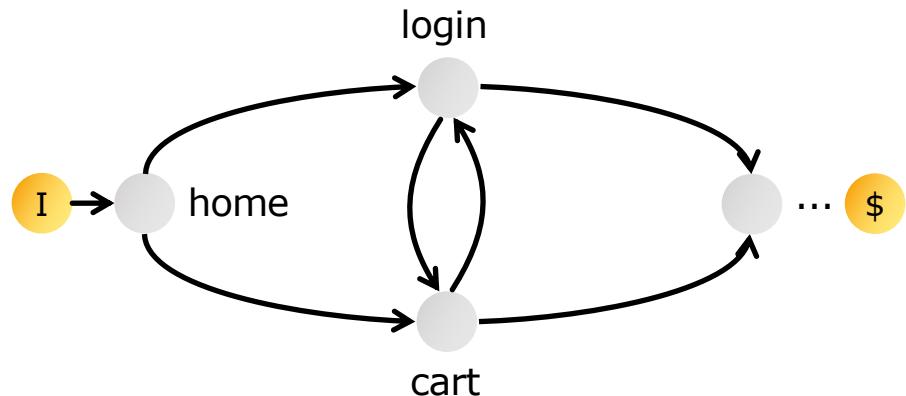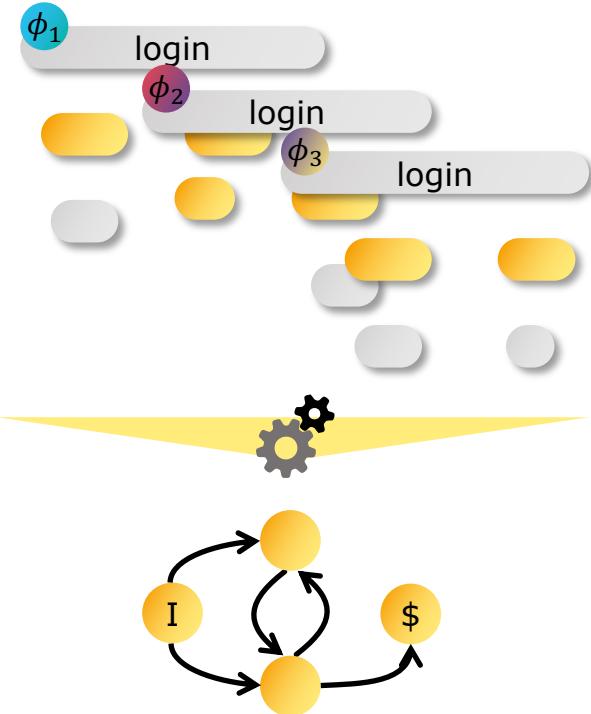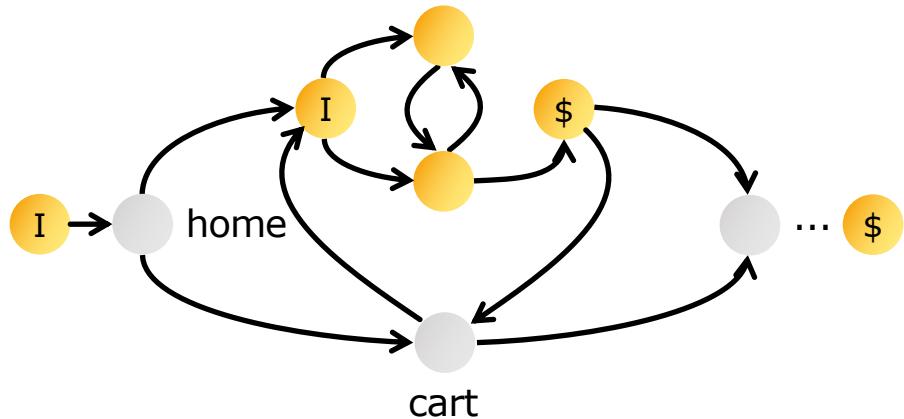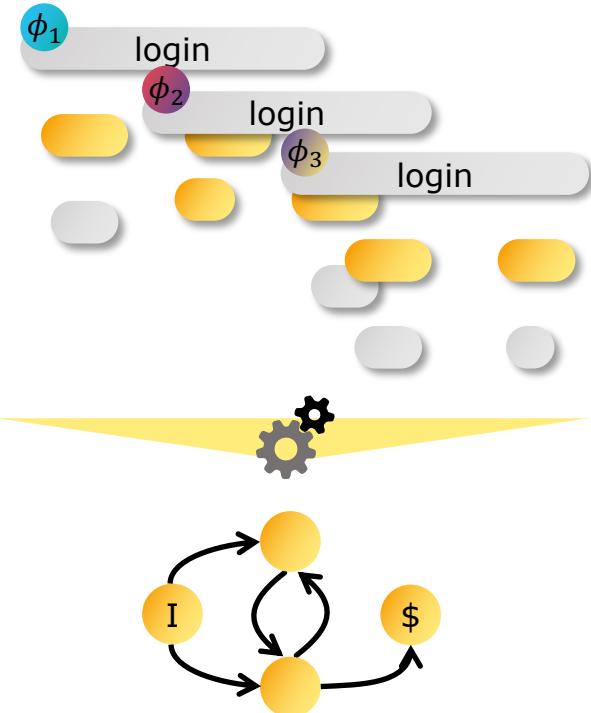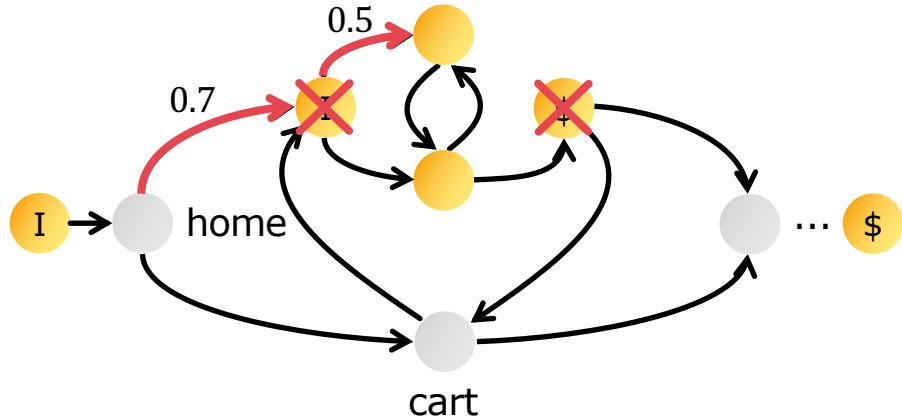