Is It Time To Put Cold Starts In The Deep Freeze?

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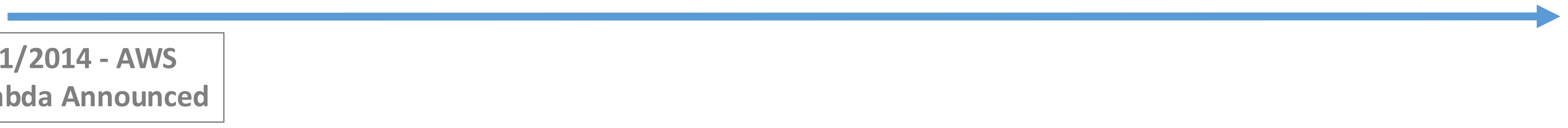
SoCC 2024 – Redmond, WA

Cold Starts Have Dominated Serverless Research



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[ATC'18] Peeking Behind

[SoCC'17] PyWren

[CIDR'19] One Step Forward Two Steps Back

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[SoCC'23] How Does It Function?

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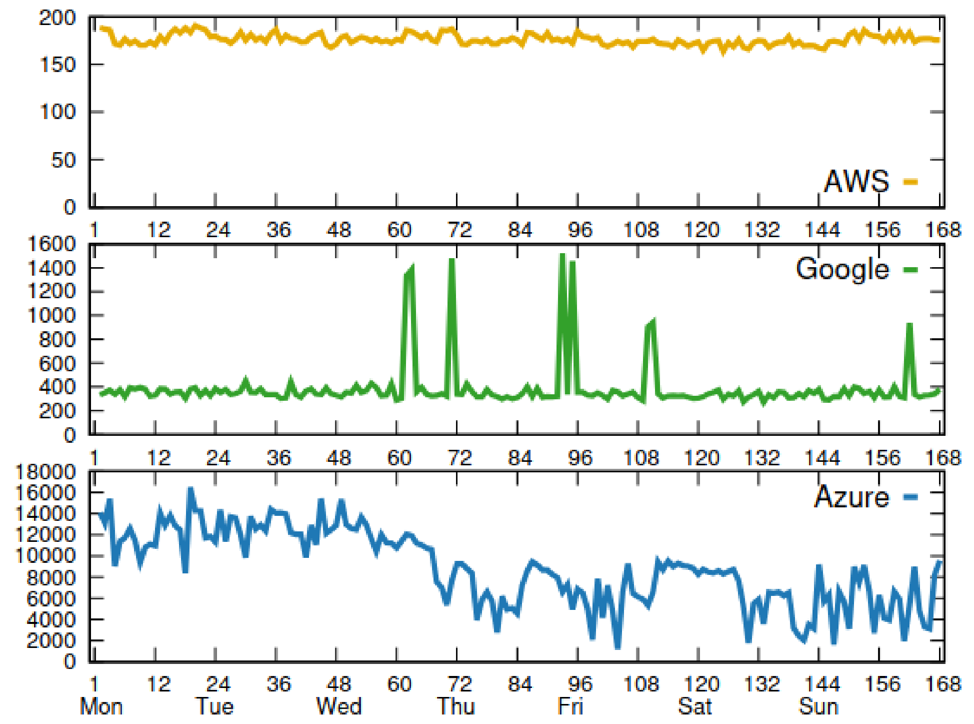

Figure 8: Coldstart latency (in ms) over 168 hours. All the measurements were started at right after midnight on a Sunday. Each data point is the median of all coldstart latencies collected in a given hour. For clarity, the y-axes use different ranges for each service.

[ATC'18] Peeking Behind the Curtains of Serverless Platforms

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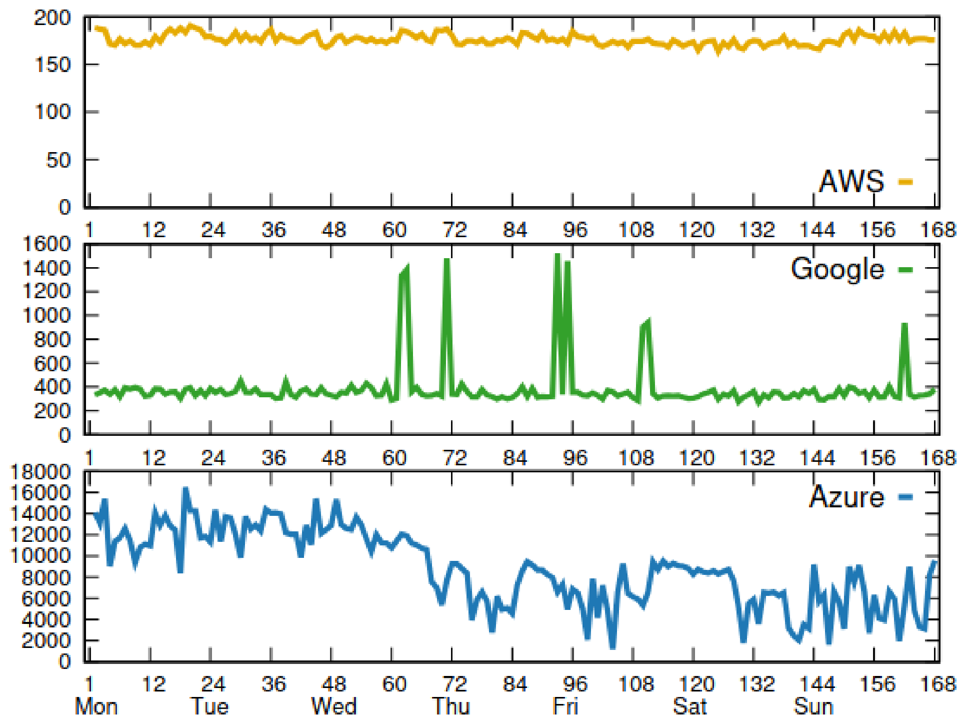

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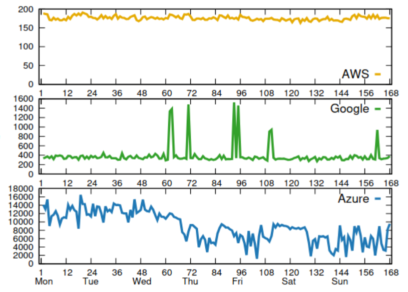

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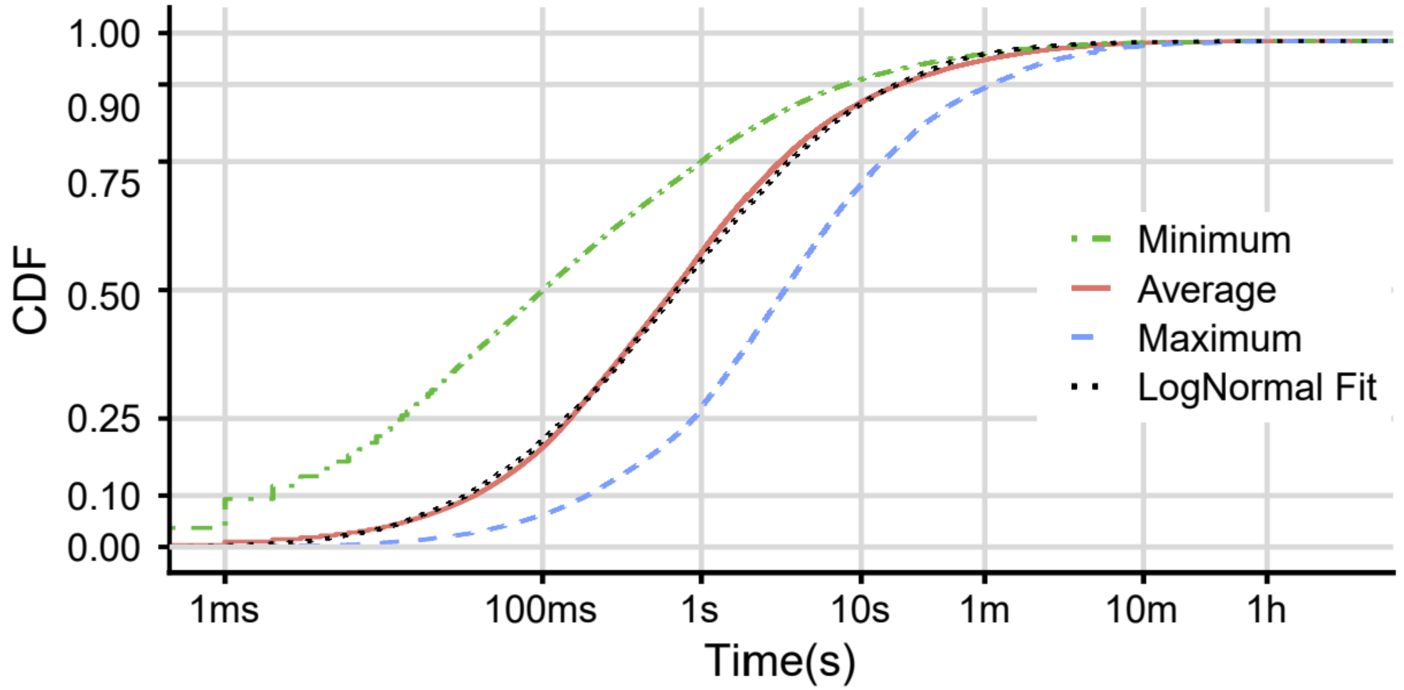

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[ATC'20] Serverless in the Wild: Characterizing and Optimizing the Serverless Workload at a Large Cloud Provider

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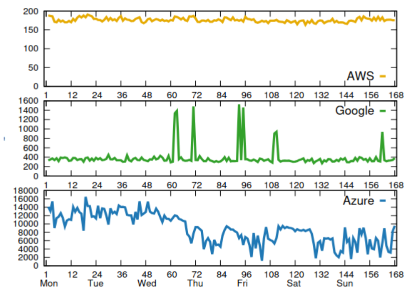

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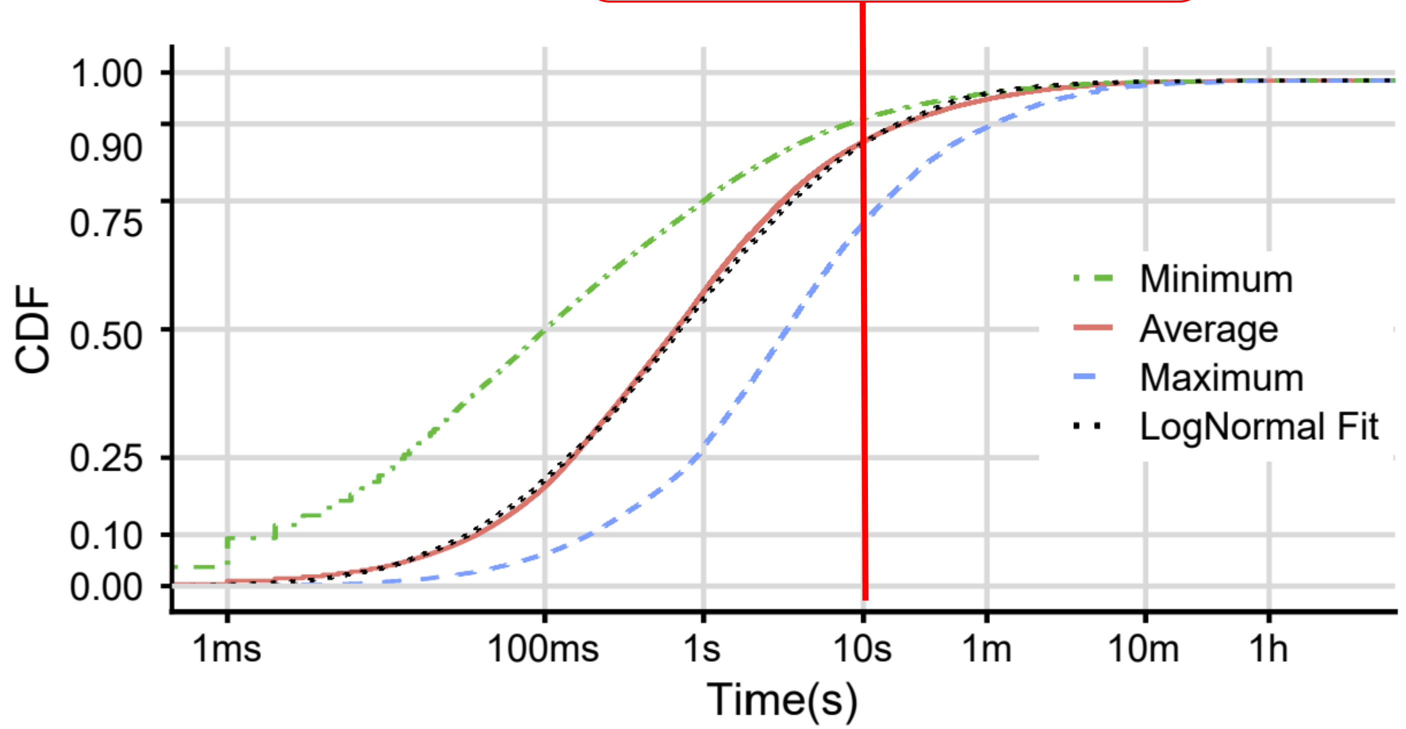

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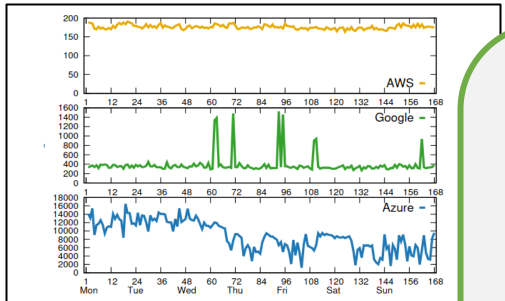

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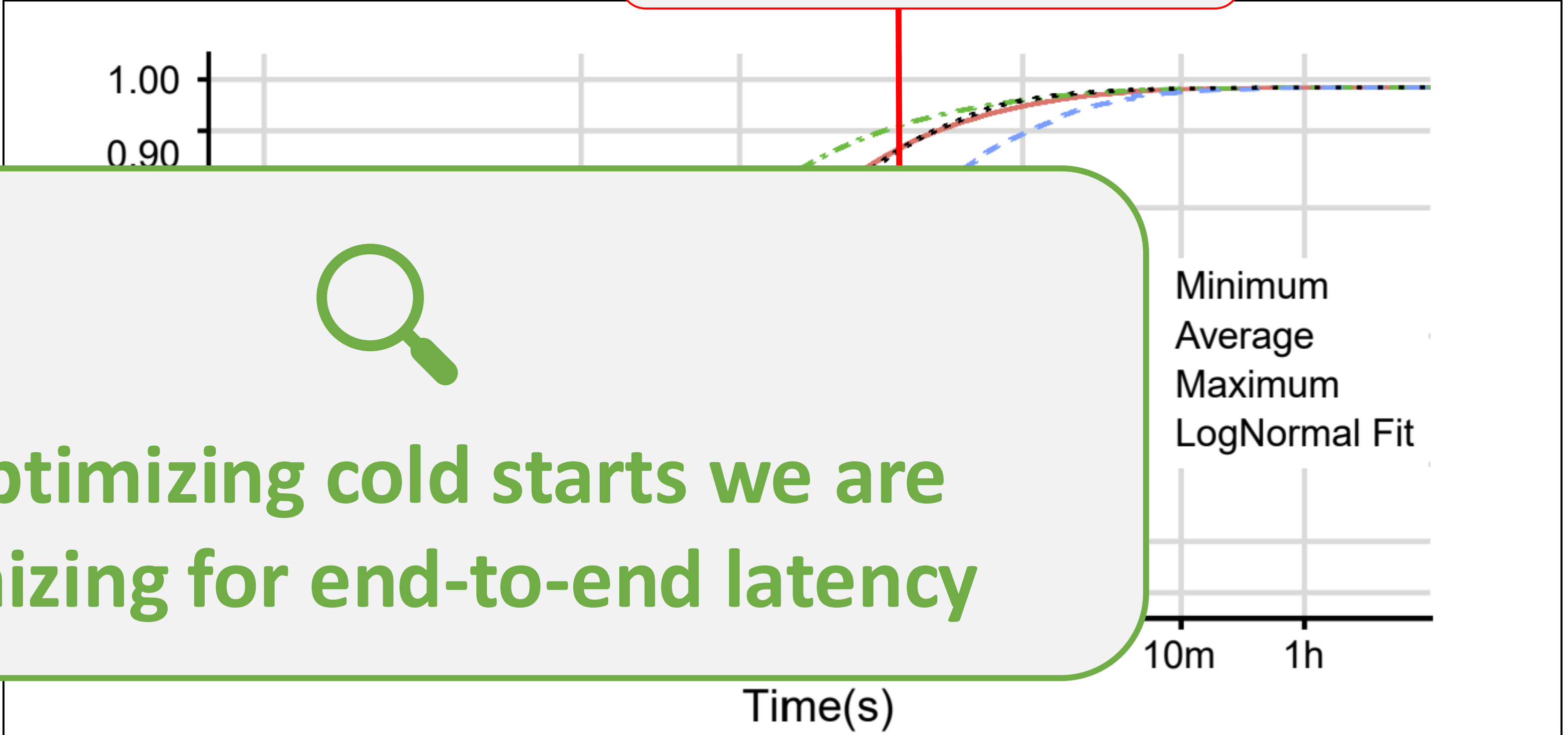

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By optimizing cold starts we are optimizing for end-to-end latency

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Azure [ATC'20]	
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35 papers	% latency insensitive
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Workflows	

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If functions are latency insensitive, why reduce end-to-end execution time?

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	% worker utilization
Huawei [SIGCOMM'24]	**~ 50%**
Meta [SOSP'23]	**~ 60%**

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Could low serverless utilization be a consequence of cold-start optimizations?

