

CoSpot: A Cooperative VM Allocation Framework for Increased Revenue from Spot Instances

Syed M. Iqbal^{1,2}, Haley Li², Shane Bergsma³,
Ivan Beschastnikh², and Alan J. Hu²

¹ Amazon Web Services*

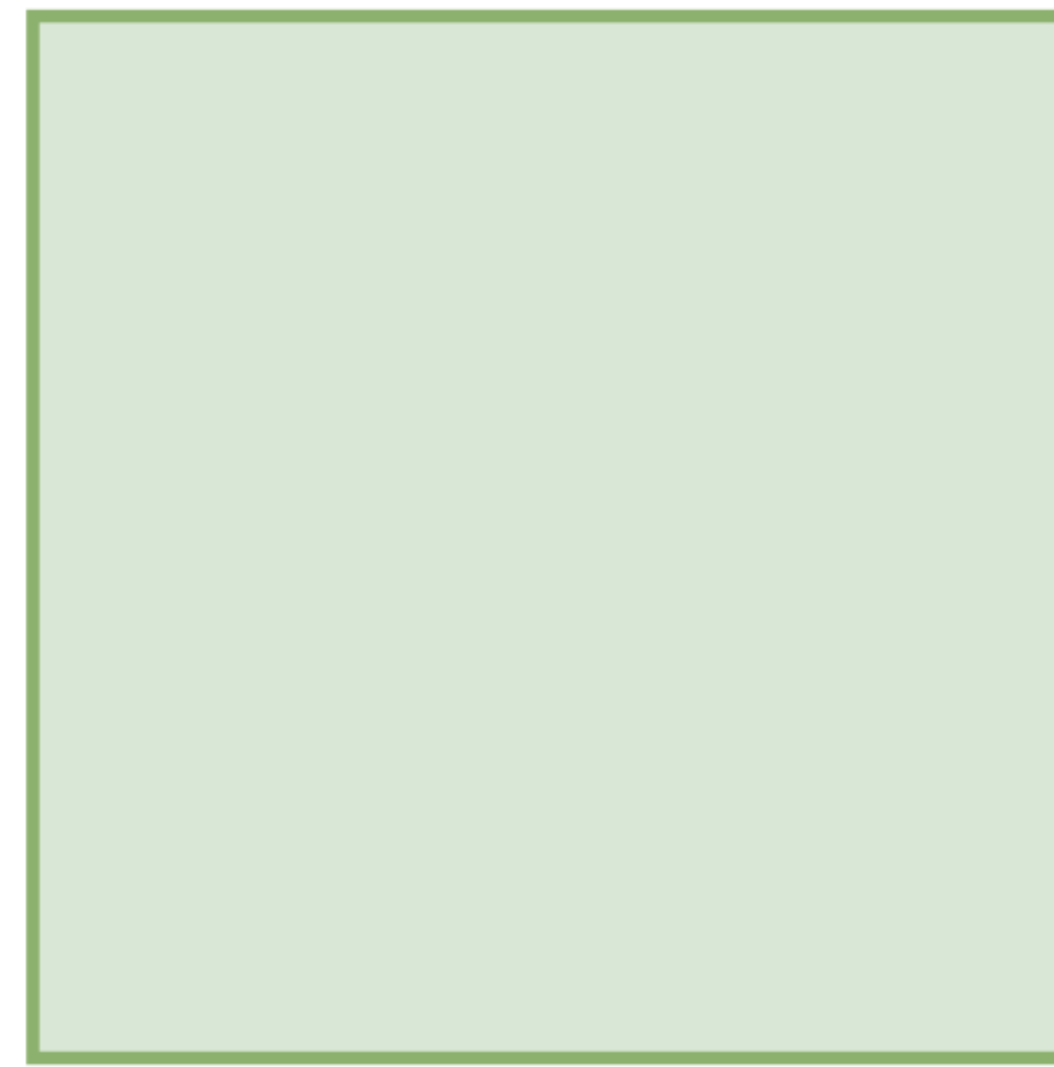
² University of British Columbia

³ Huawei Cloud, Toronto Research Center

Background



s_1



s_2

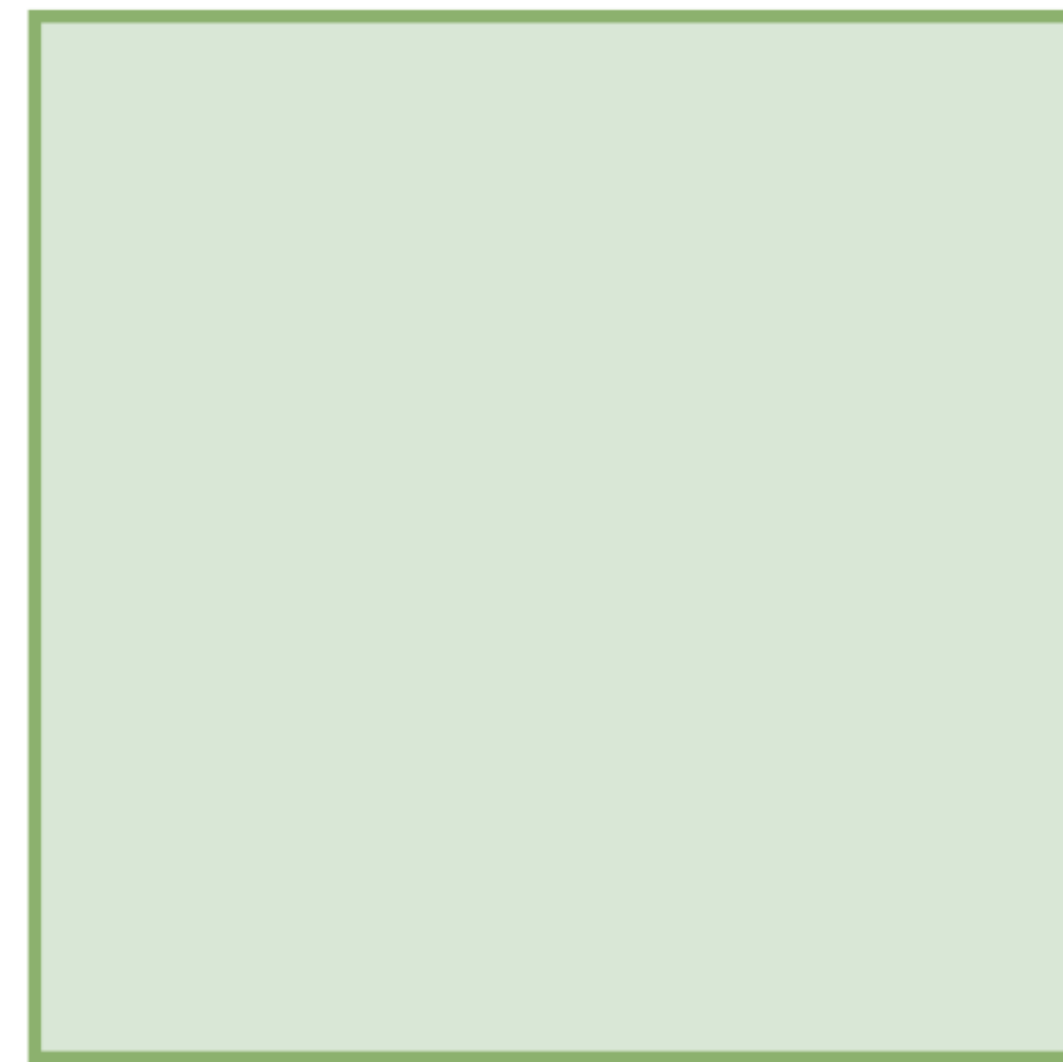
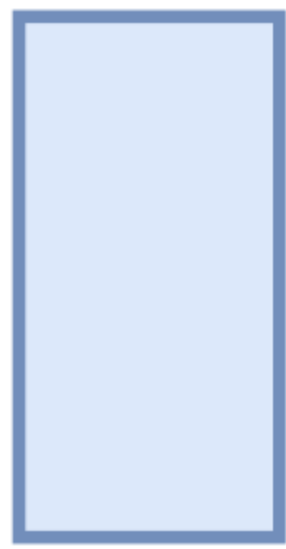


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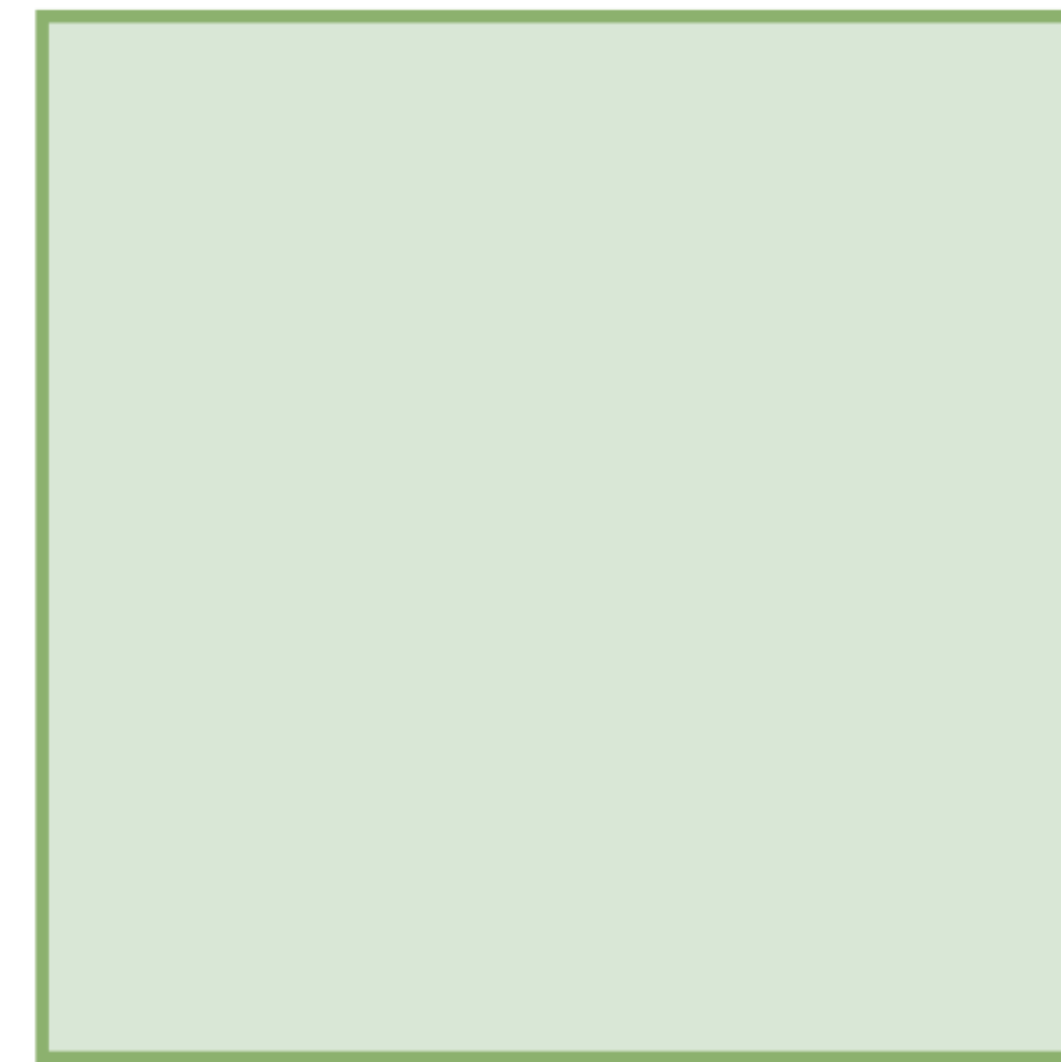


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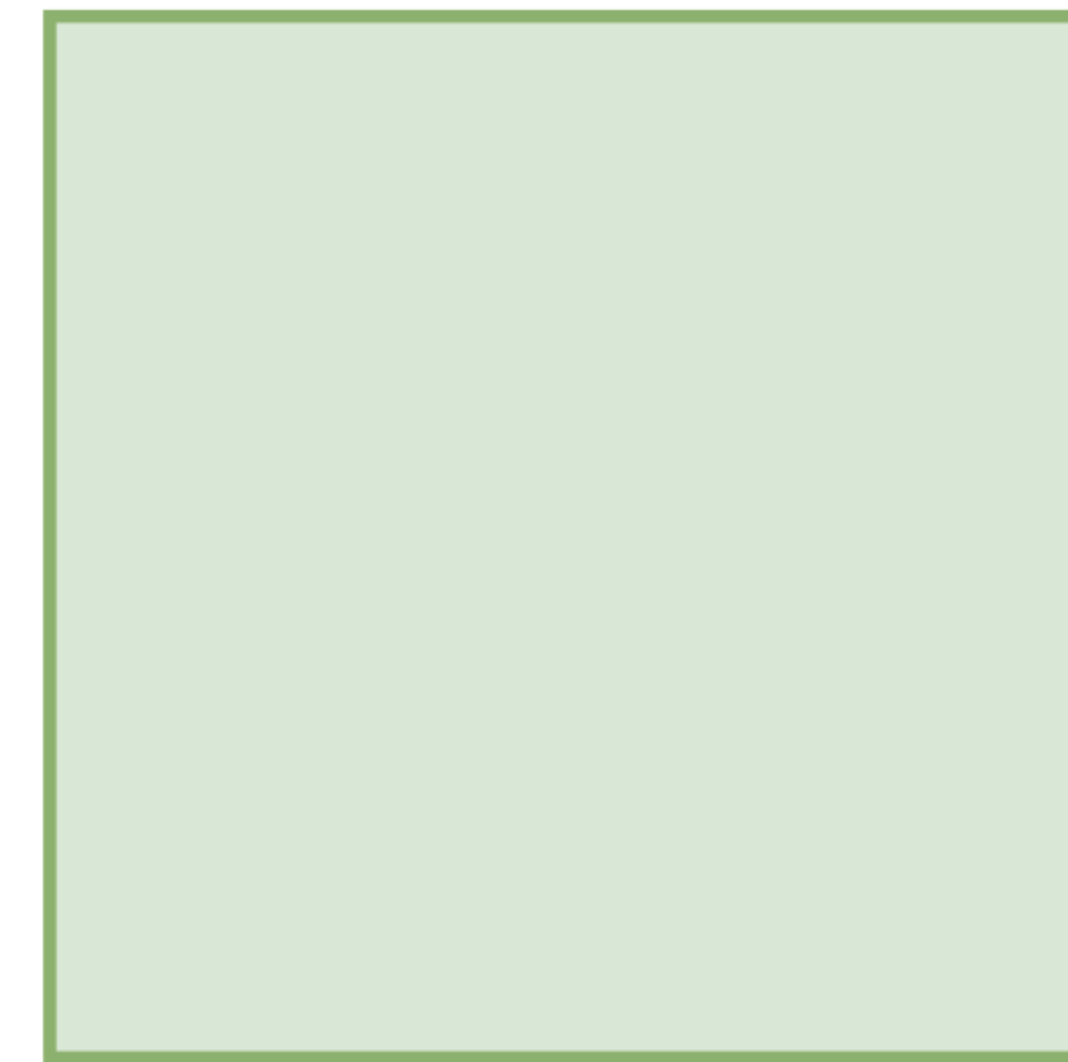
vm_1



s_1

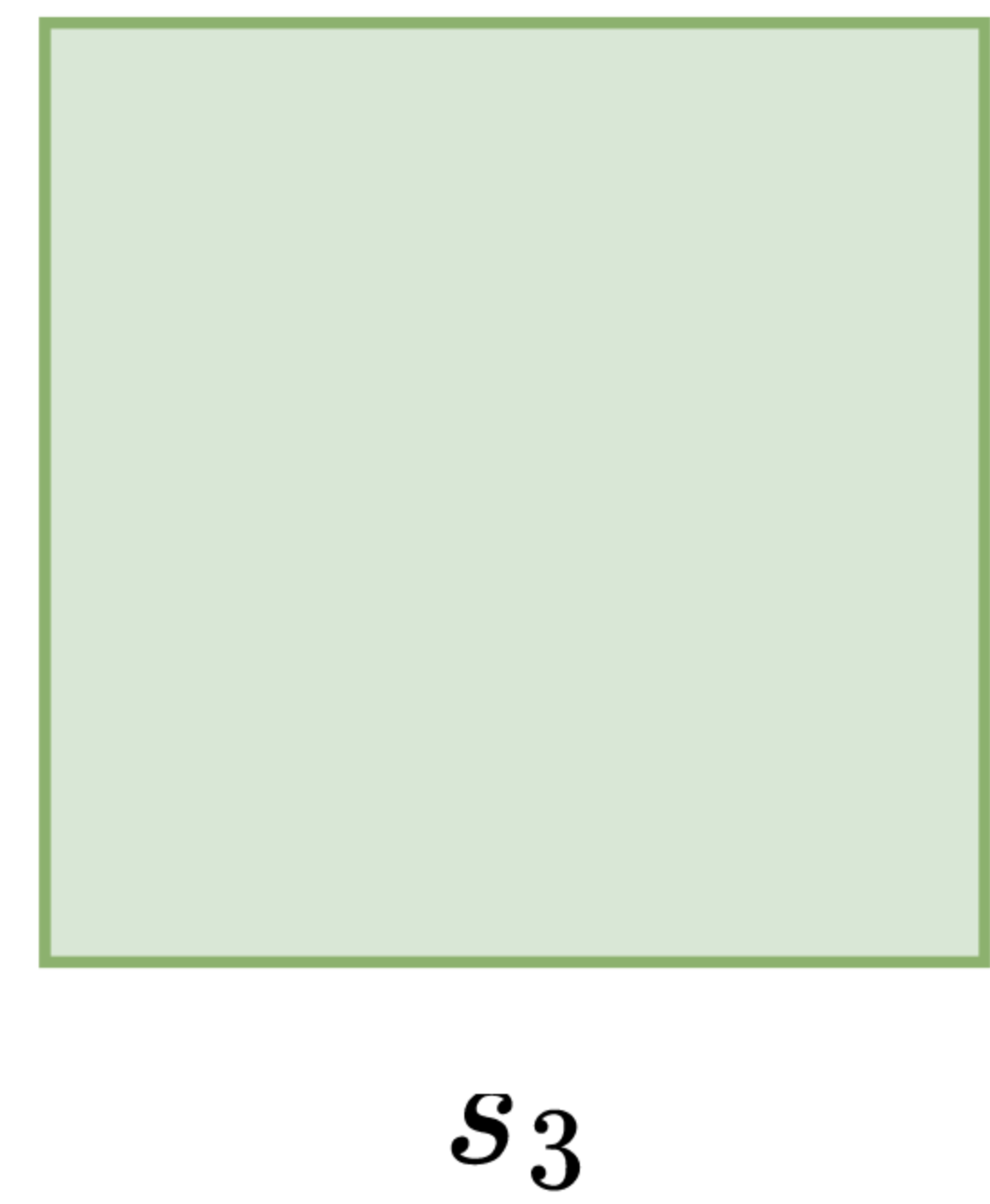
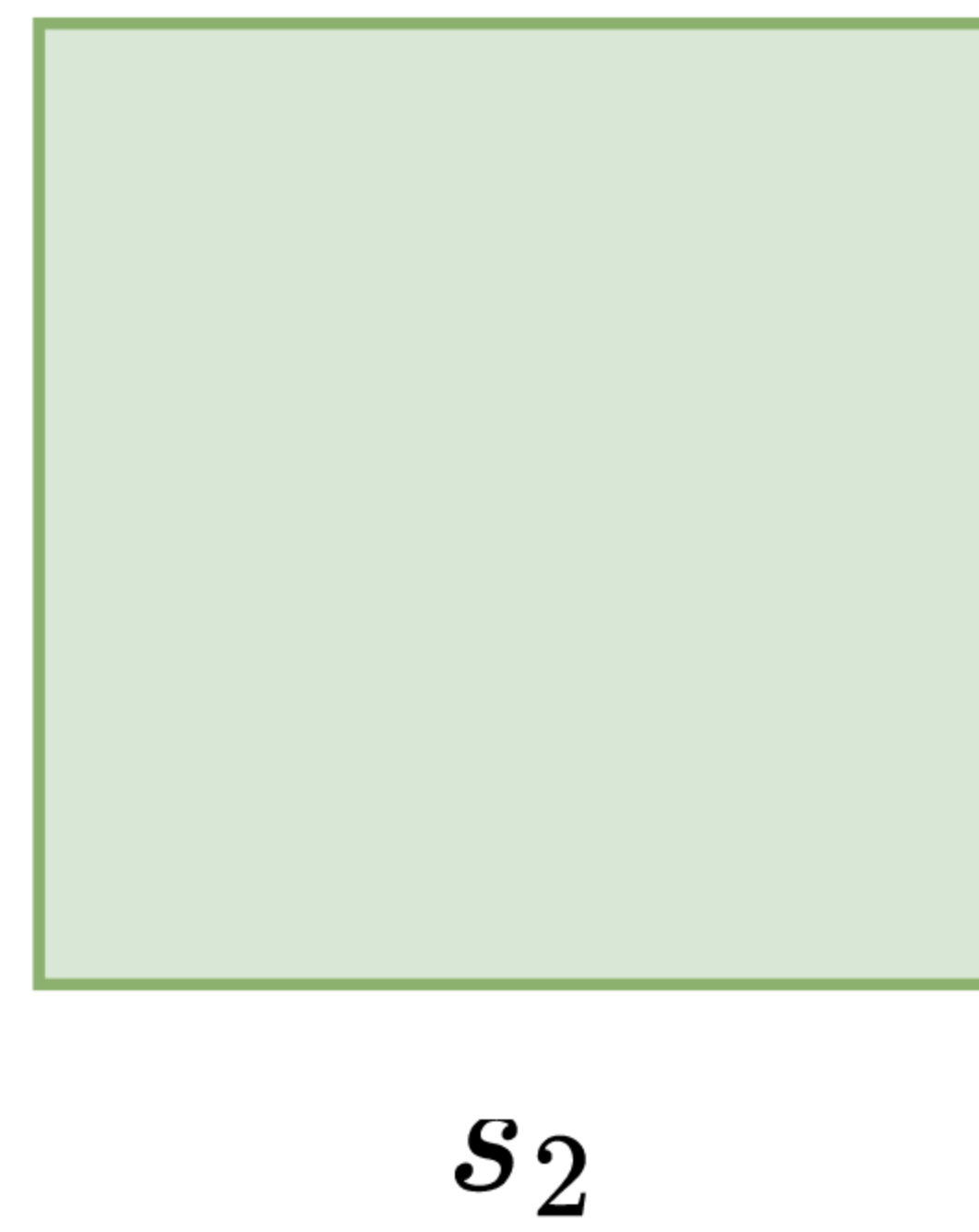
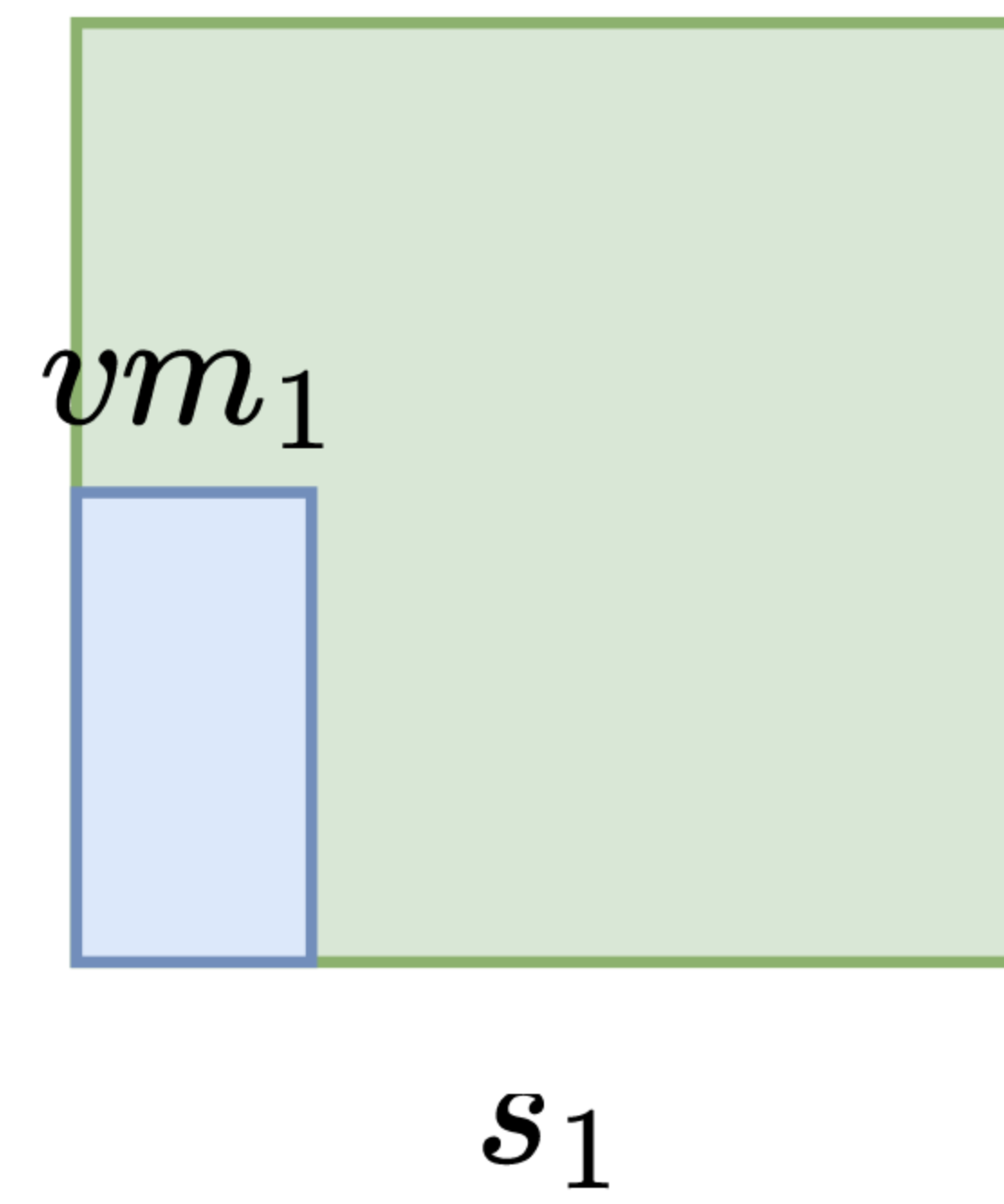


