Unleashing True Utility Computing with Quicksand

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Inefficiency 1: resource overprovisioning

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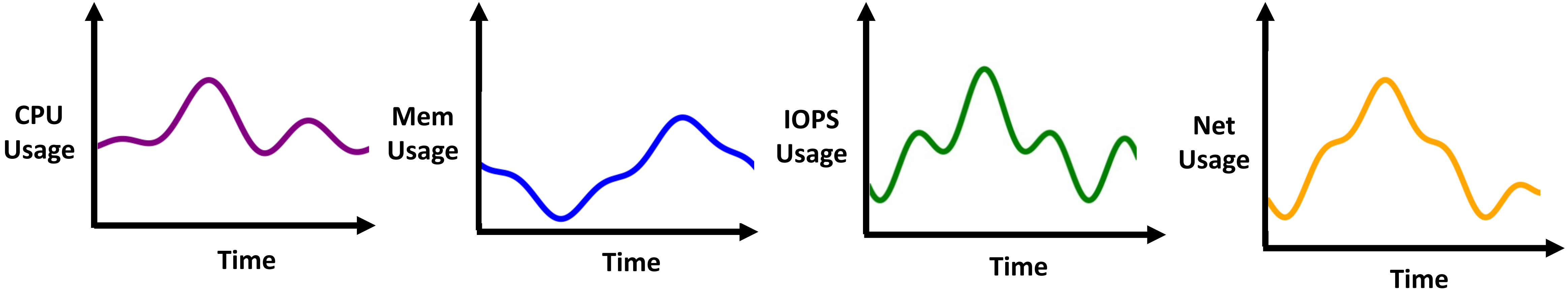

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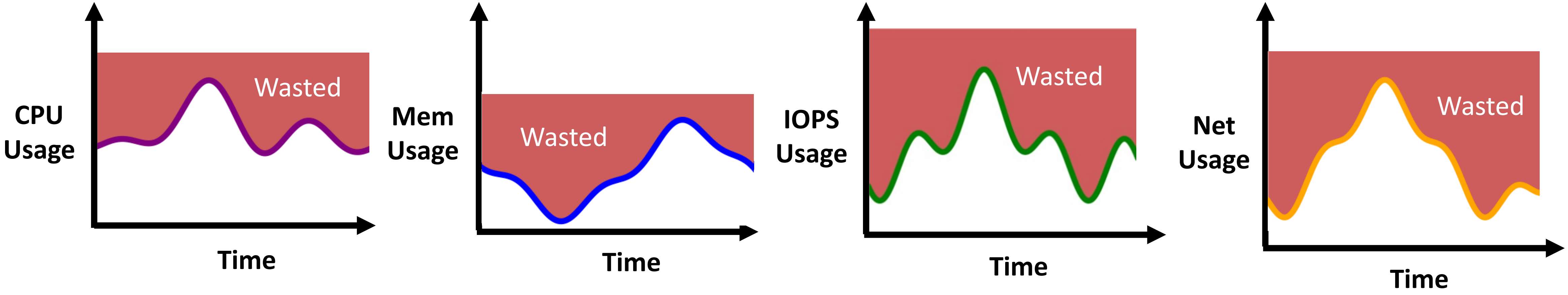

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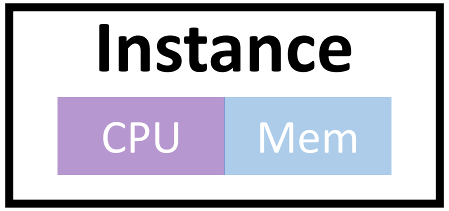
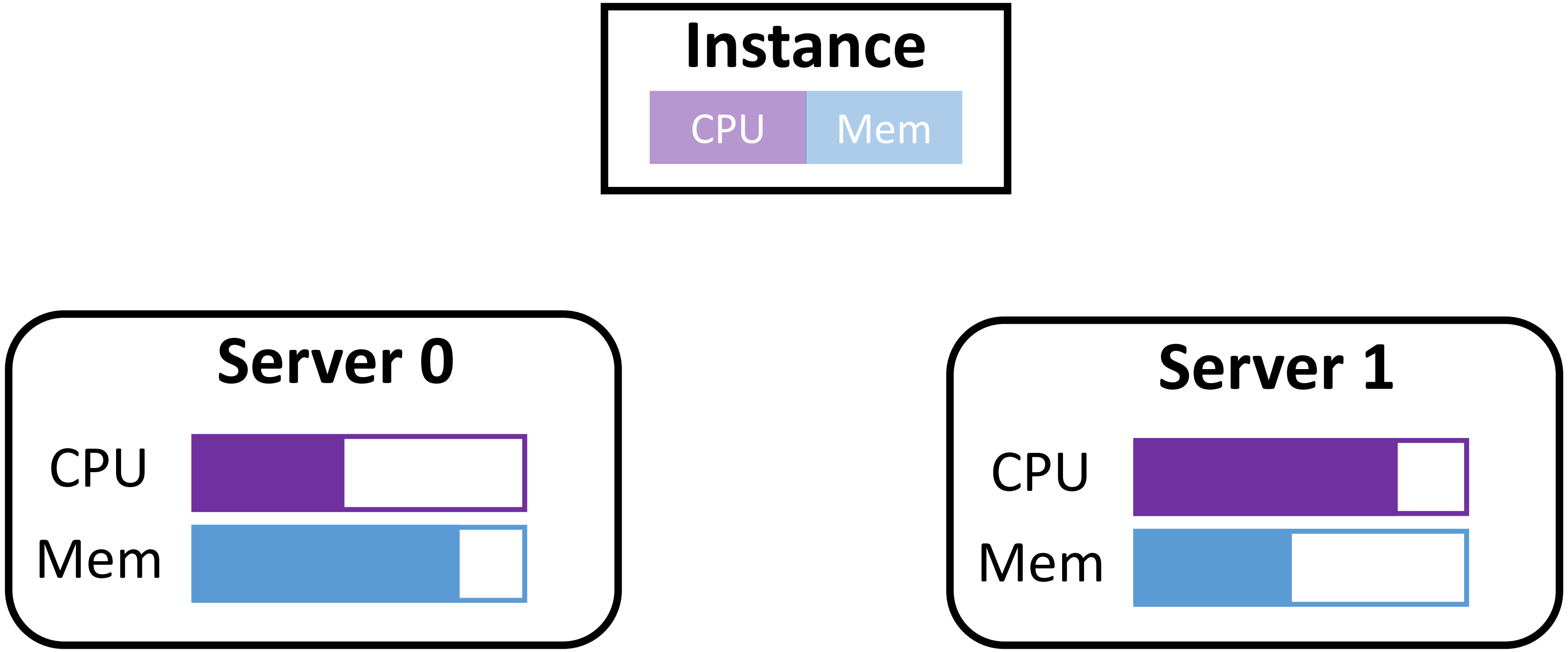


Inefficiency 2: resource stranding

- Try to binpack the instance into available physical machines.



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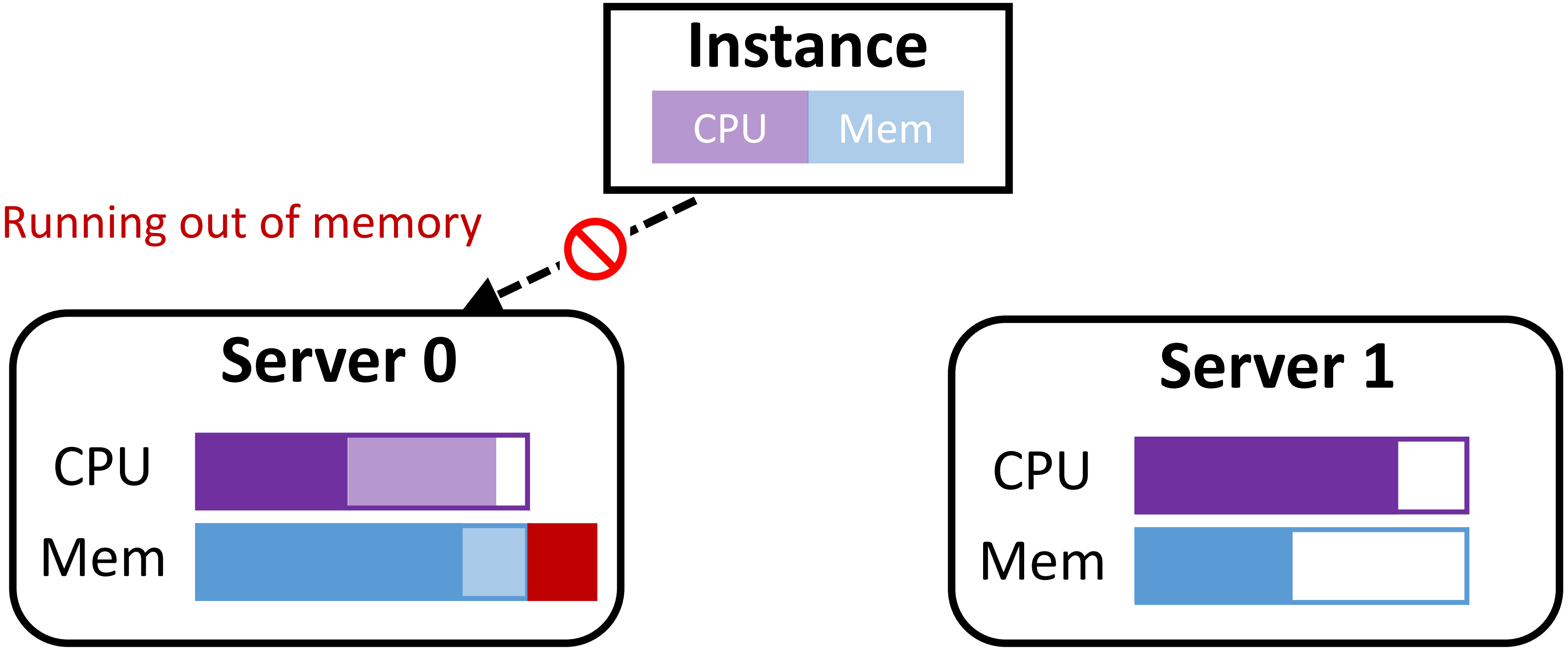