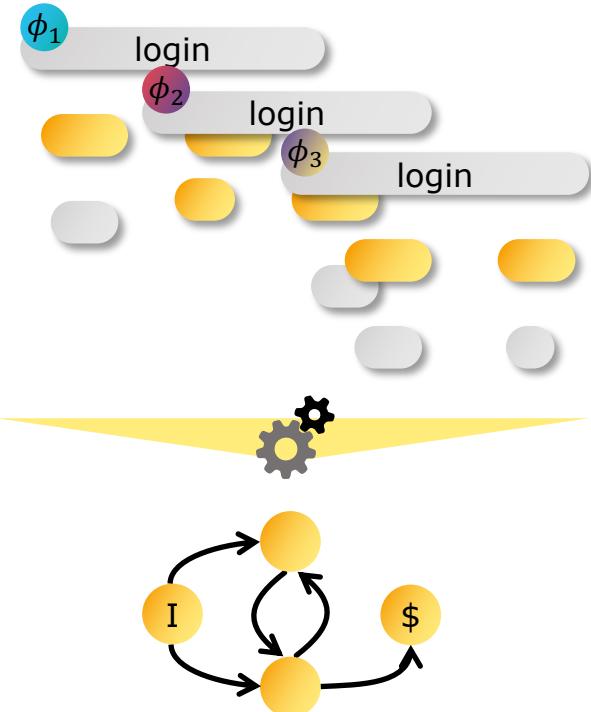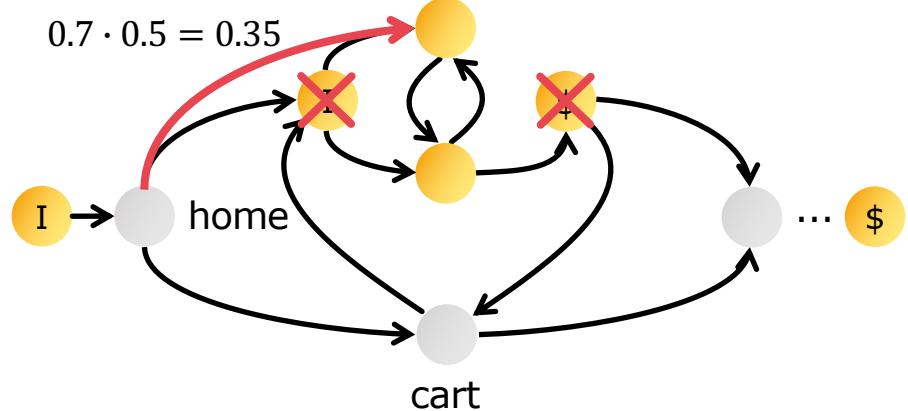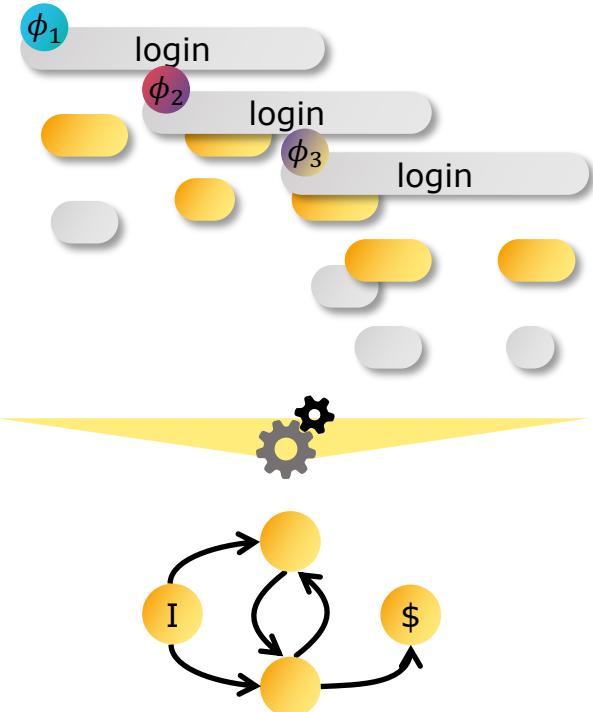
Model-based Tailoring
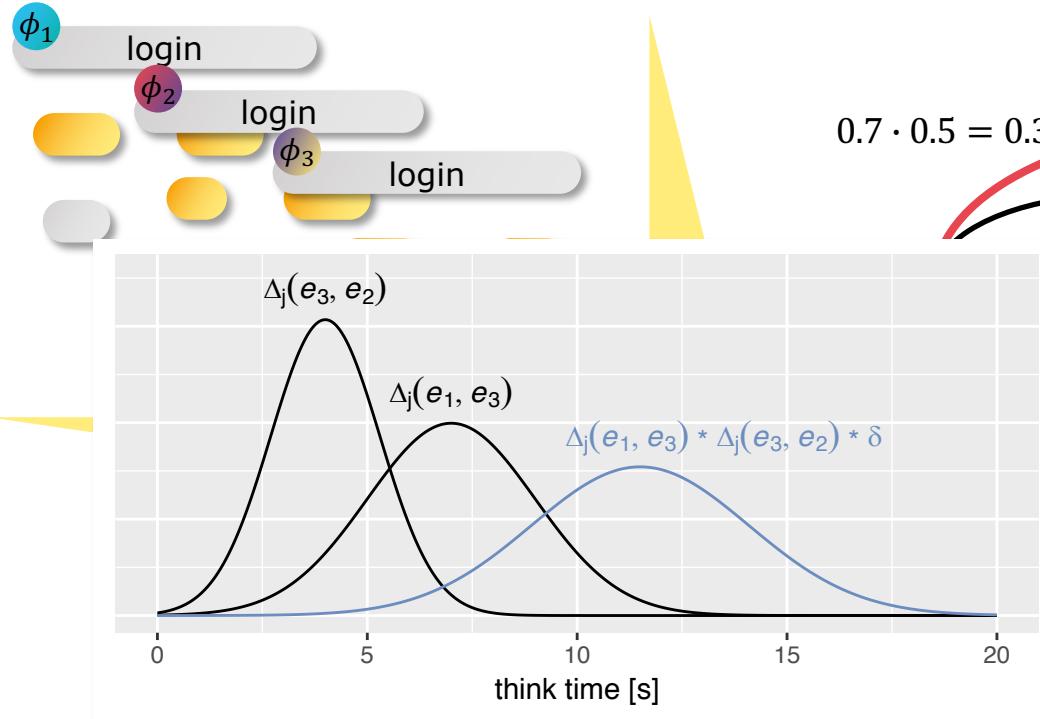
$$0.7 \cdot 0.5 = 0.35$$