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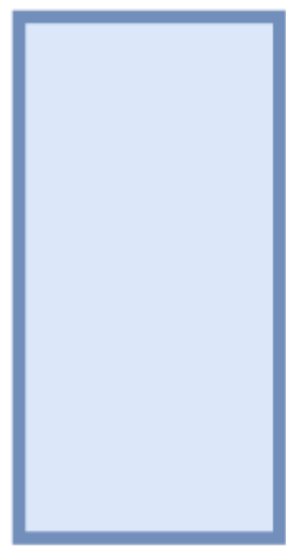
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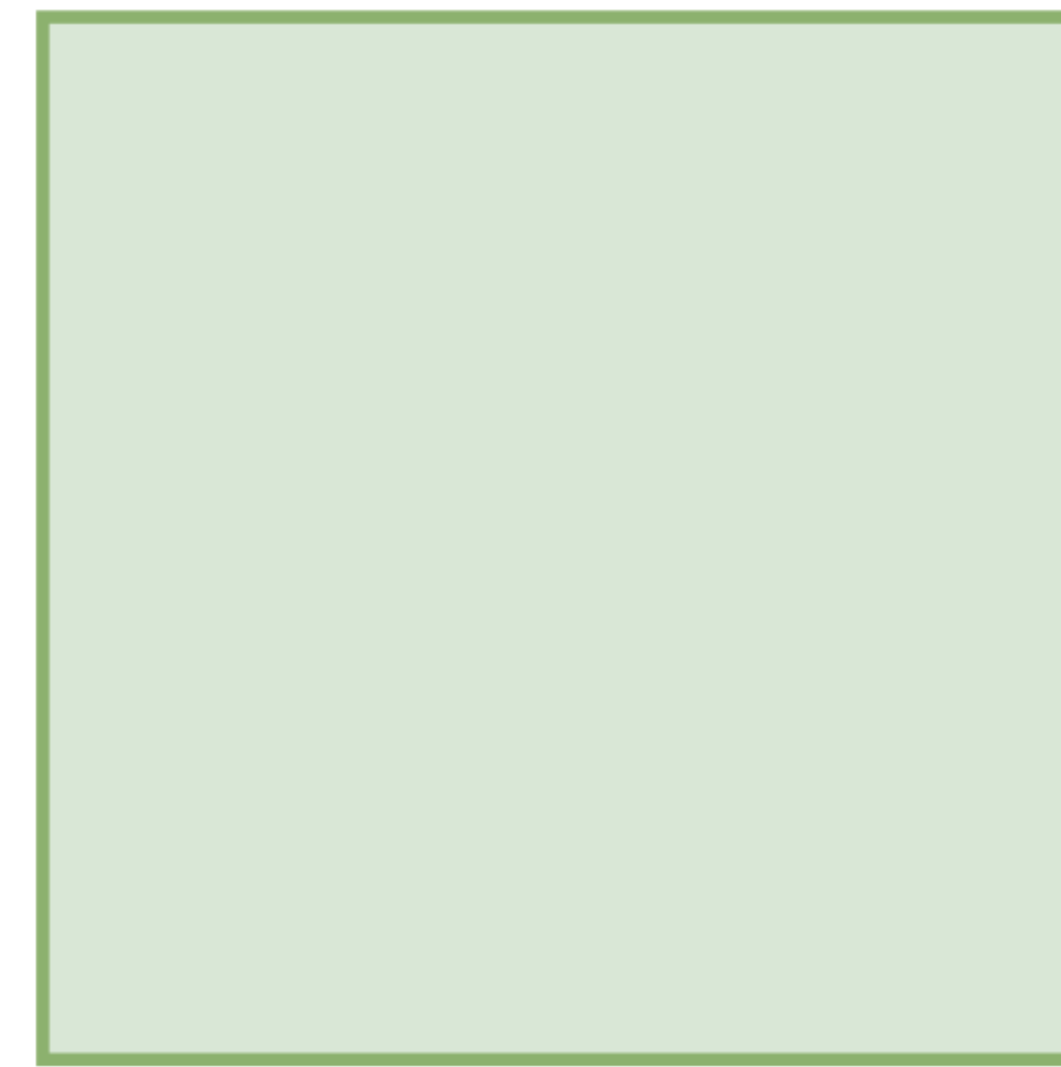
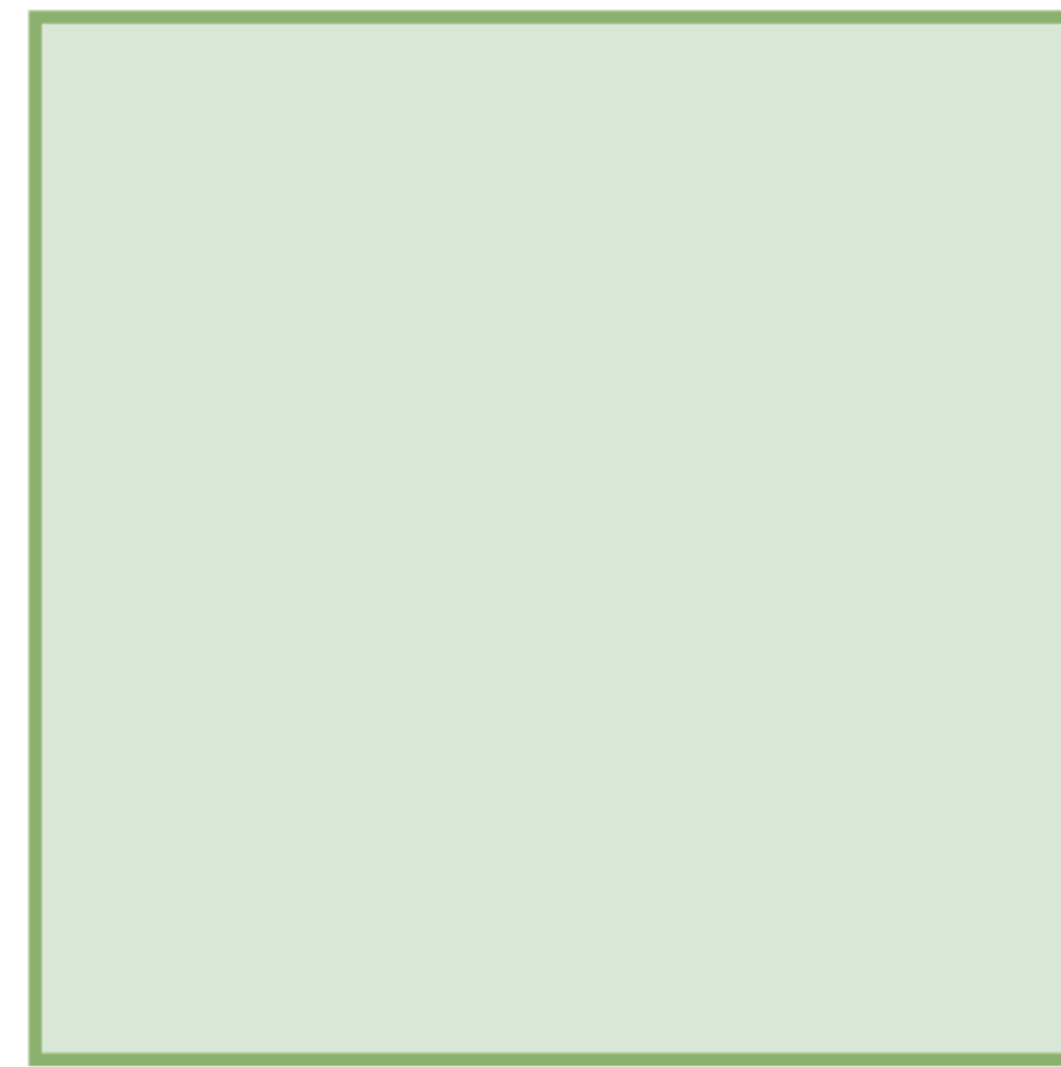
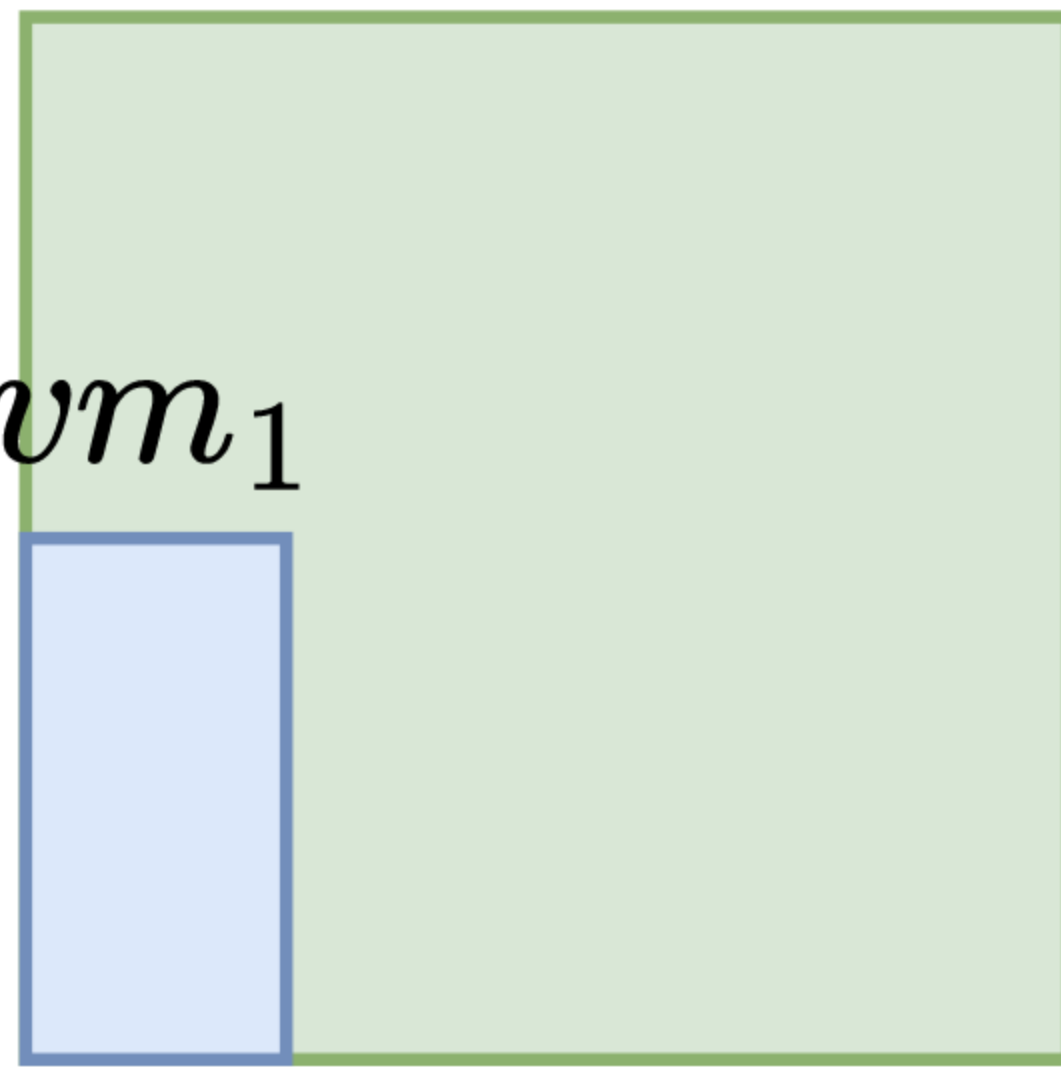
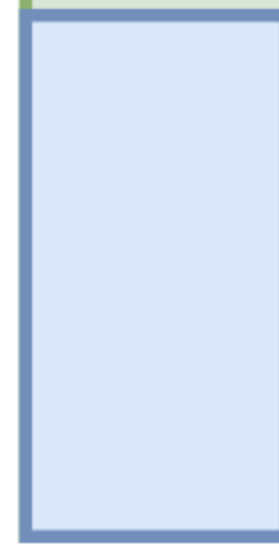