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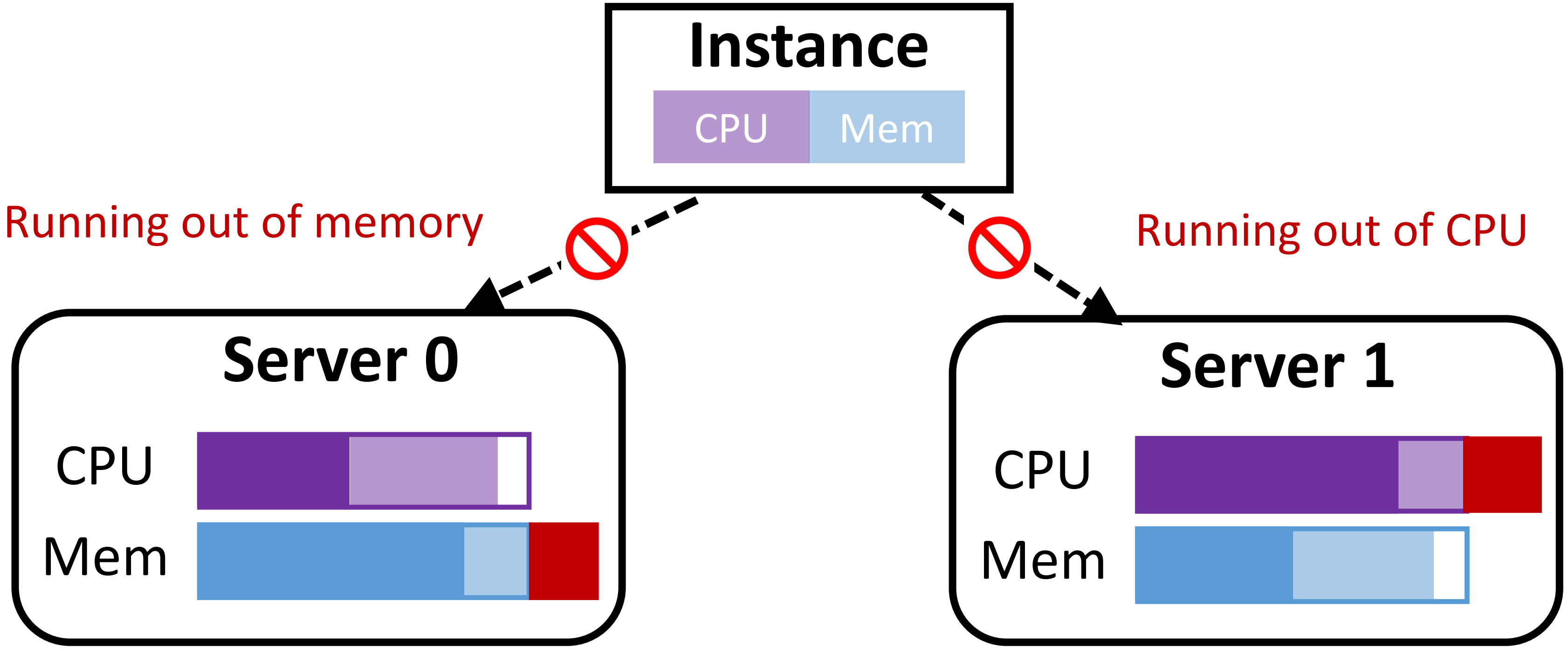

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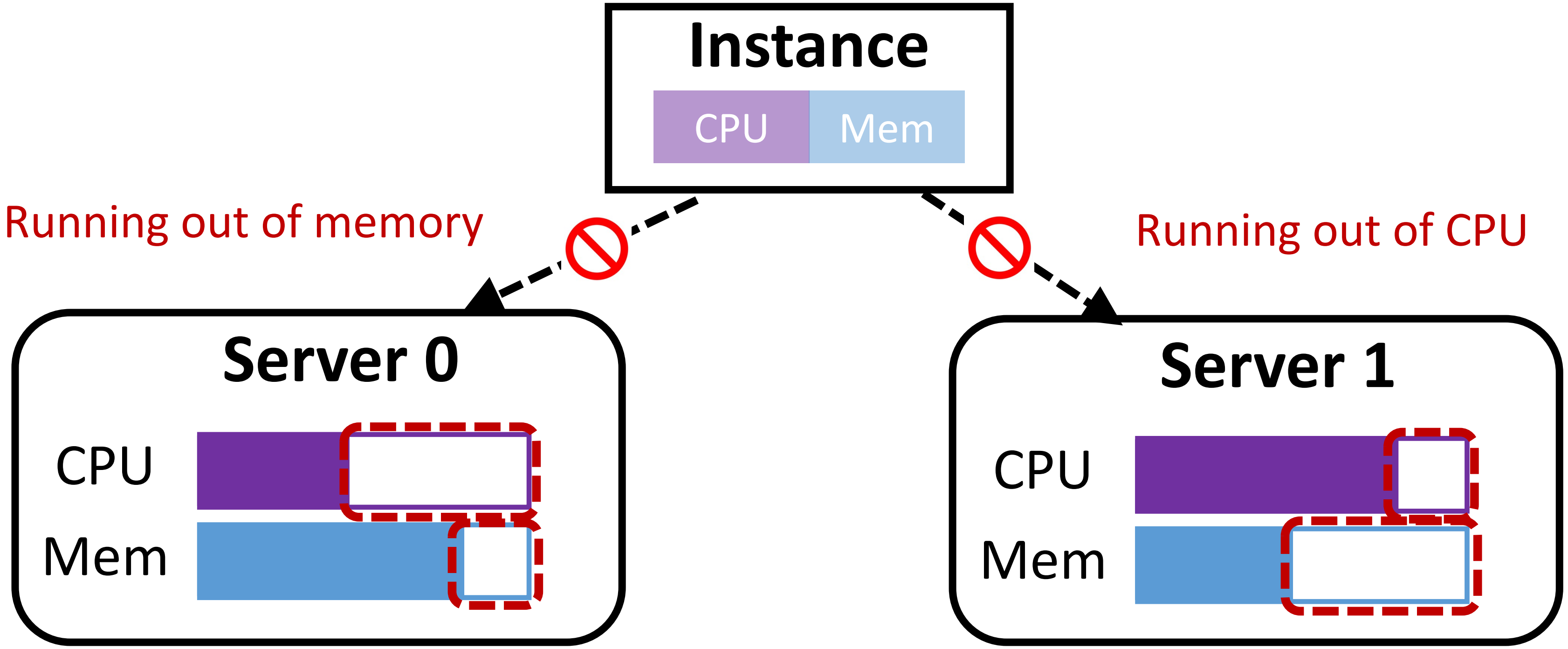

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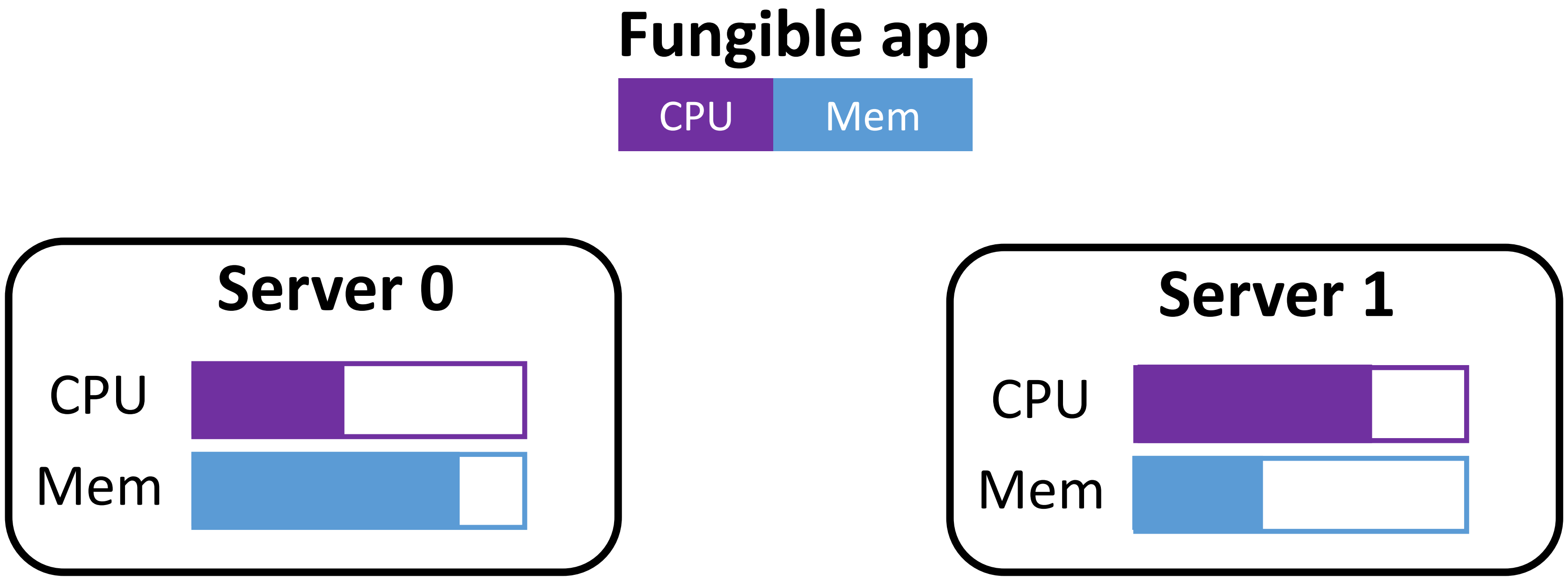