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Utilization

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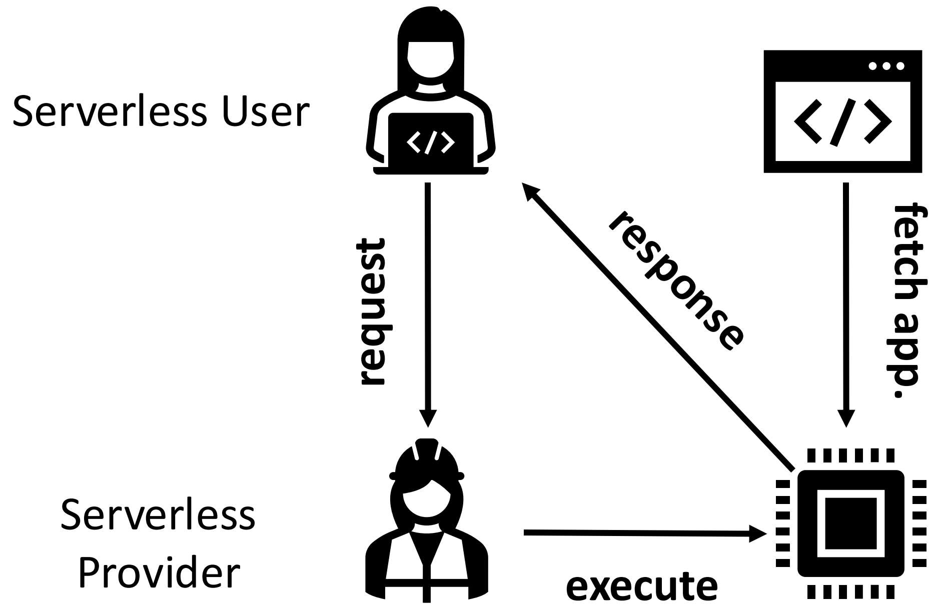
Utilization

Throughput

Batch Workloads Fit The Serverless Model

Traditional Serverless



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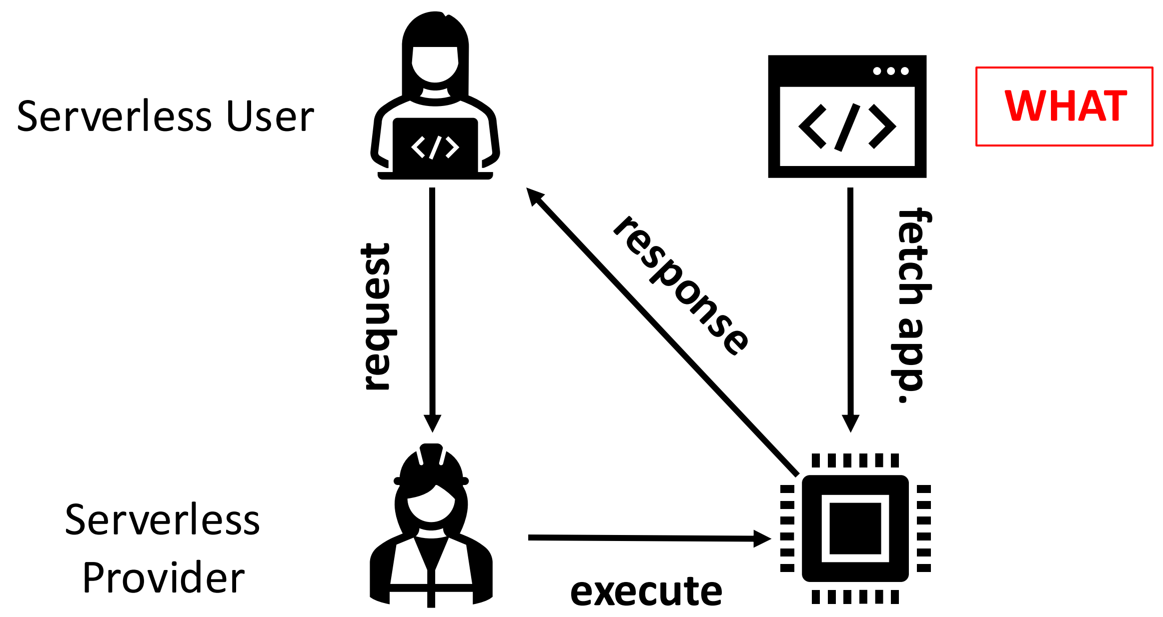

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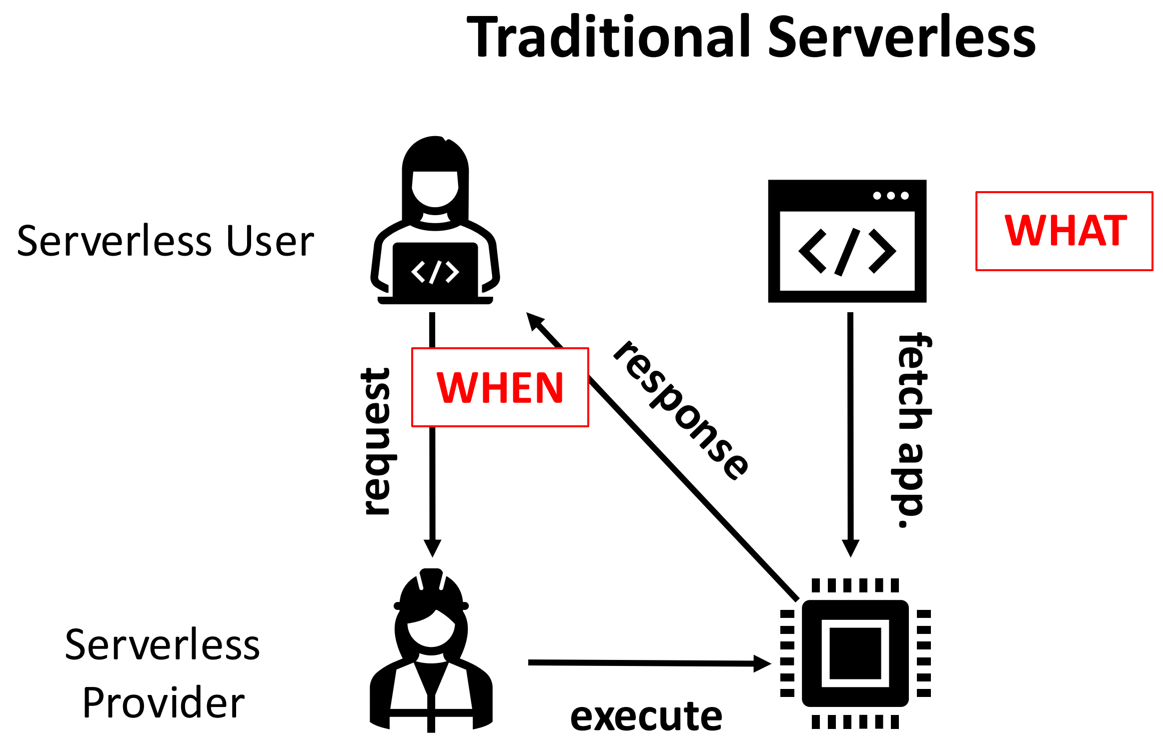

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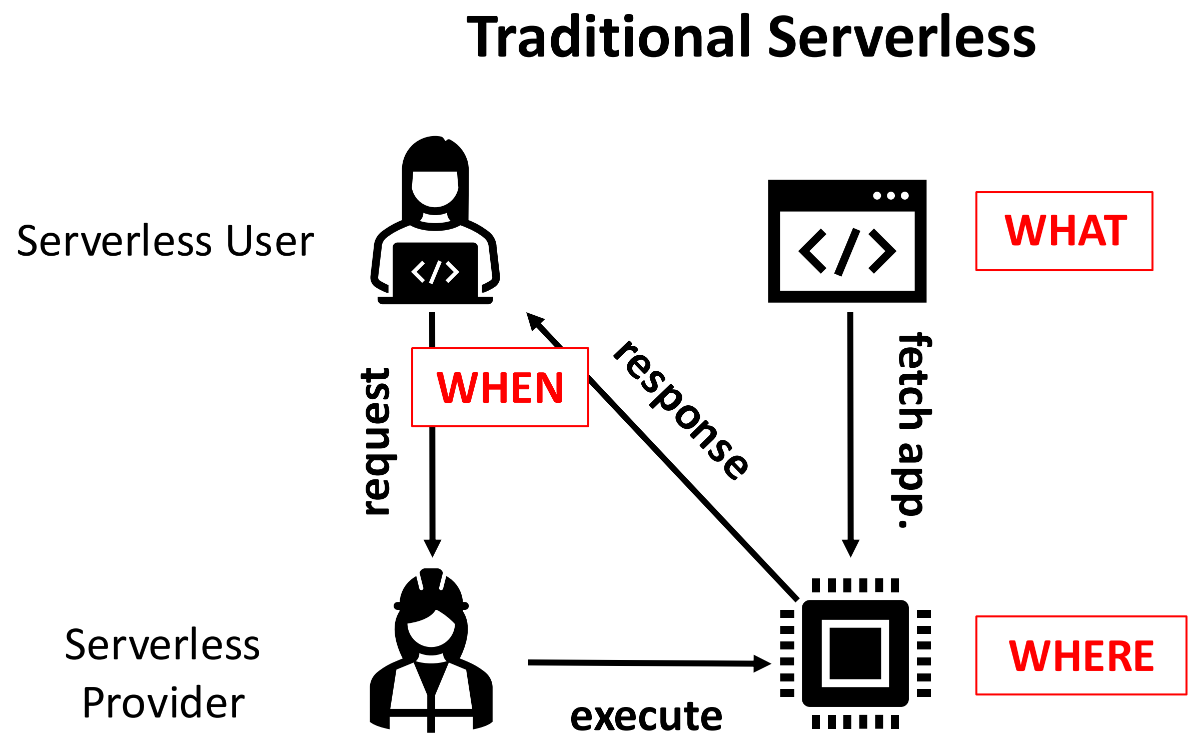

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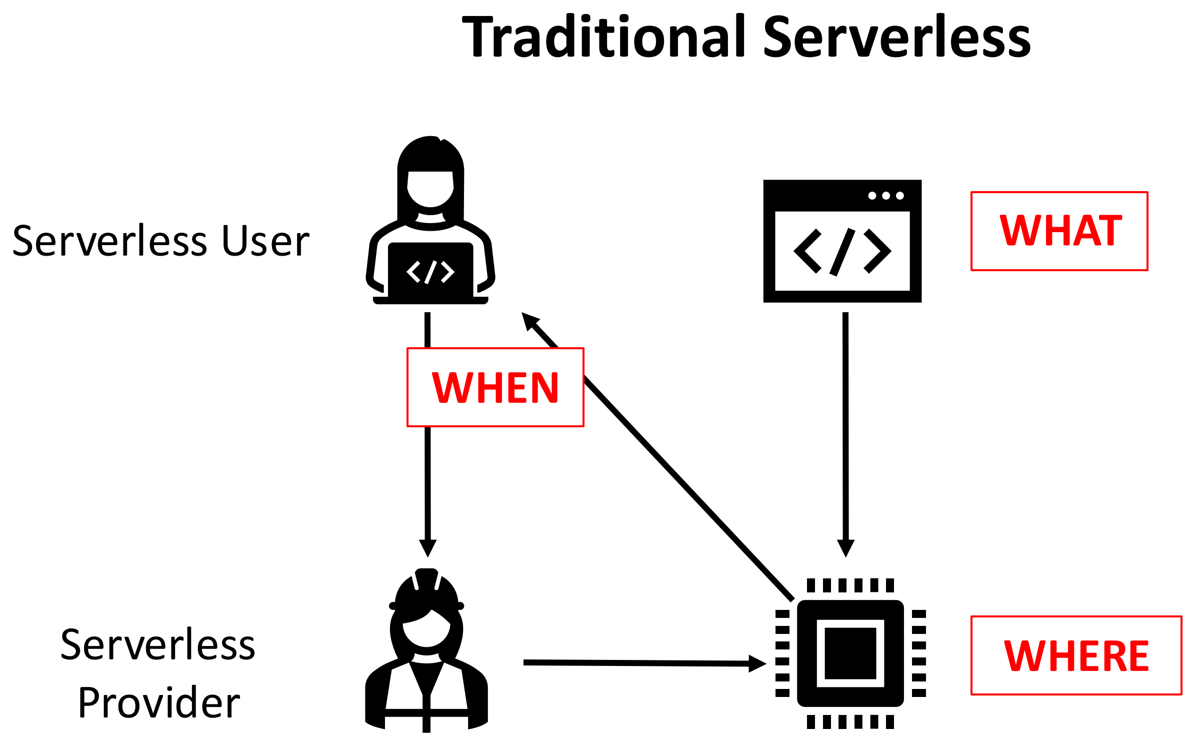

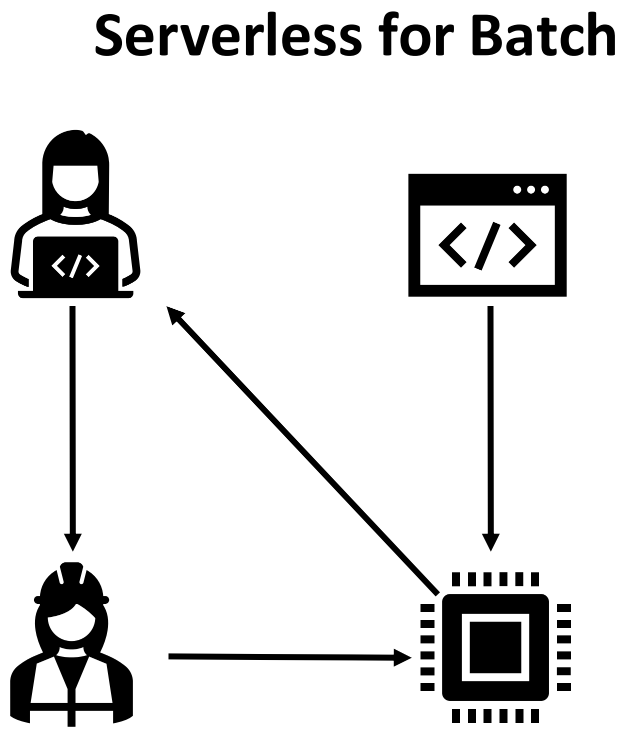

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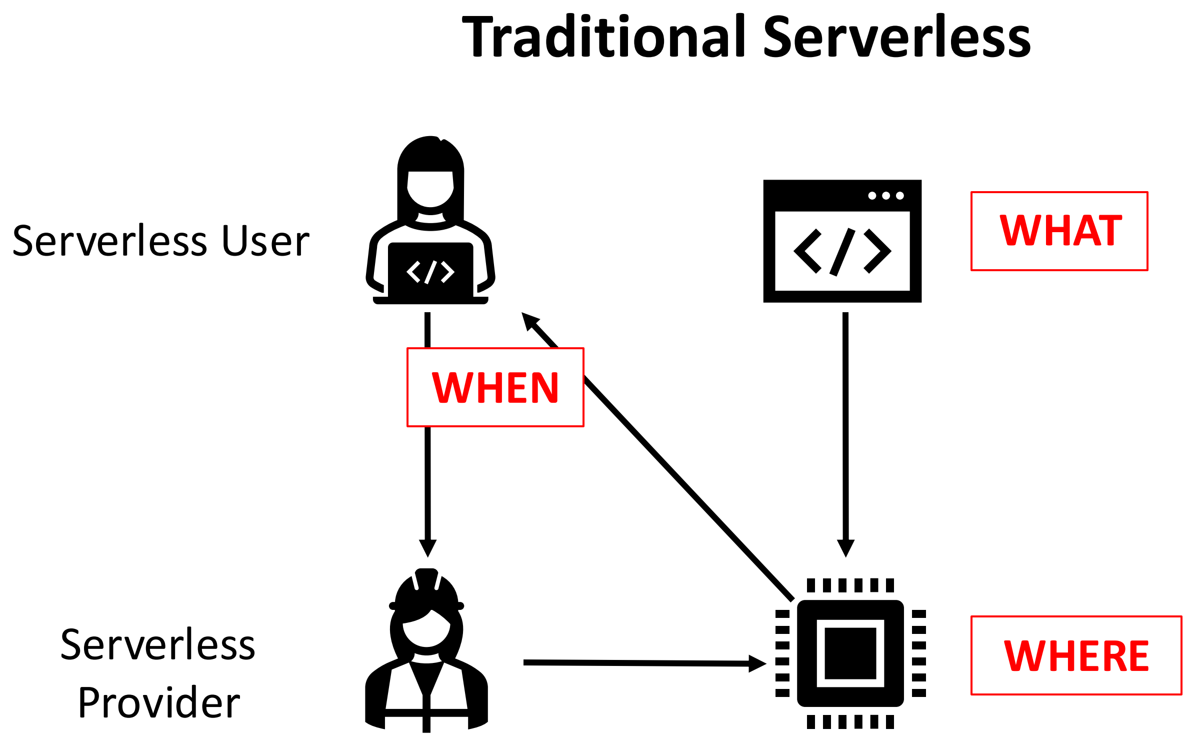

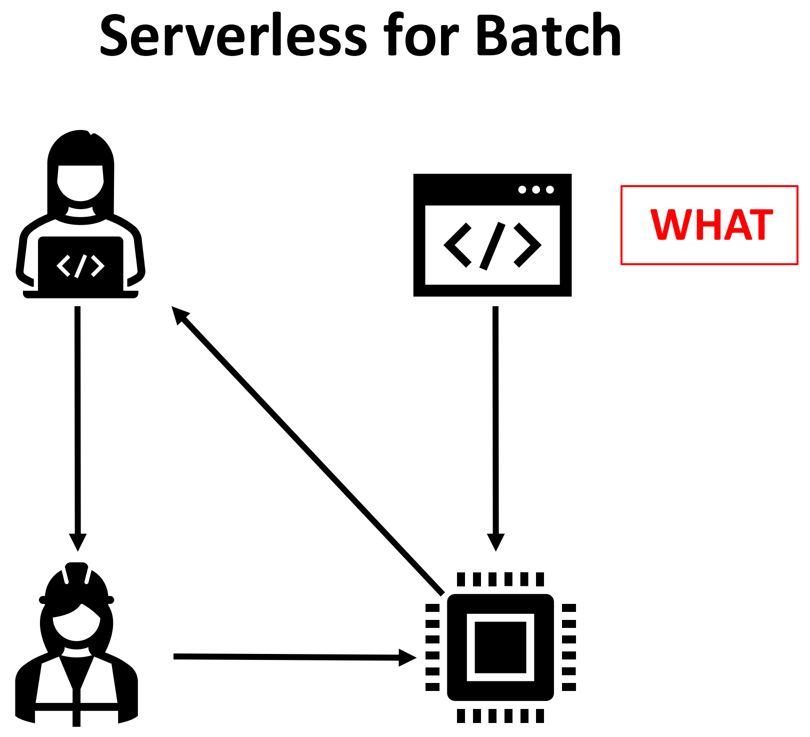

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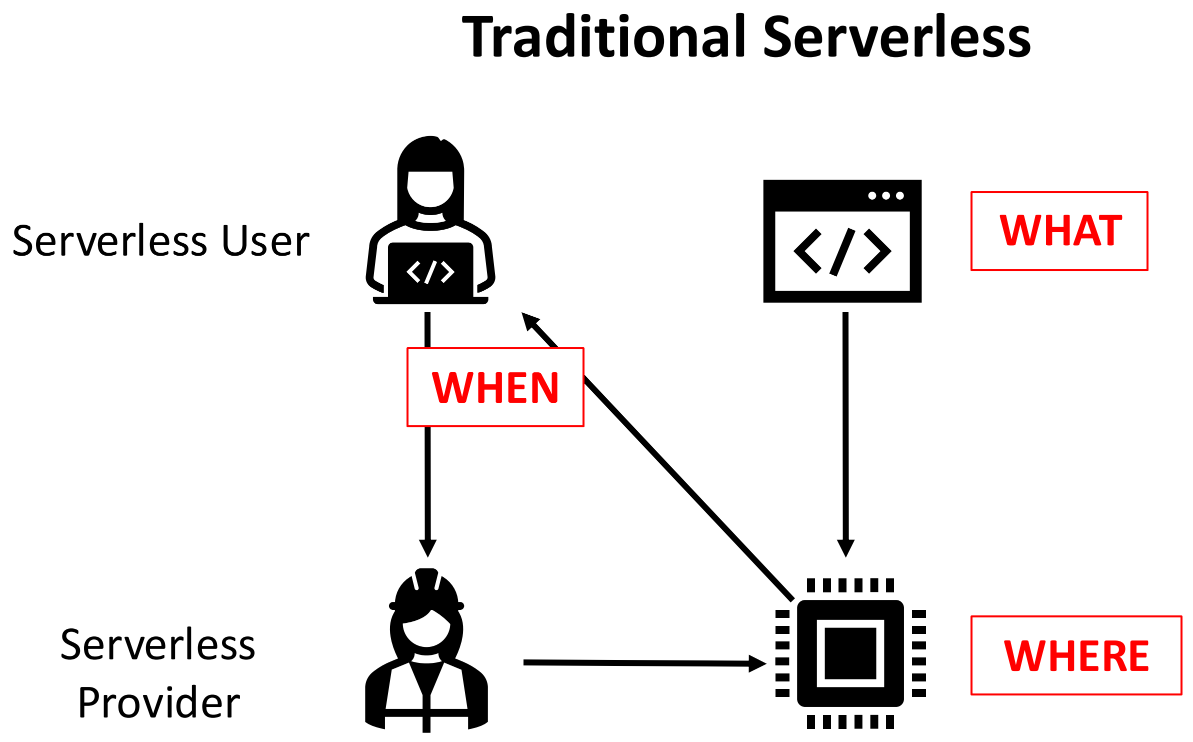