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vm_2



vm_1



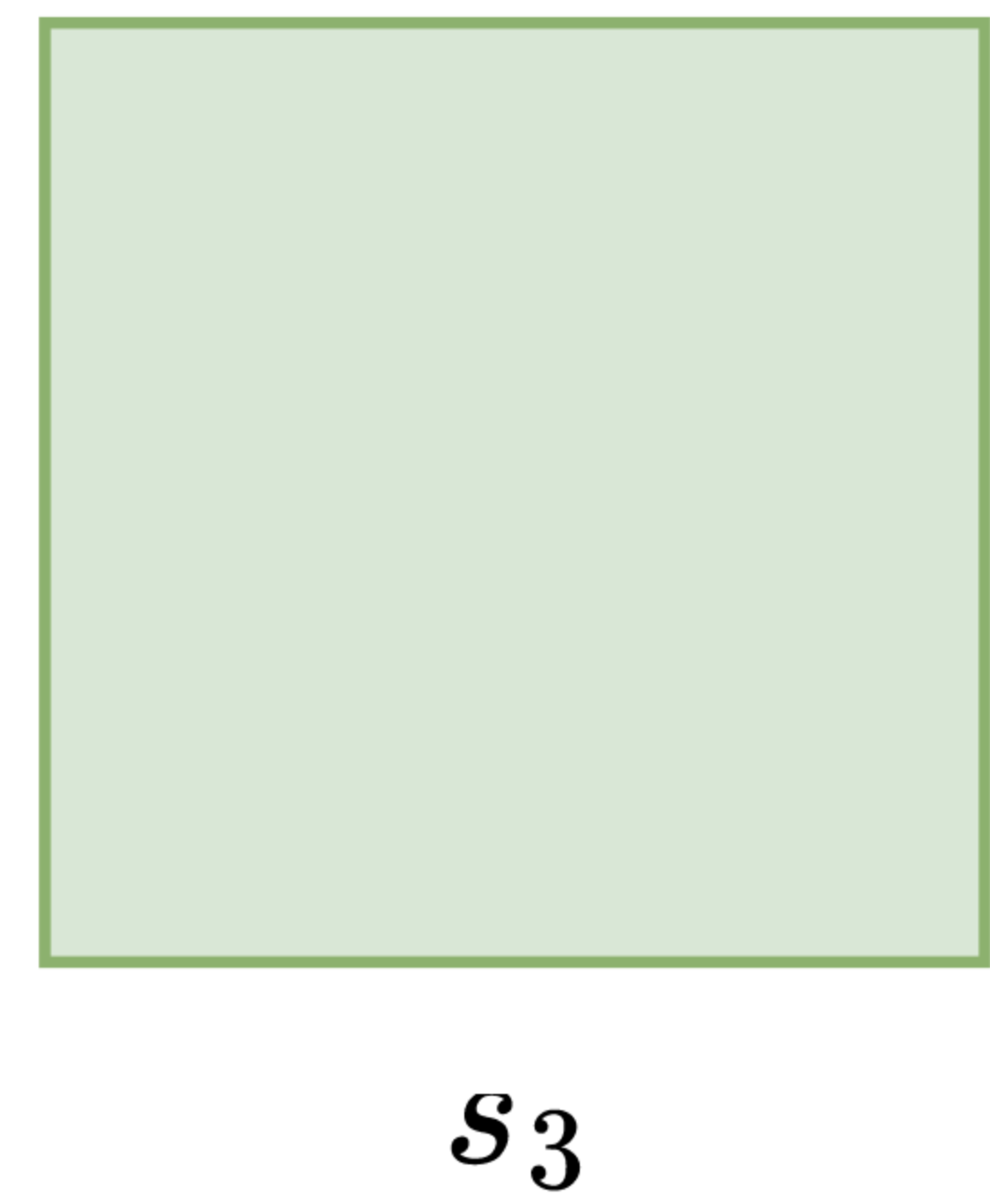
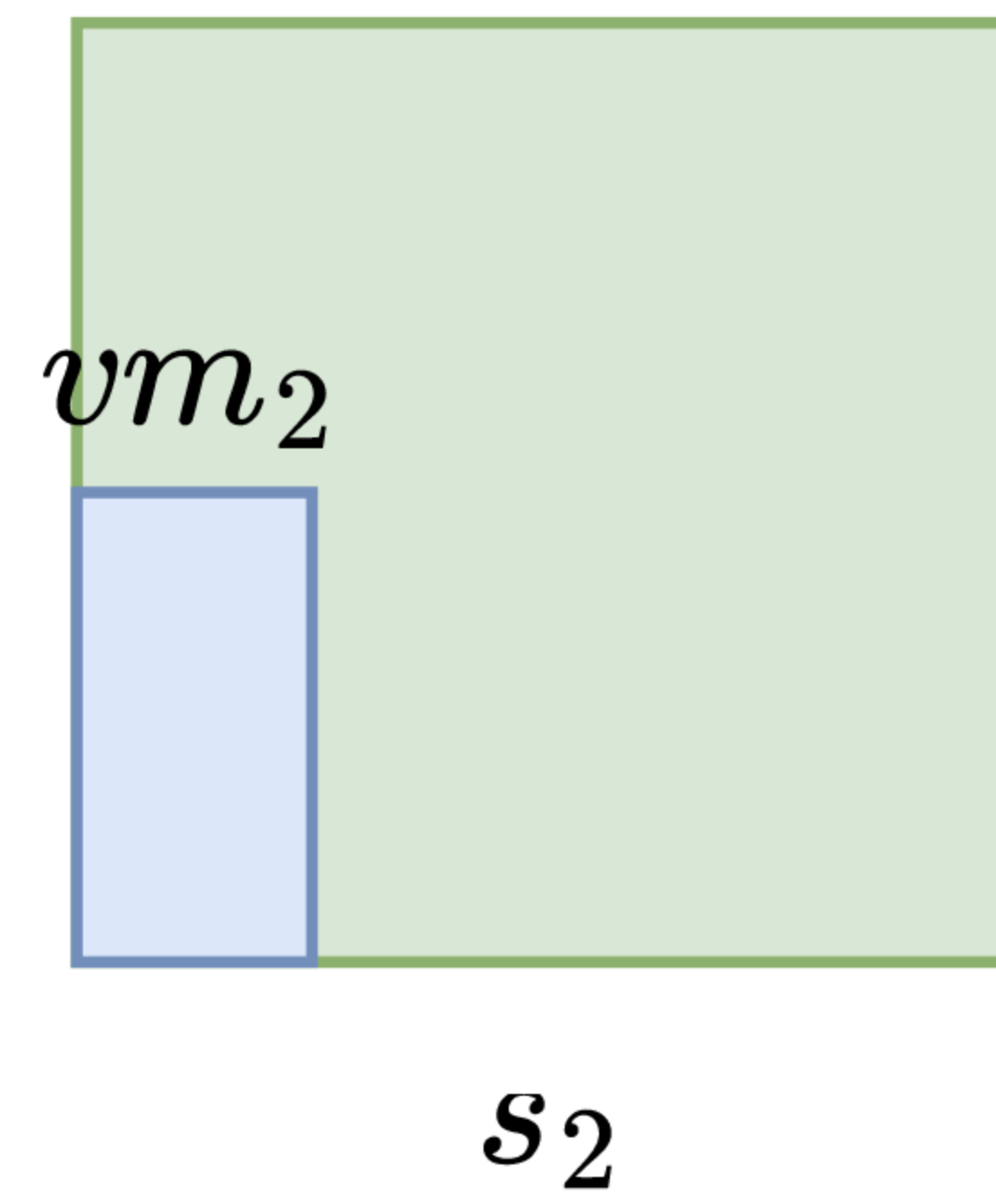
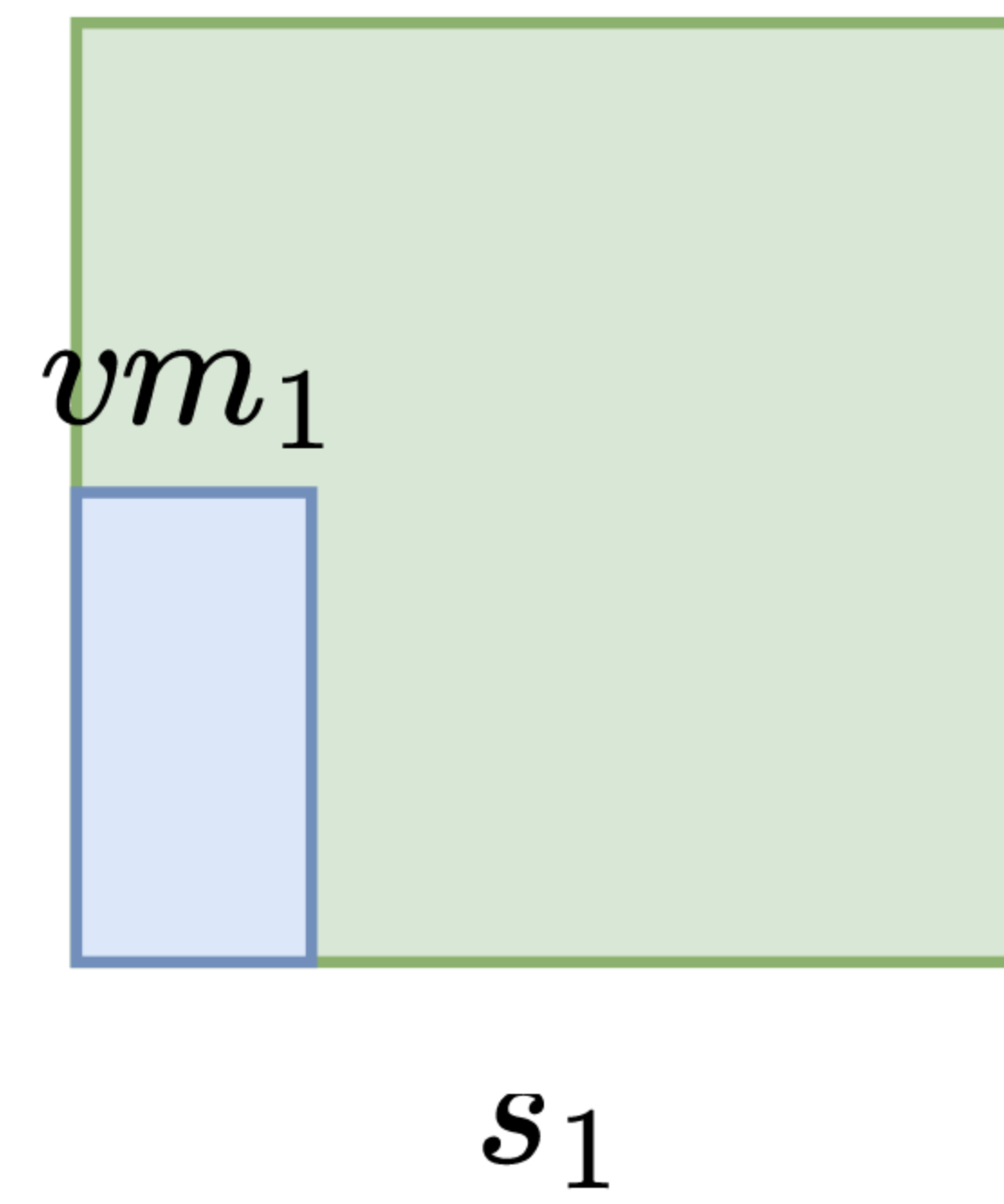
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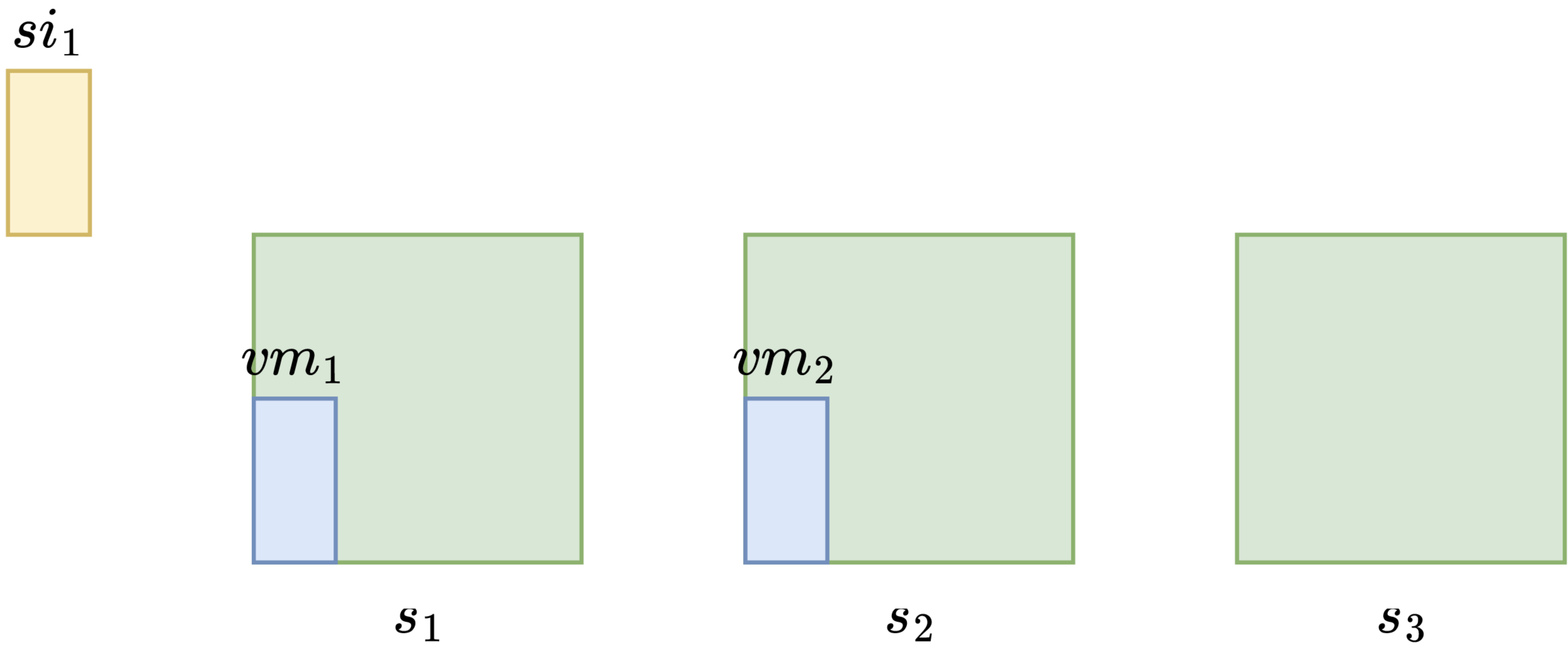
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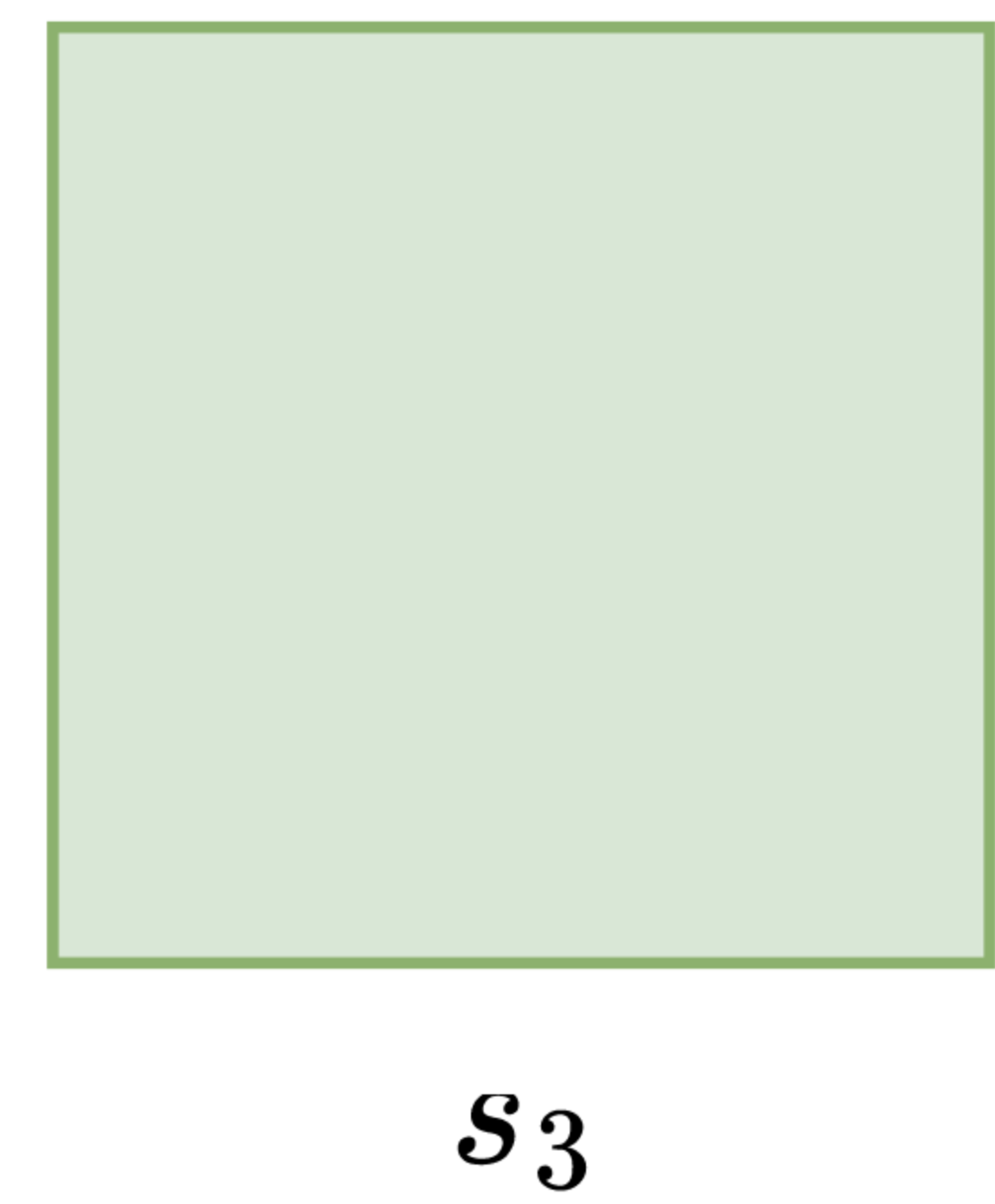
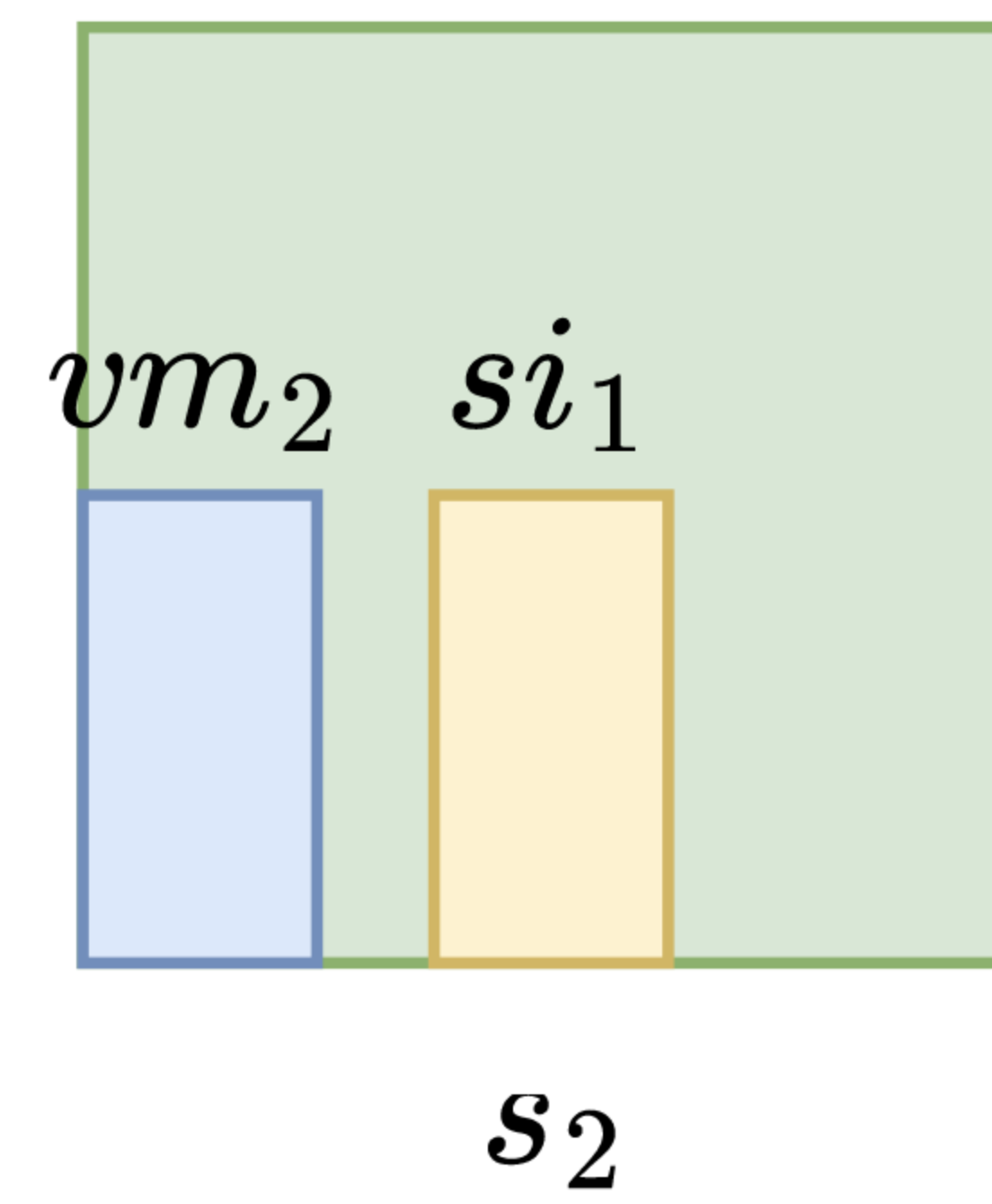