Model-based Tailoring

ϕ_1

login

ϕ_2

login

ϕ_3

login

$0.7 \cdot 0.5 = 0.35$

$\Delta_j(e_3, e_2)$

$\Delta_j(e_1, e_3)$

$\Delta_j(e_1, e_3) * \Delta_j(e_3, e_2) * \delta$

0   5   10   15   20

think time [s]

cart

$\$$

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Model-based Tailoring

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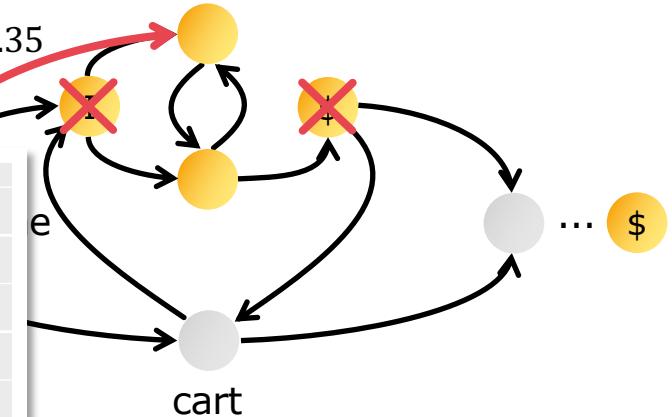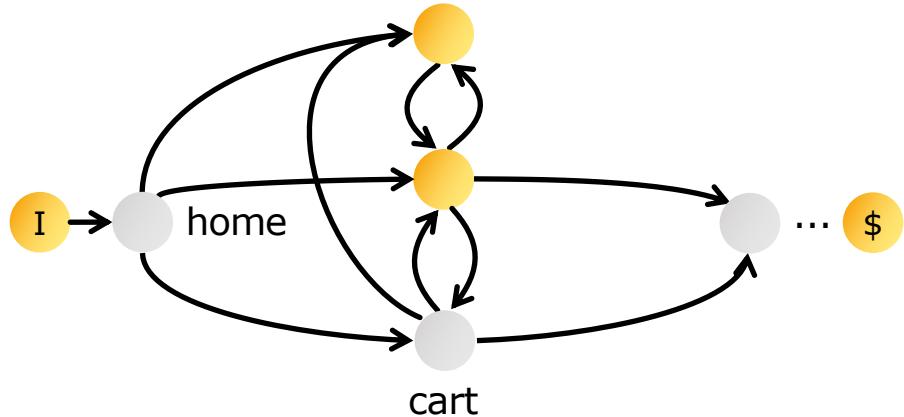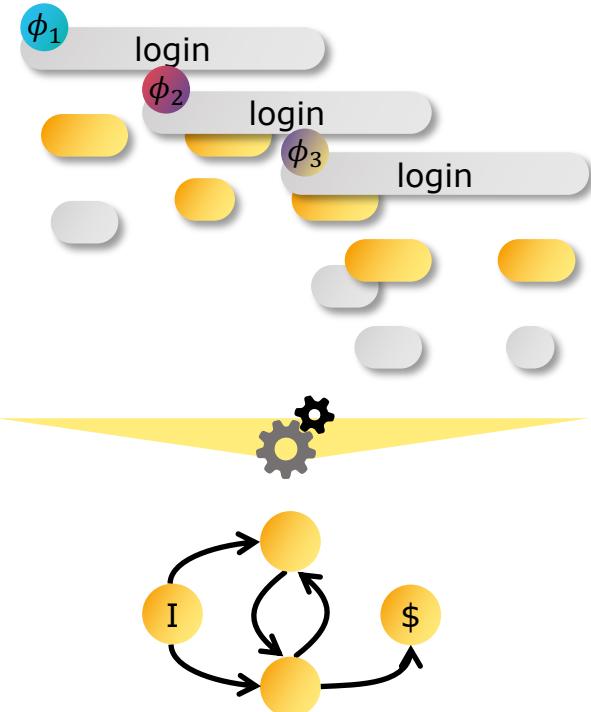
Evaluation: Research Questions