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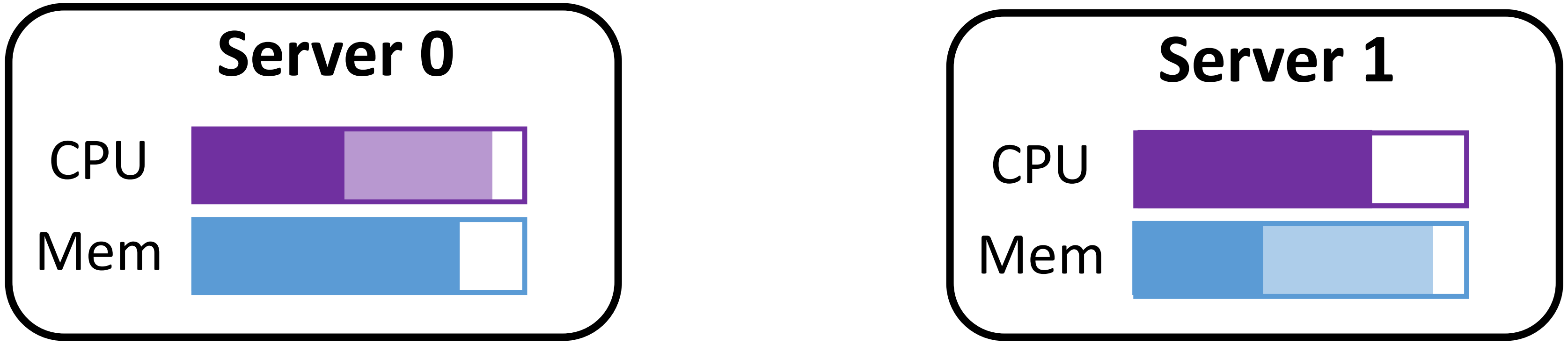

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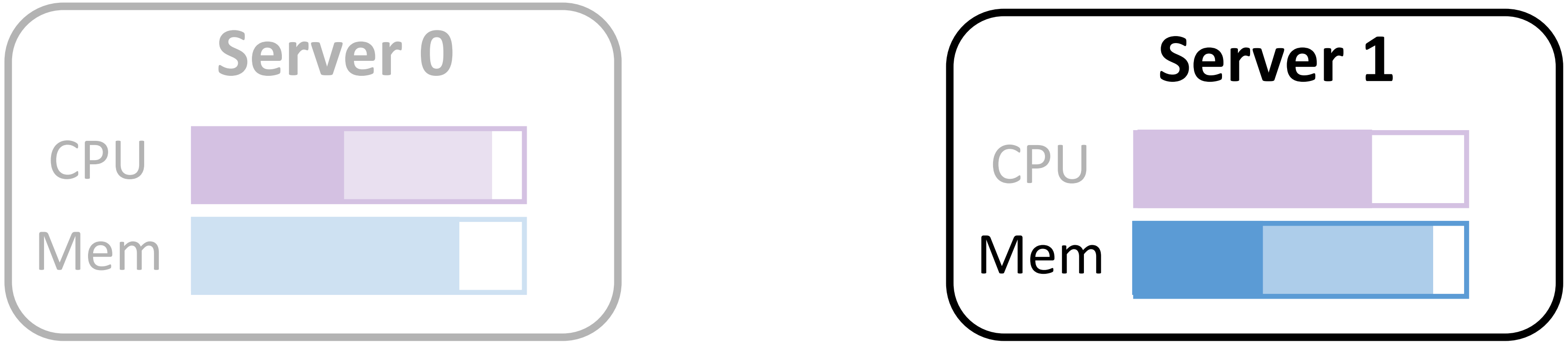

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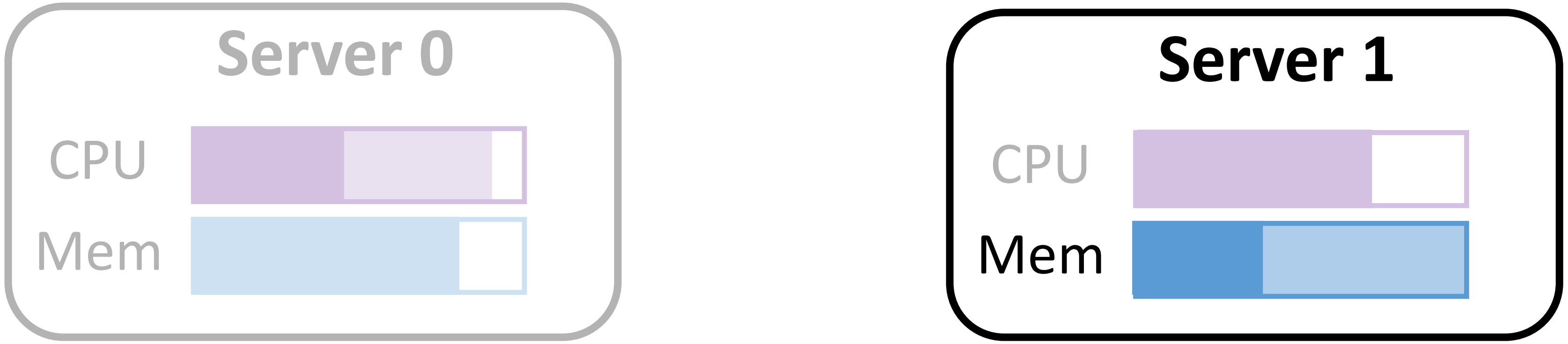

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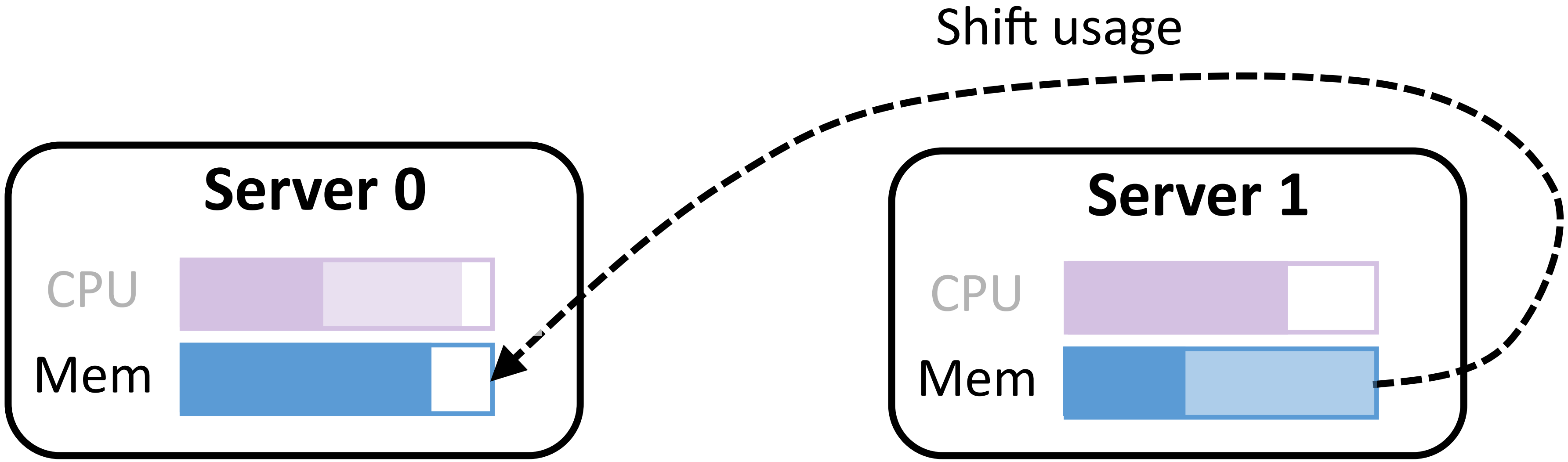

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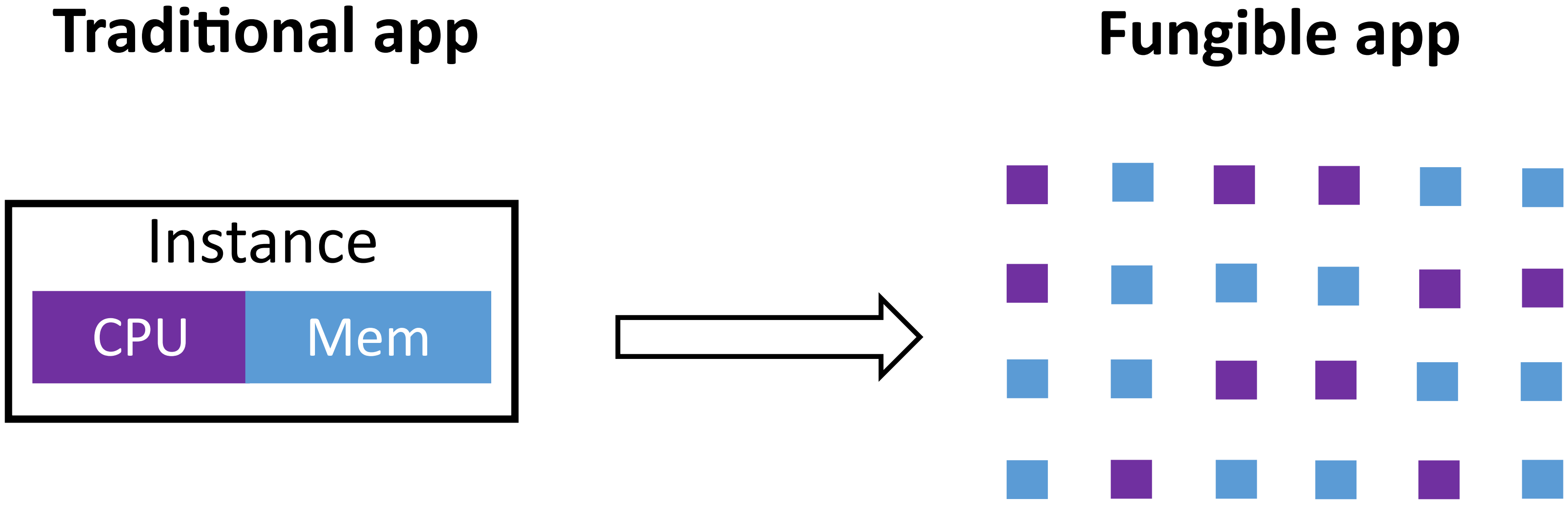