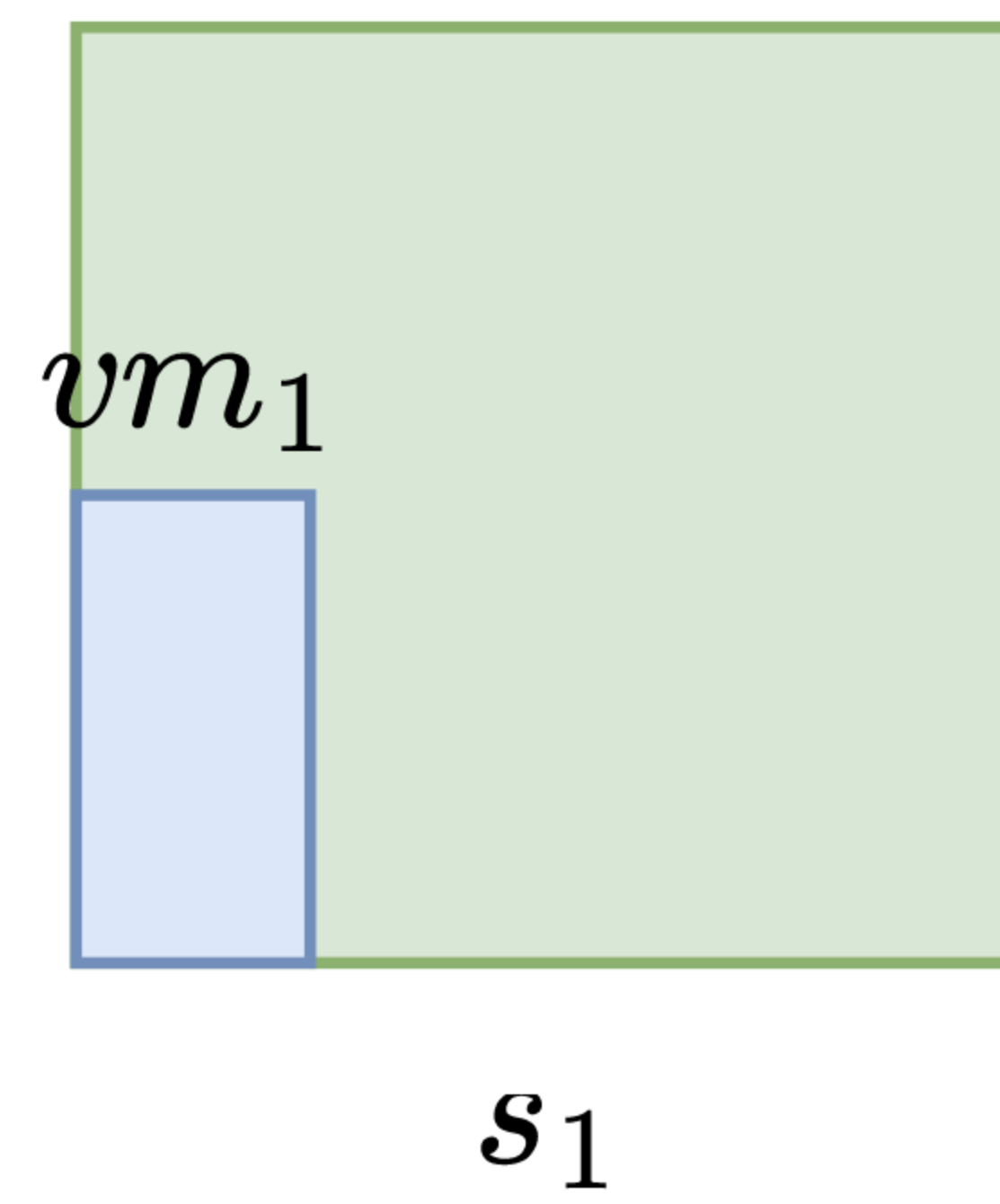
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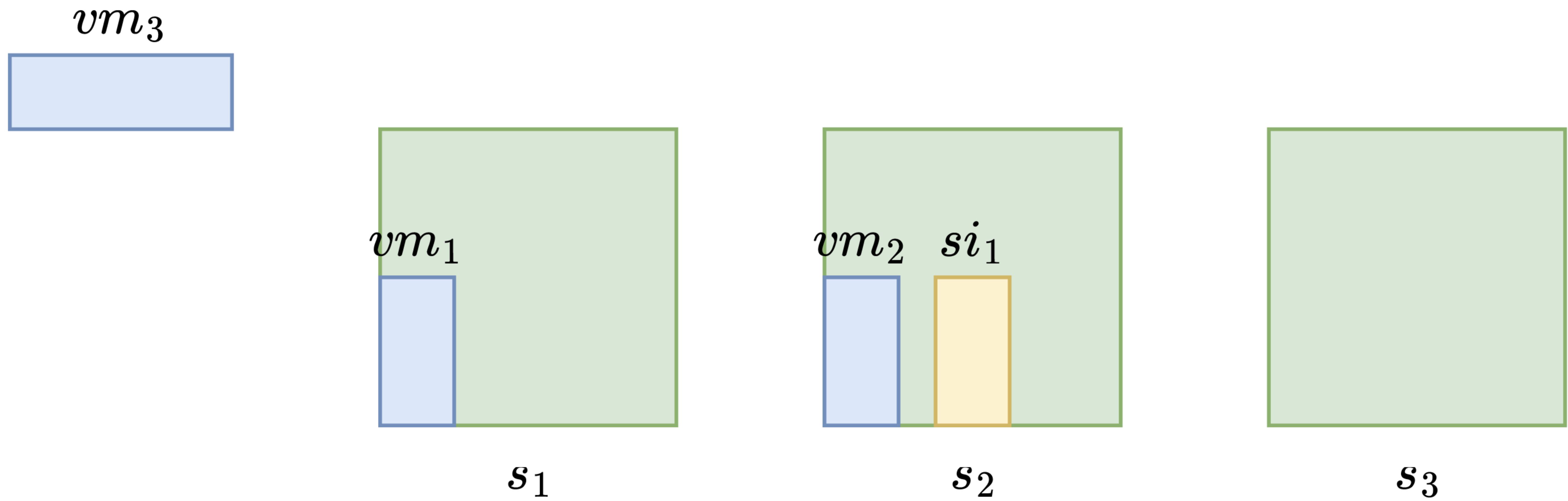
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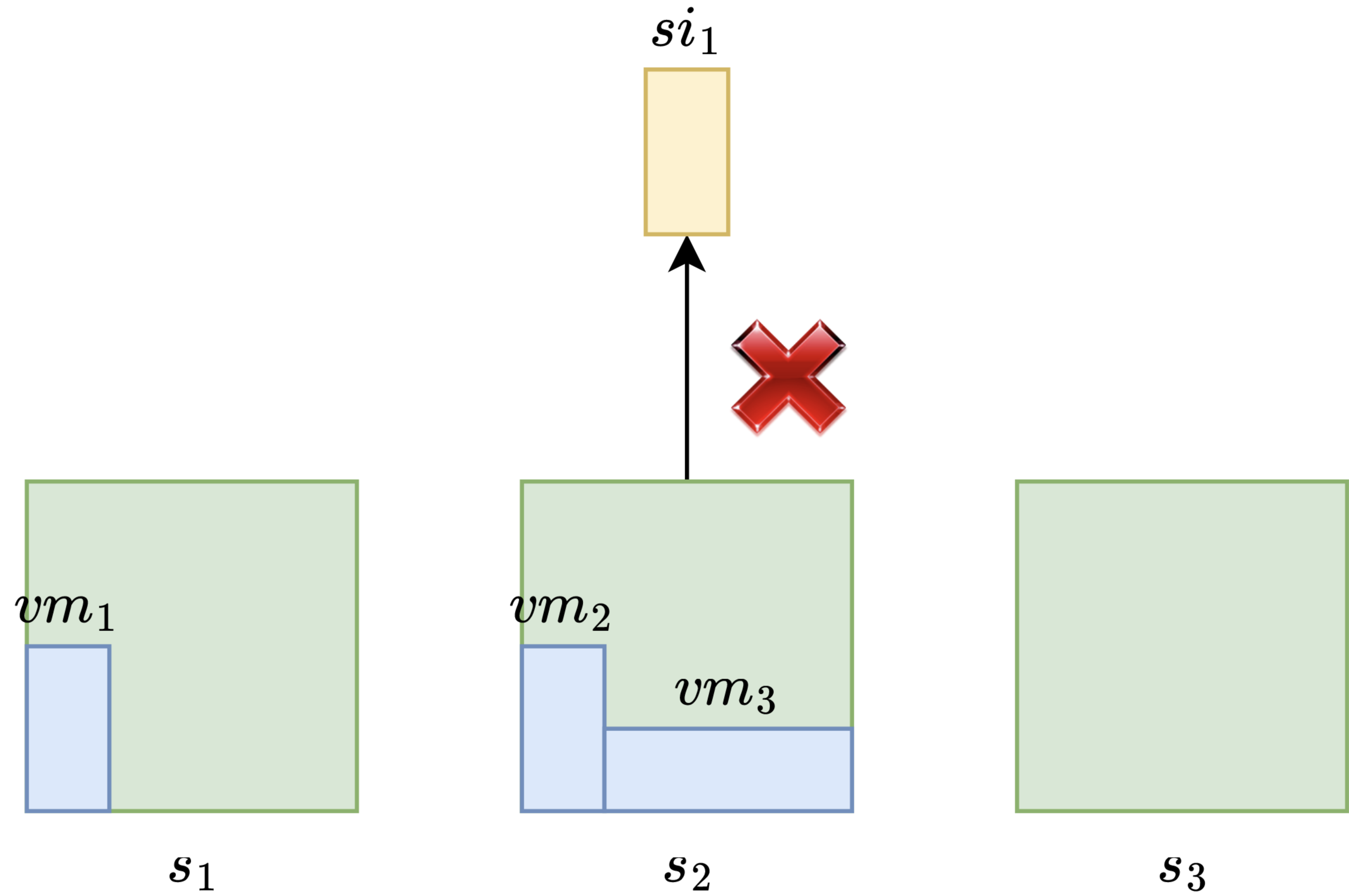
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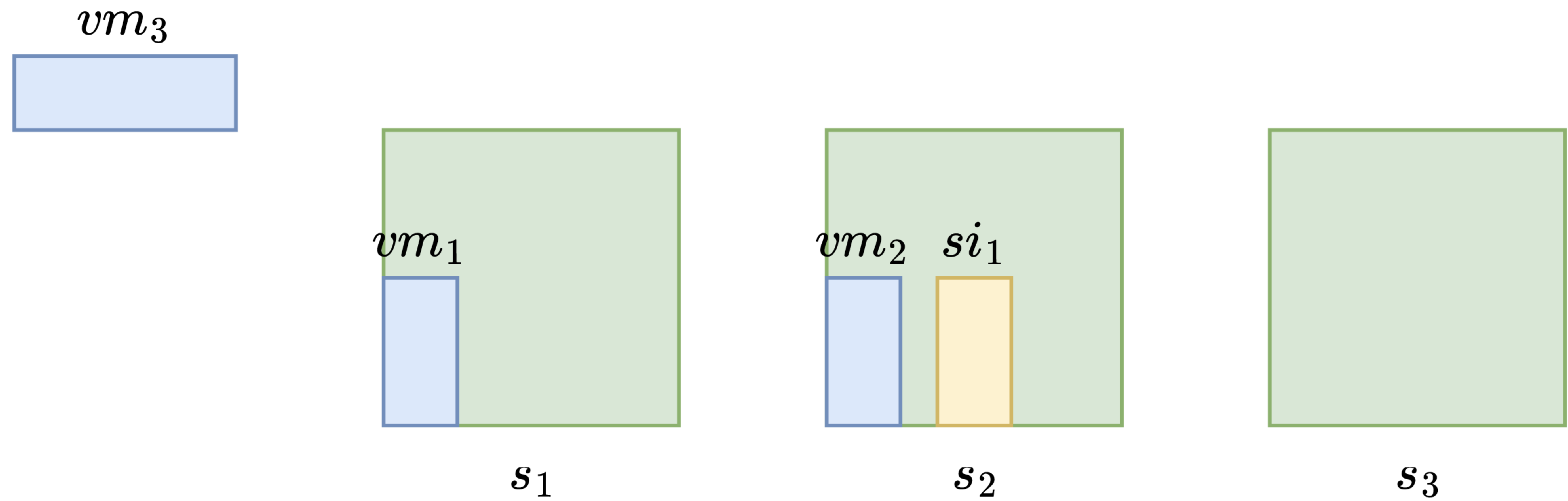
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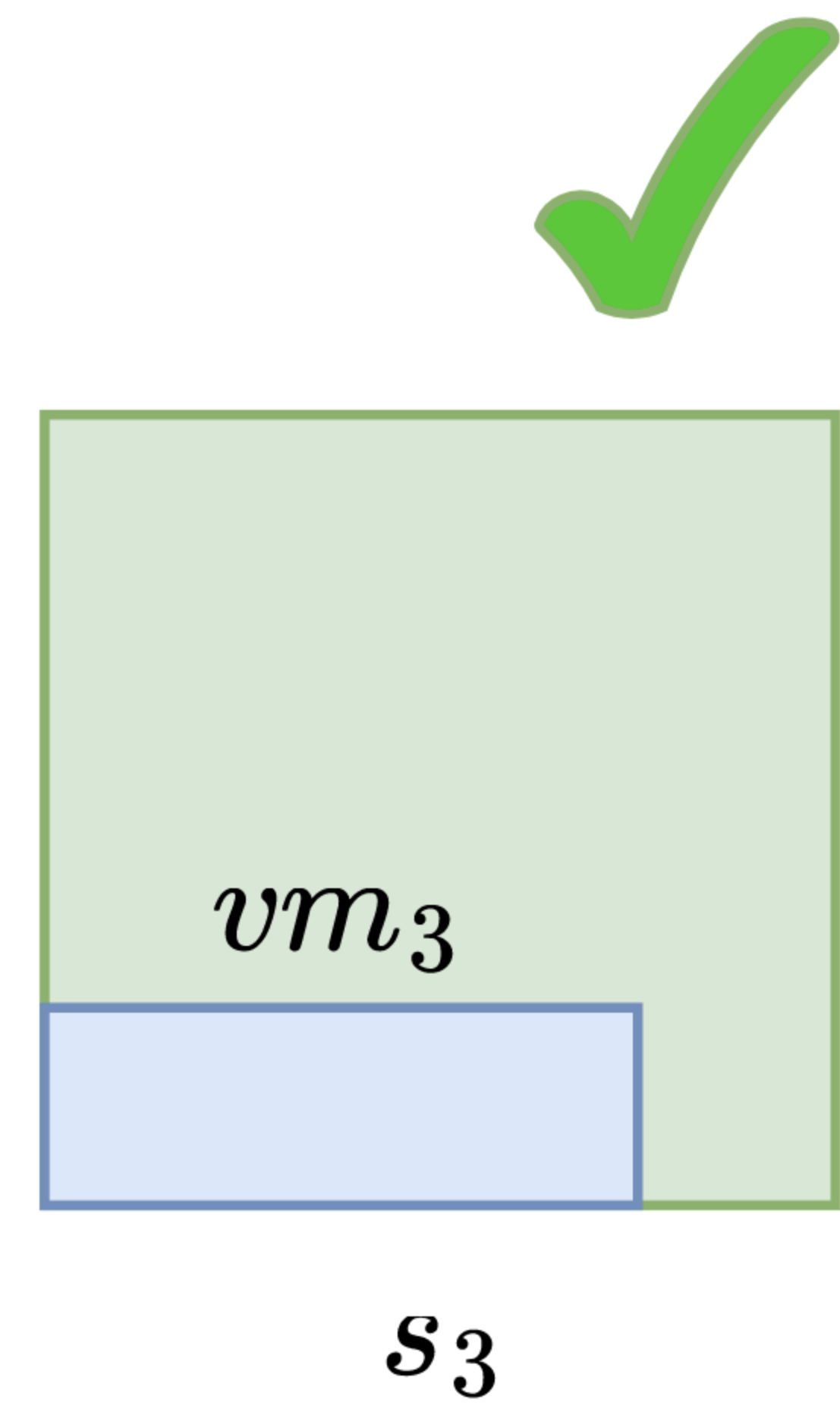