RQ1: Representativeness compared to untailored and request-based test

RQ2: Impairment of performance metrics

RQ4: Qualitative differences of tailored workload models

RQ3: Test execution time

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System Under Test: Sock Shop

Aderaldo et al., 2017

image: https://microservices-demo.github.io/

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System Under Test: Sock Shop

Aderaldo et al., 2017

image: https://microservices-demo.github.io/
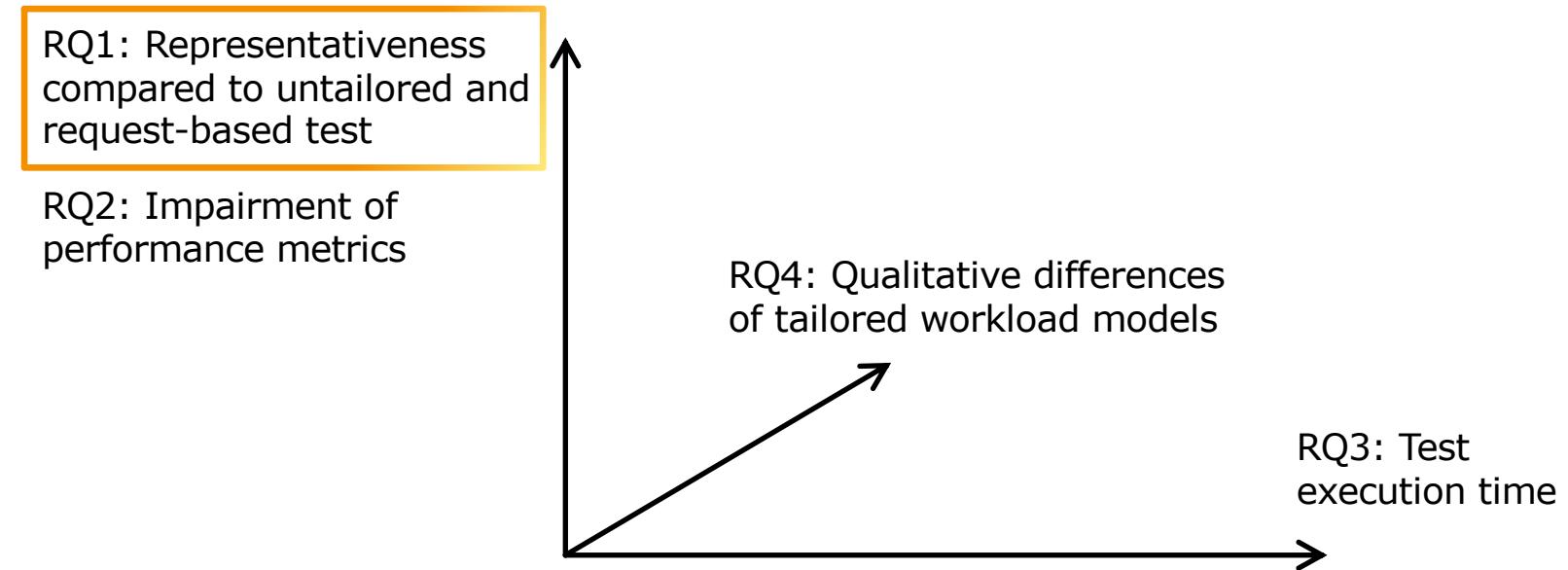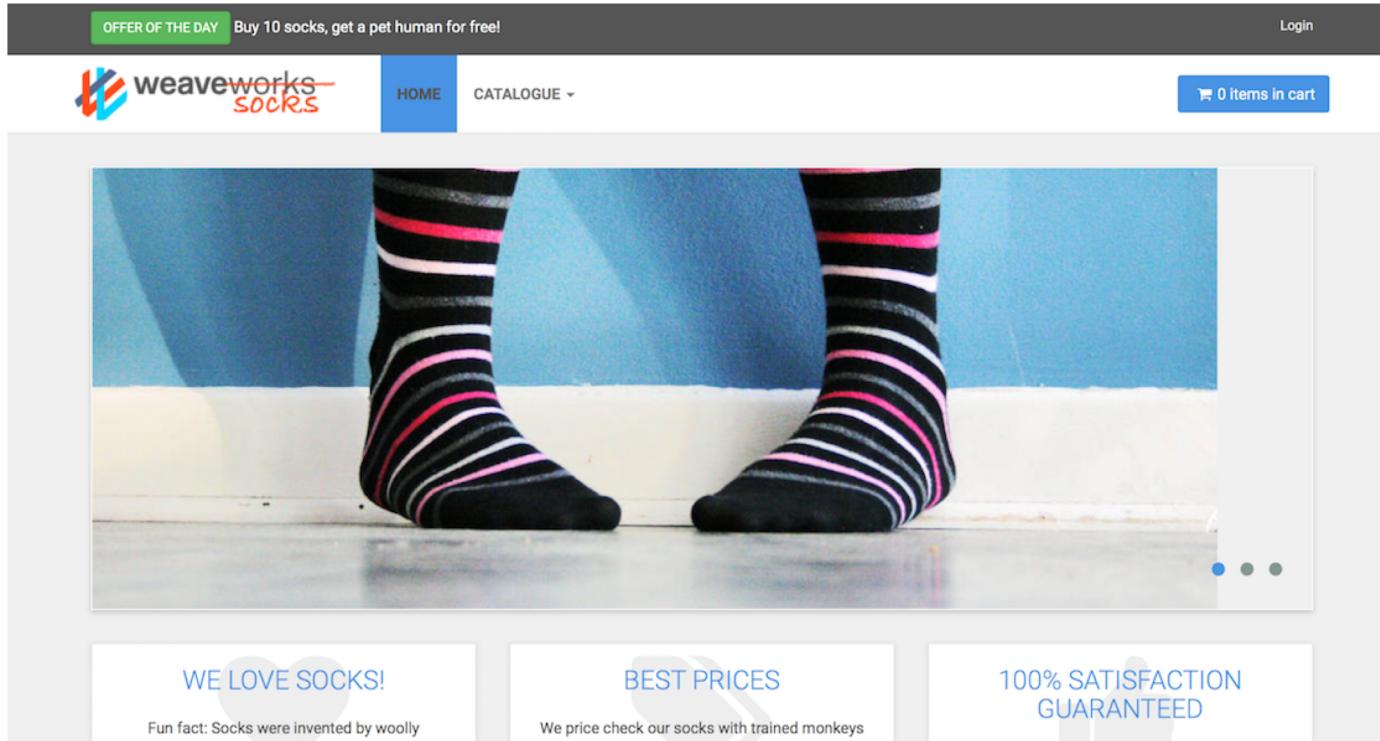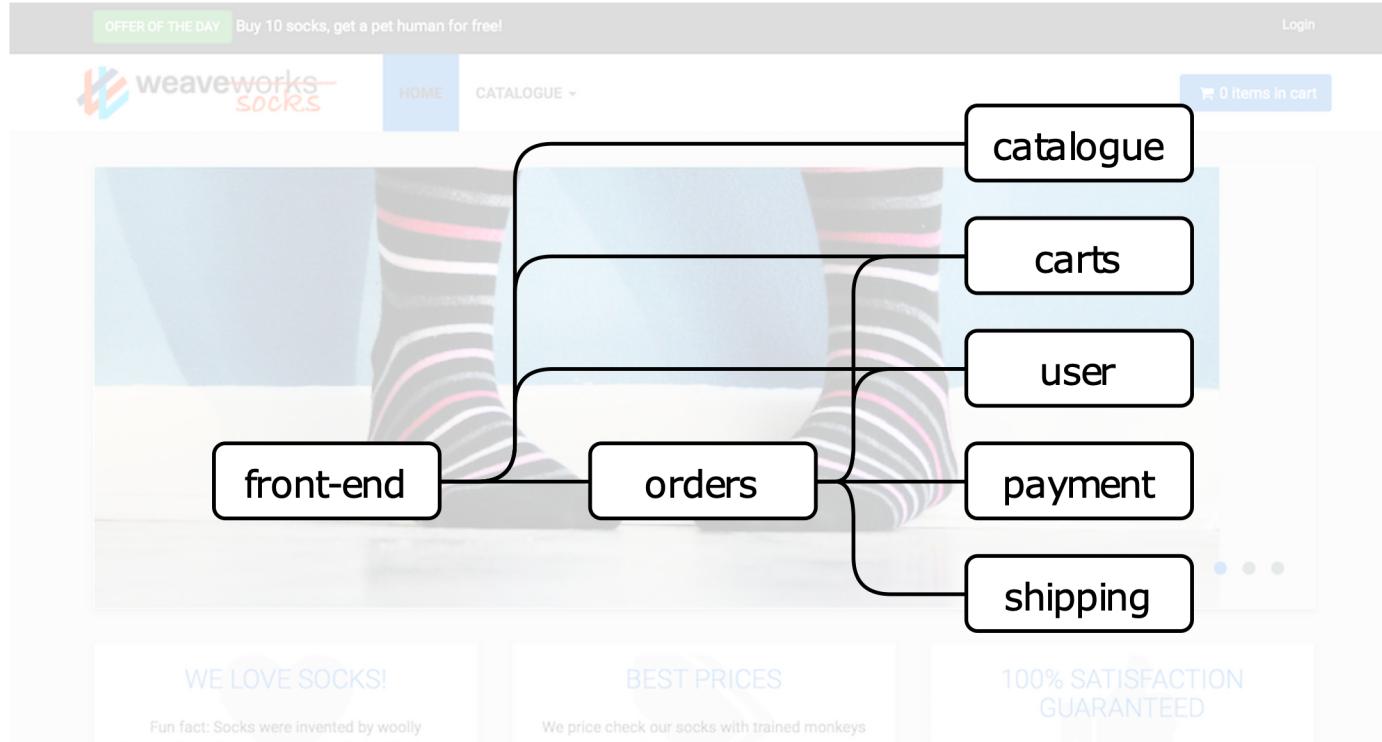
Experimentation Process