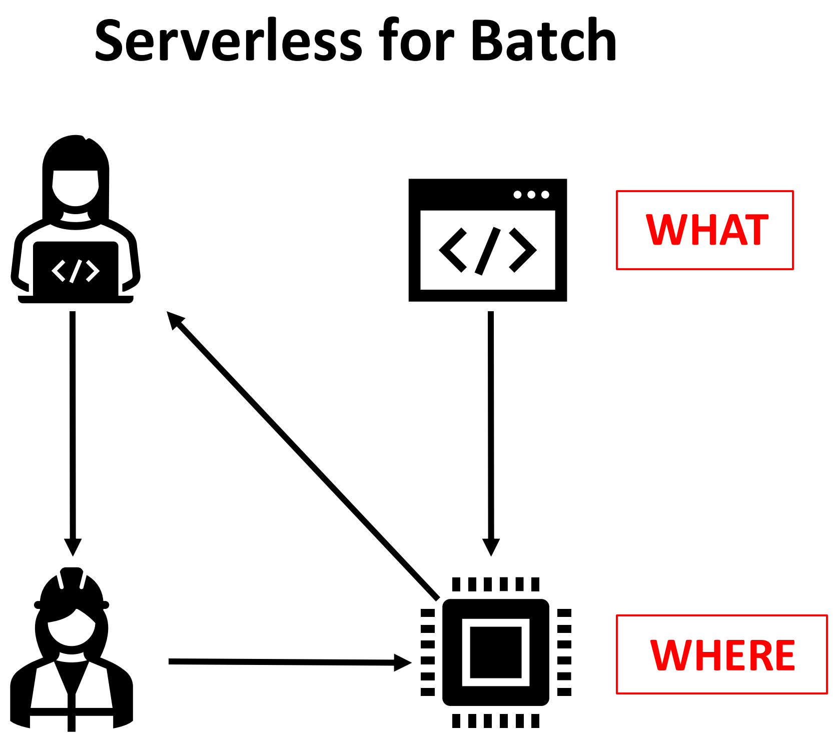

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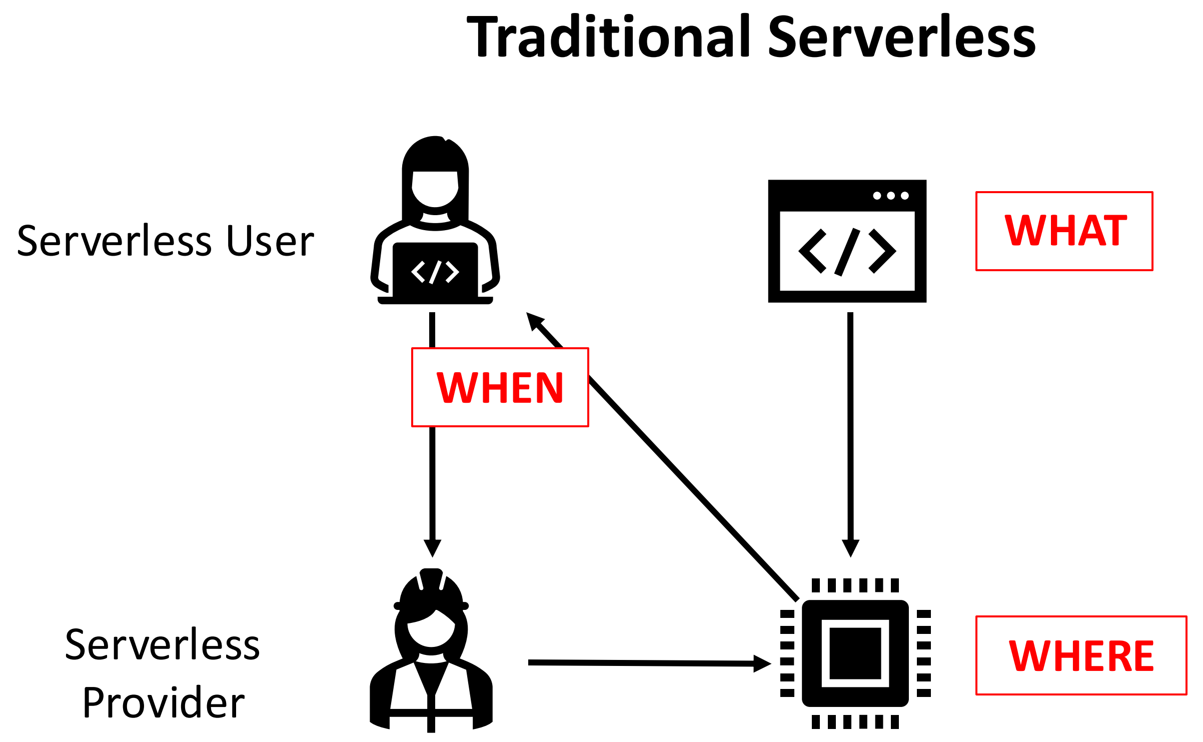

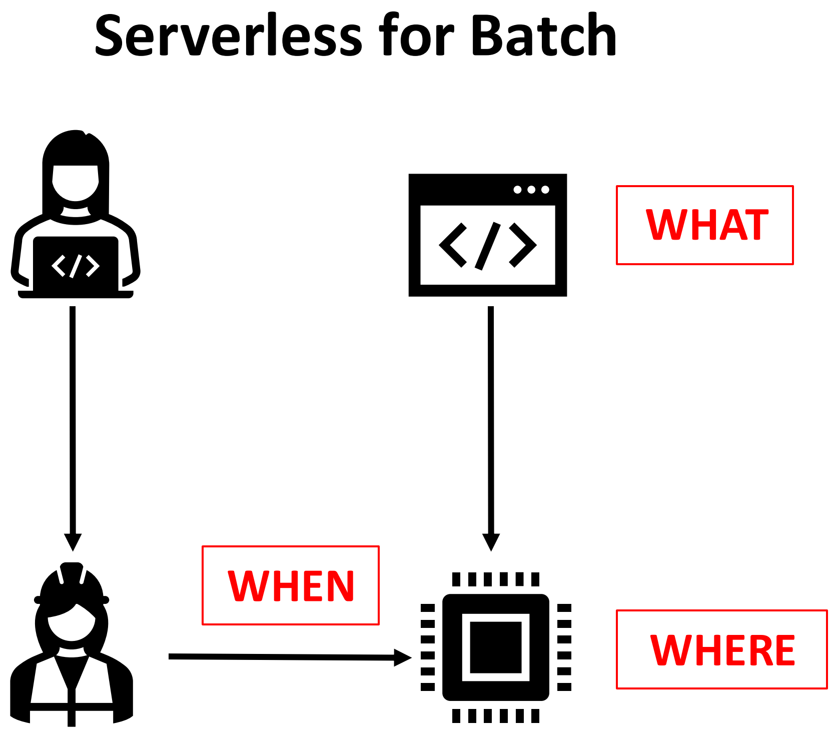

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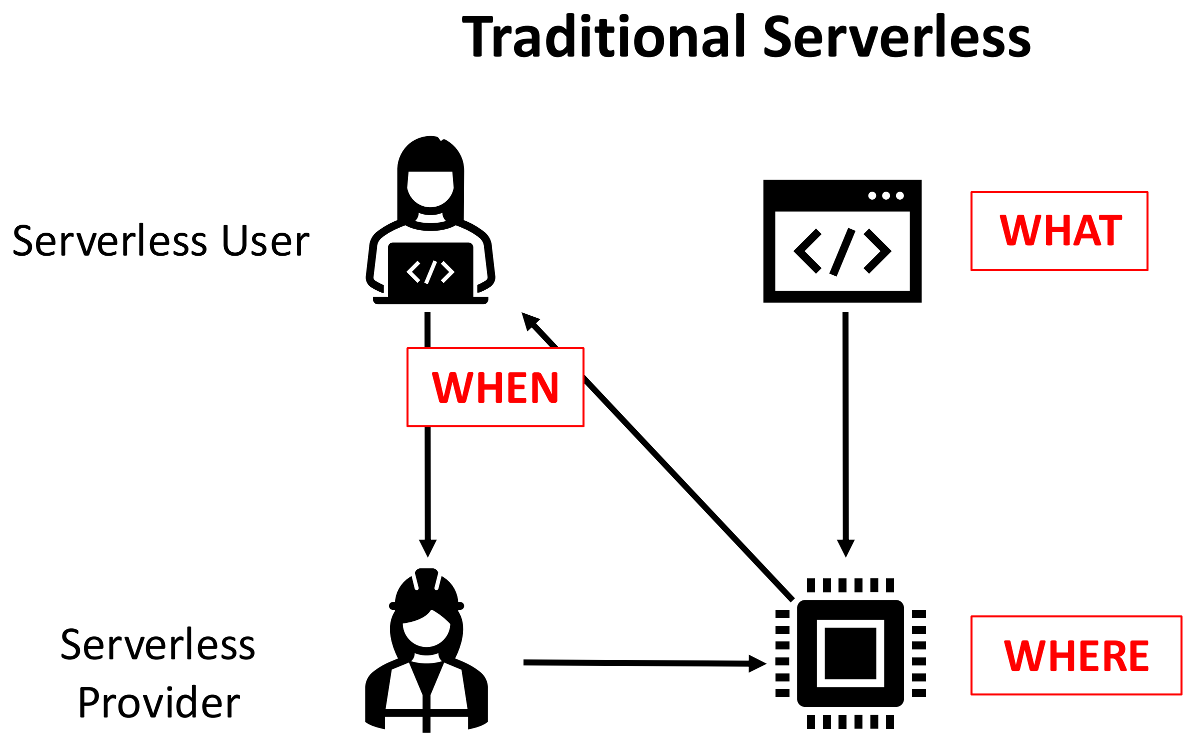

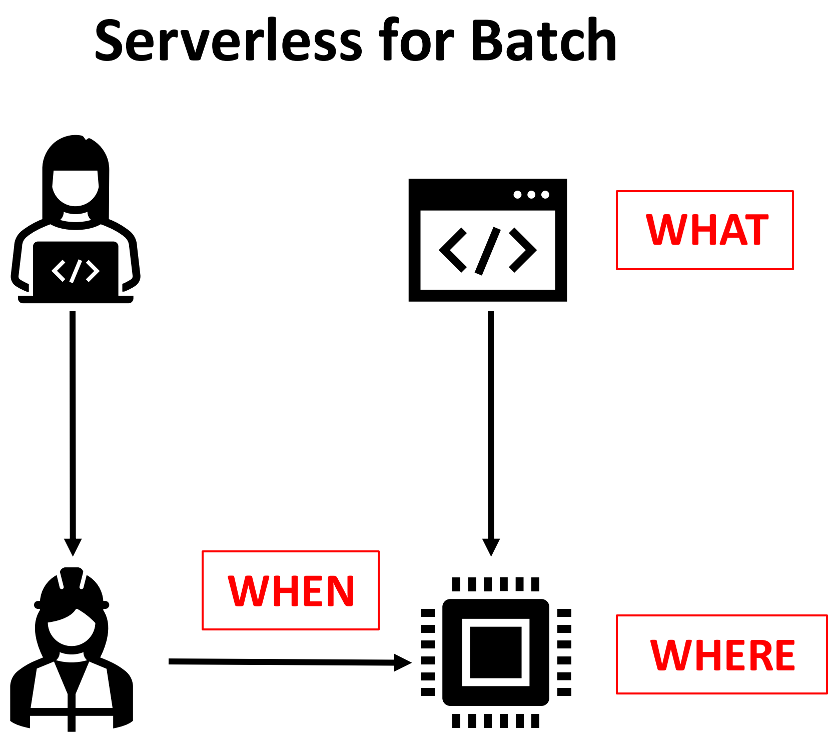

Serverless for non-interactive batch workloads can improve **resource utilization** by further delegating control to the serverless provider

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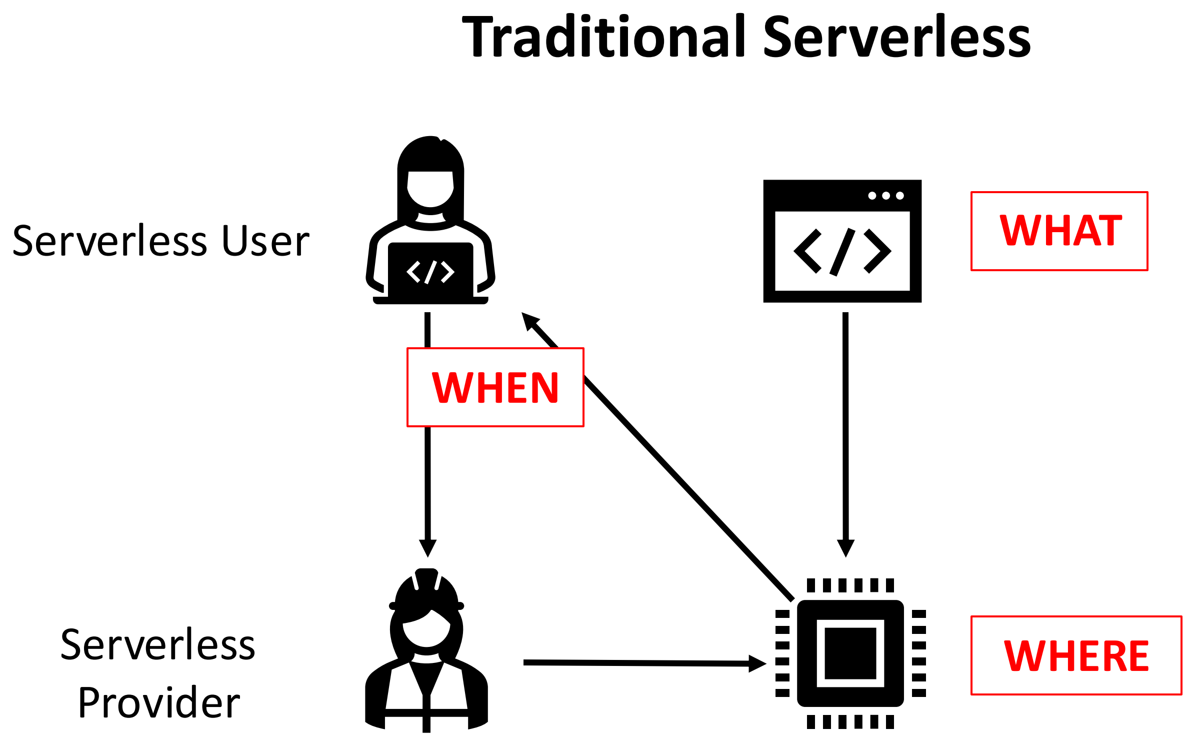

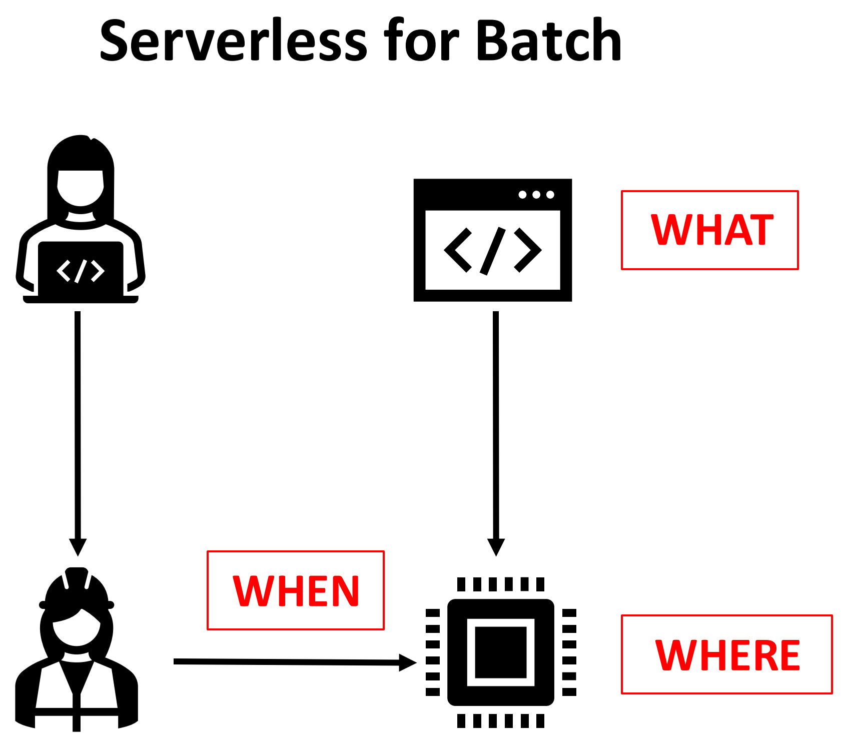

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Serverless for Batch

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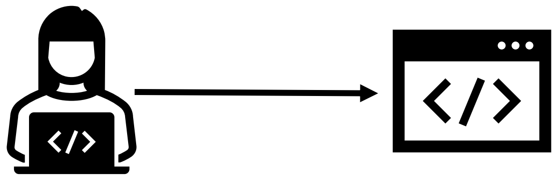