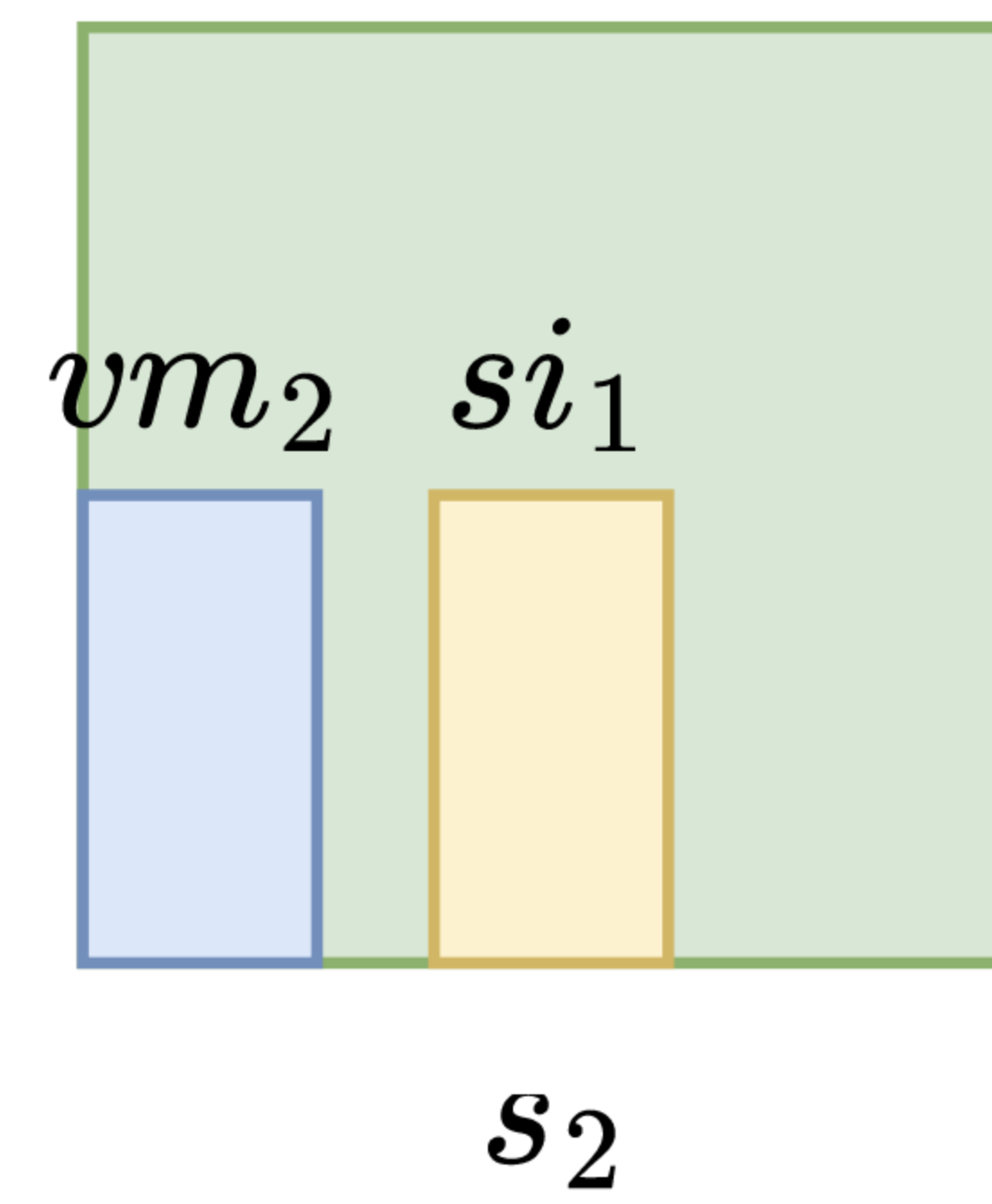
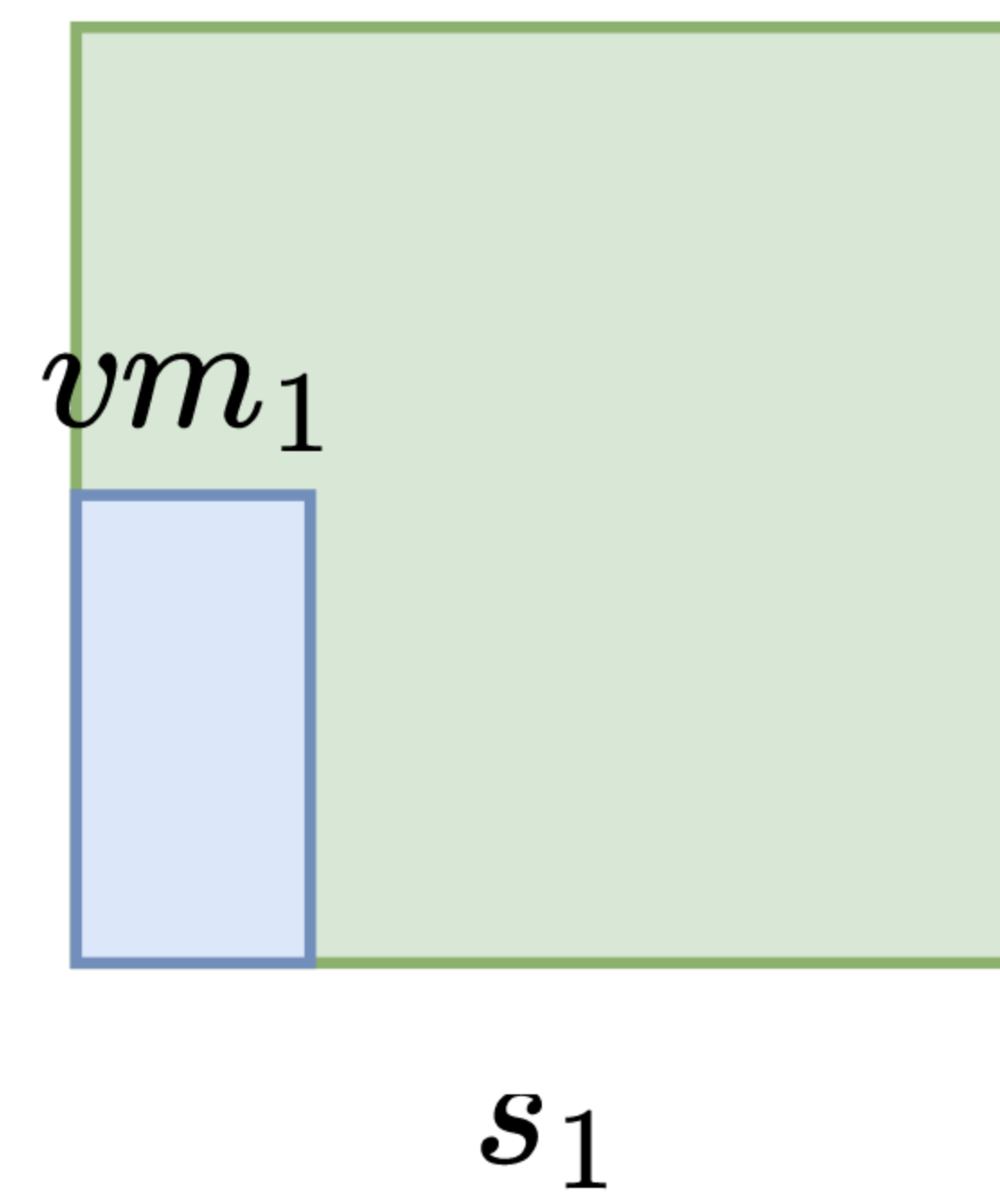
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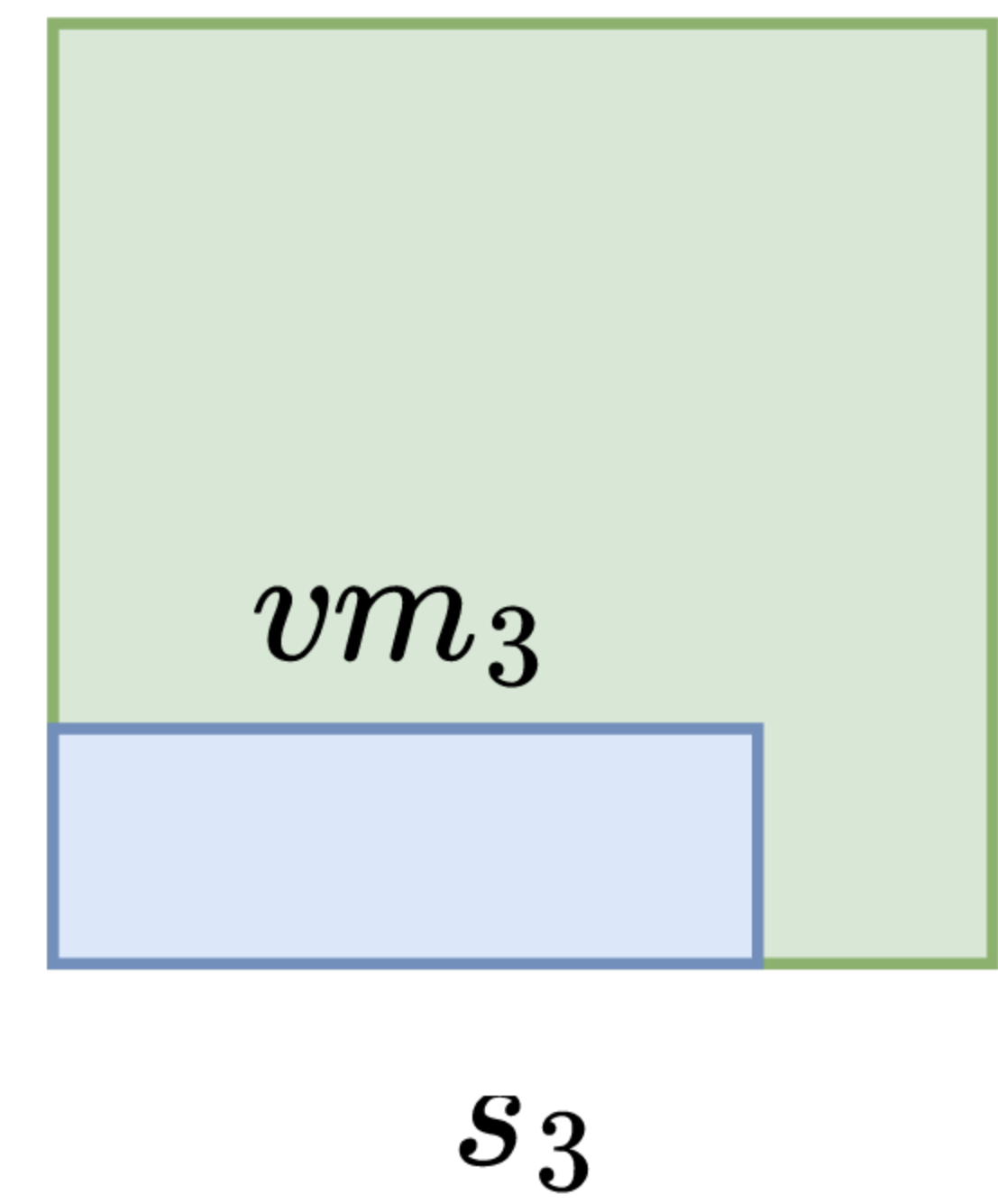
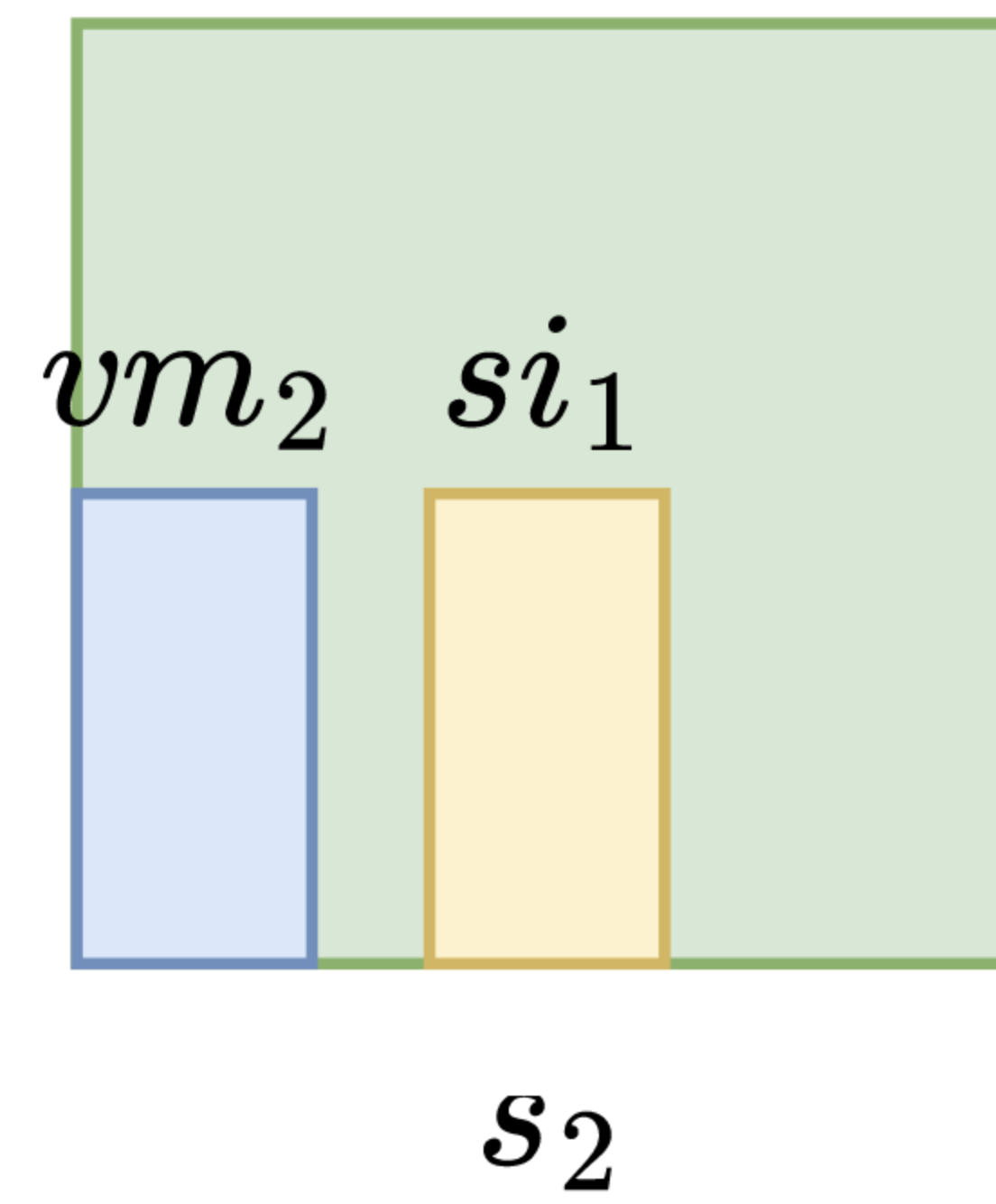
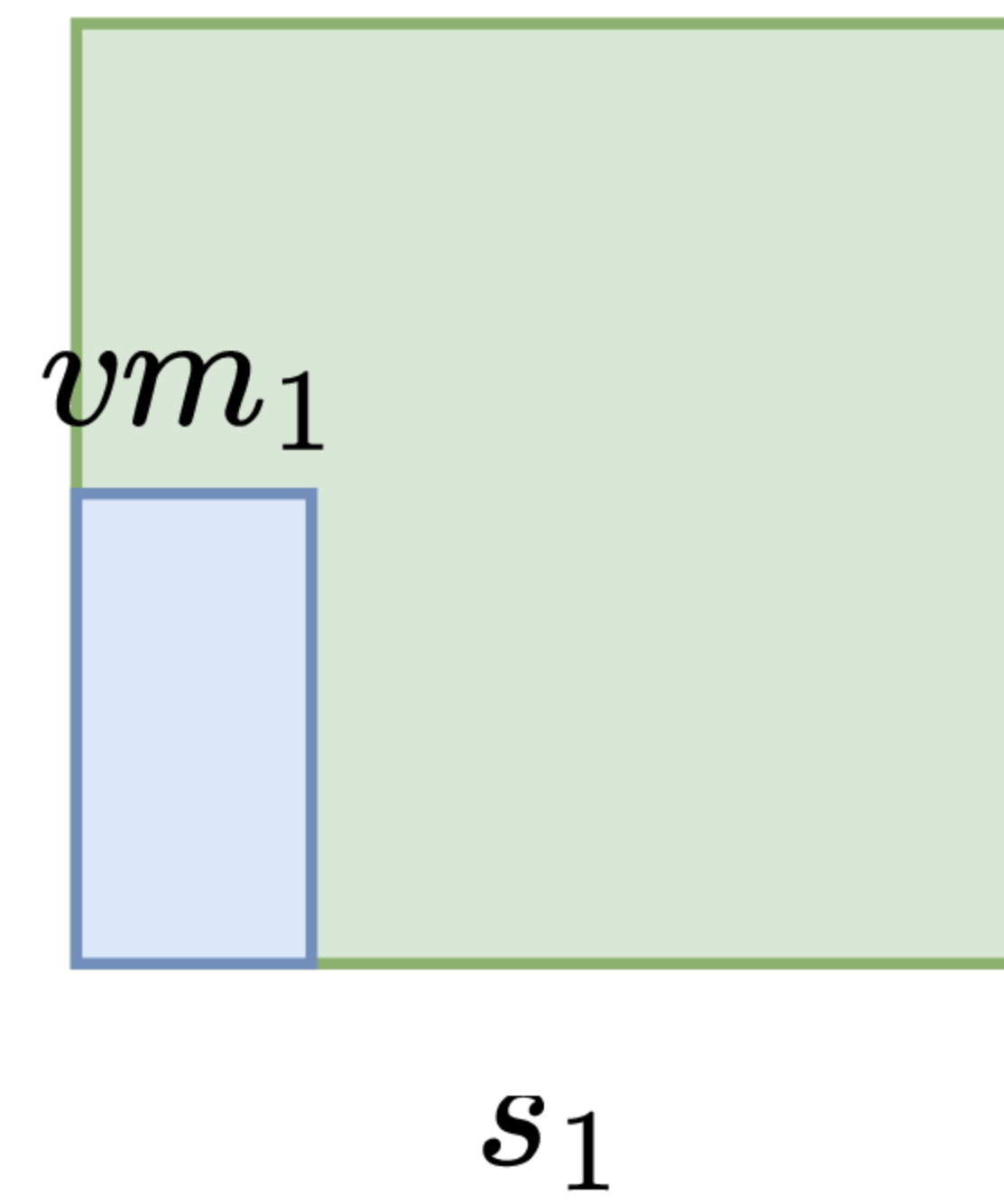
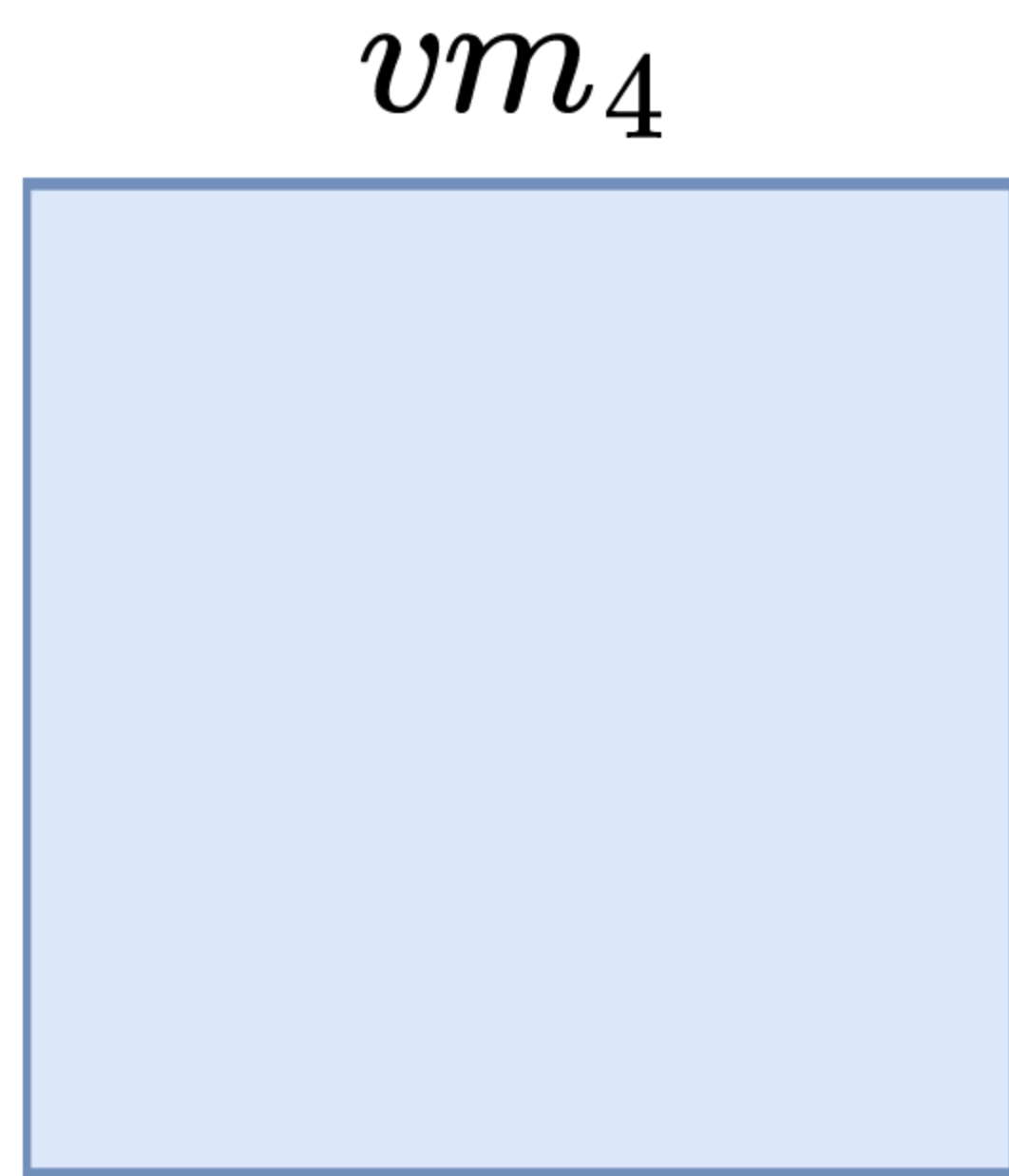
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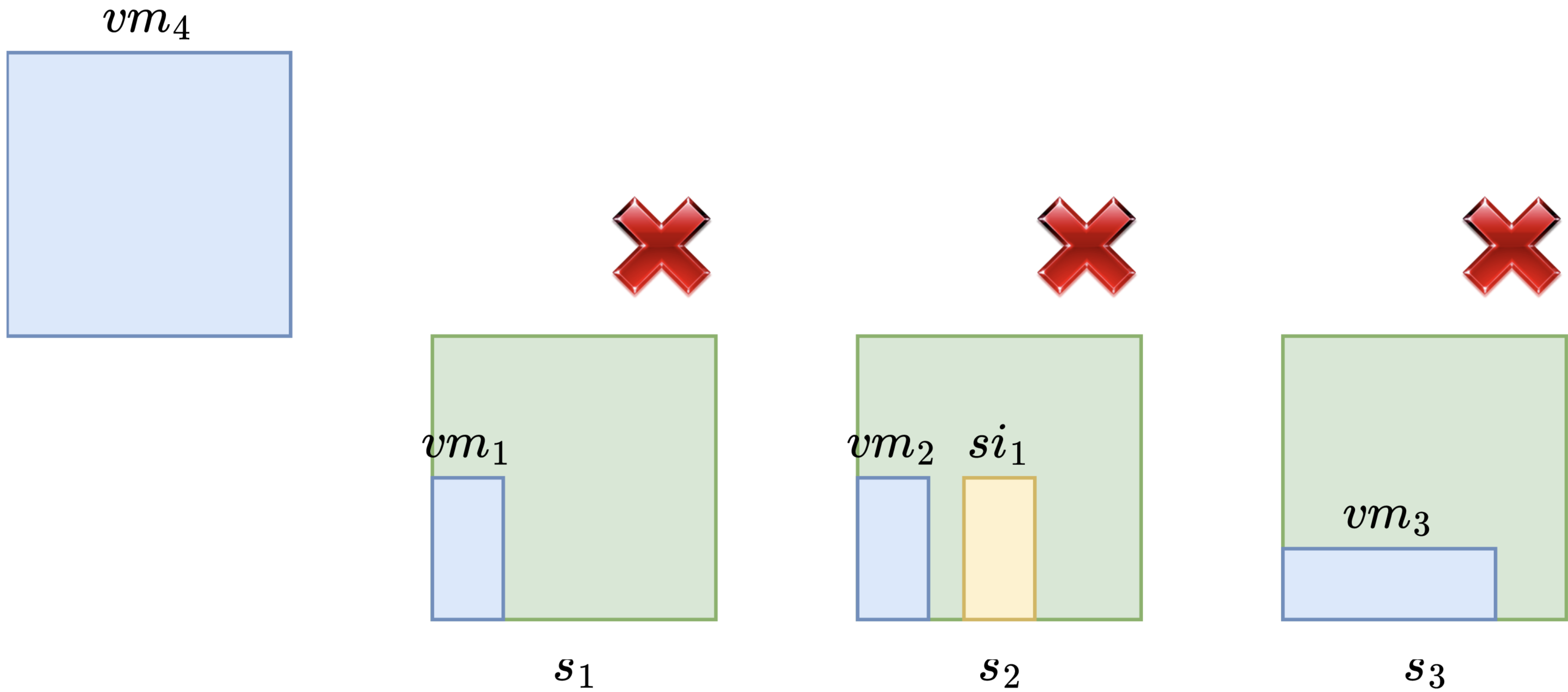