reference

+

untailored

+

7x

{ log-based
model-based
request-based }

tailored

results

Experiment Automation

load test

Trace Monitoring

Metric Monitoring

Sock Shop

Restarter

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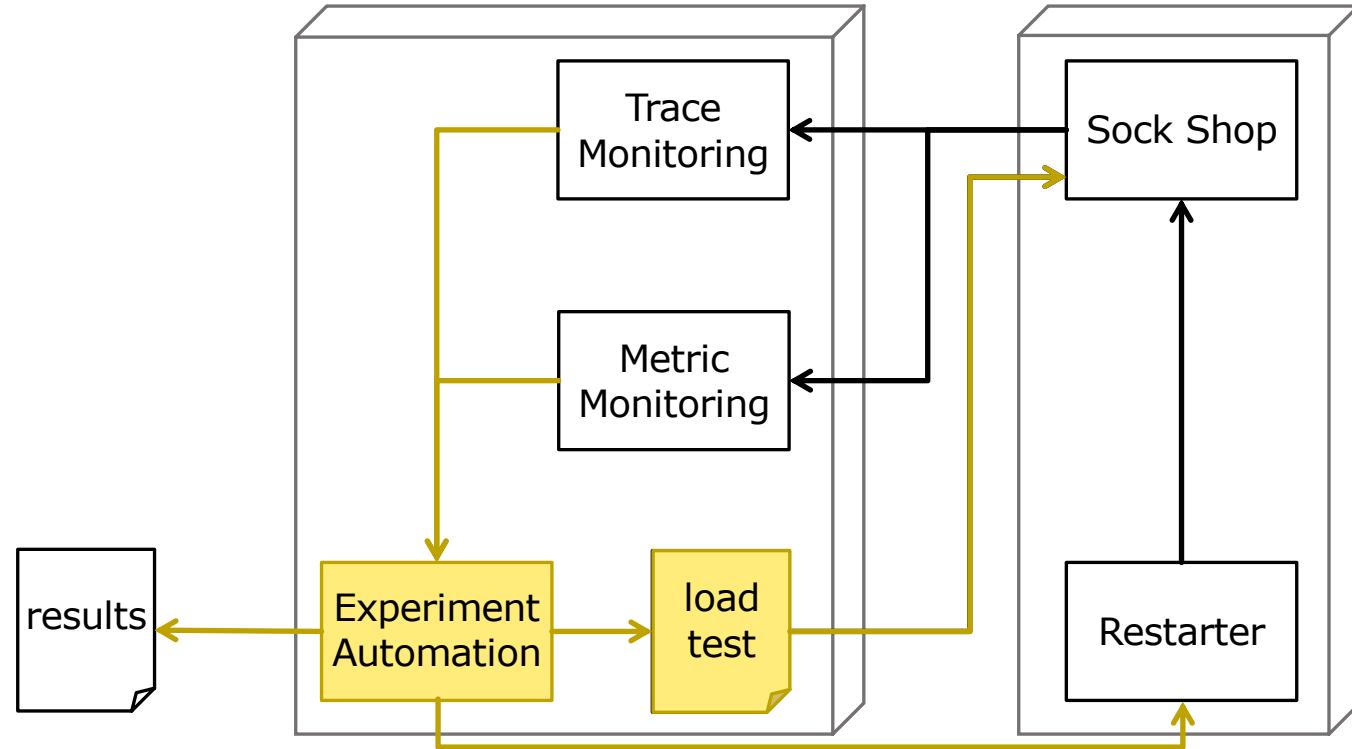
Representativeness Metric based on Kolmogorov Smirnov

inter-arrival time

time

cumulative probability

generated

reference

KS statistic

inter-arrival time

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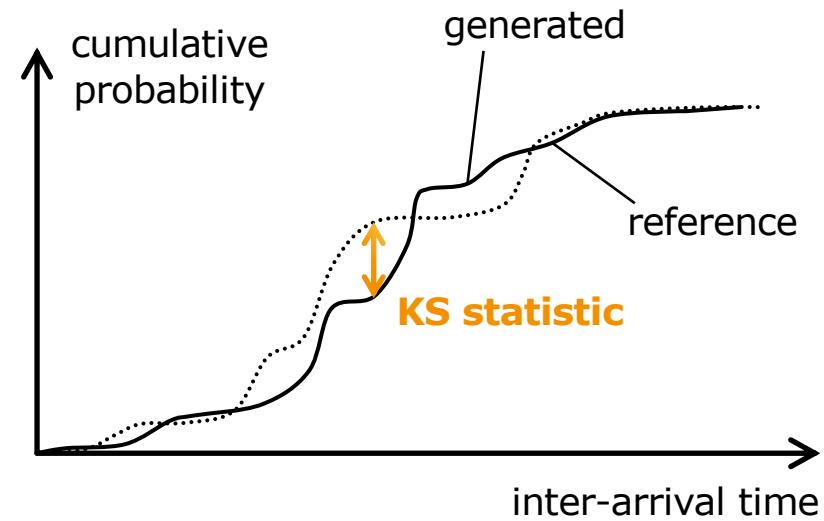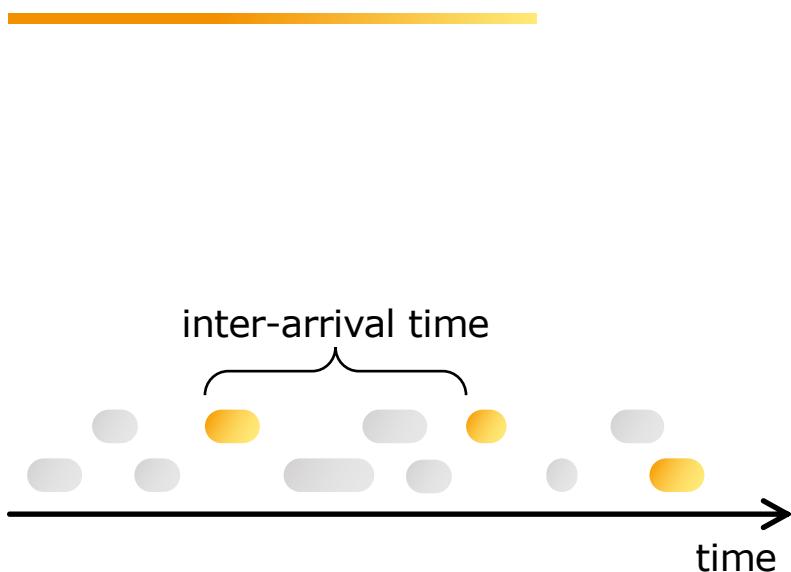
Model-based is Most Representative Tailoring