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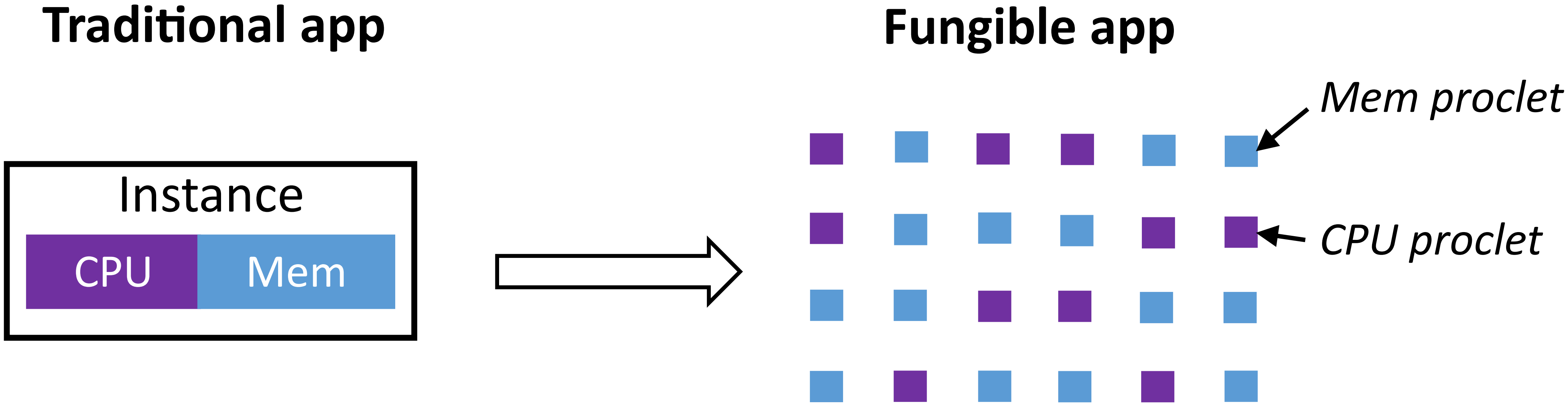

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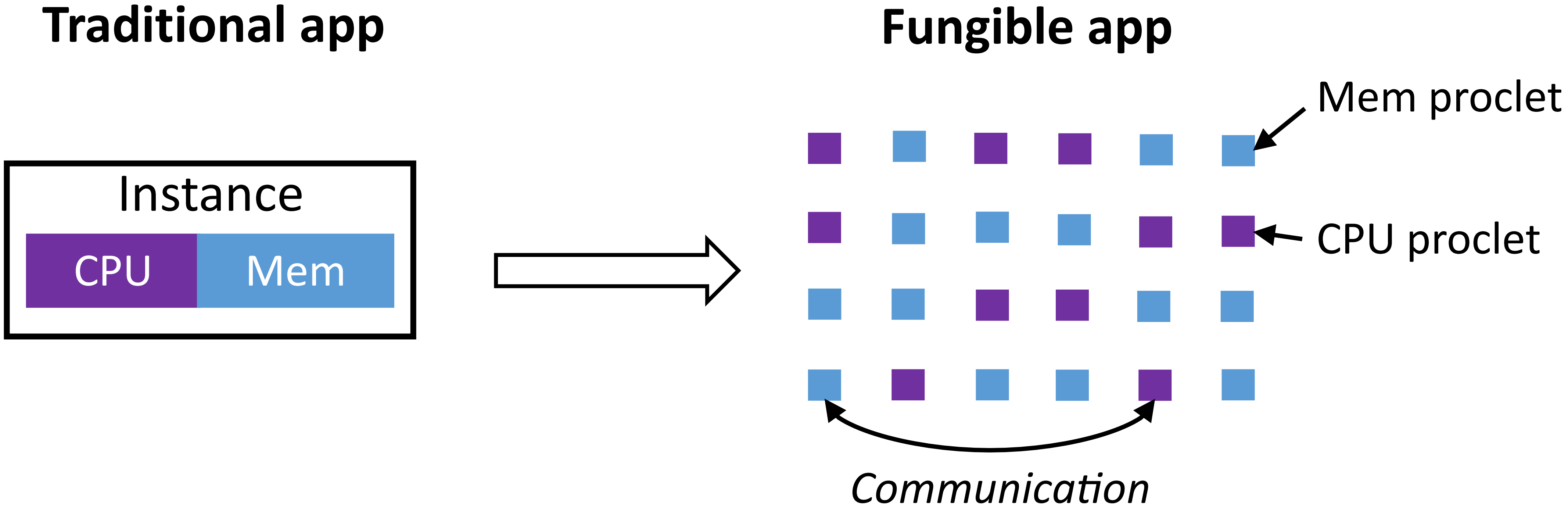

Traditional app

Fungible app

Instance

CPU

Mem

Mem proclet

CPU proclet

Communication

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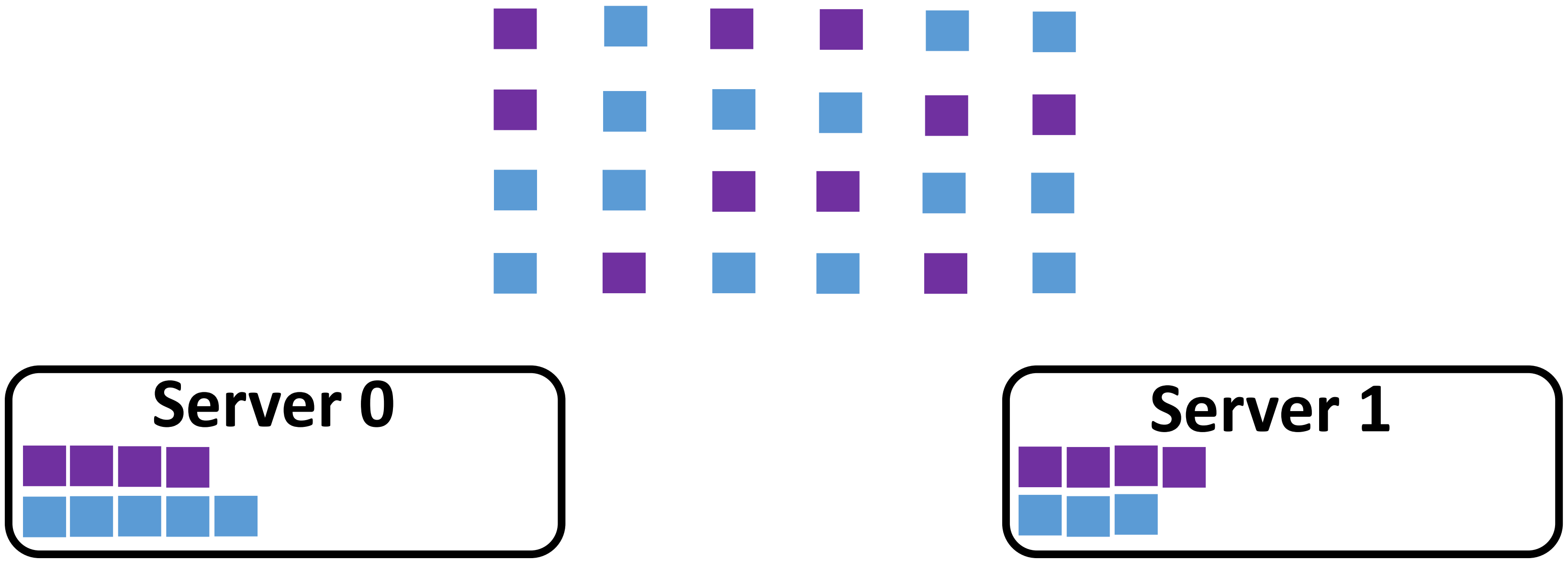

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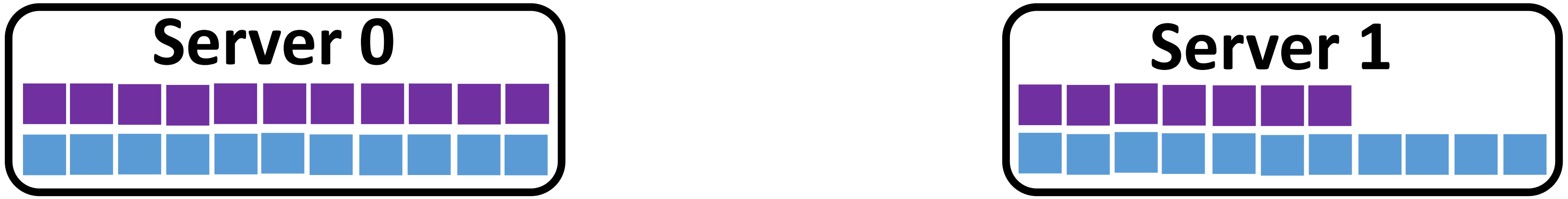

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Server 0
Server 1

How to program with resource proclets?