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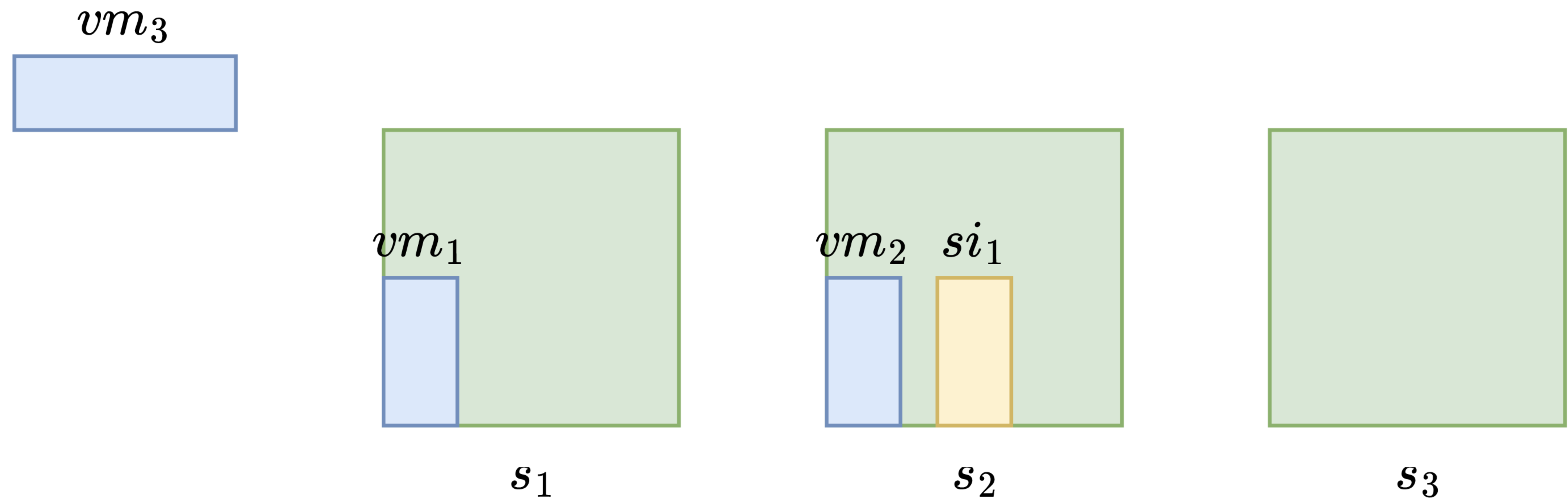
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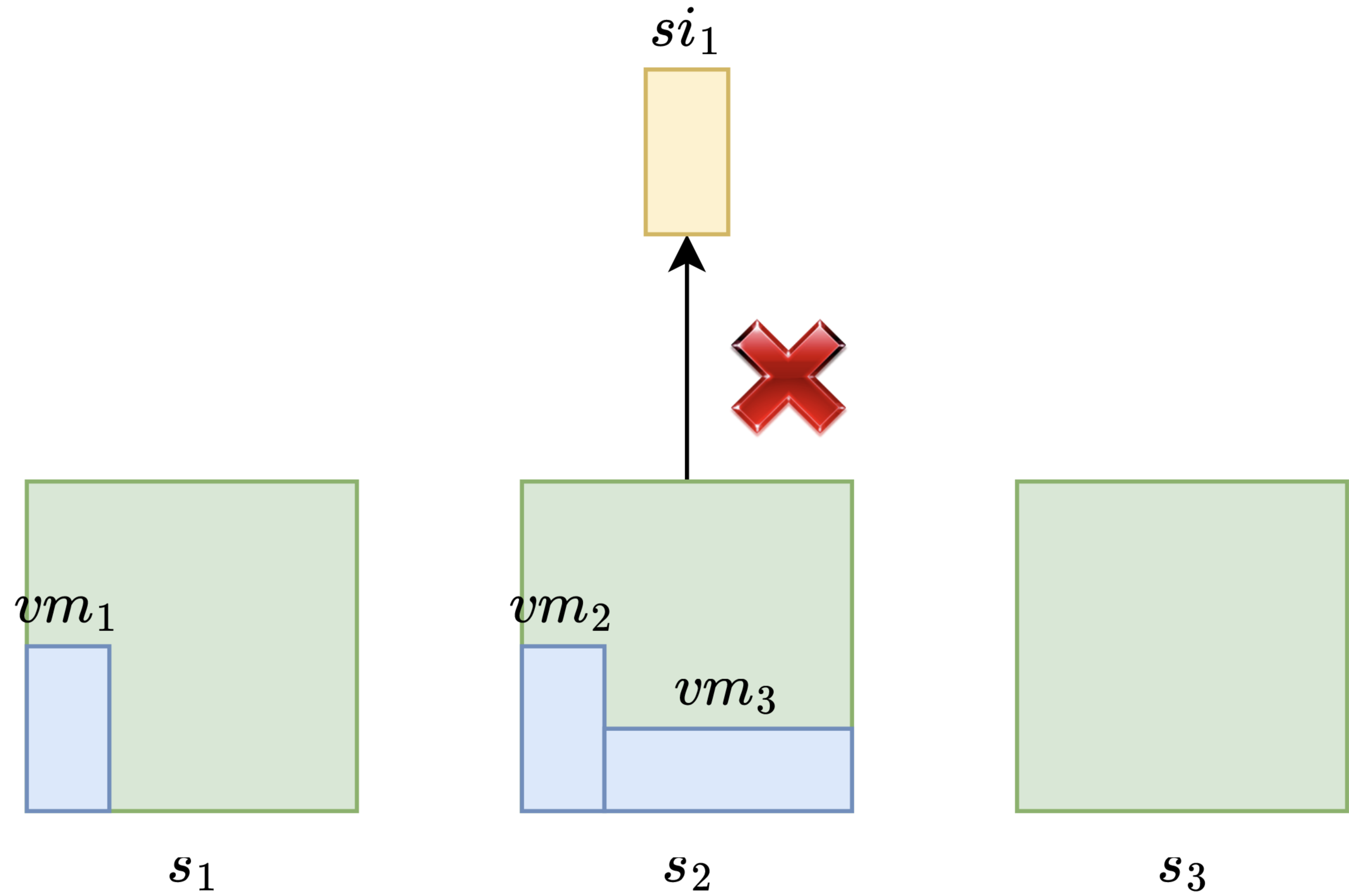
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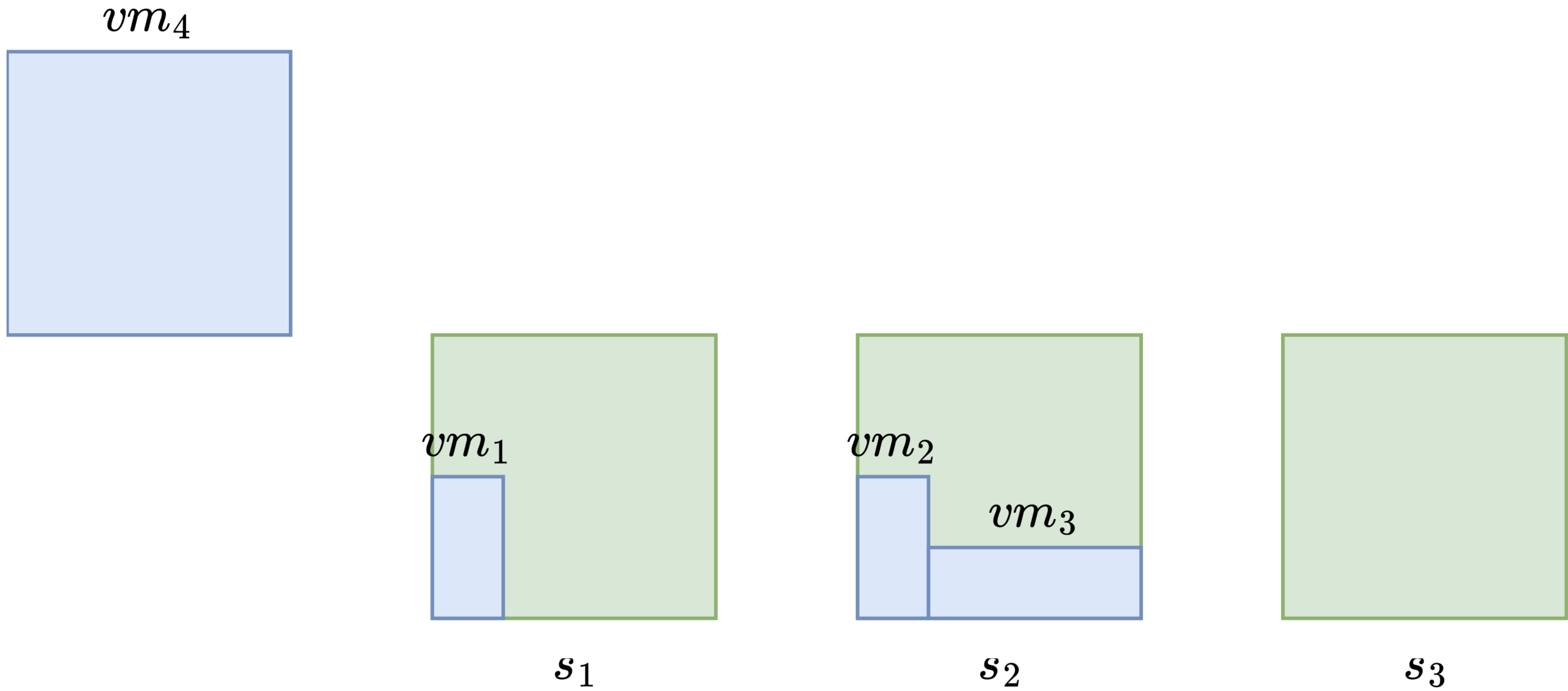
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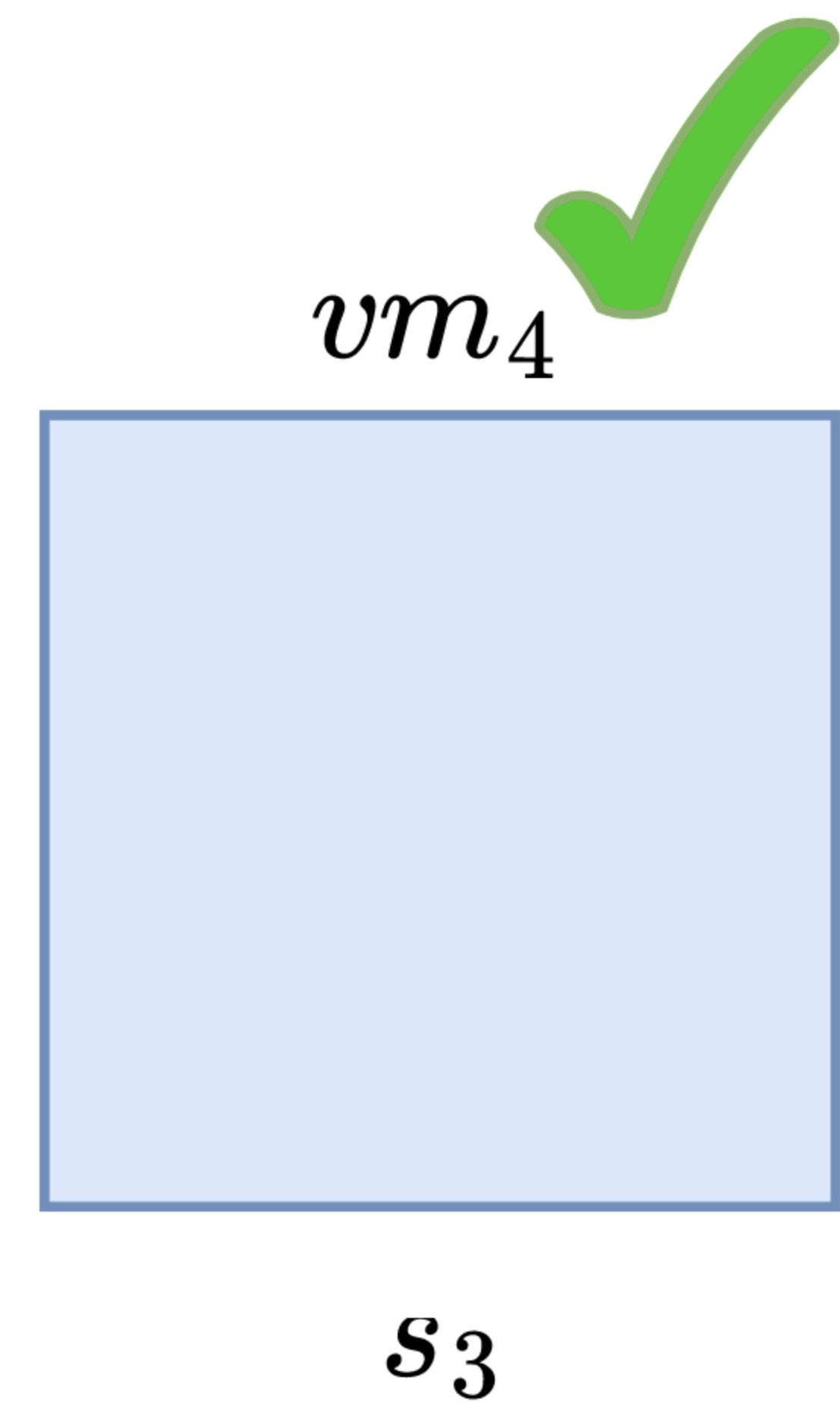
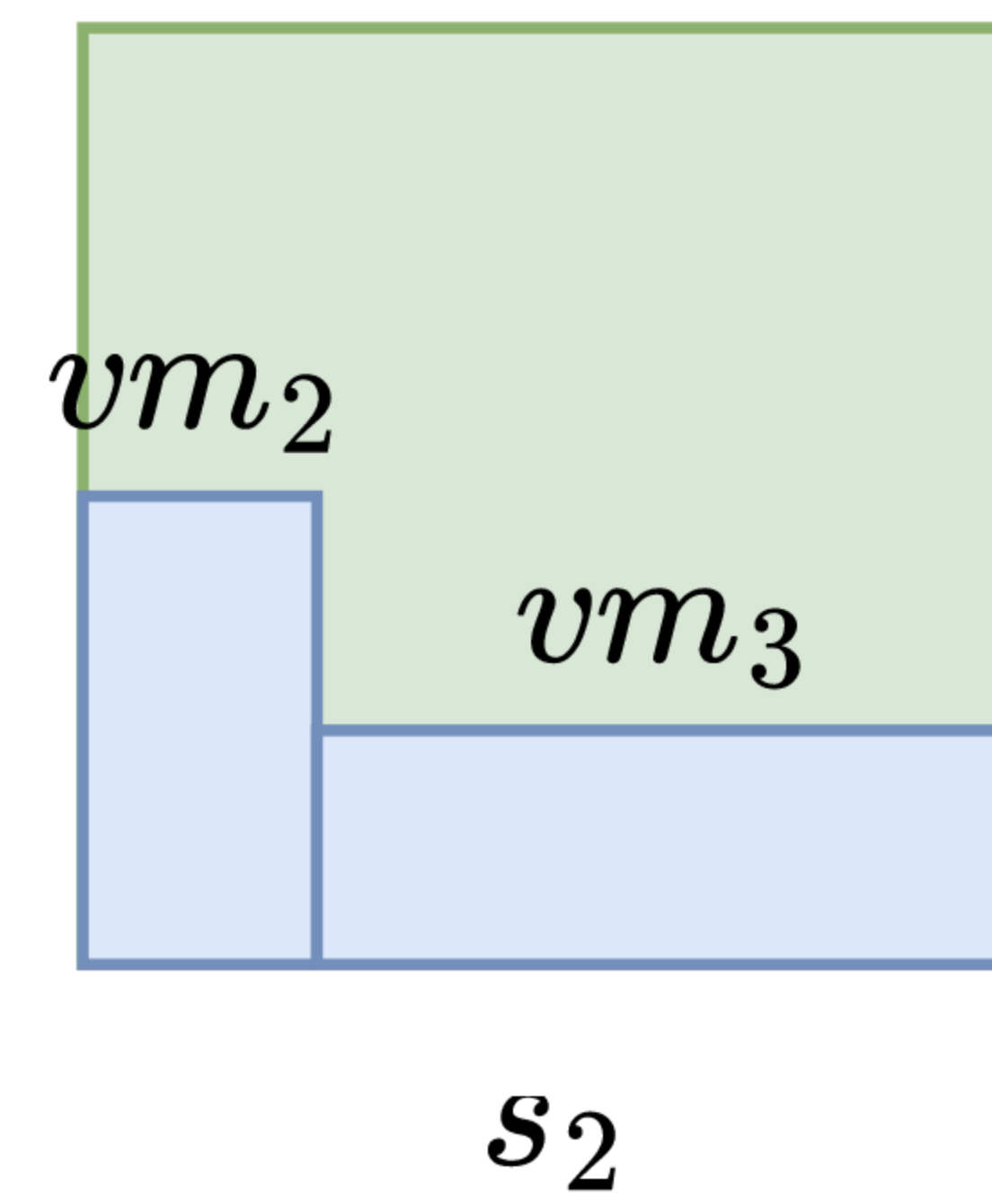
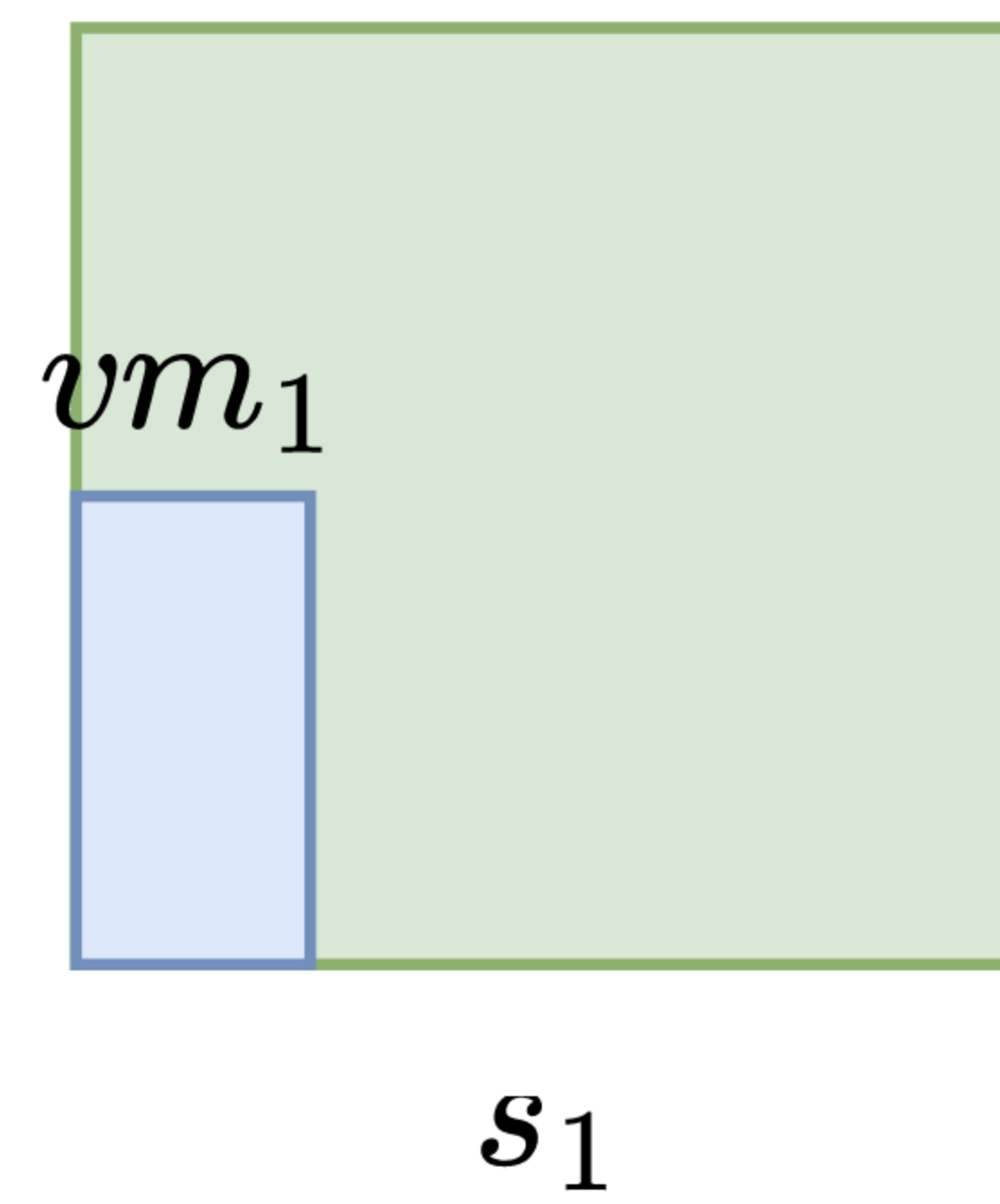
Background