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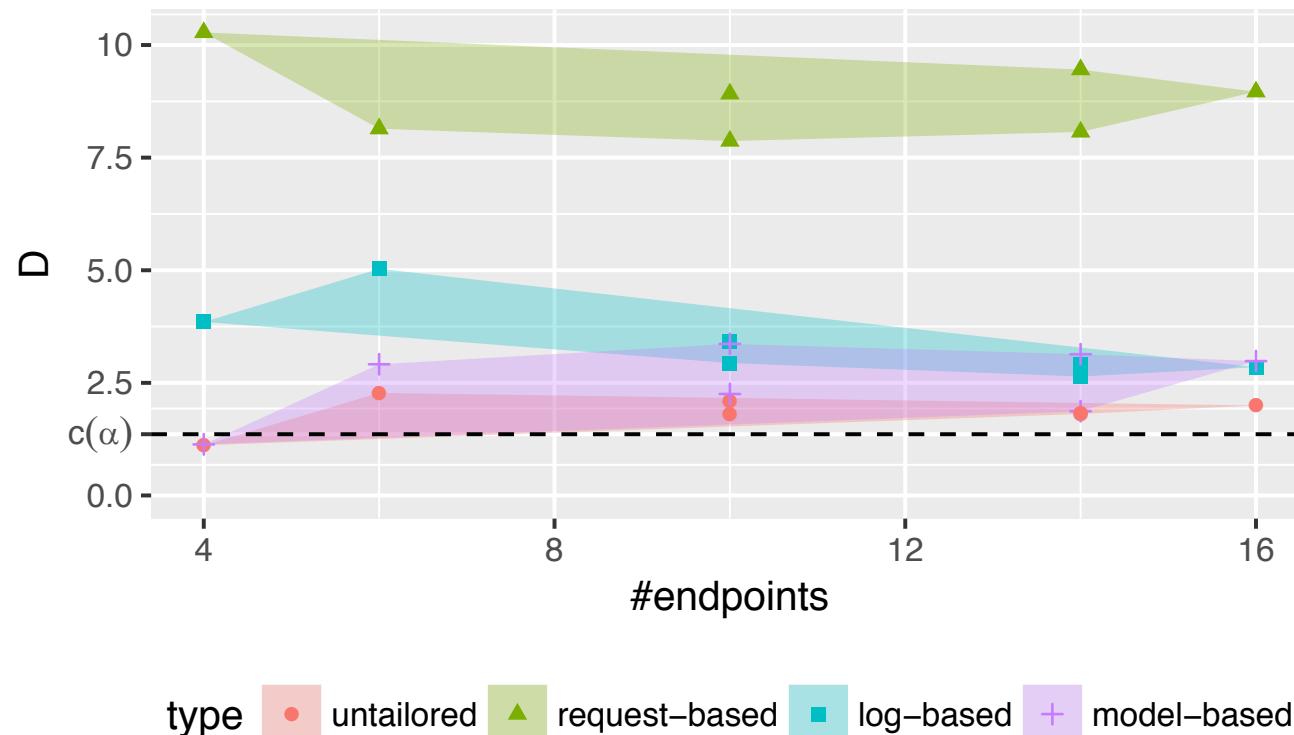
Evaluation Summary (Qualitative)
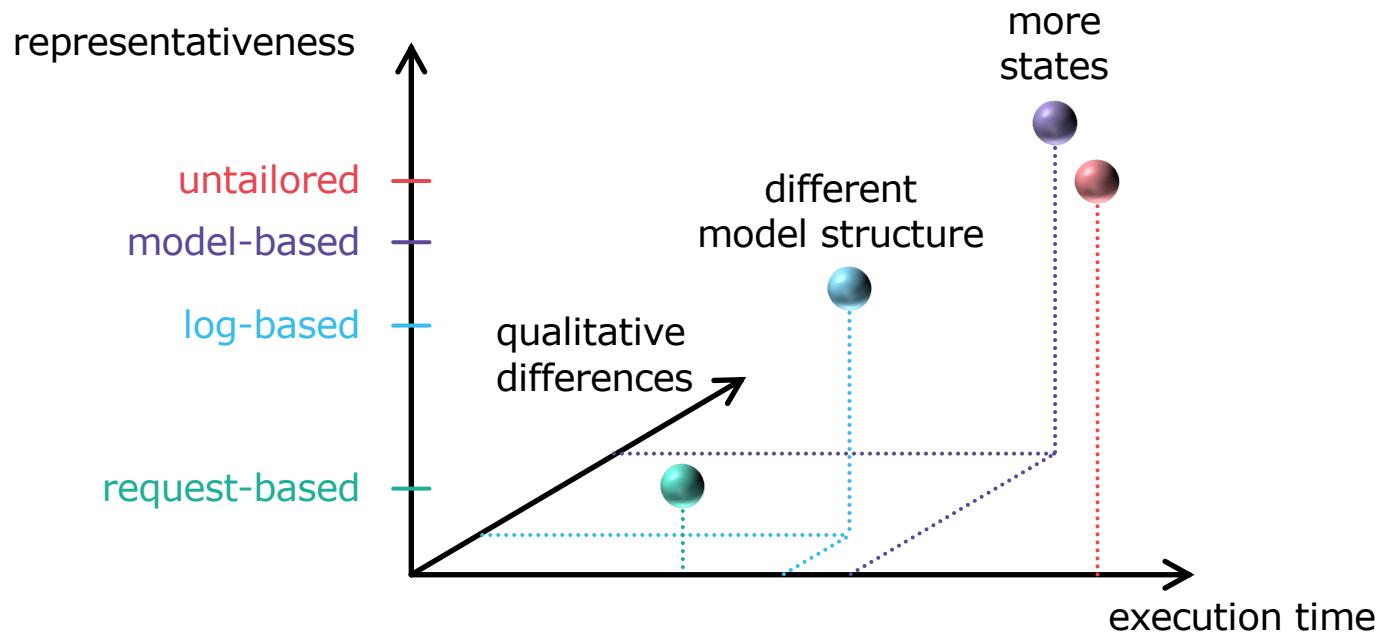
representativeness

more states

untailored

model-based

different model structure

log-based

qualitative differences

request-based

execution time

Replication Package:
https://doi.org/10.5281/zenodo.3333367

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Workload Model Tailoring Allows Representative Load Testing for Microservices