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FungibleVector<T>

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push_back(T)
T operator[](size_t);
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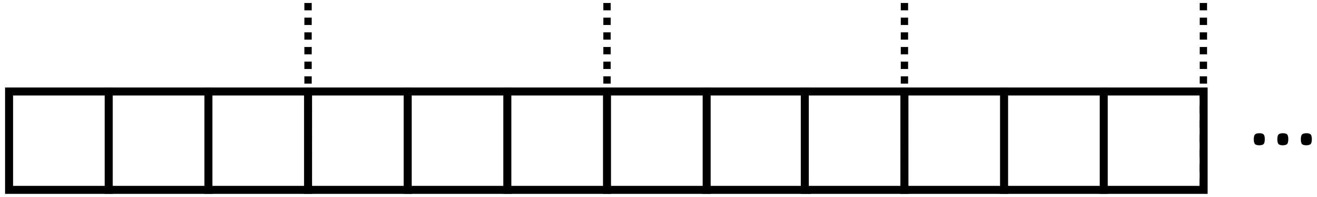

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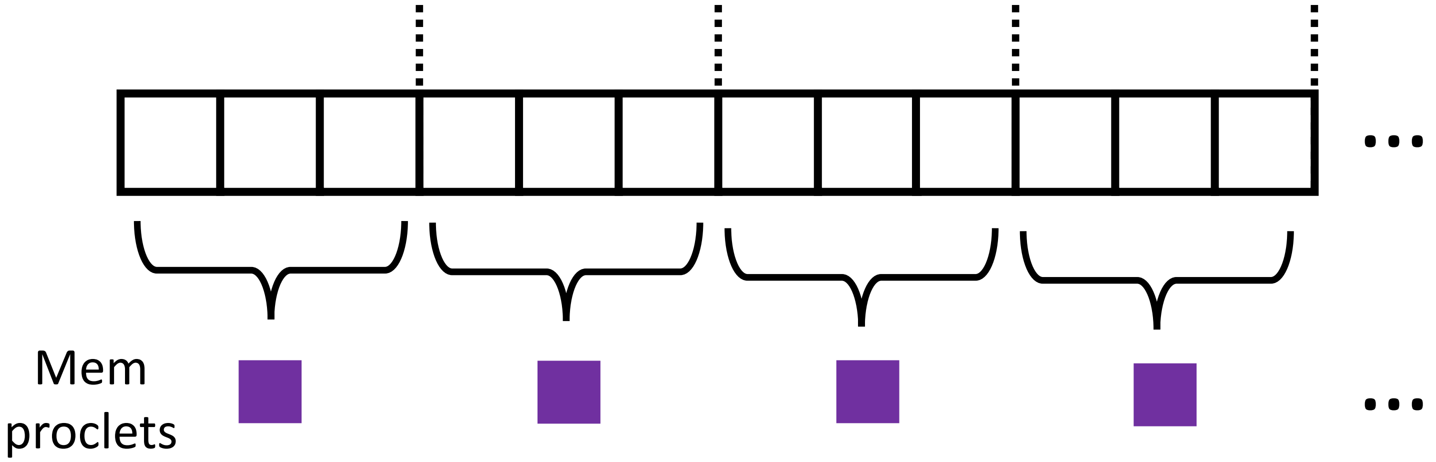

Mem proclets

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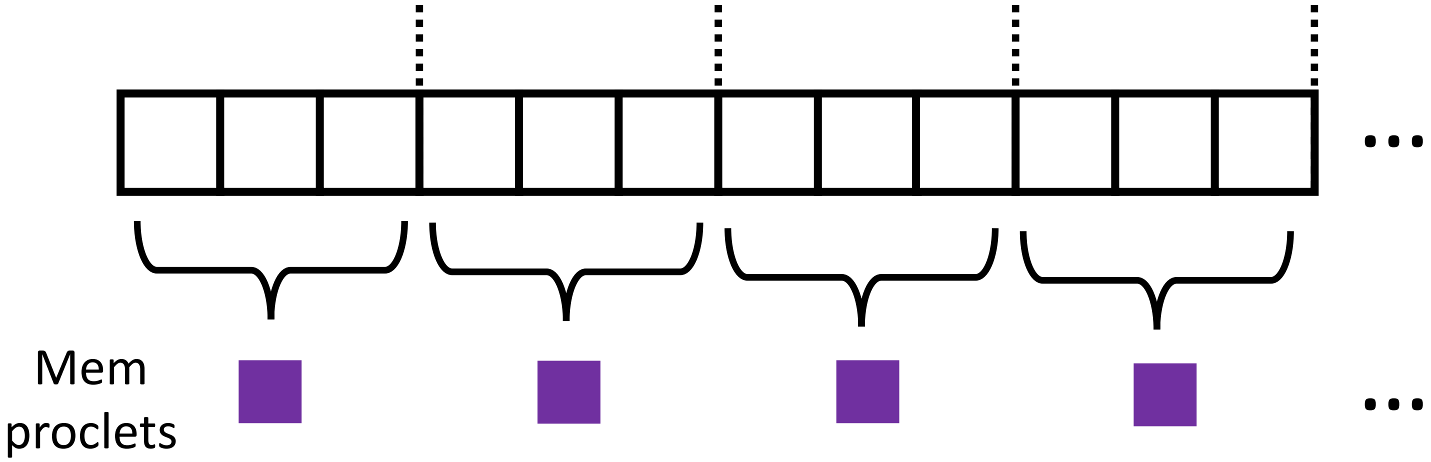

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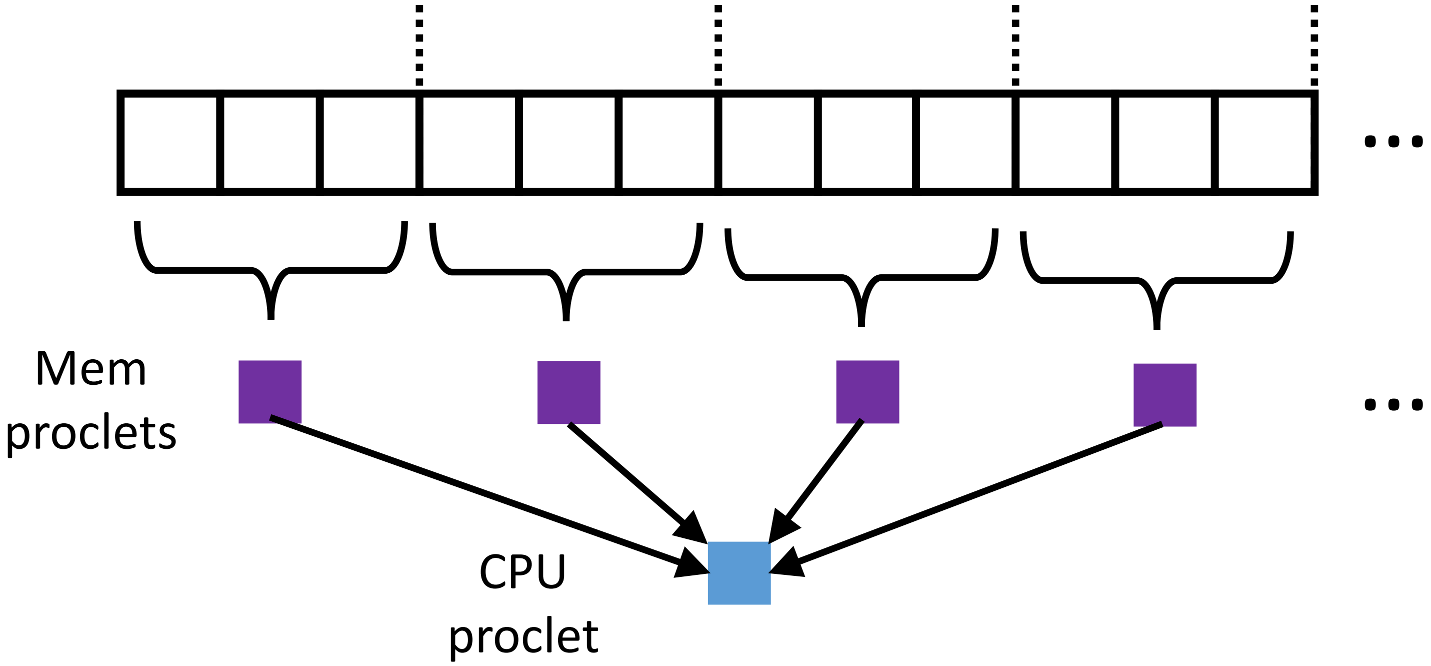