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Problem

Can we increase spot instance revenue without impacting on-demand VM revenue?

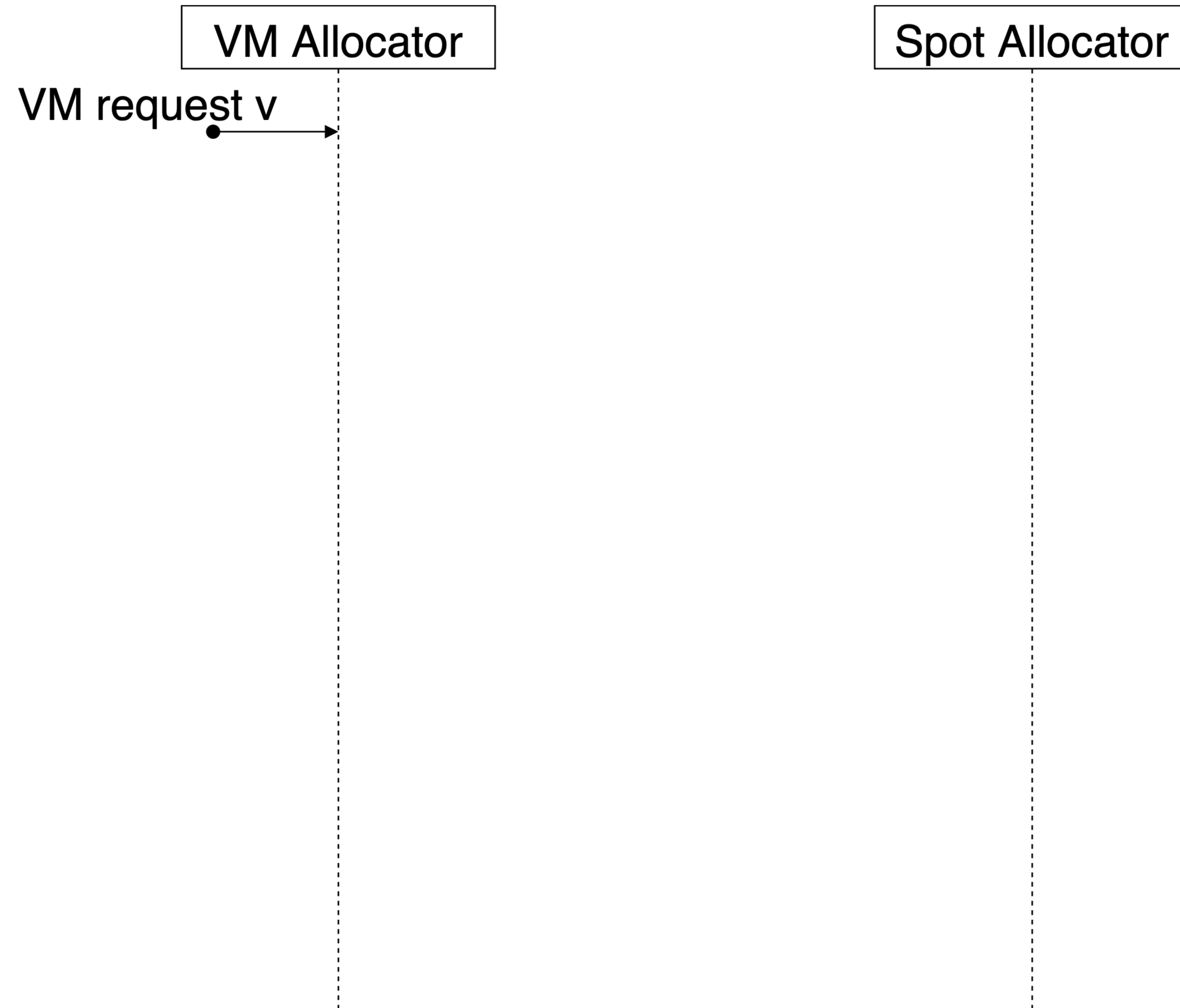
Current VM Allocation

VM Allocator

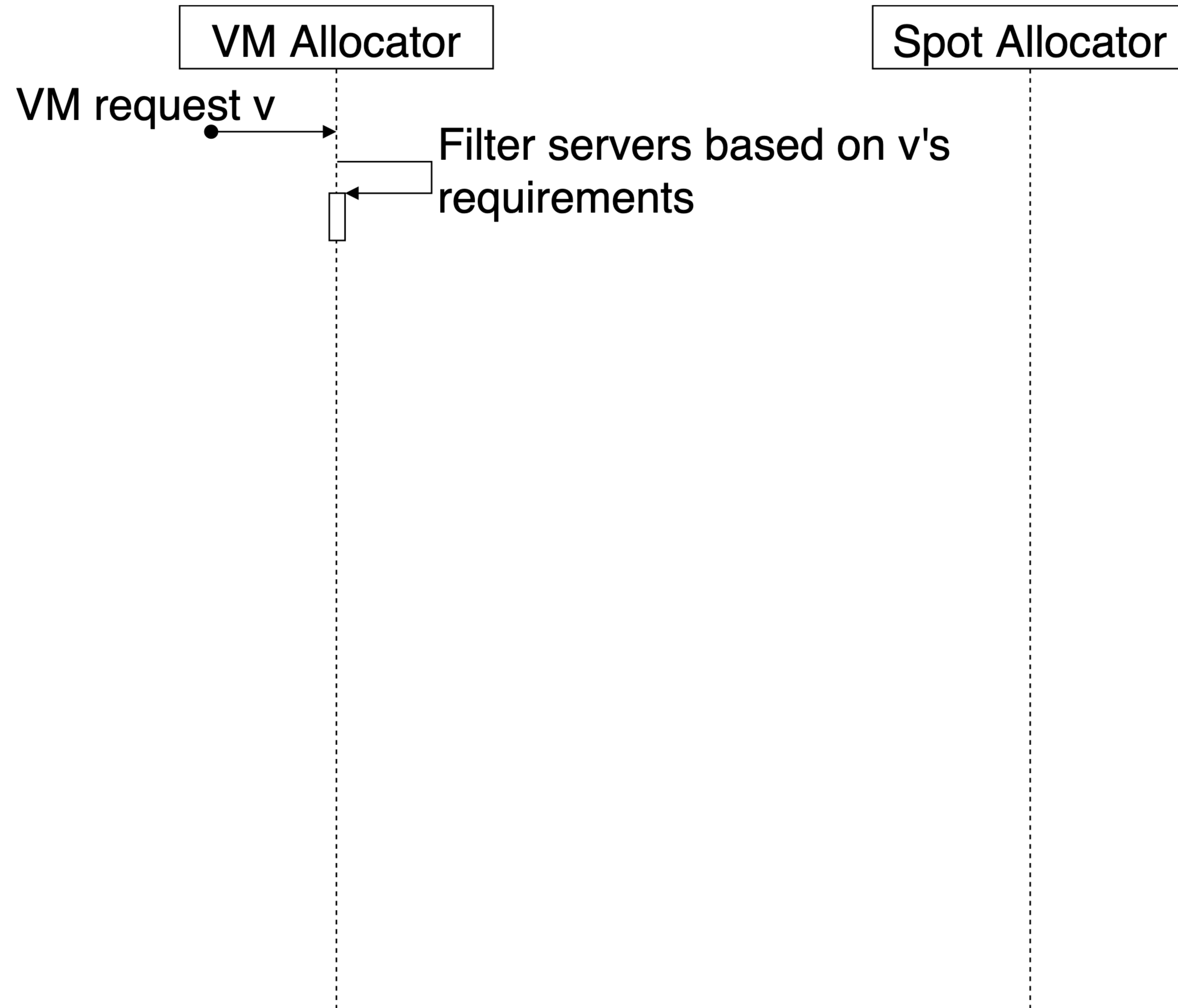
Spot Allocator



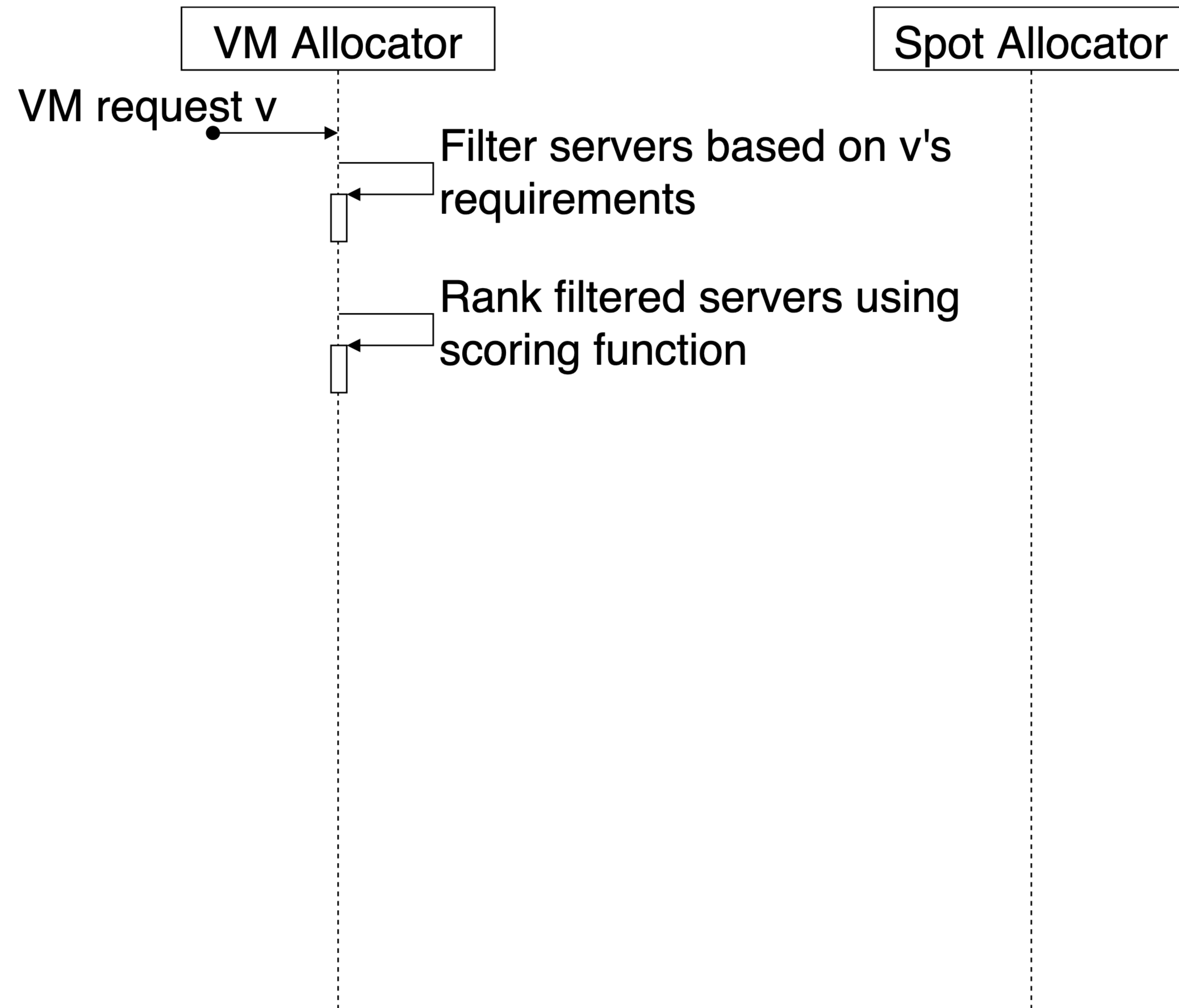
Current VM Allocation



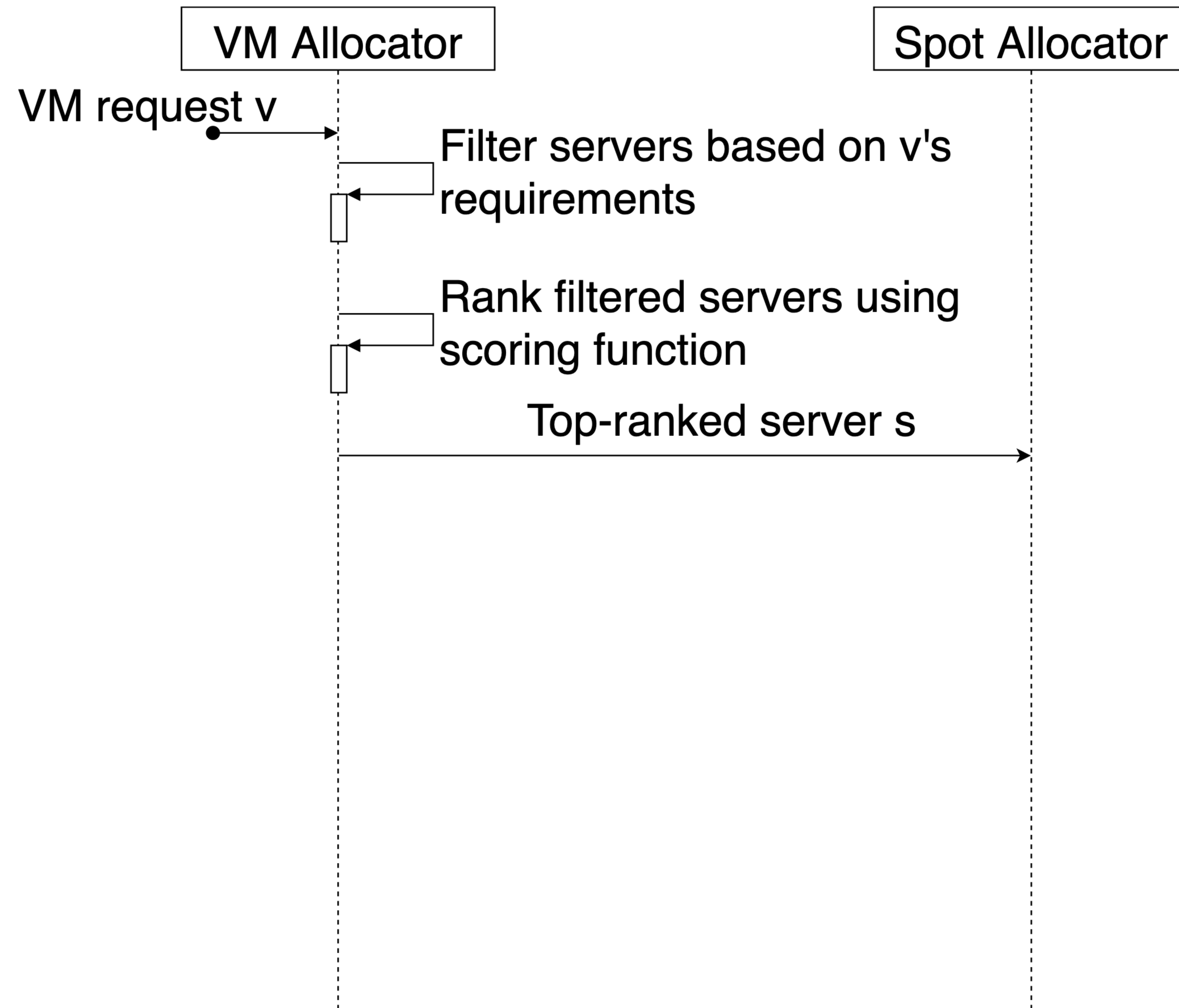
Current VM Allocation



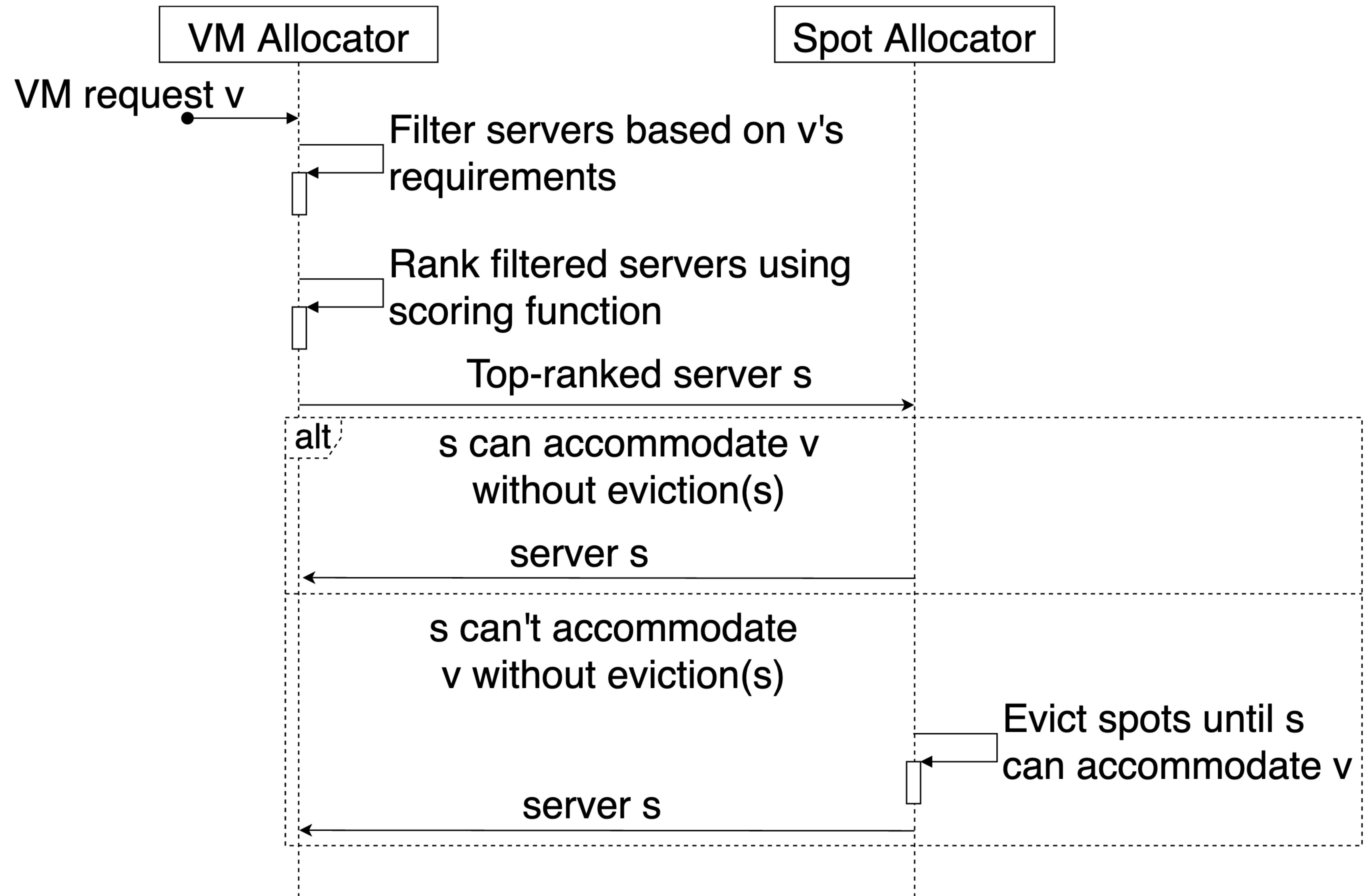
Current VM Allocation



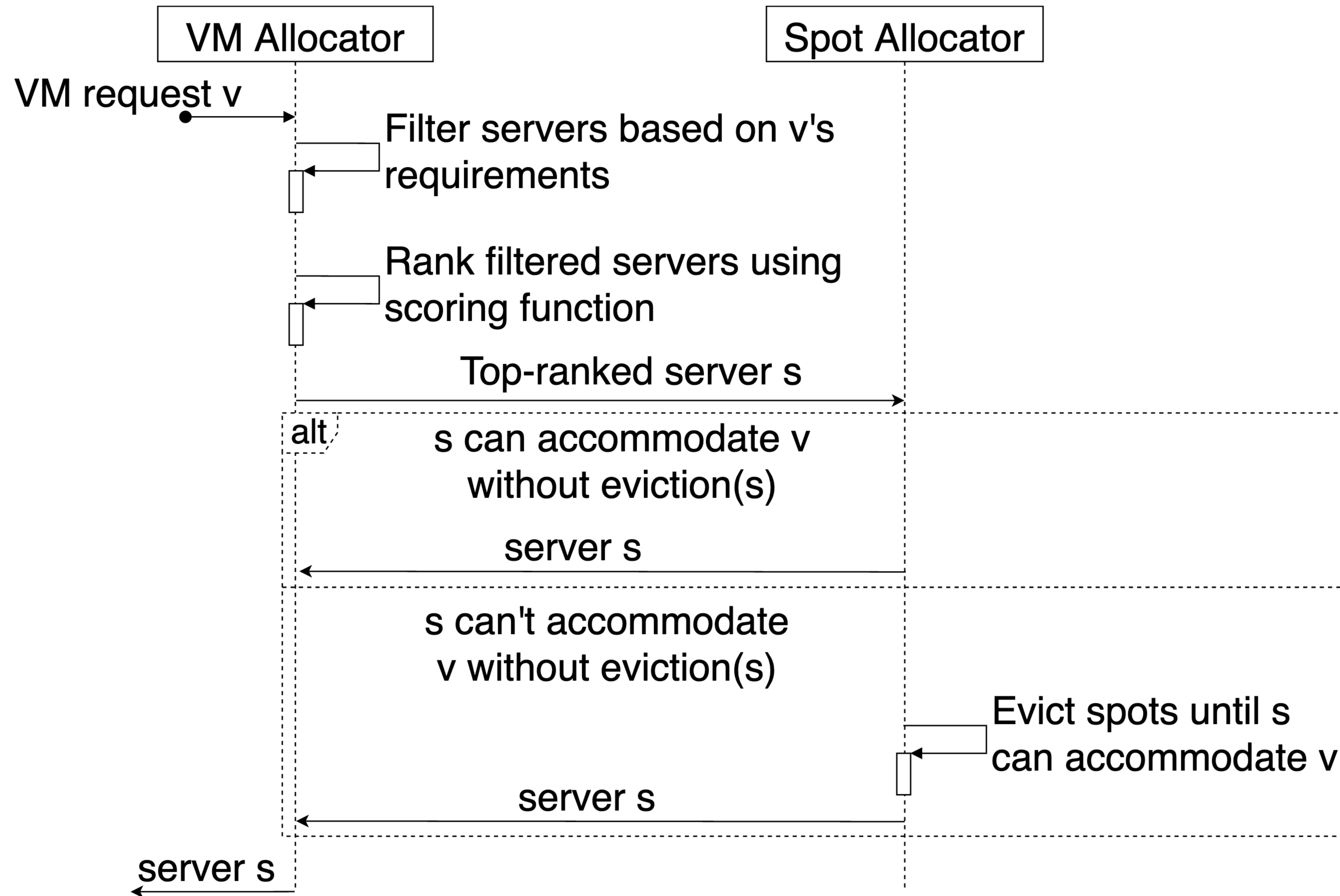
Current VM Allocation



Current VM Allocation



Current VM Allocation



CoSpot Framework

The freedom created by not choosing the top-ranked server for VM allocation gives the spot allocator flexibility to achieve greater spot revenue

- Our CoSpot framework consists of two parameters:
 - Offer Top-N
 - Spot Avoiding Filter