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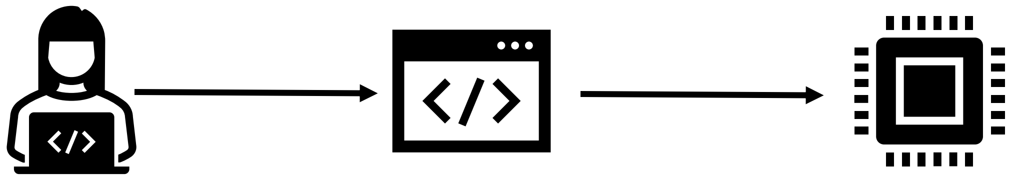

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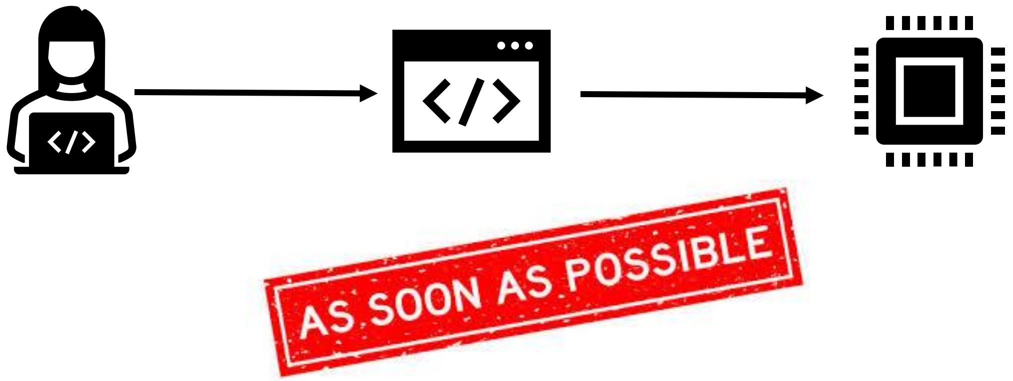

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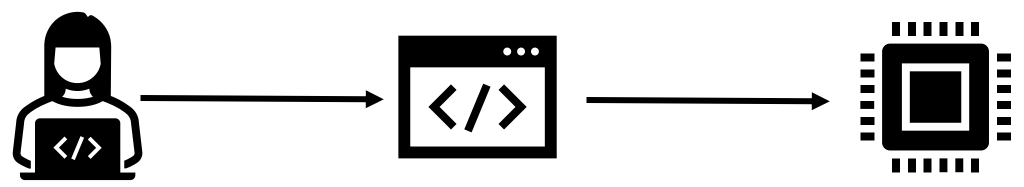

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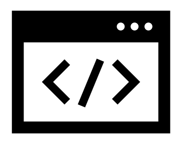

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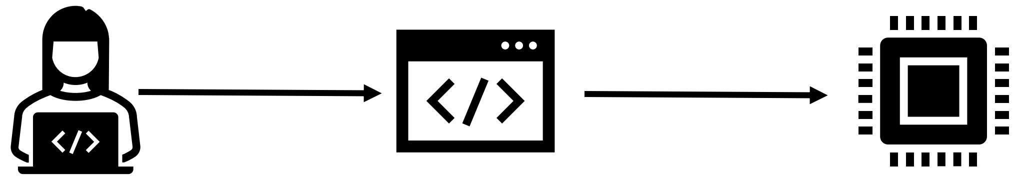

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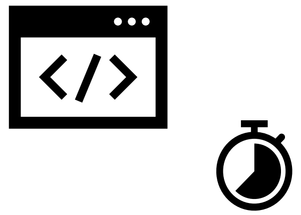

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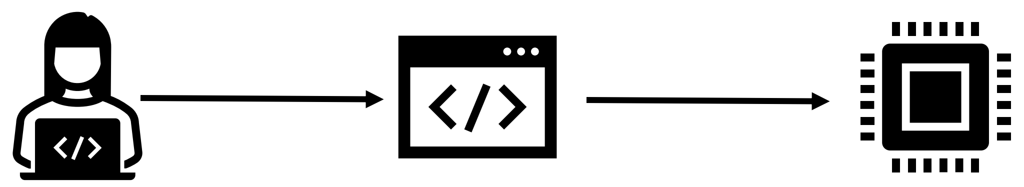

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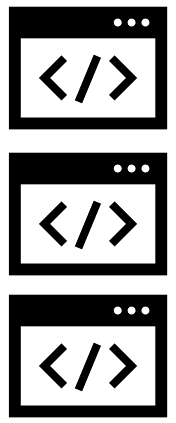

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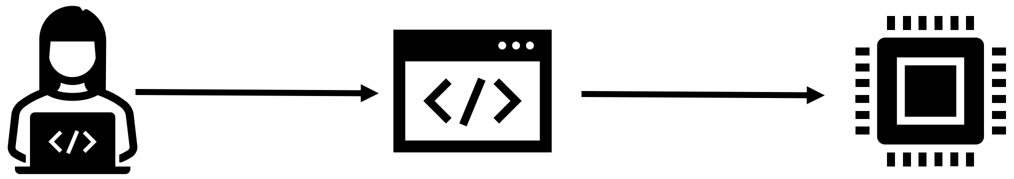

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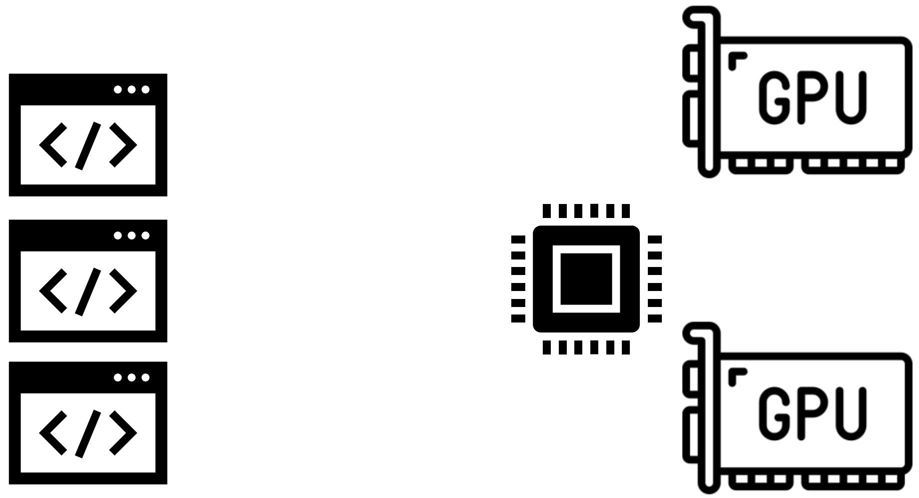

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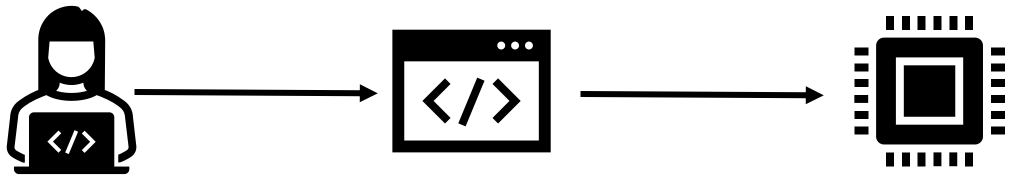
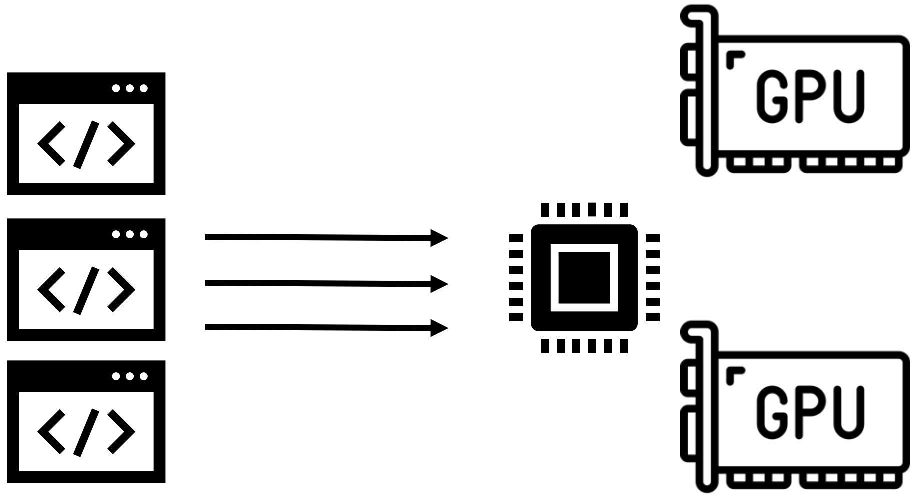
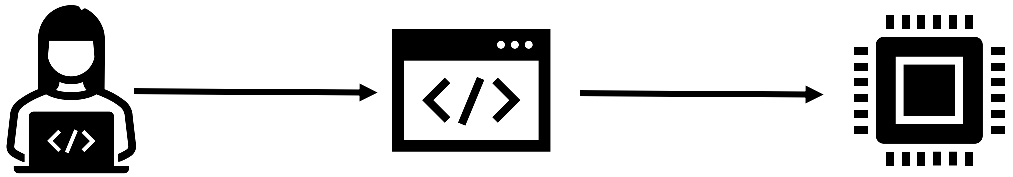


Serverless for Batch

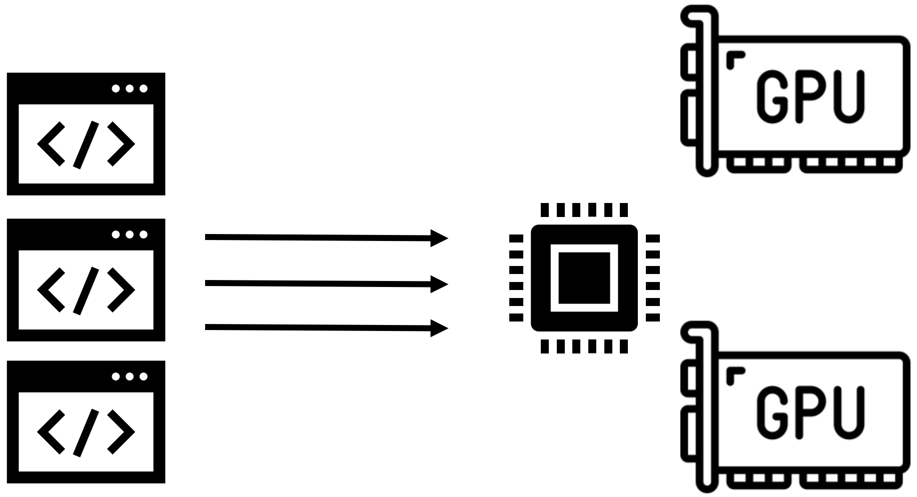


The Serverless Model Fits Batch Workloads

Traditional Serverless



Serverless for Batch



+ Efficiency

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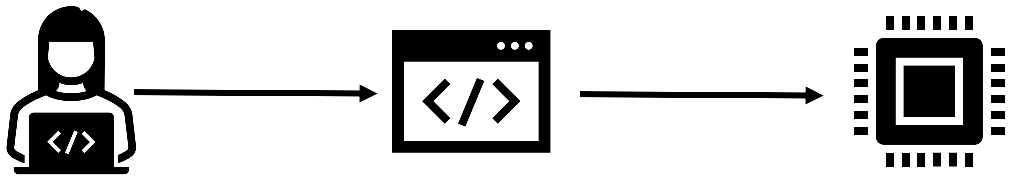
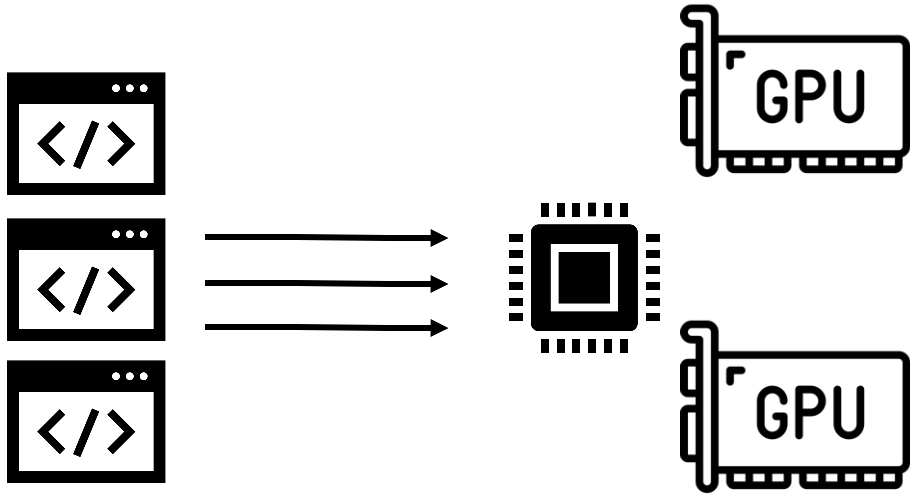
Traditional Serverless



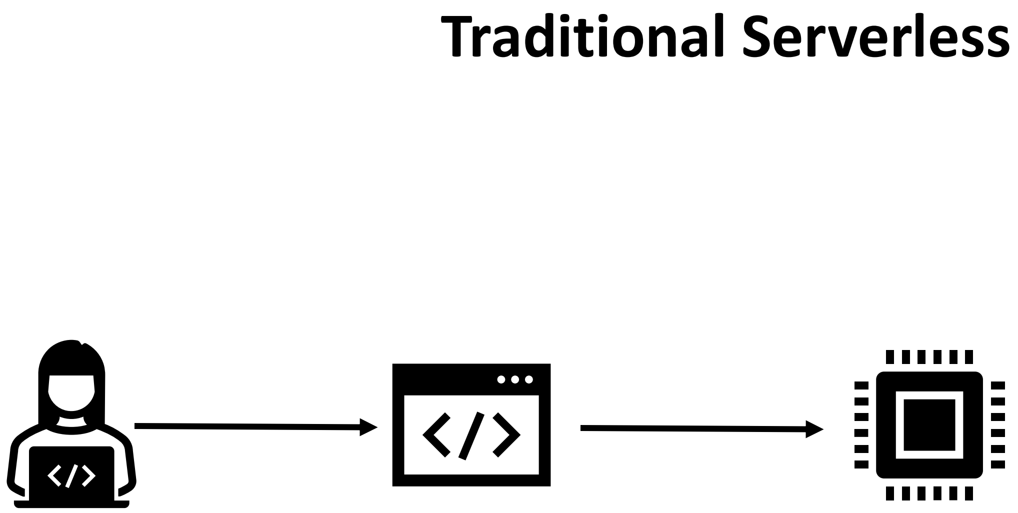
Serverless for Batch

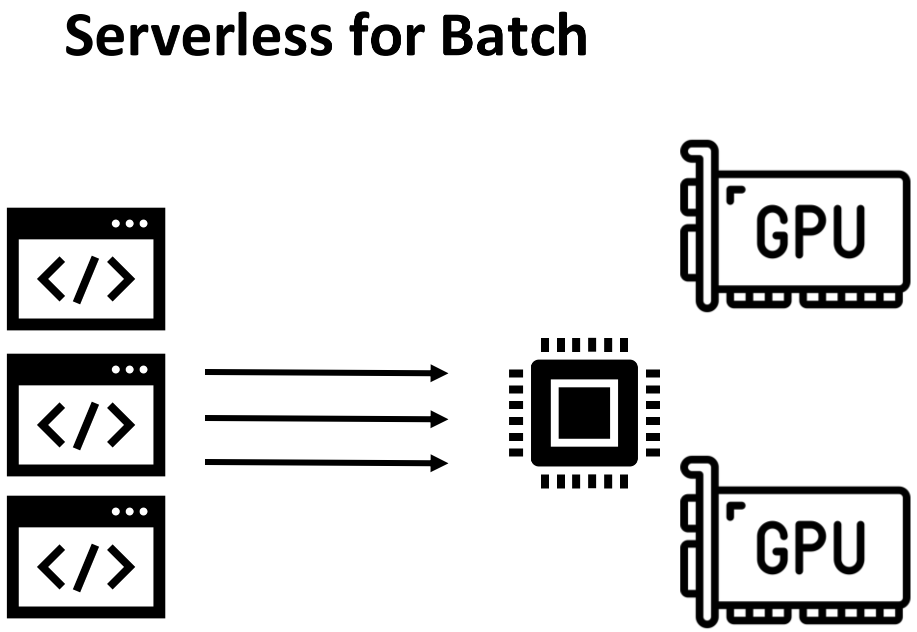


+ Efficiency

- Cost

The Serverless Model Fits Batch Workloads





Serverless for batch workloads can improve **throughput** by leveraging accelerators

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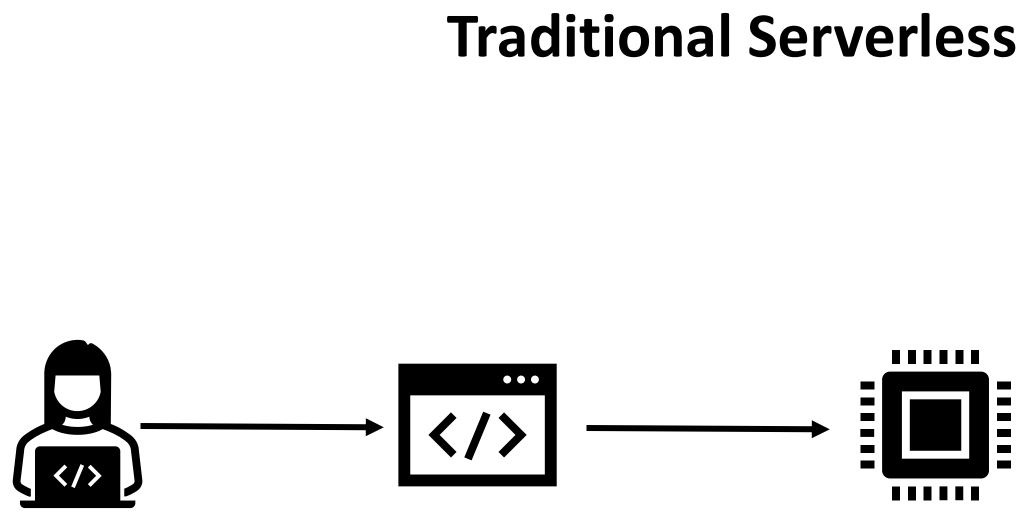

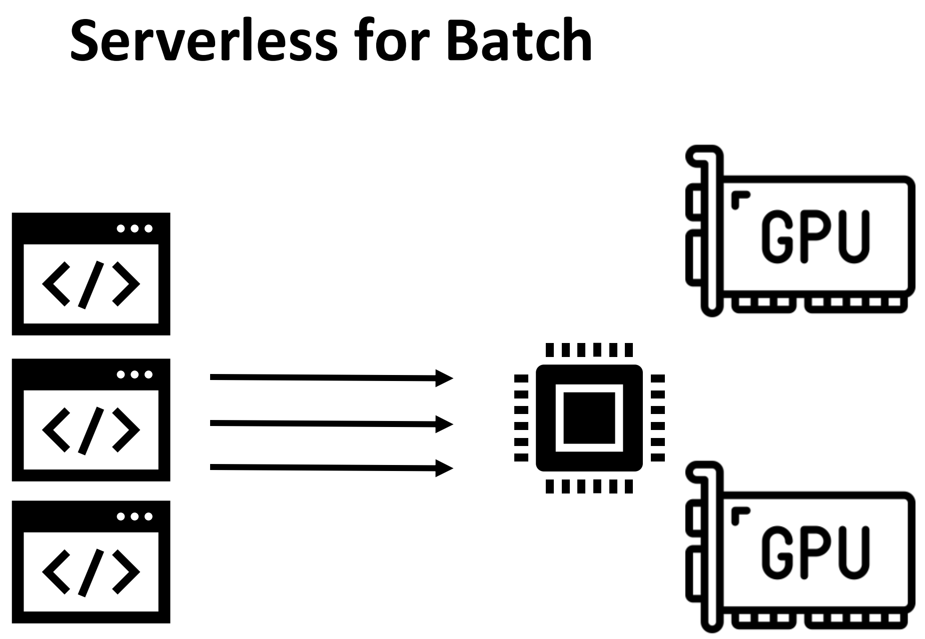

Serverless for batch workloads can improve **throughput** by **transparently** leveraging accelerators

[ASPLOS'22] Molecule

DFaaS: Delayable FaaS

How can we better support batch workloads with a serverless model?