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Mem proclets

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CPU proclet

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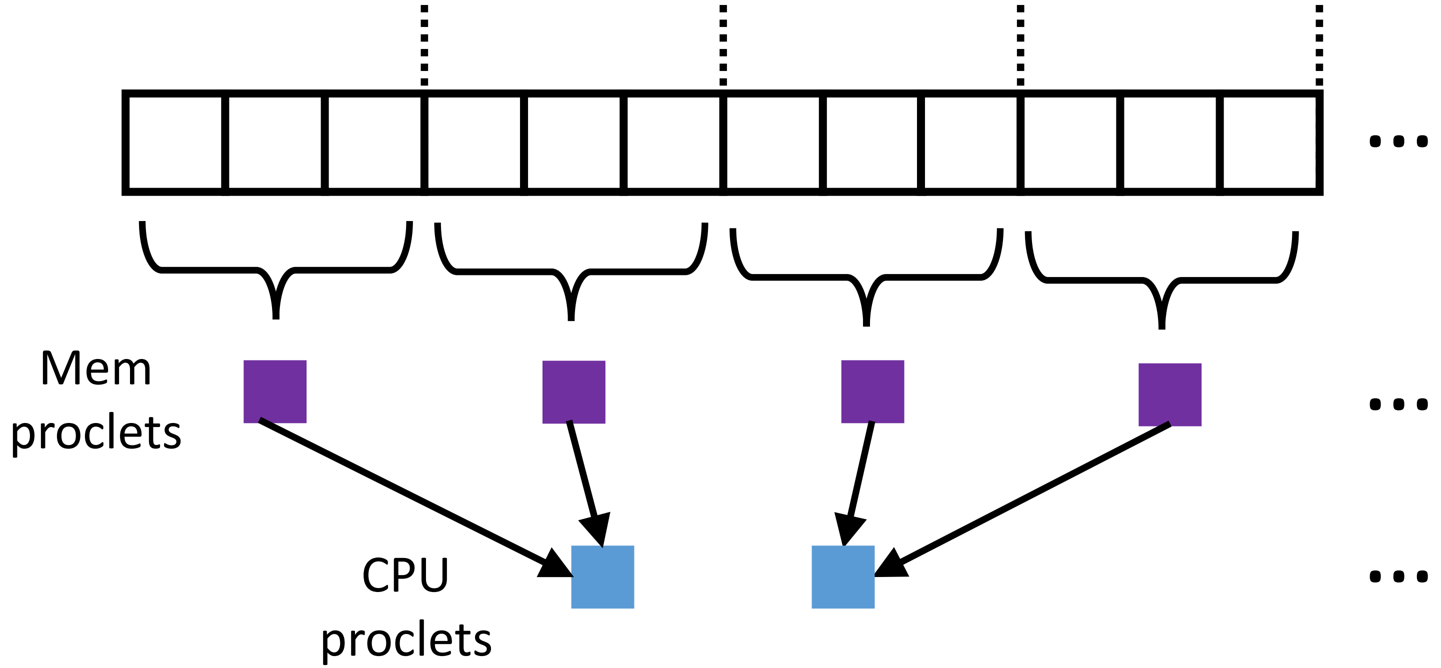

How to overcome communication cost?

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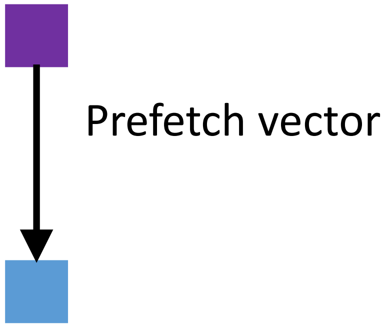

➢ **1. Prefetching**

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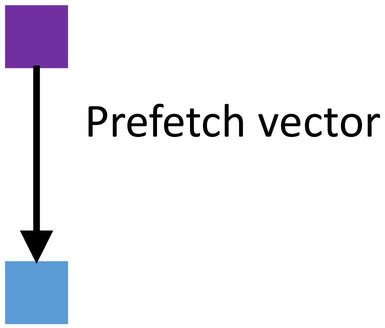

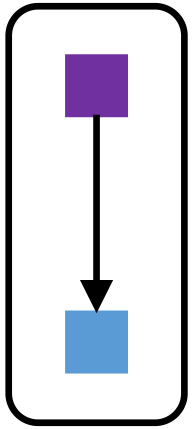

- **1. Prefetching**

➢ **2. Colocation**

Performance Under Imbalance

- Can we successfully combine resources to achieve fungibility?

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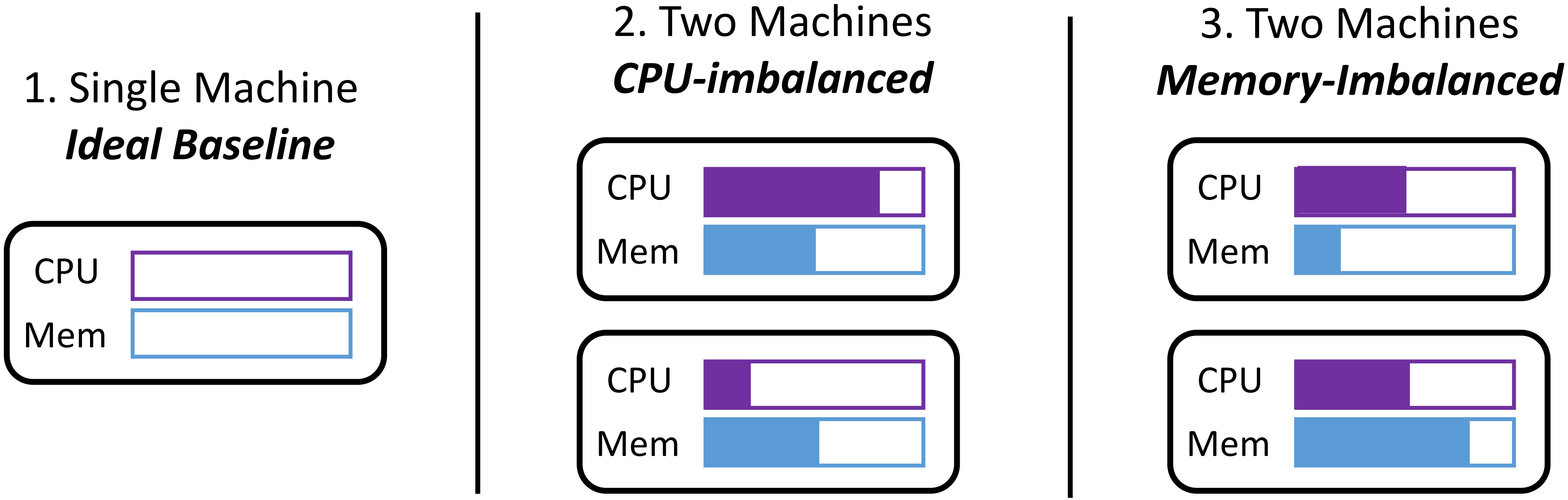
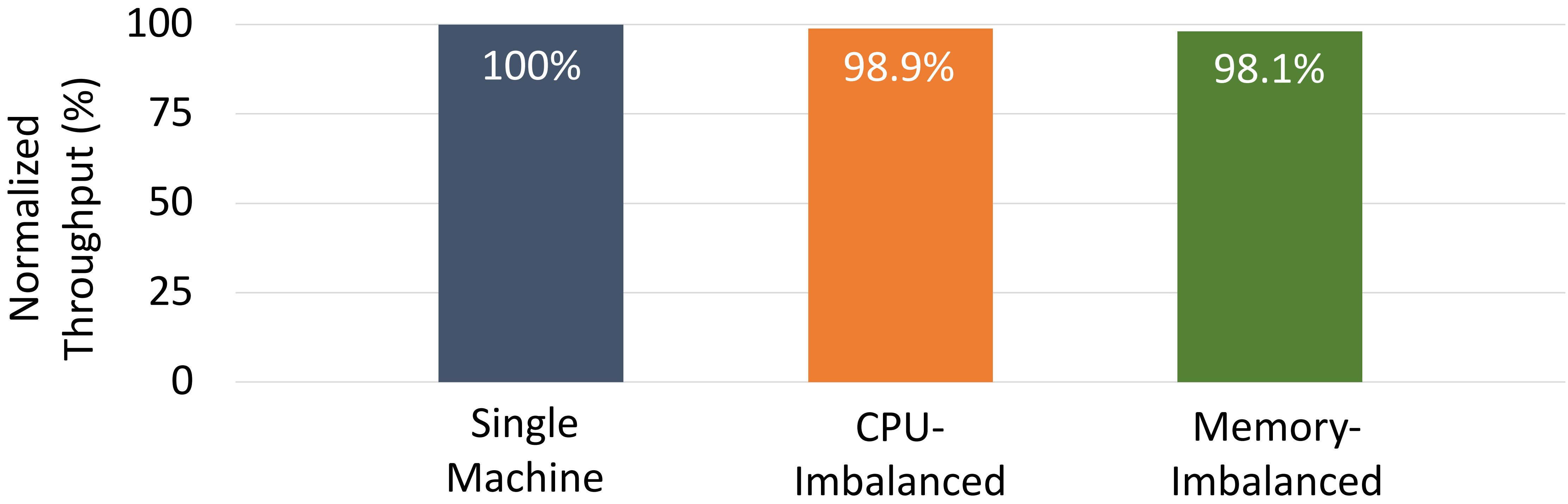