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Workload Model Tailoring Allows Representative Load Testing for Microservices

log-based & model-based

front-end

orders

user

carts

DevOps team

- ☑ less resources
- (☑) shorter execution
- ☑ representative
- ☑ DevOps ready
- 🔄 Industrial-scale study

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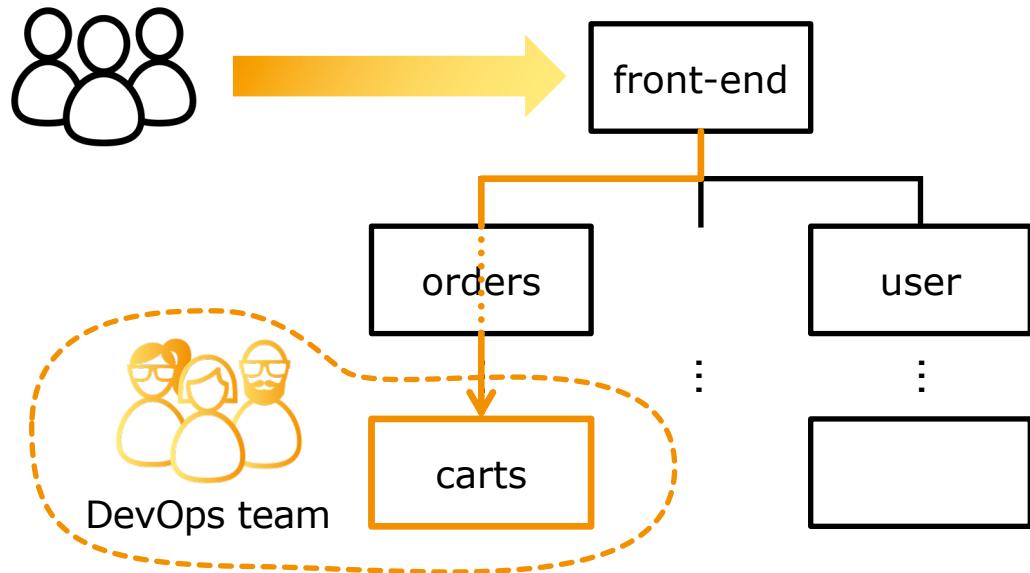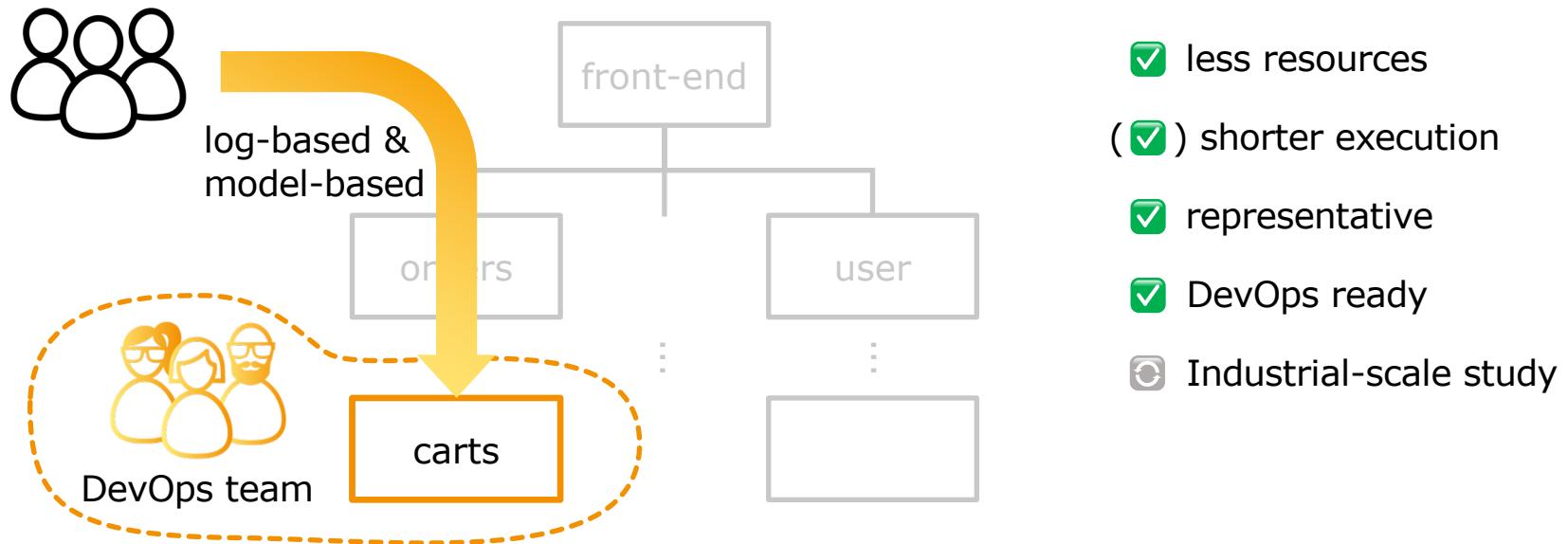
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