DFaaS: Delayable FaaS

How can we better support batch workloads with a serverless model?

delay tolerance

DFaaS: Delayable FaaS

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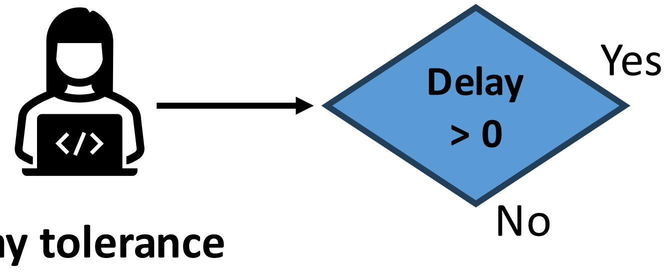

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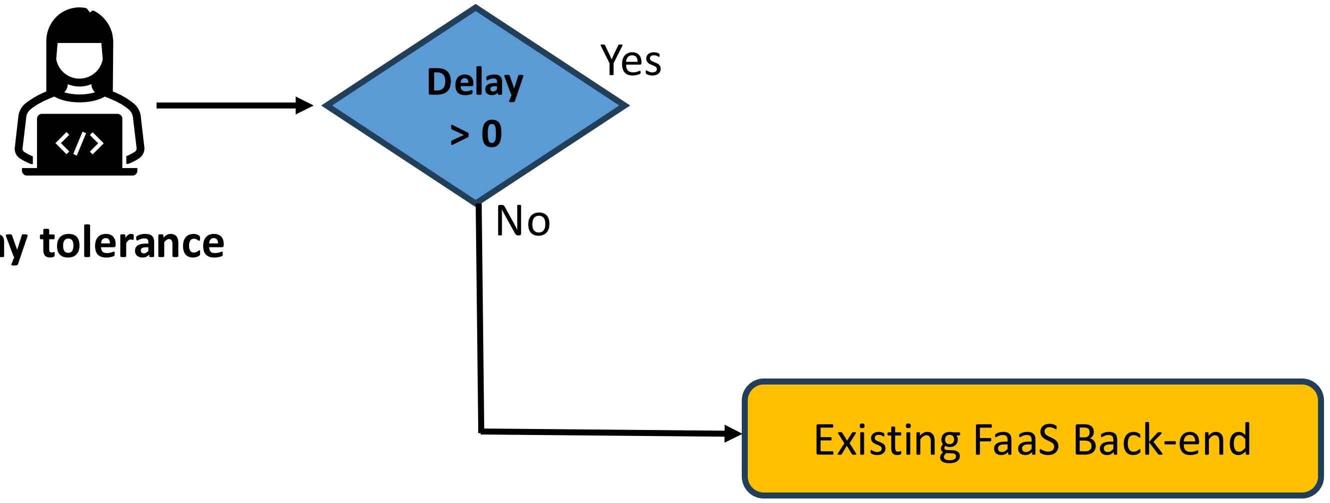

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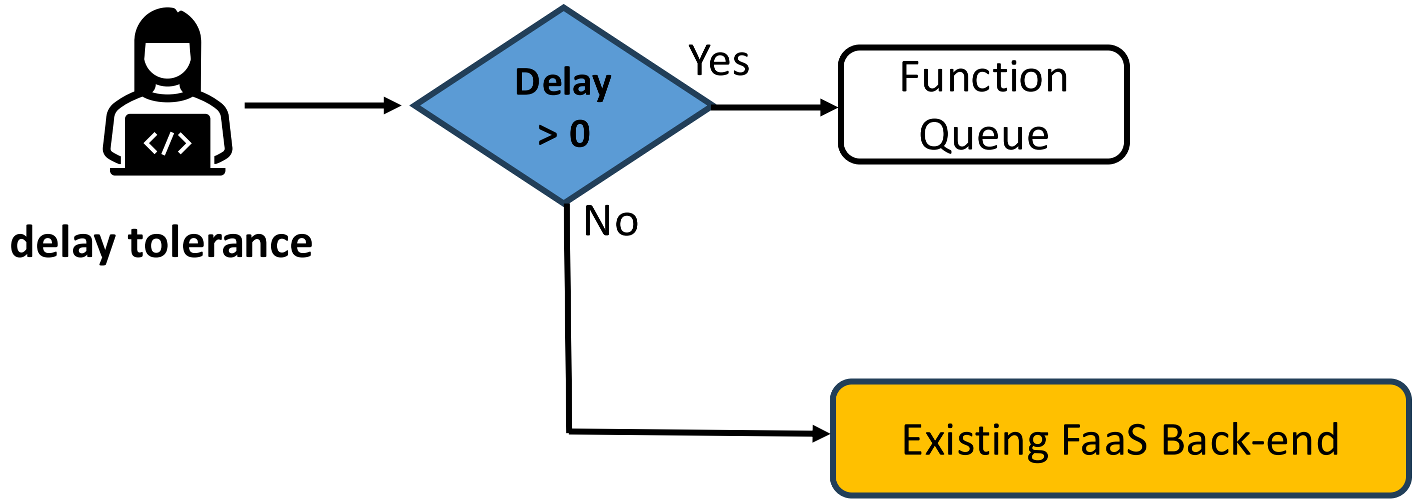

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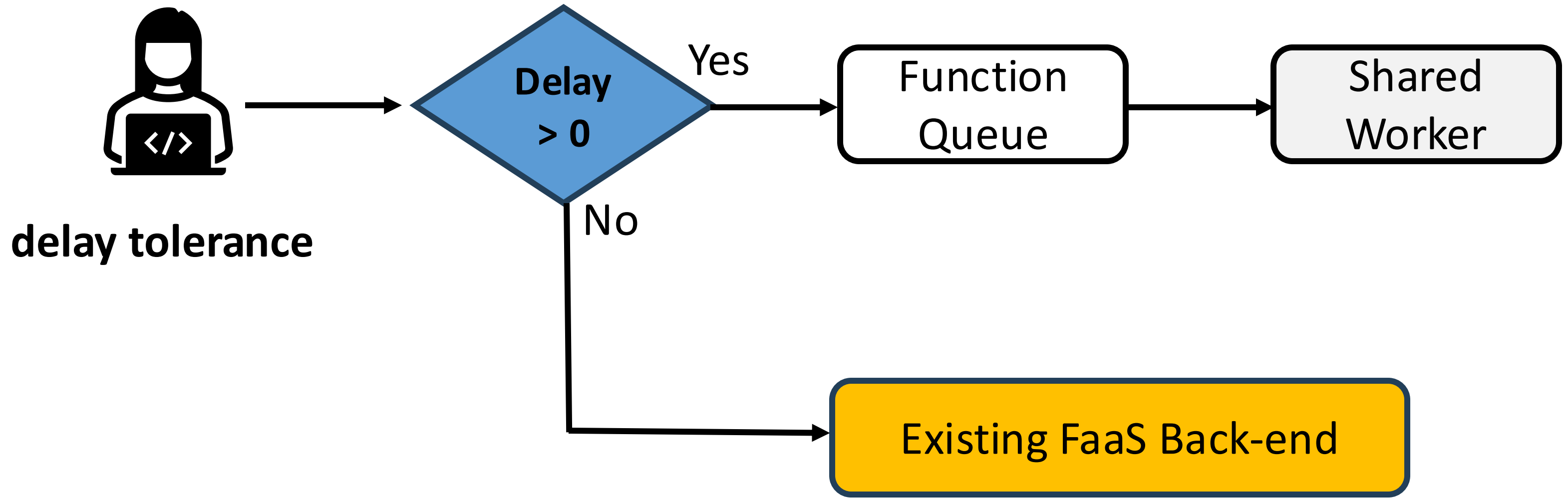

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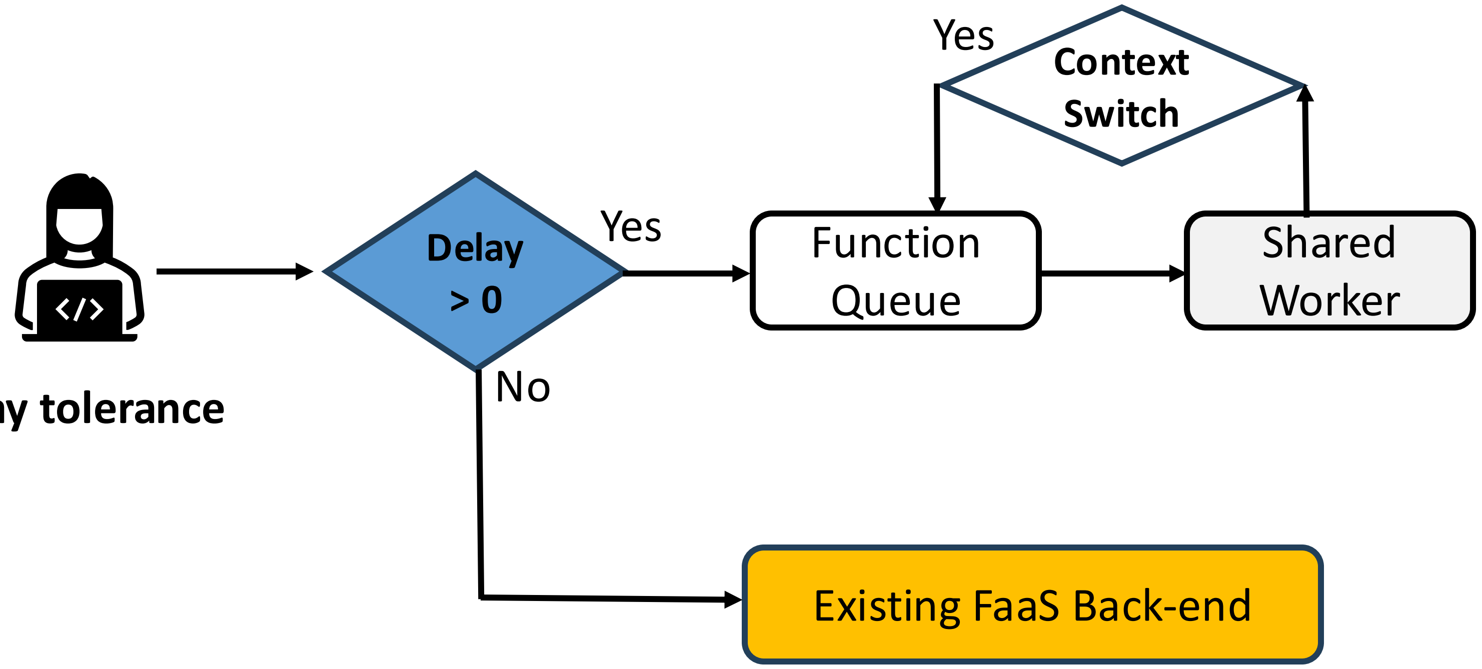

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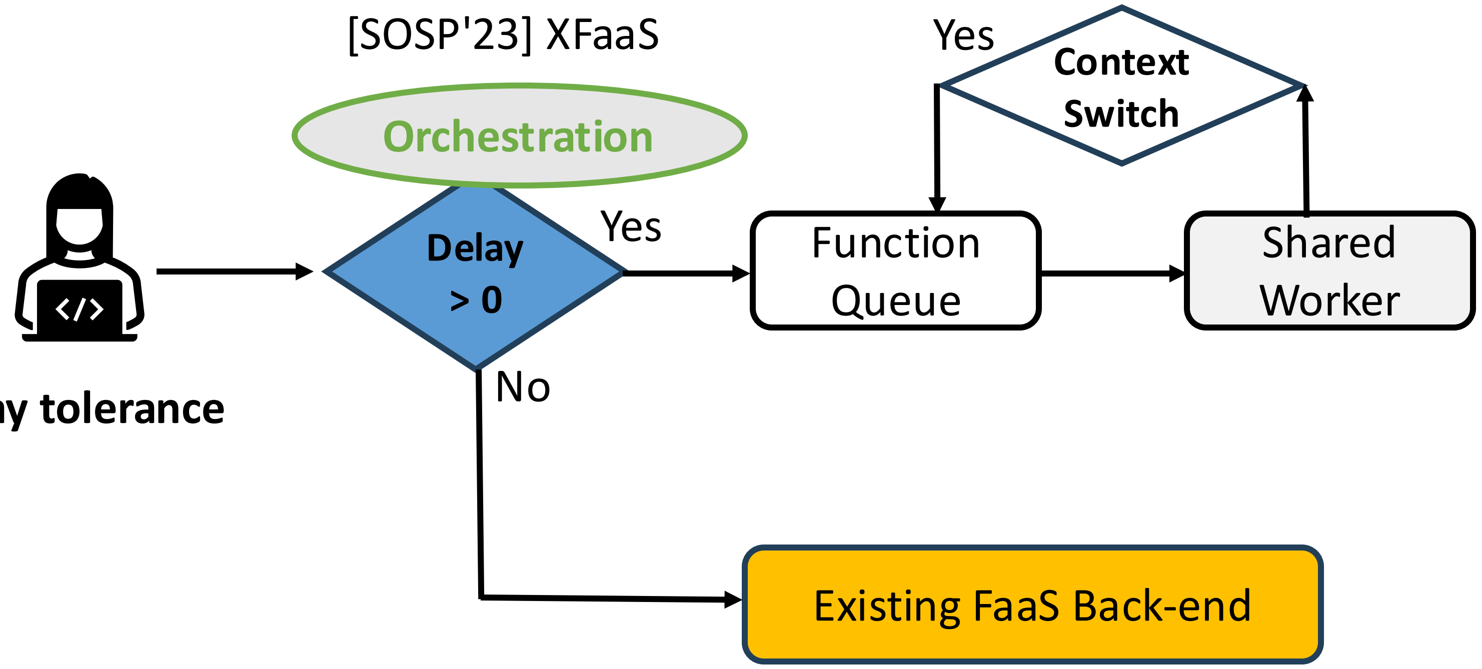

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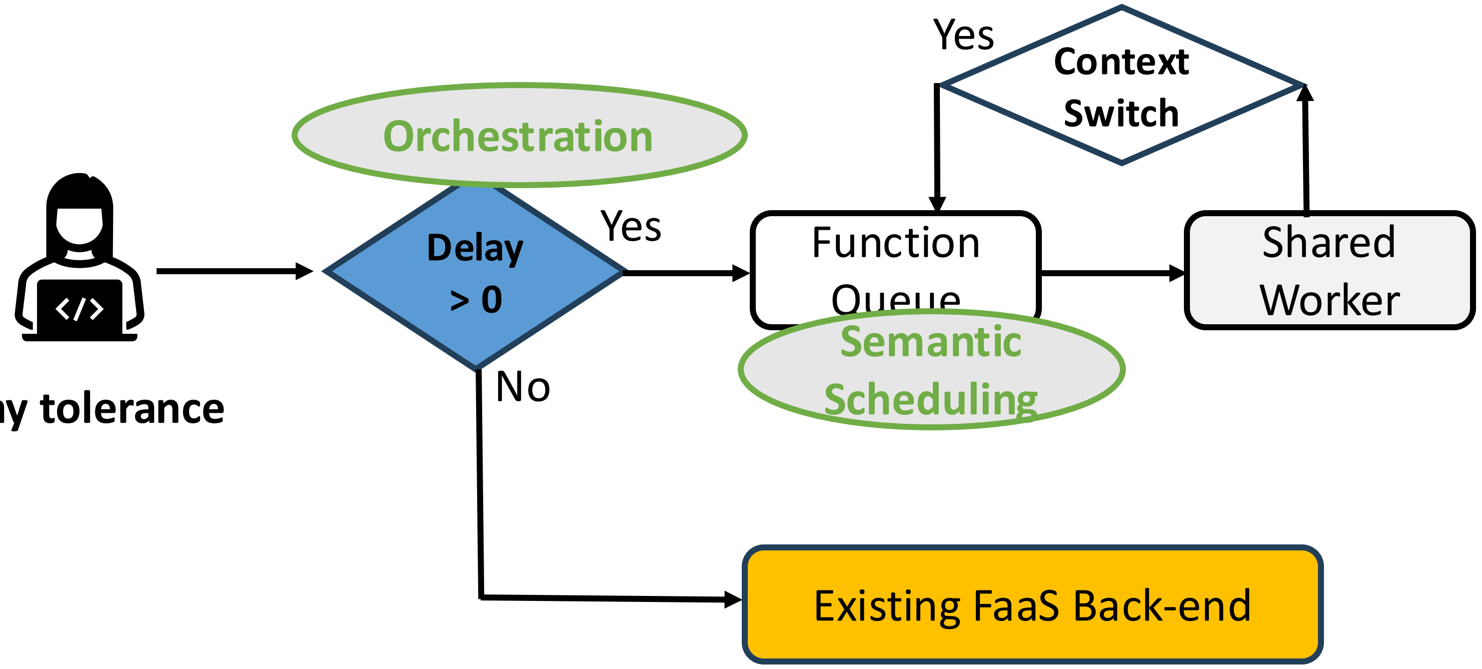