1. Single Machine
Ideal Baseline

2. Two Machines
CPU-imbalanced

3. Two Machines
Memory-Imbalanced

Performance Under Imbalance



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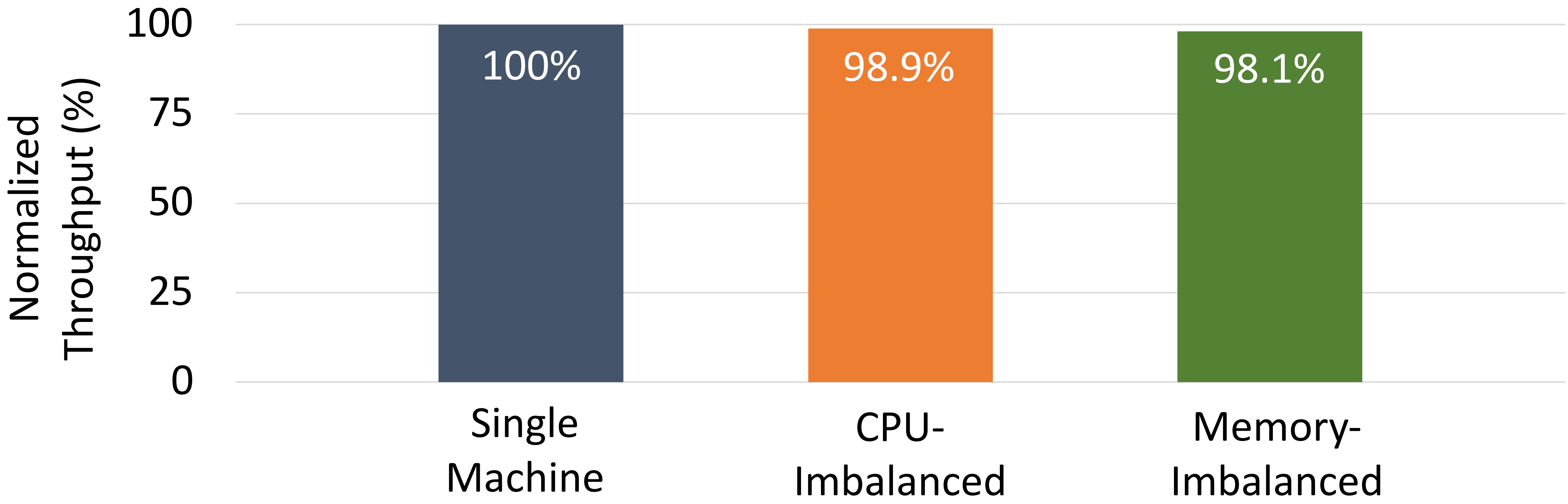
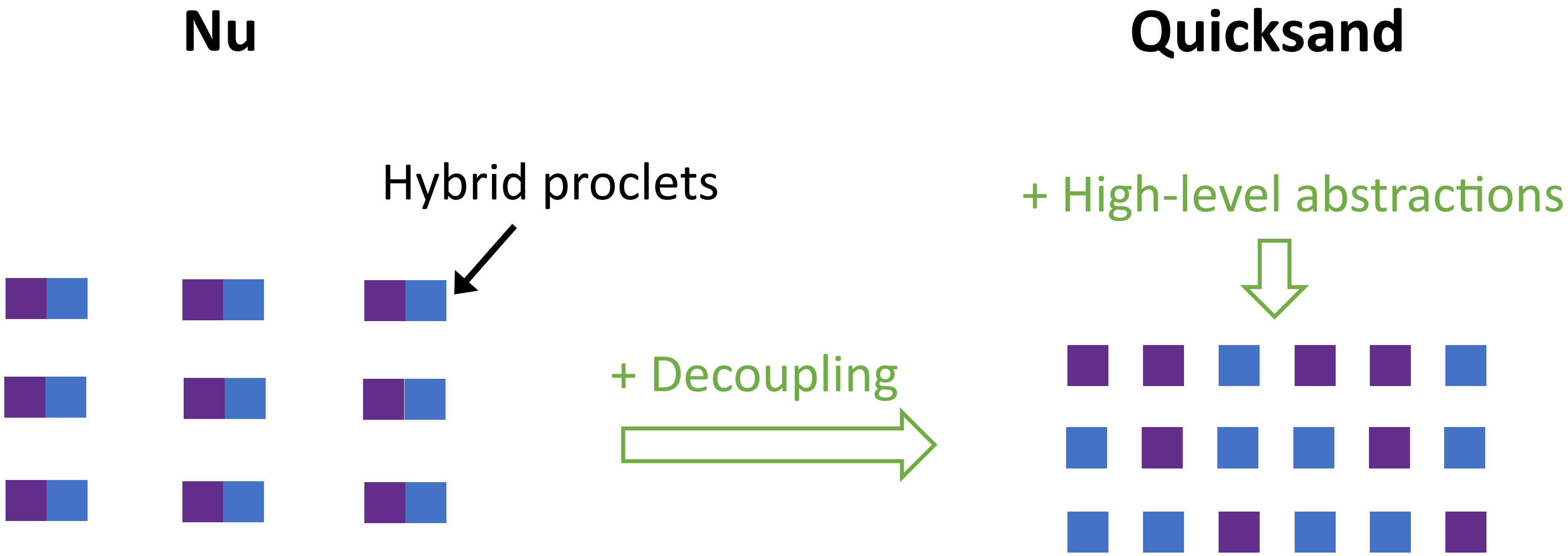


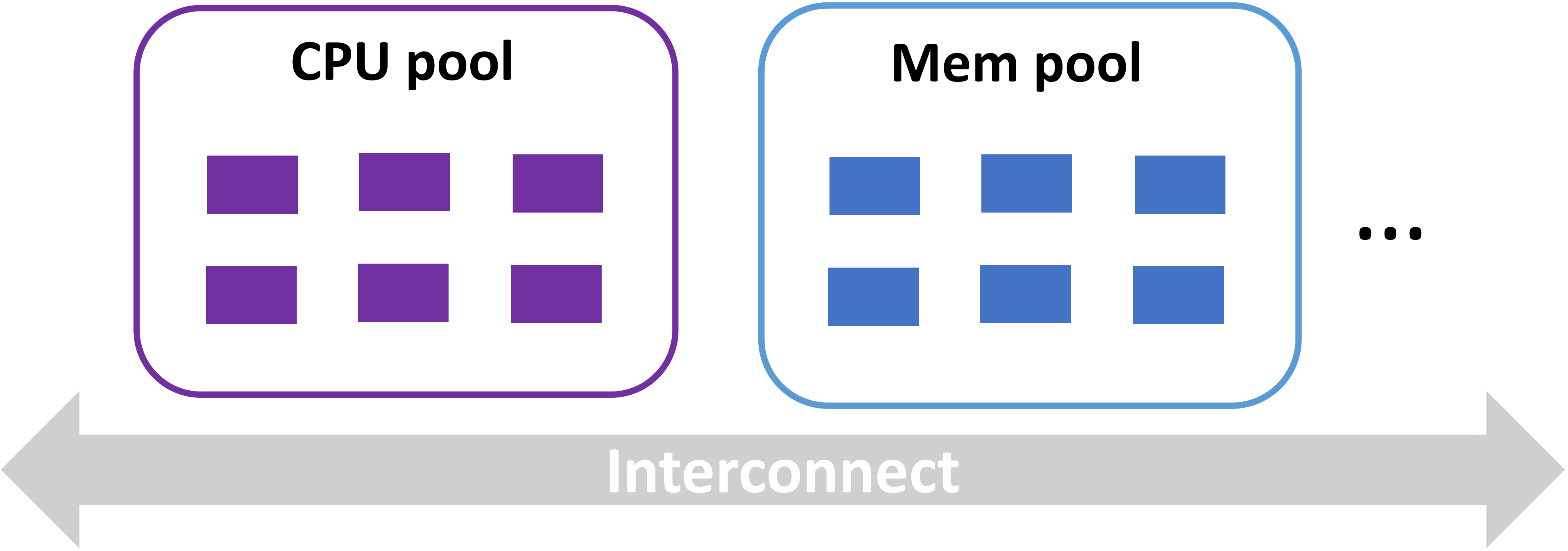
- **Promising to achieve fungibility with today’s datacenter hardware!**

Related work 1: Nu [NSDI' 23]