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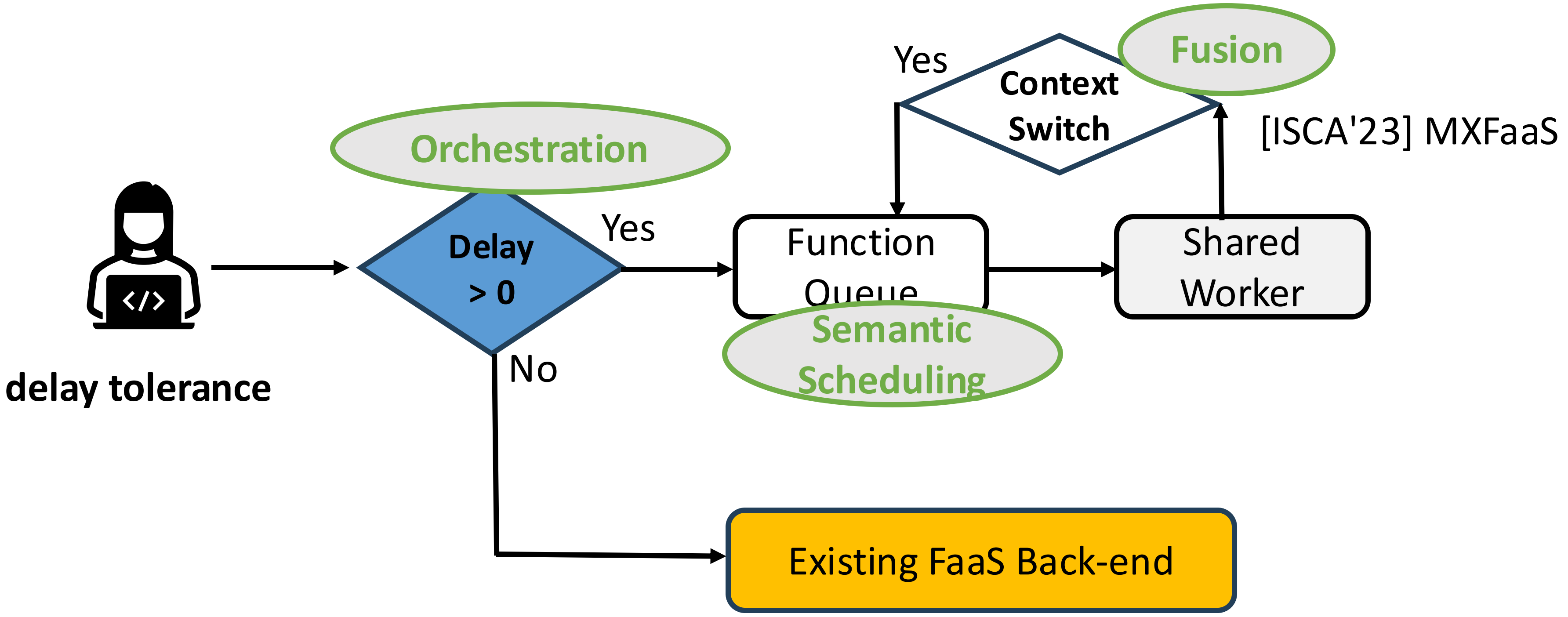

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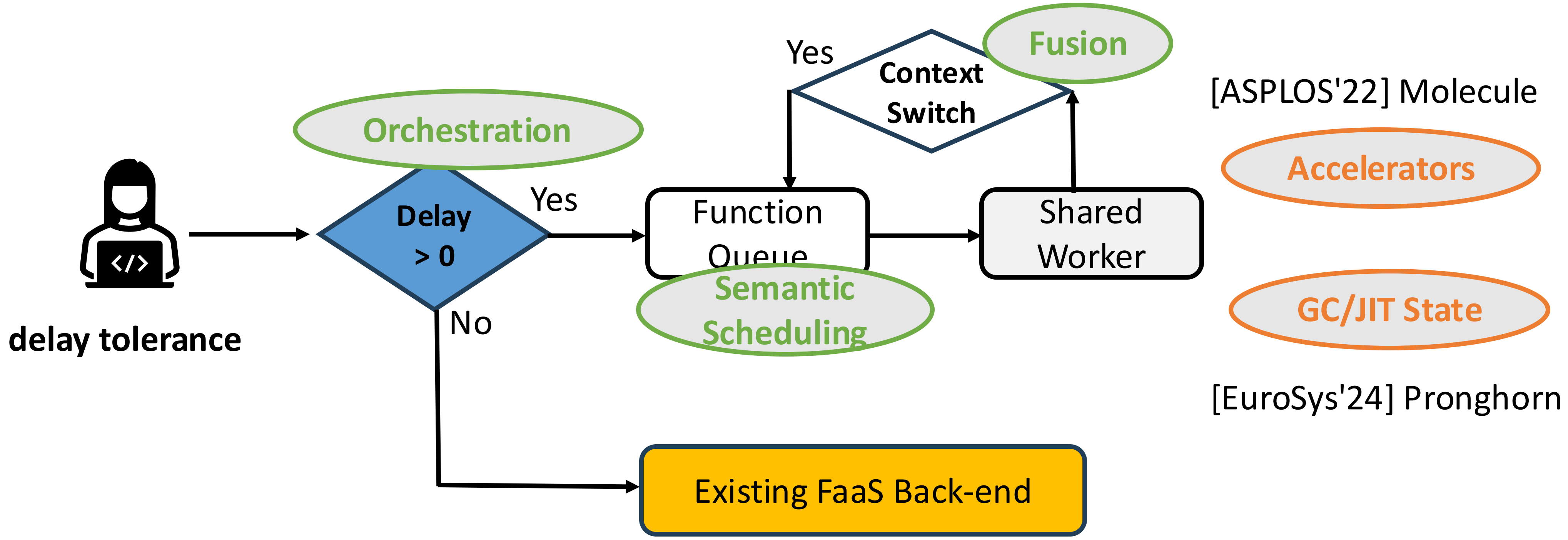

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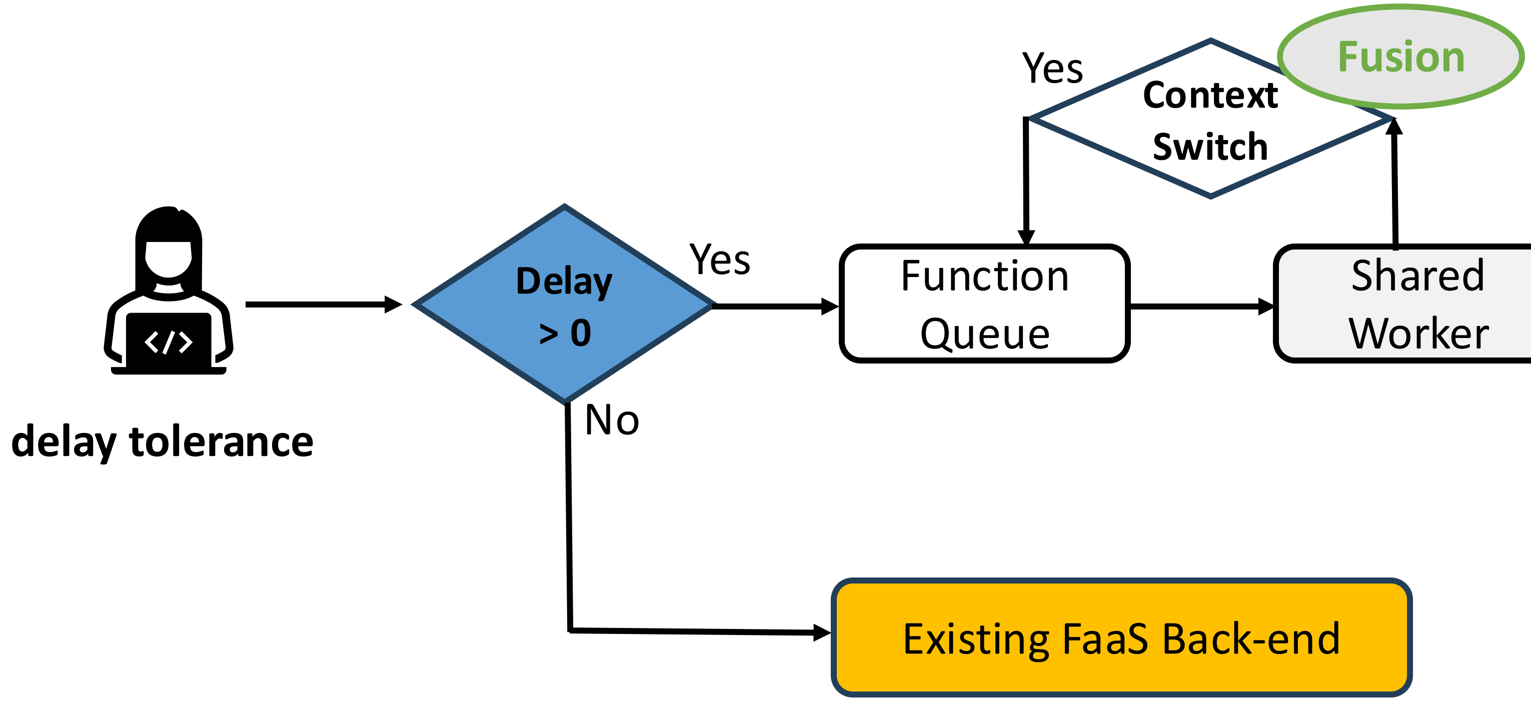
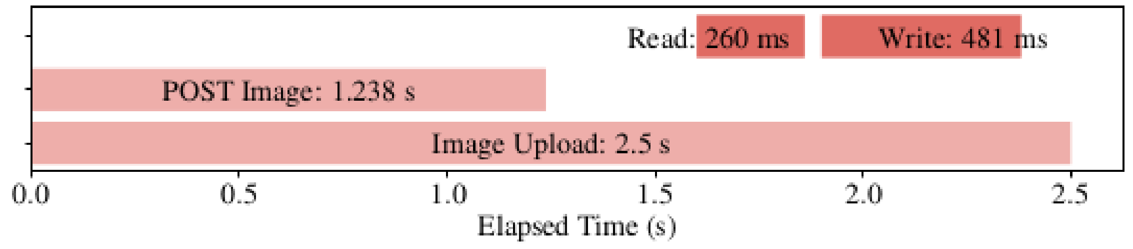


DFaaS: Function Fusion



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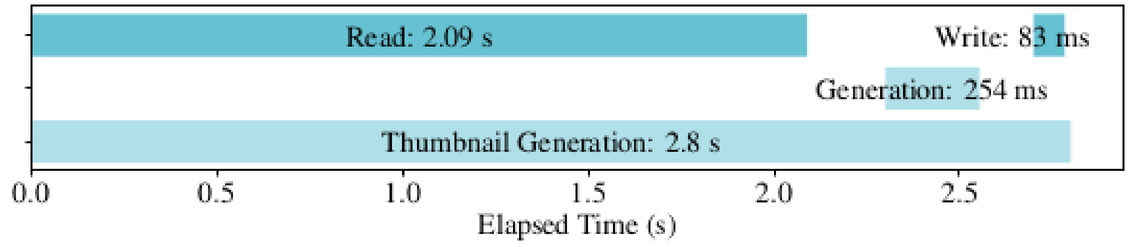
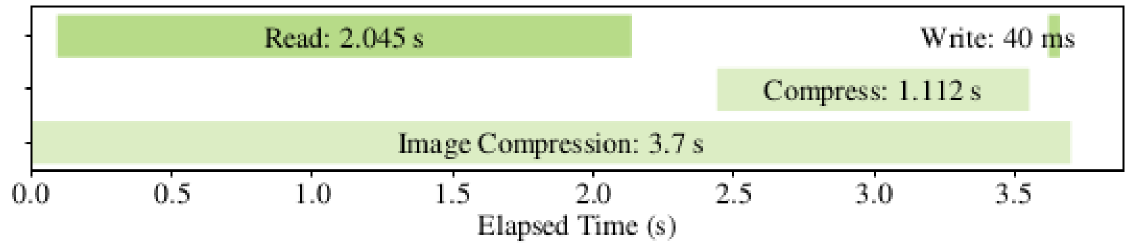
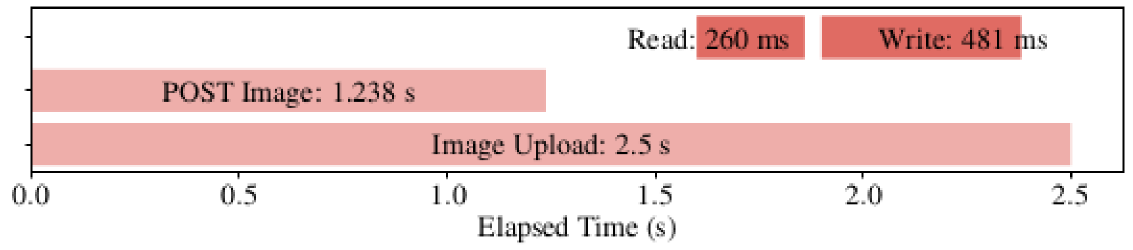


(b) Thumbnail generation



(c) Compression

DFaaS: Function Fusion



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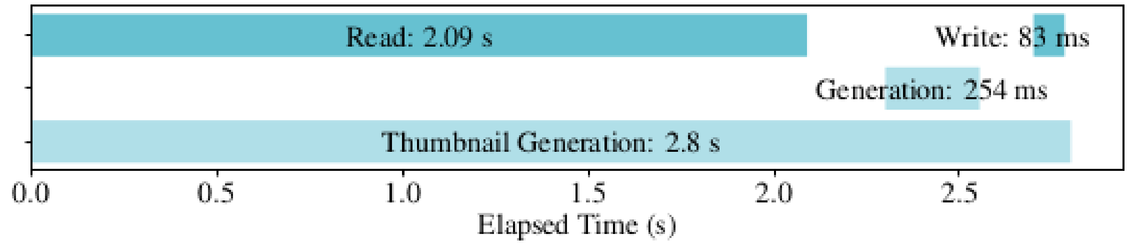

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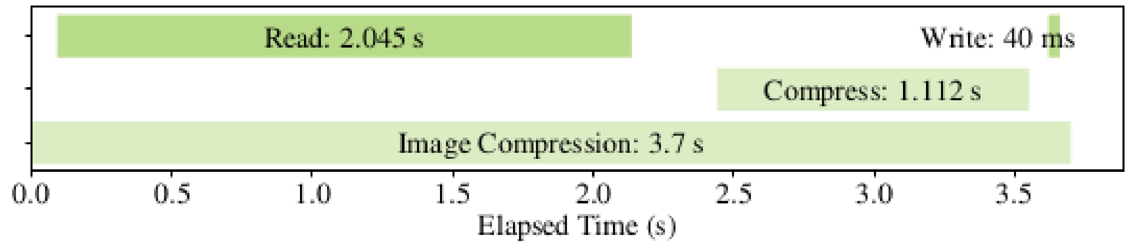

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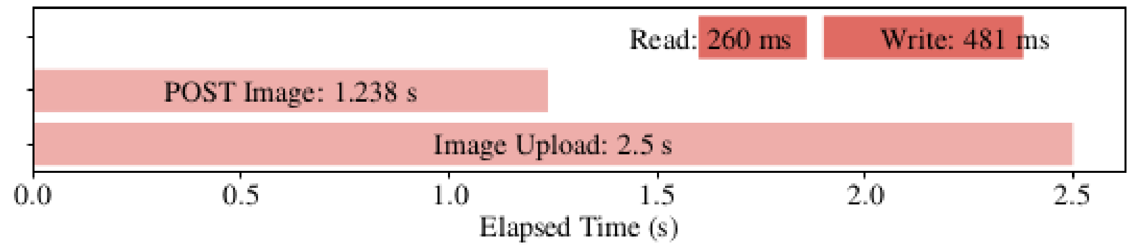

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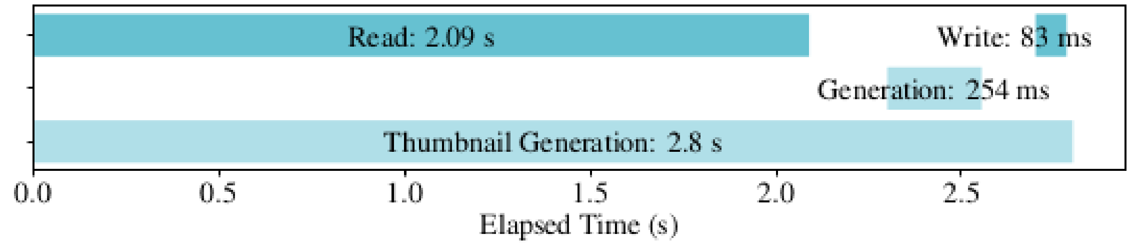

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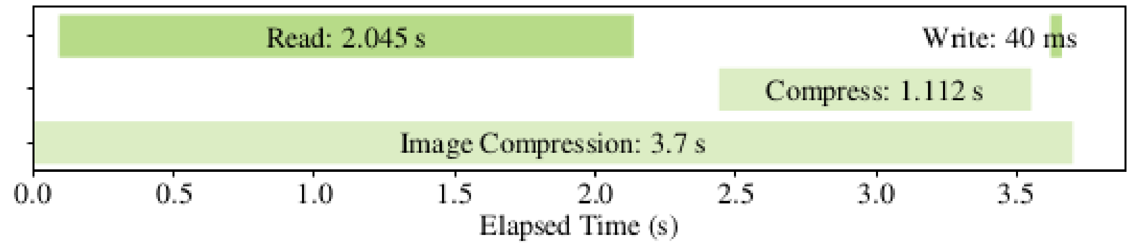