Related work 2: HW resource disaggregation

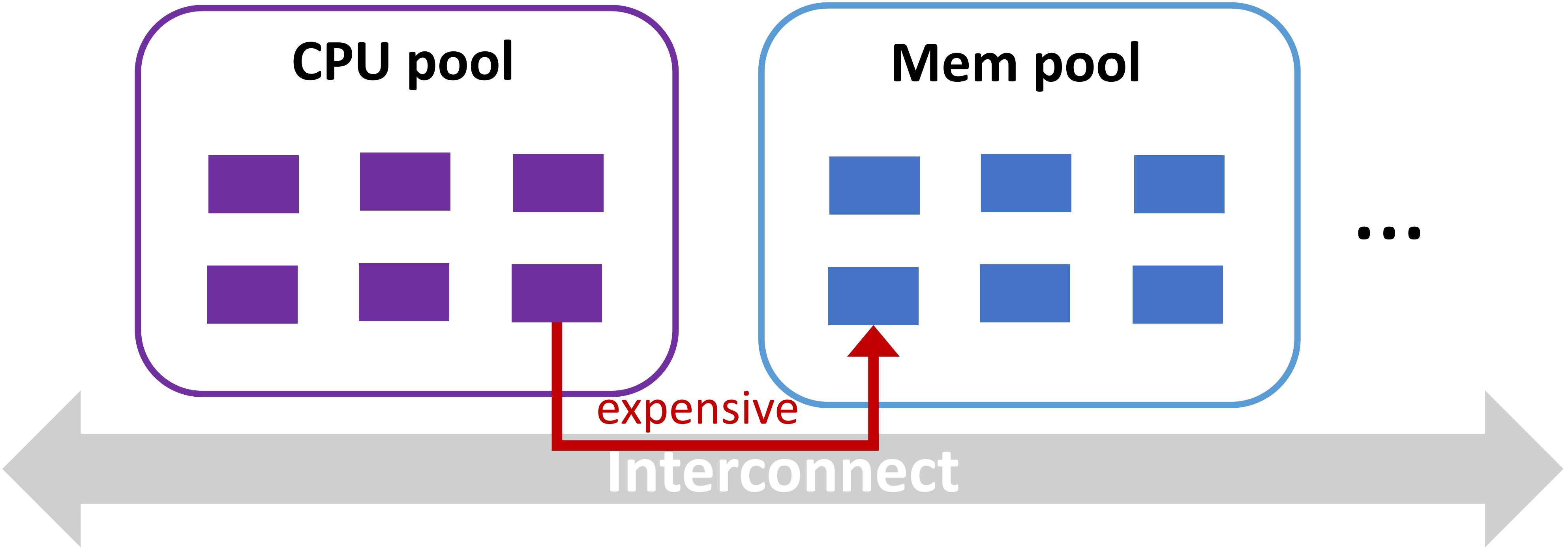
+ Transparent



Related work 2: HW resource disaggregation

+ Transparent

-- Loses the control over resource placement

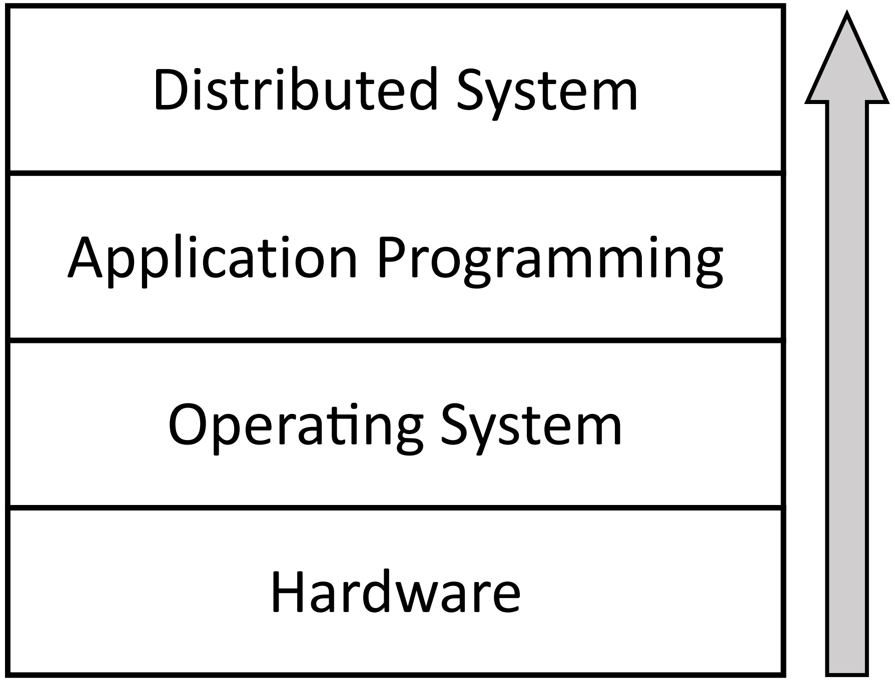


Related work 3: distributed programming model

- Actor --- ServiceWeaver [HotOS’ 23], Ray [OSDI’ 18]
- Microservice --- Nightcore [ASPLOS’ 21]
- Serverless --- Boki [SOSP’ 21]

➢**Shared trend: applications are going granular.**

Many untapped opportunities



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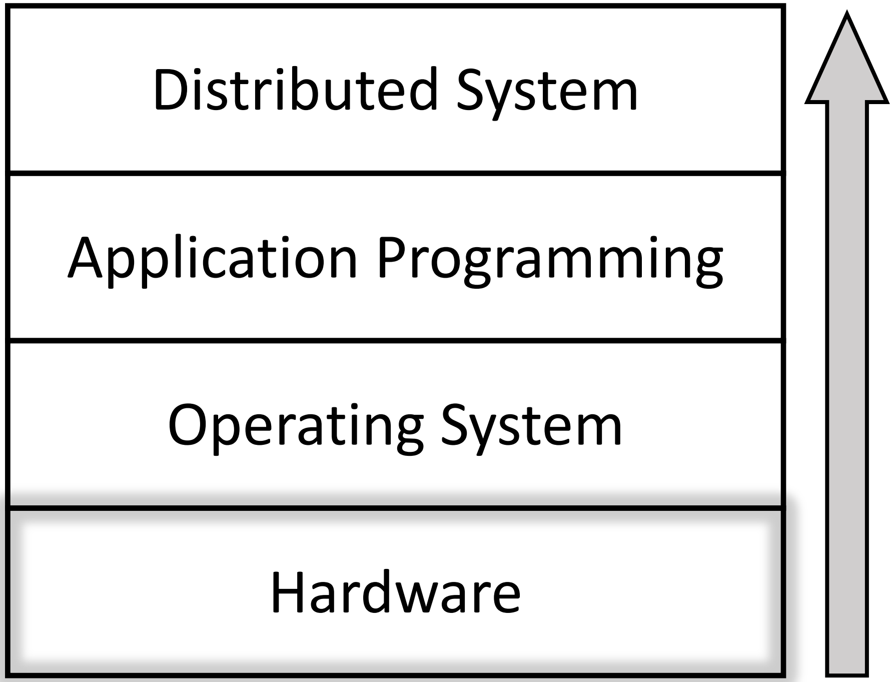

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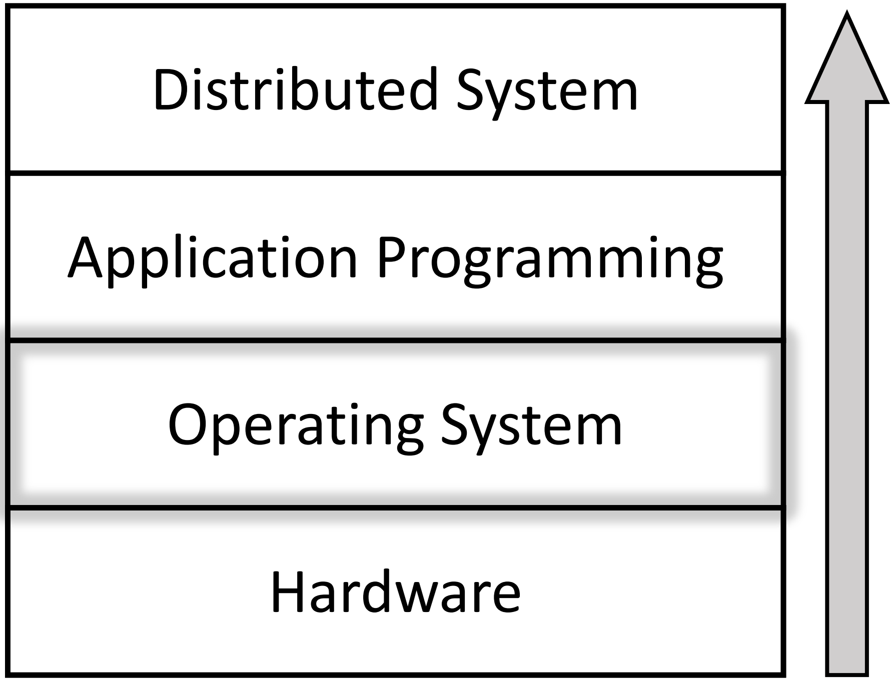

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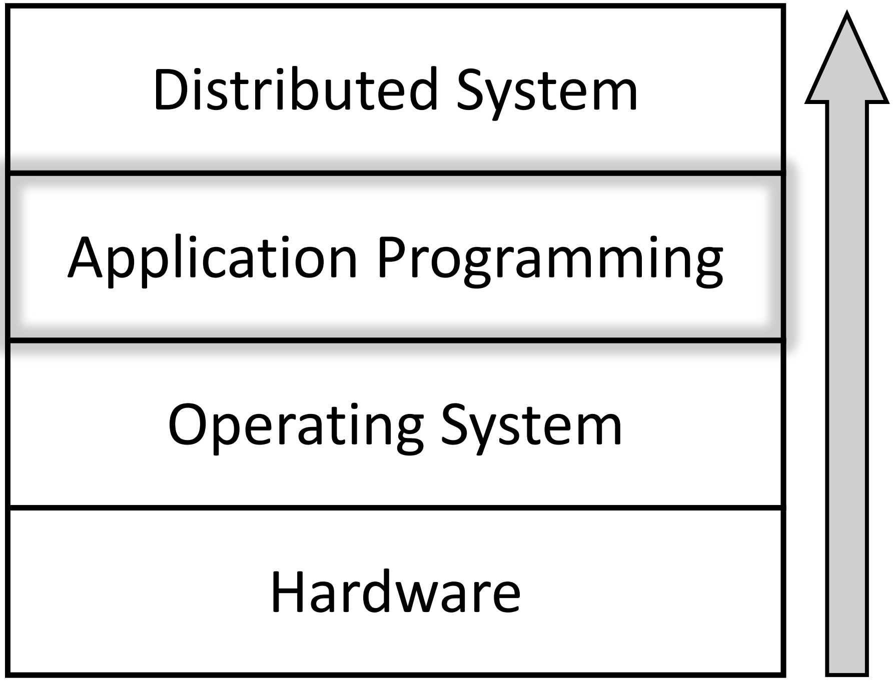

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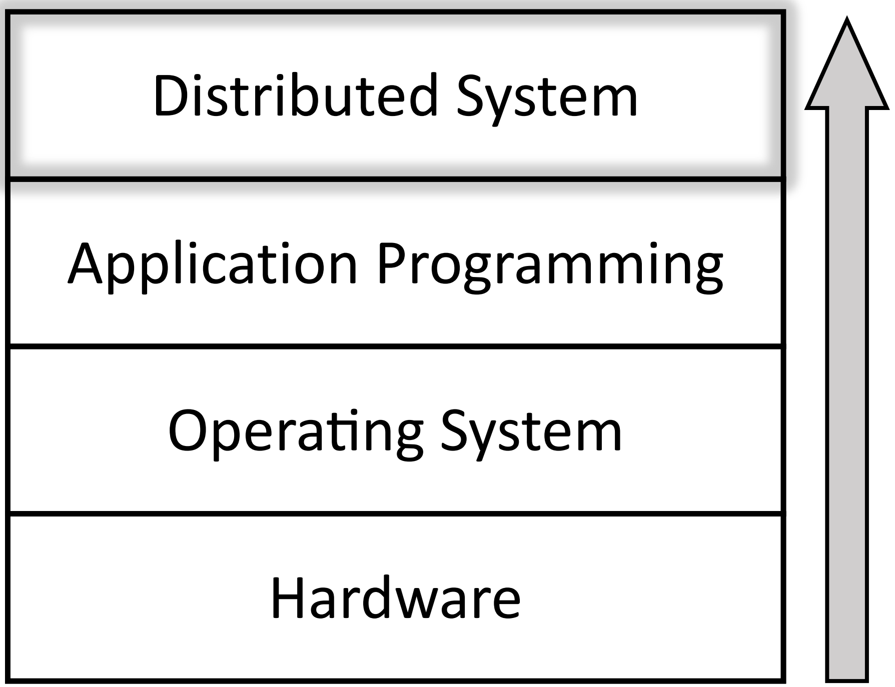

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- Compiler can minimize code change
- OS can provide a native support to RPs
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Now is the time to realize resource fungibility!