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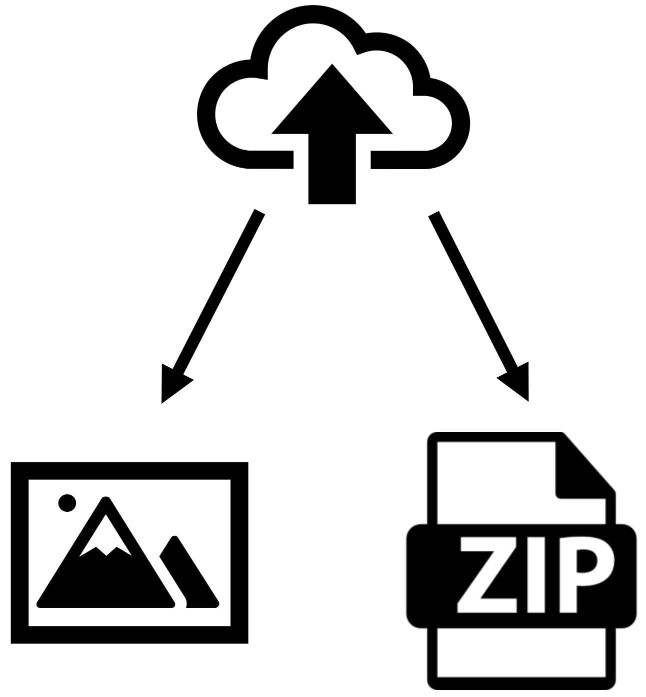
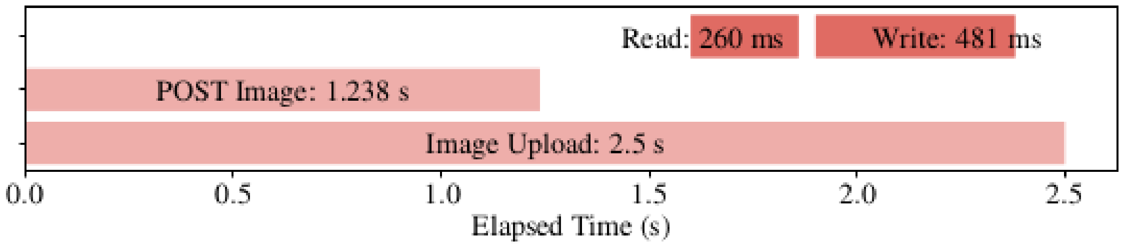


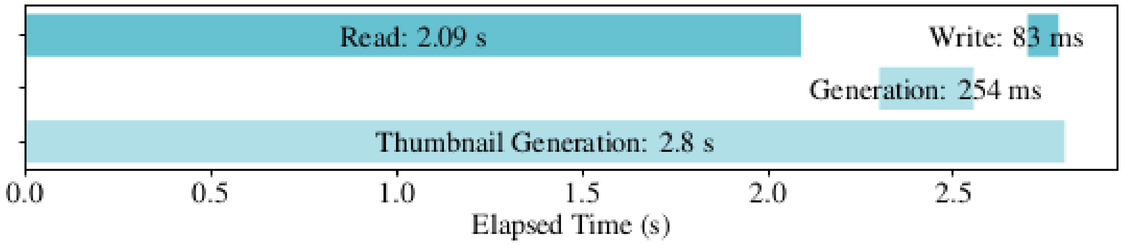
DFaaS: Function Fusion

COMPUTE



(a) Image upload

COMPUTE



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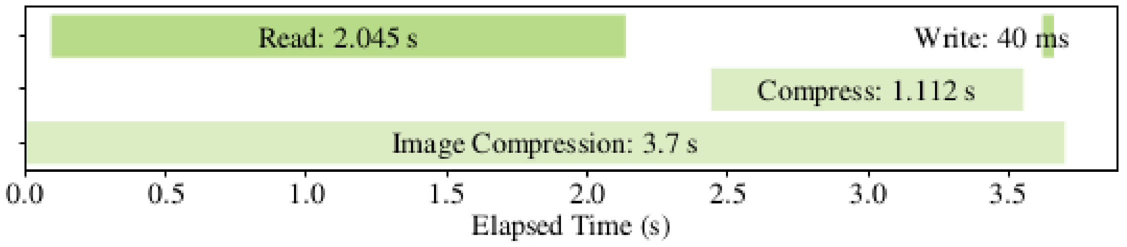

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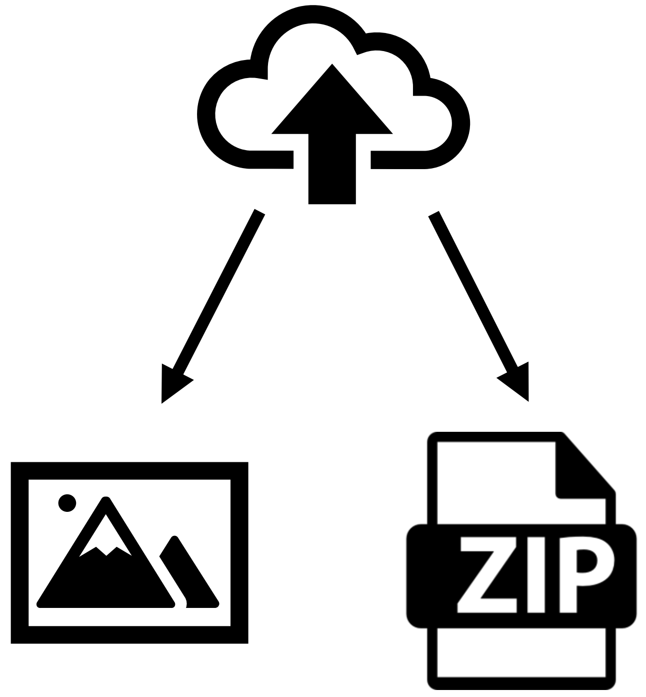

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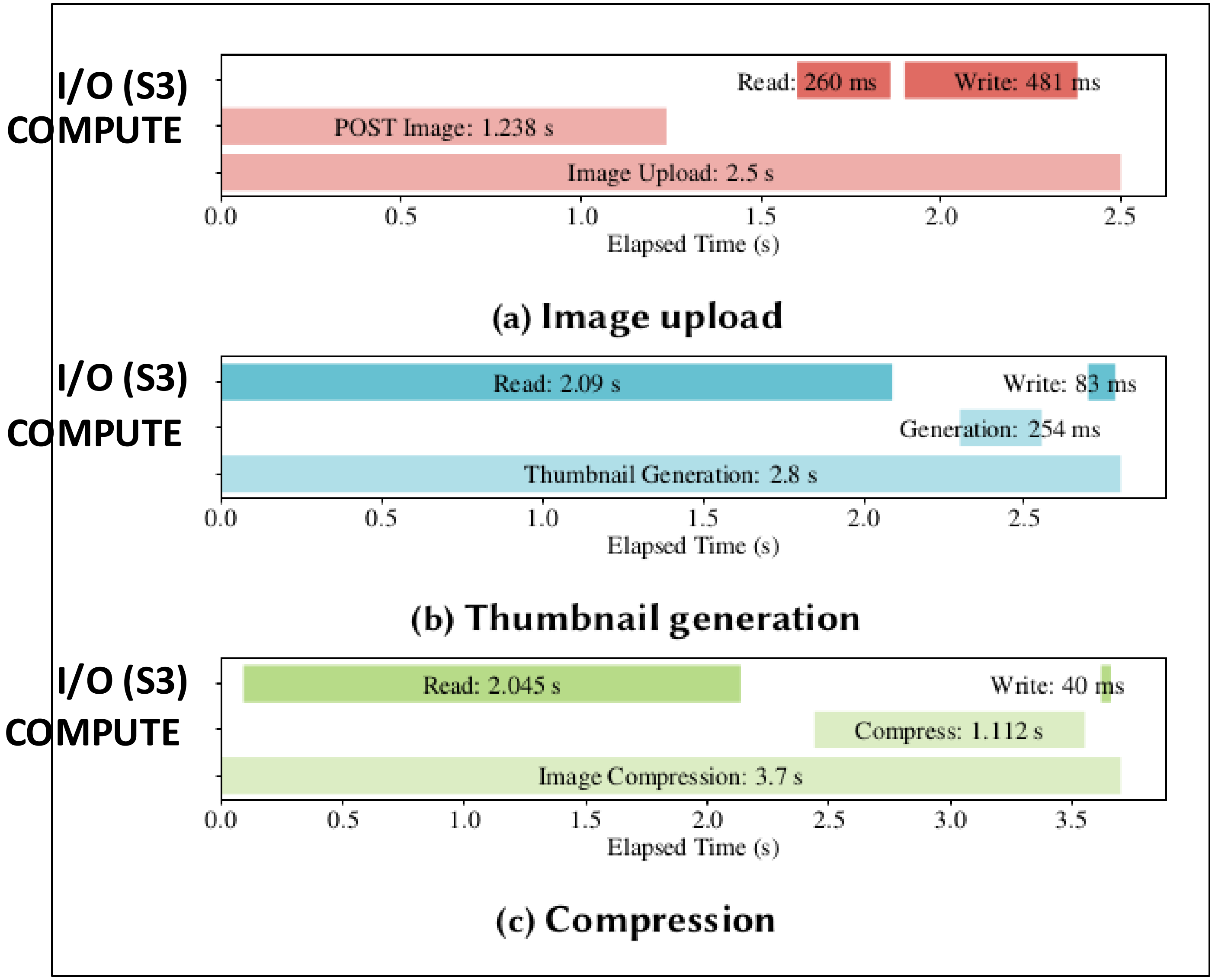

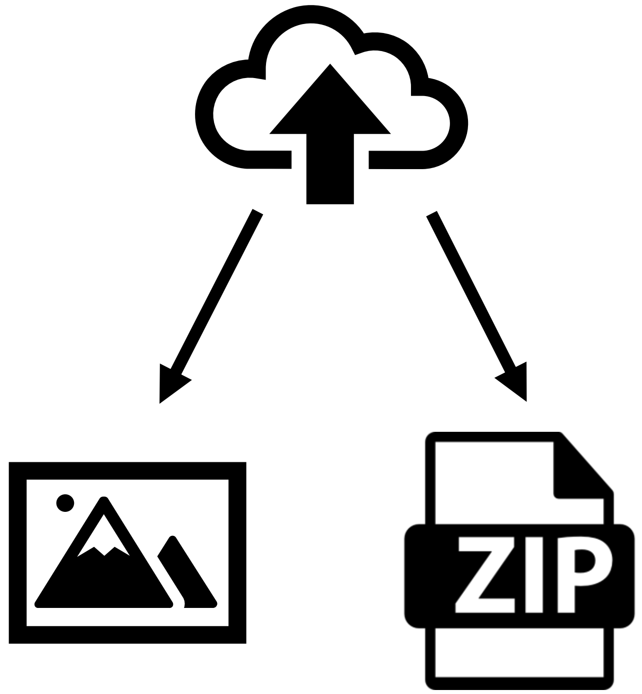

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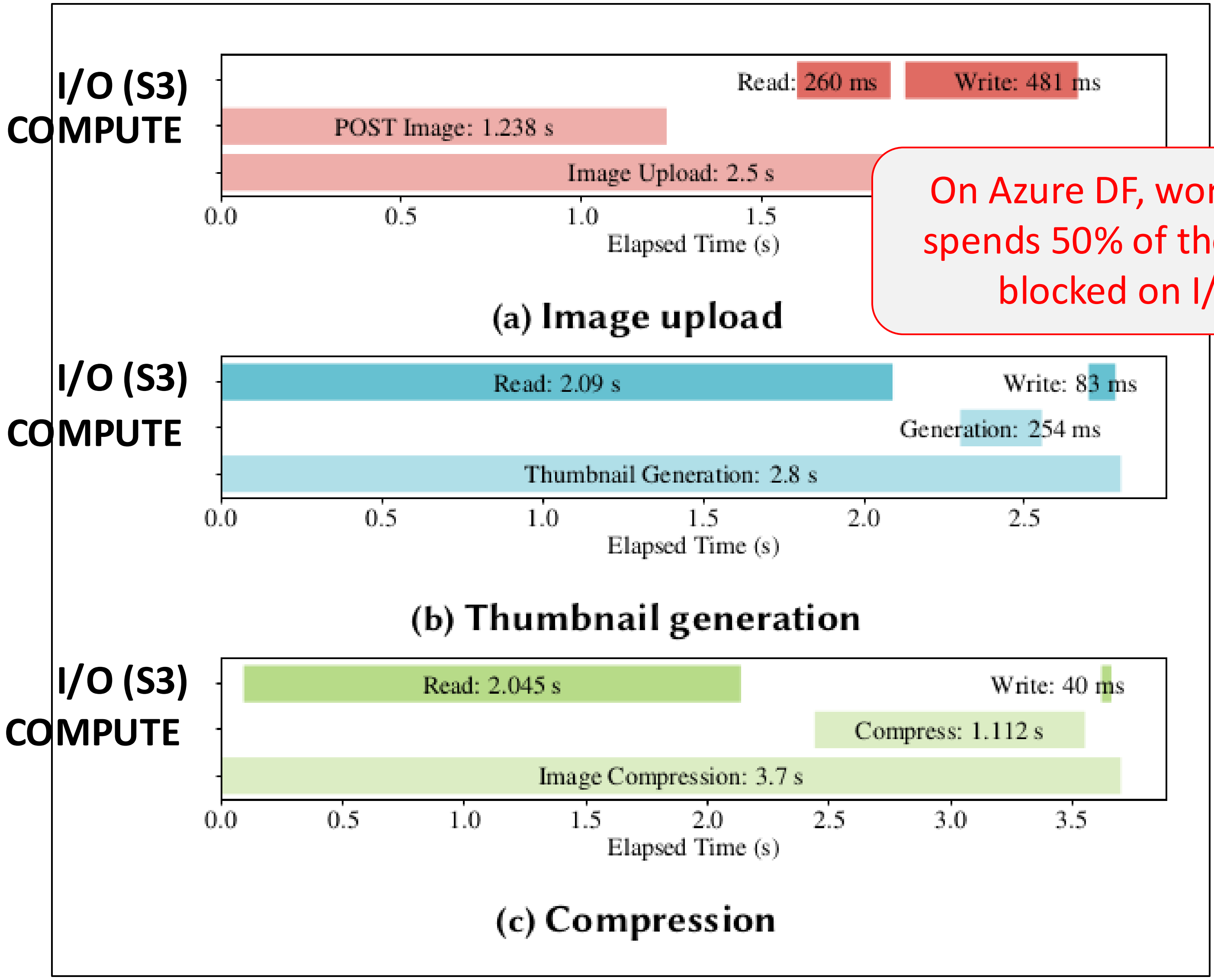
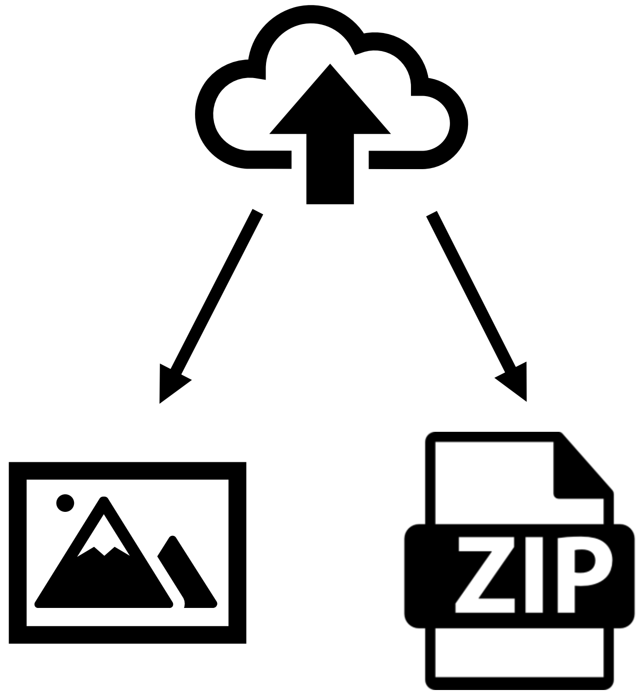


On Azure DF, workflow spends 50% of the time blocked on I/O



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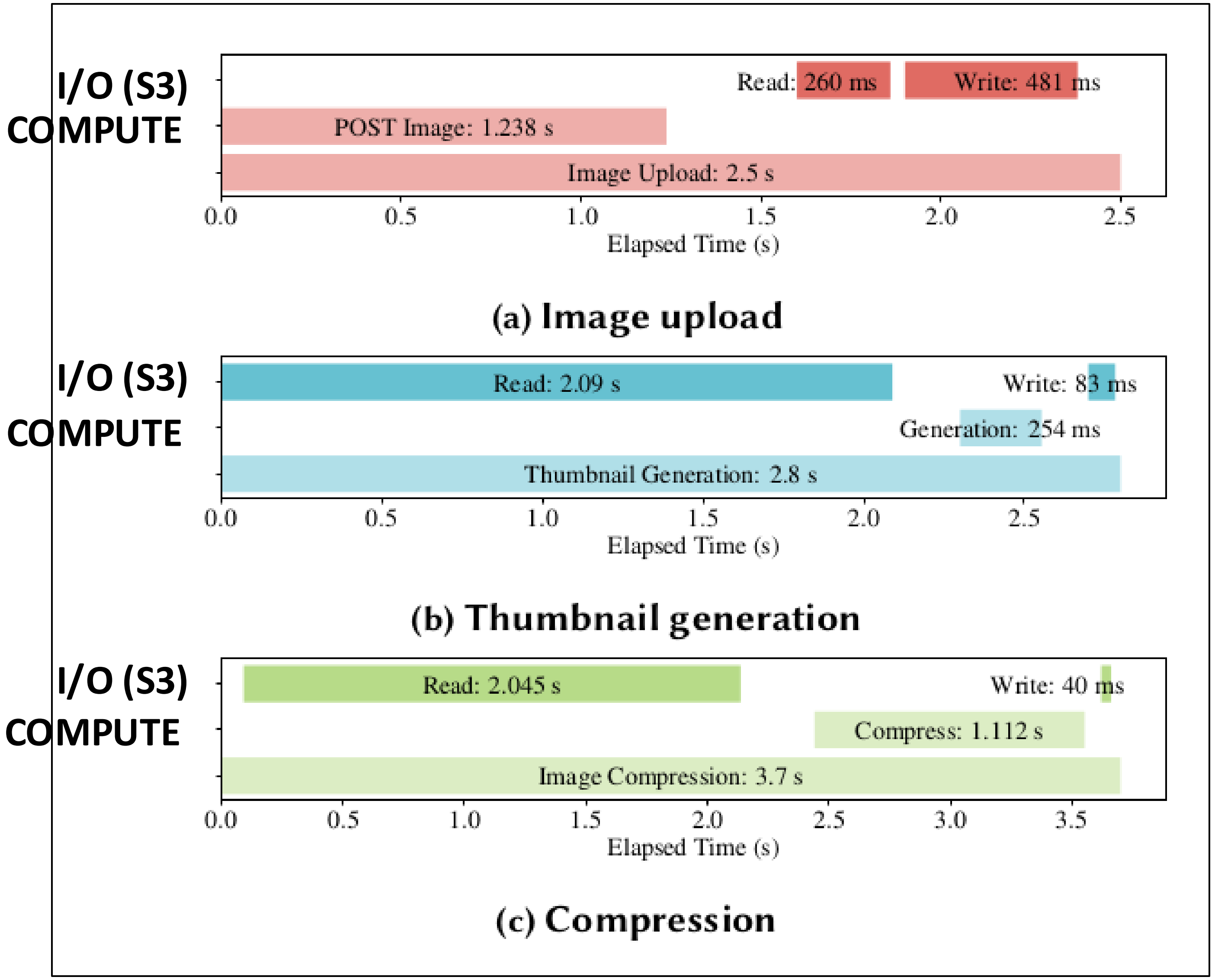

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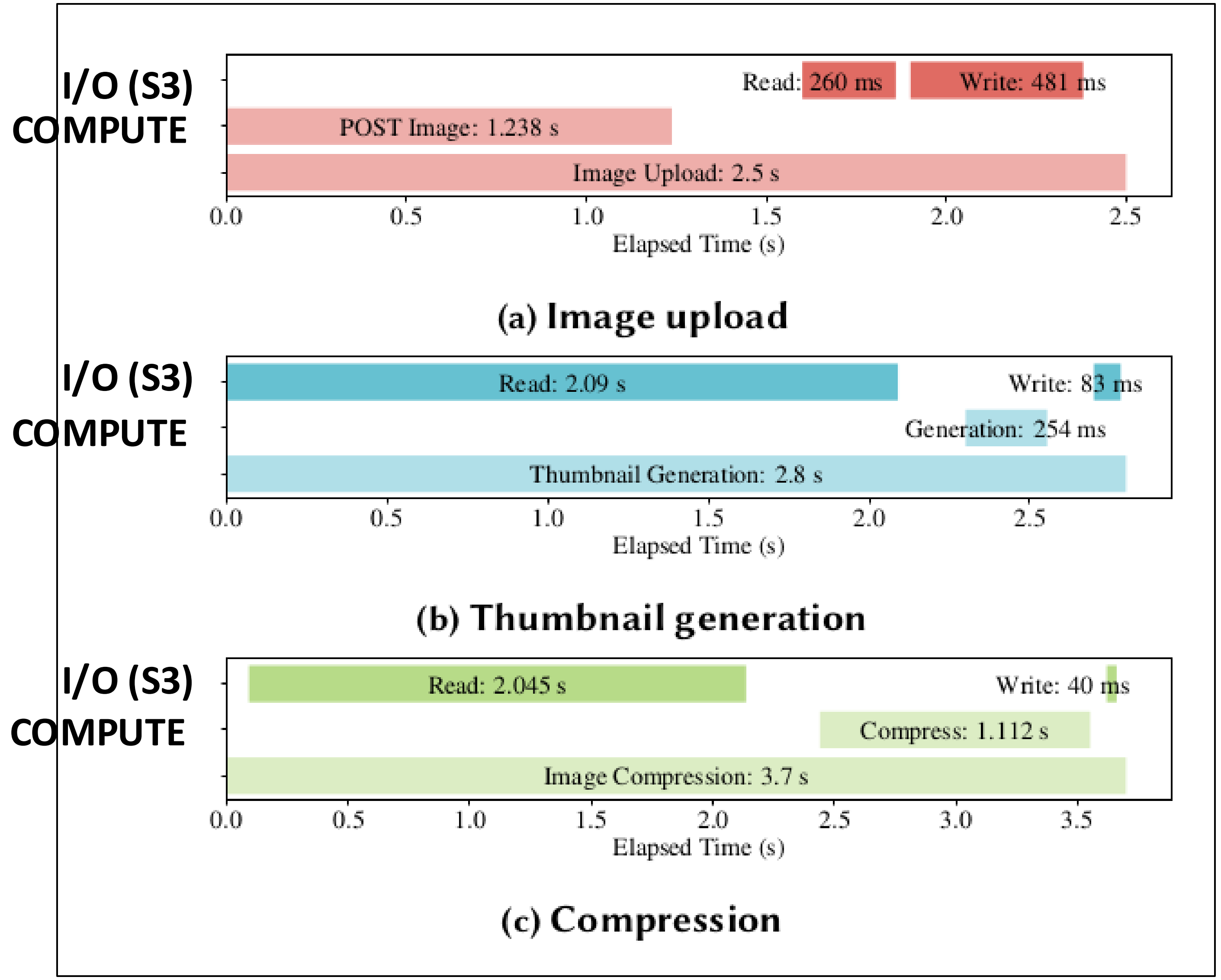

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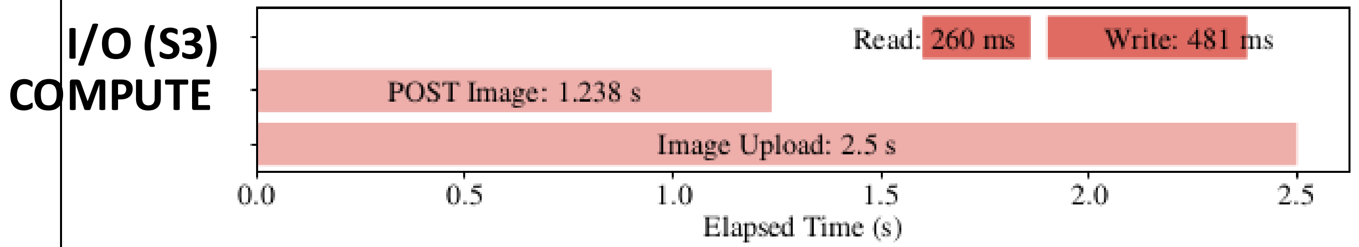

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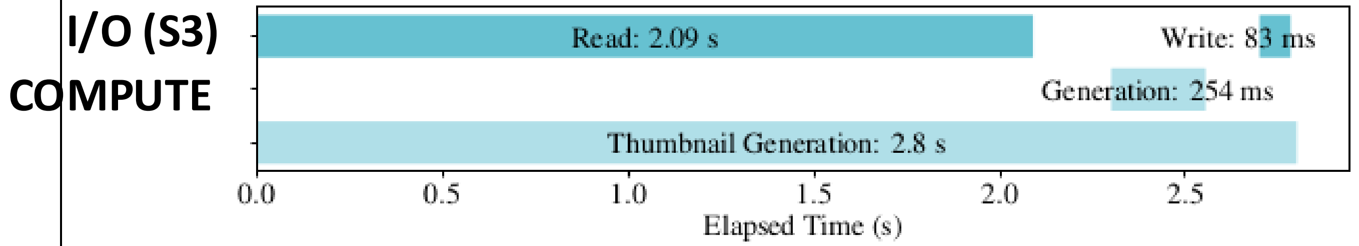

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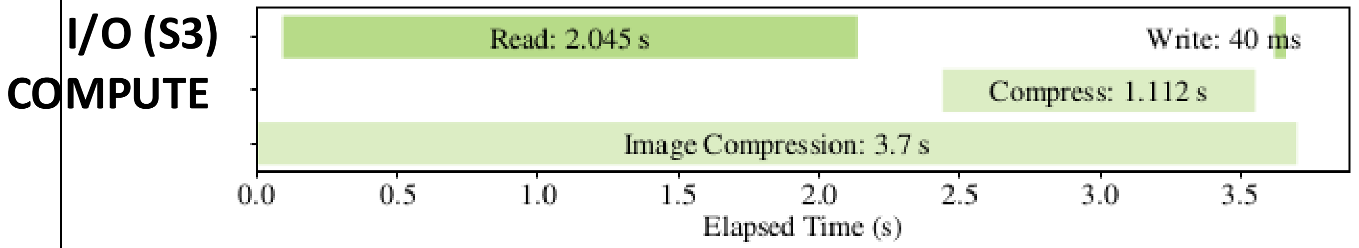

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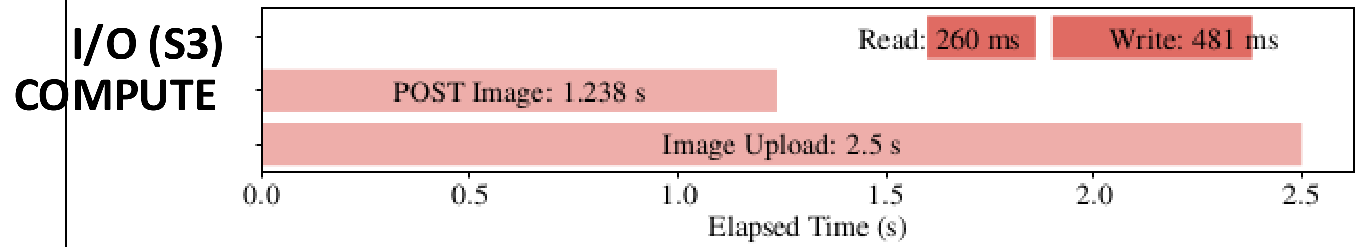

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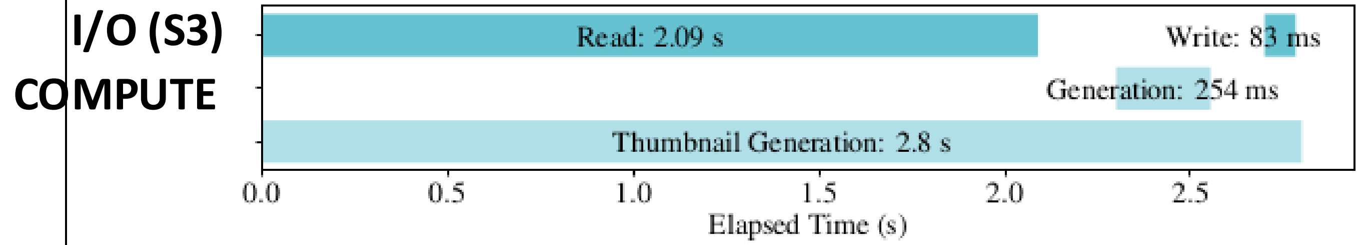

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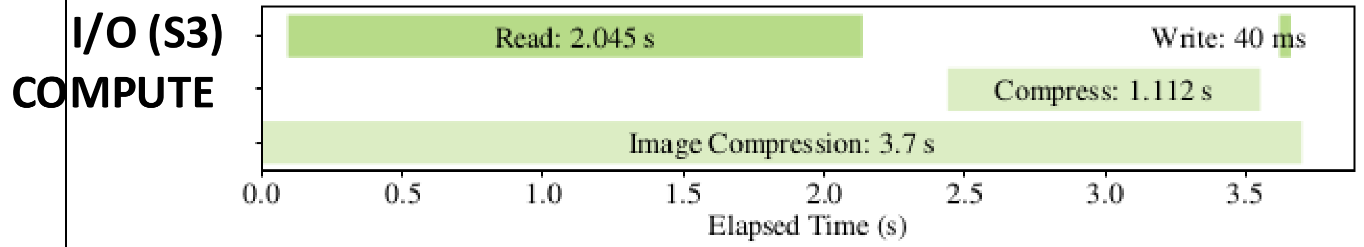

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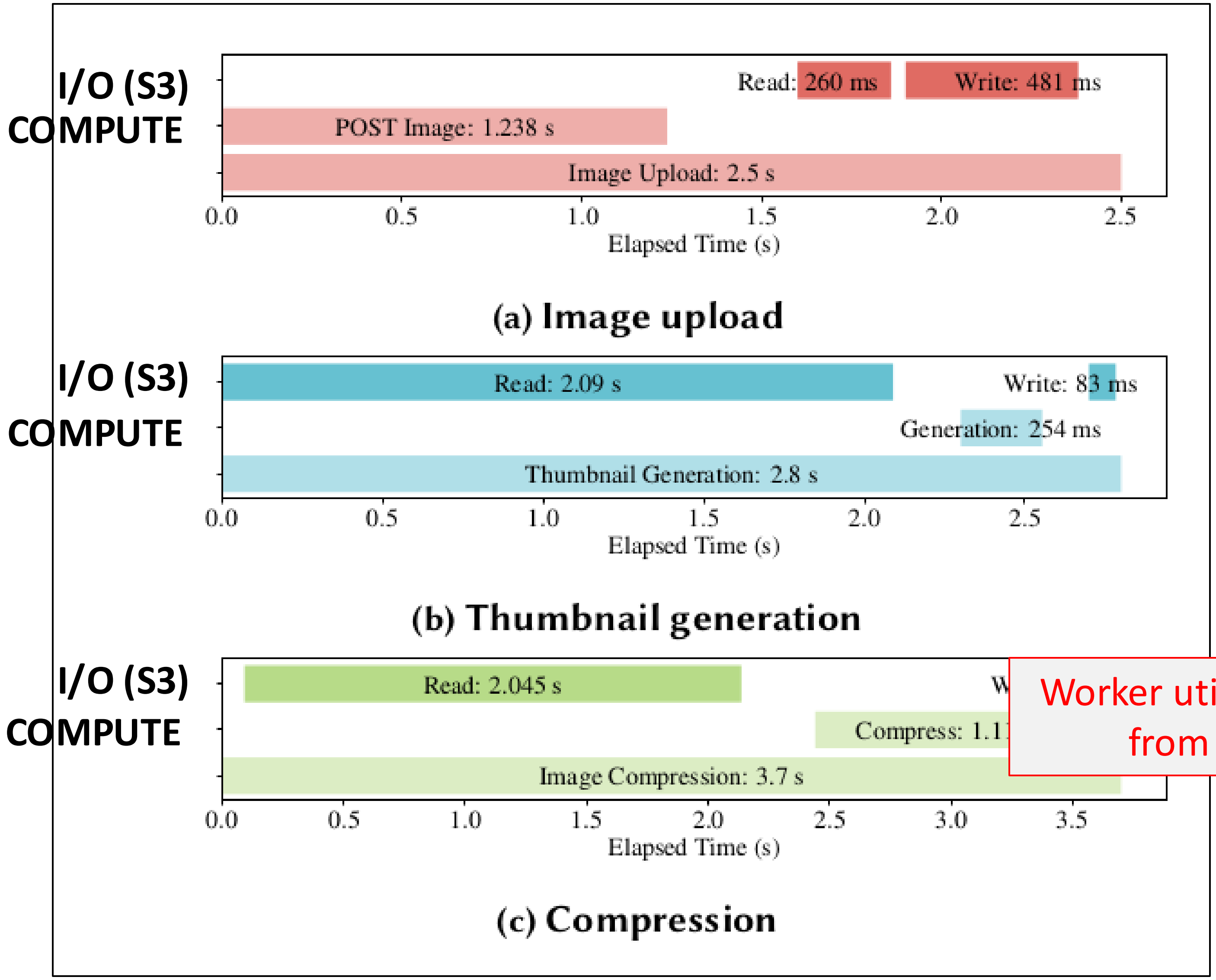

Worker utilization increases from 50% to 89%

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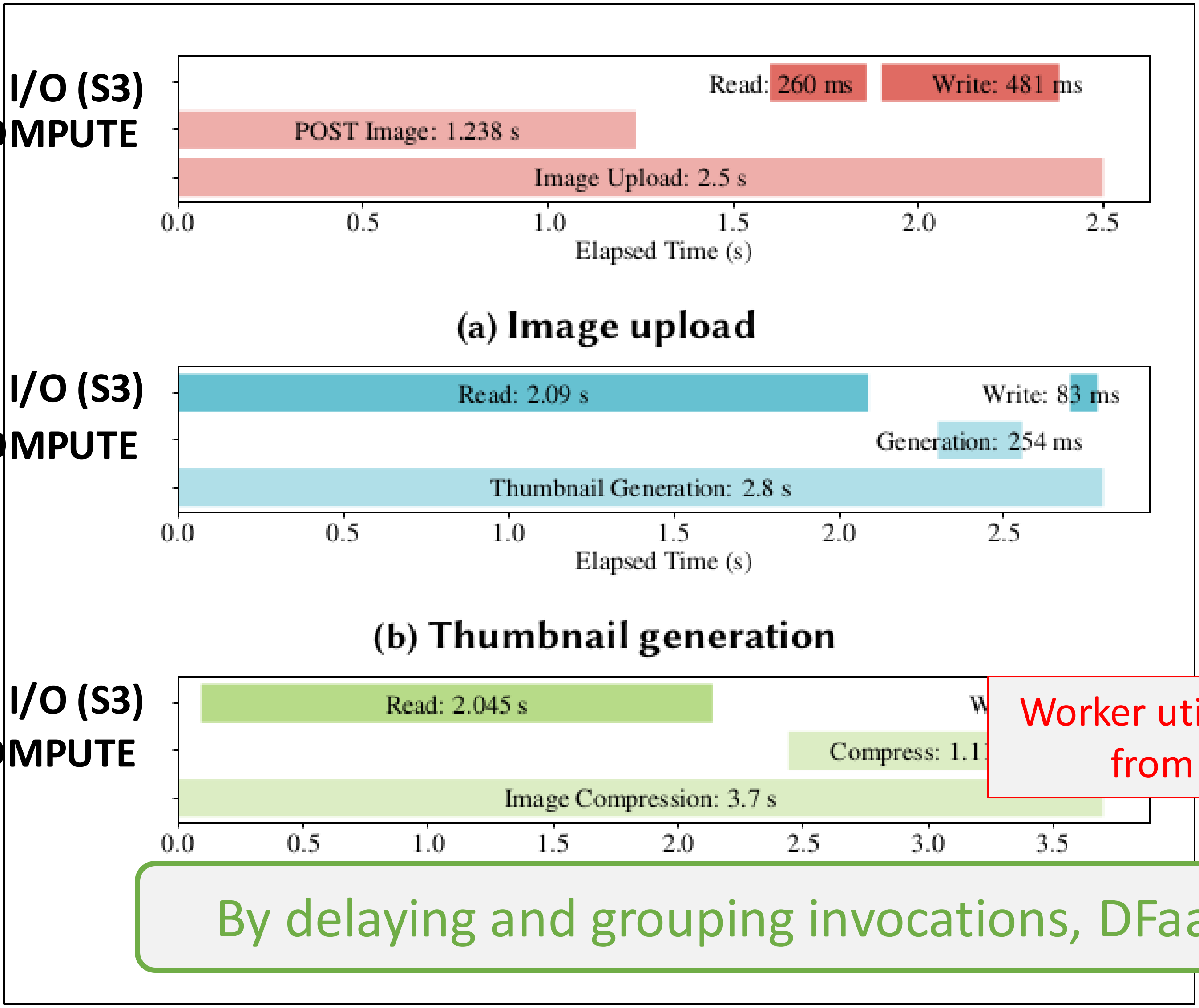

Worker utilization increases from 50% to 89%

By delaying and grouping invocations, DFaaS can improve **resource utilization**

Is It Time To Put Cold Starts In The Deep Freeze?

Cold start optimizations have dominated serverless research for the past decade

Carlos Segarra (Imperial College London)

carlossegarra.com <cs1620@ic.ac.uk>

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Improve **resource utilization** and reduce cost

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delay tolerance

Improve **resource utilization** and reduce cost

Future: improve **throughput** with transparent access to accelerators

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