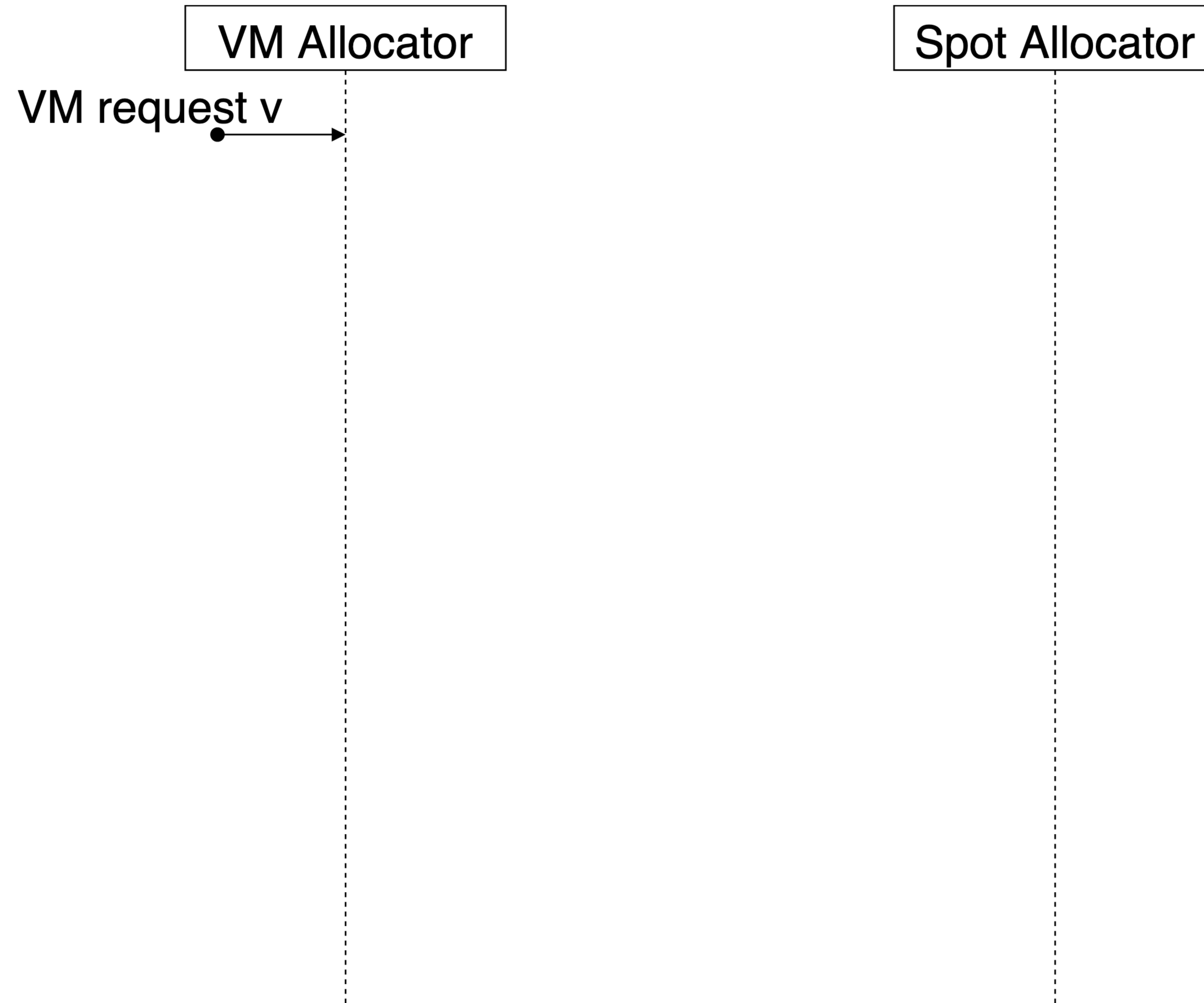
CoSpot VM Allocation

VM Allocator

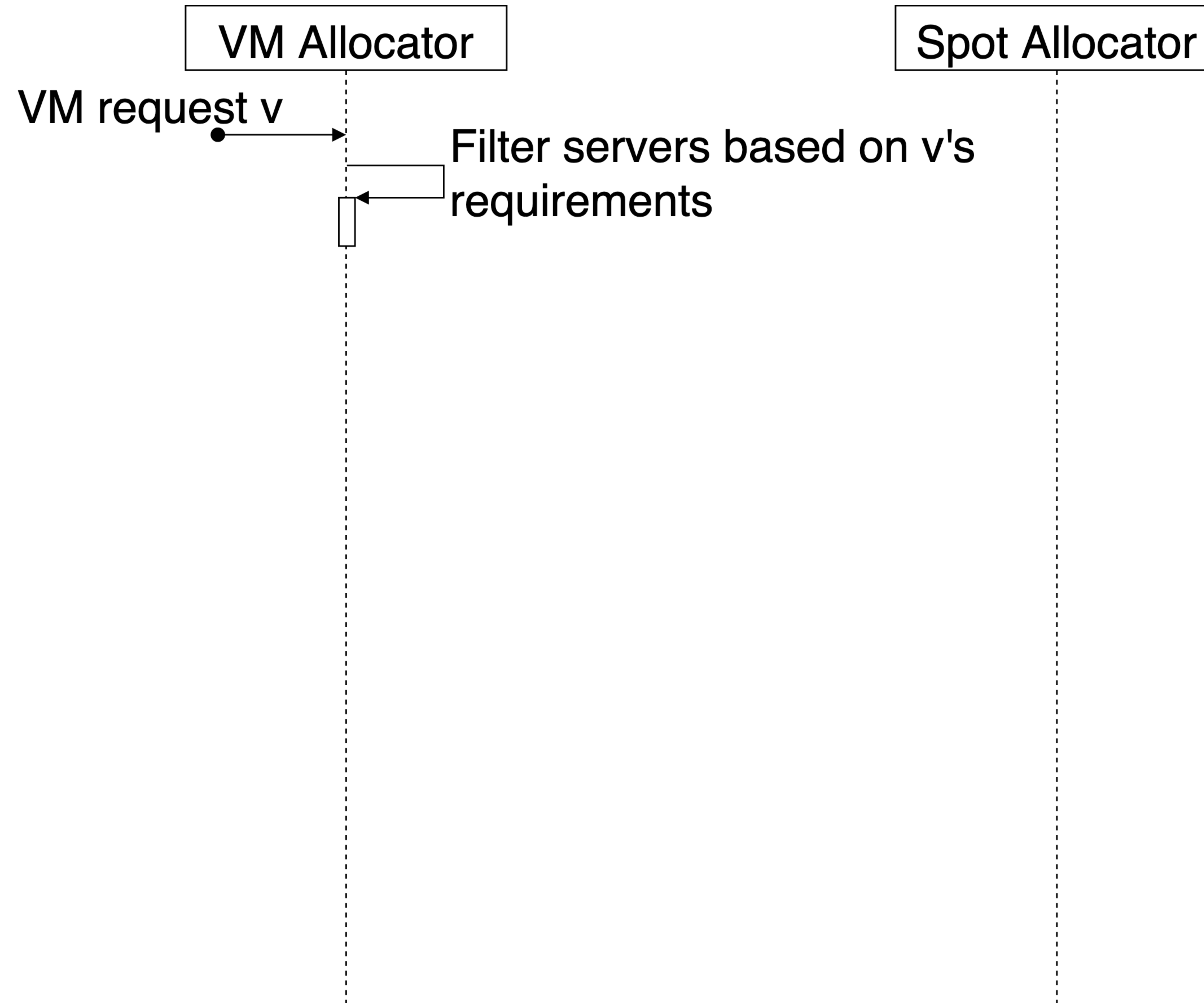
Spot Allocator



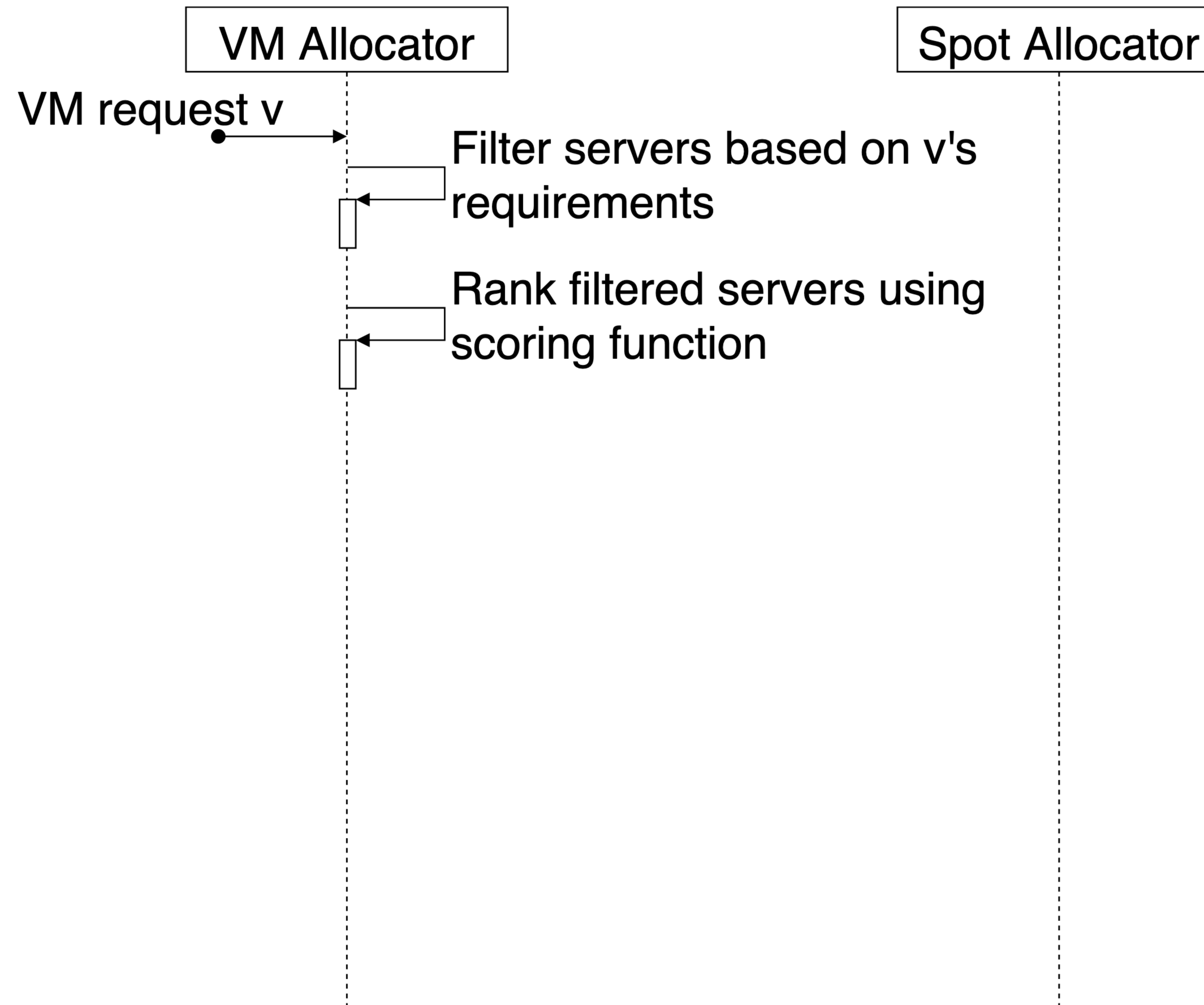
CoSpot VM Allocation



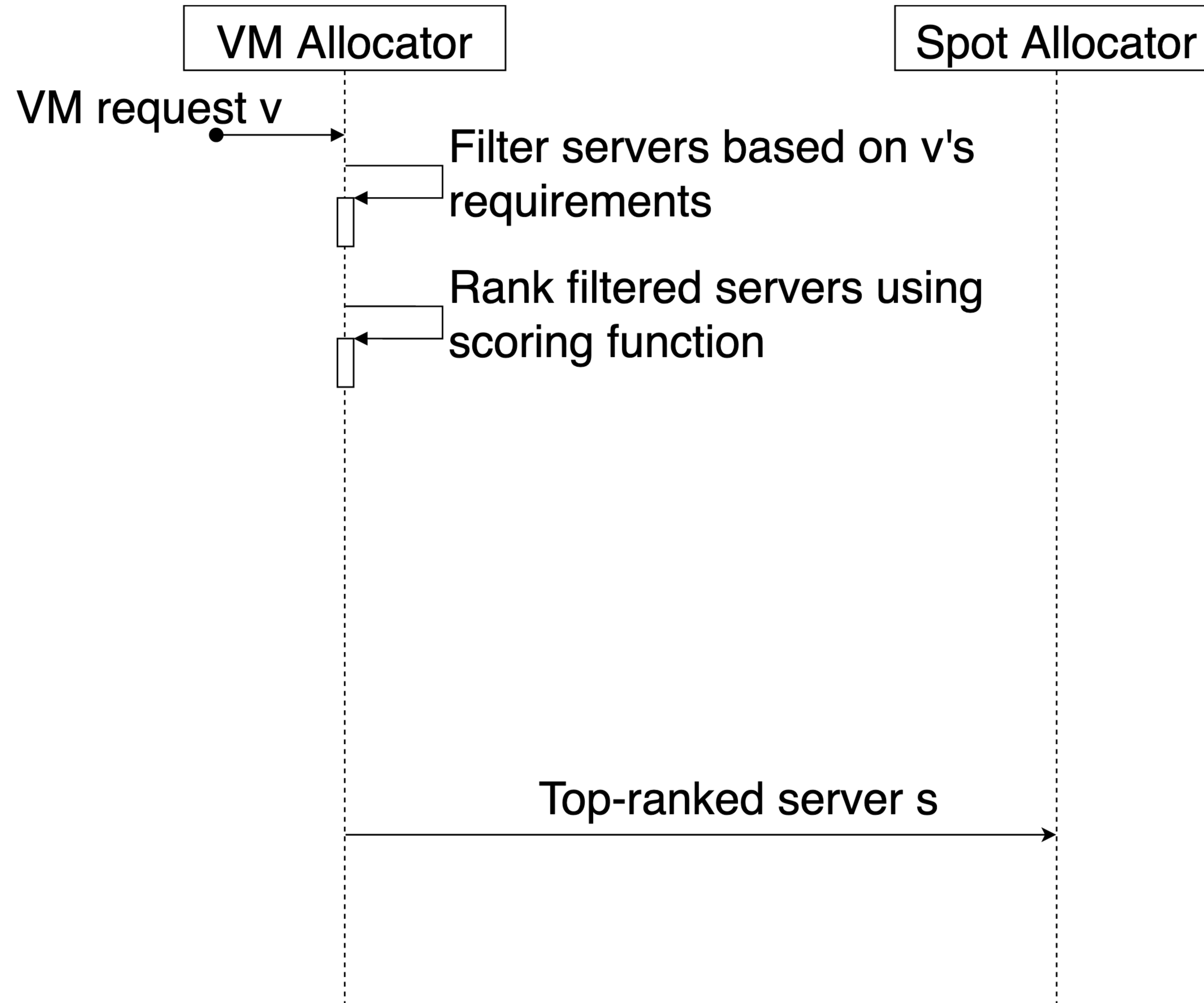
CoSpot VM Allocation



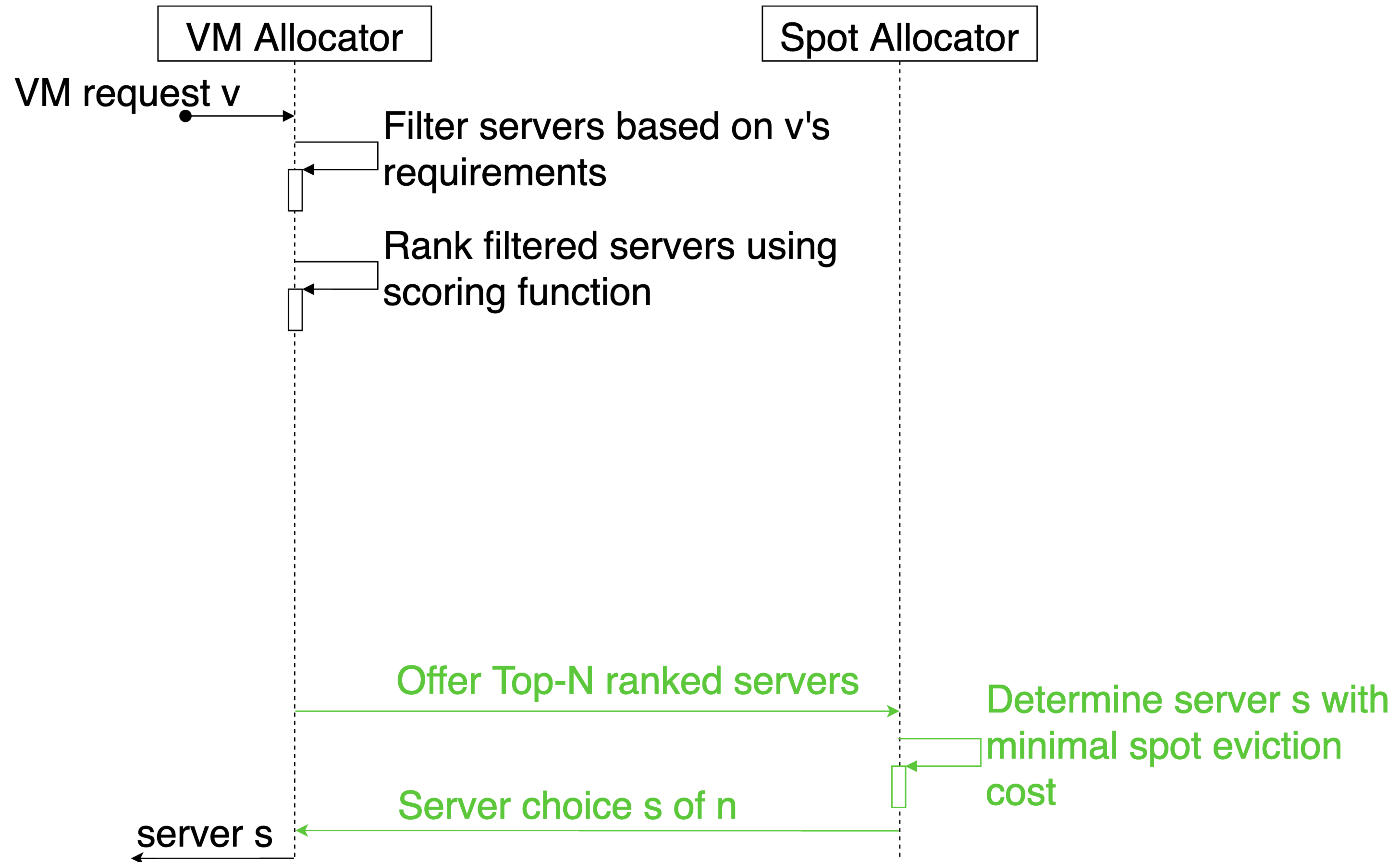
CoSpot VM Allocation



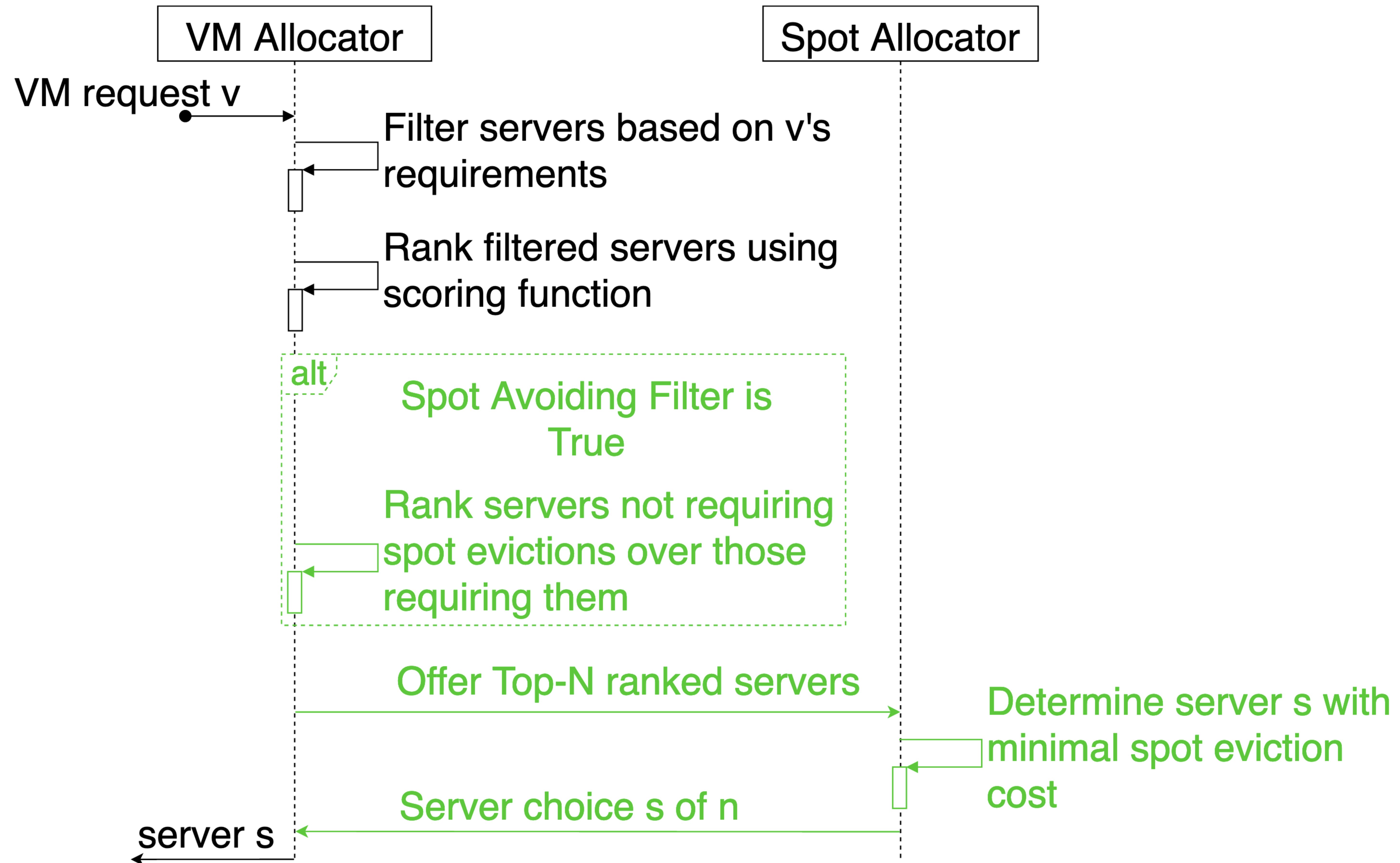
CoSpot VM Allocation



CoSpot VM Allocation



CoSpot VM Allocation



Does It Work?

- We need to evaluate CoSpot on a realistic workload.
- We need to evaluate CoSpot under a wide variety of operating conditions.

Workload

The Protean¹ workload contains a trace table with logged VM/spot requests.

¹Protean: VM Allocation Service at Scale, O. Hadary, L. Marshall, A. Pan, E. E. Greeff, D. Dion, S. Dorminey, S. Joshi, Y. Chen, M. Russinovich, and T. Moscibroda



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1	0	0	0.020833333	0.00390625		0.01006429	0.000125
2	1	0	0.020833333	0.00911458		0.01341906	0.0025
3	2	0	0.041666666	0.01822916		0.02683813	0.005
...
16	15	1	0.00104166	0.00088888		0.00687138	0.0025
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1	0	0	0.02083333	0.00390625		0.01006429	0.000125
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Workload

id	vmTypeId	machineId	core	memory	hdd	ssd	nic
1	0	0	0.020833333	0.00390625		0.01006429	0.000125
2	1	0	0.020833333	0.00911458		0.01341906	0.0025
3	2	0	0.041666666	0.01822916		0.02683813	0.005
...
16	15	1	0.00104166	0.00088888		0.00687138	0.0025
...

- We constructed an ILP with constraints based on fractional resource requirement information.
- The full system was infeasible. We had to exclude 18 (out of 265) flavors to force feasibility.
- The excluded flavors corresponded to less than 6% of the entire trace.



Does It Work?

- We need to evaluate CoSpot on a realistic workload. ✓
- We need to evaluate CoSpot under a wide variety of operating conditions.

Experimental Setup

64,800 experiments in total:

Parameter	Values
Workload	2 Sampling Methodologies * 10 Samples Each
Datacenter	0%, 1%, 2%, 3%, 4% Headroom
VM Allocation	3 Policies
Spot Allocation	6 Policies
Spot Eviction	3 Policies
Spot Avoiding Filter	False, True
Offer Top-N	1, 2, 4, 8, 16, 32

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Experimental Setup

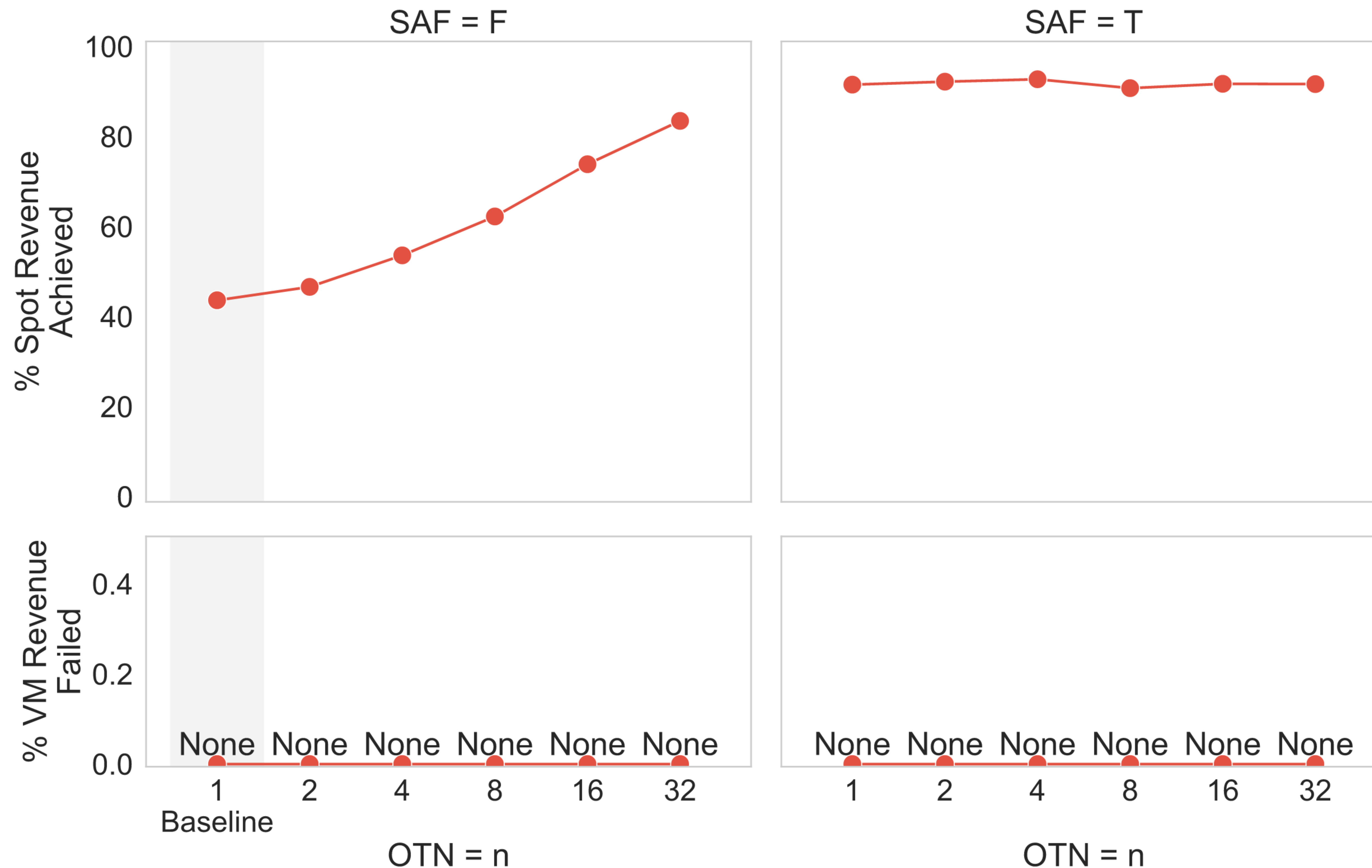
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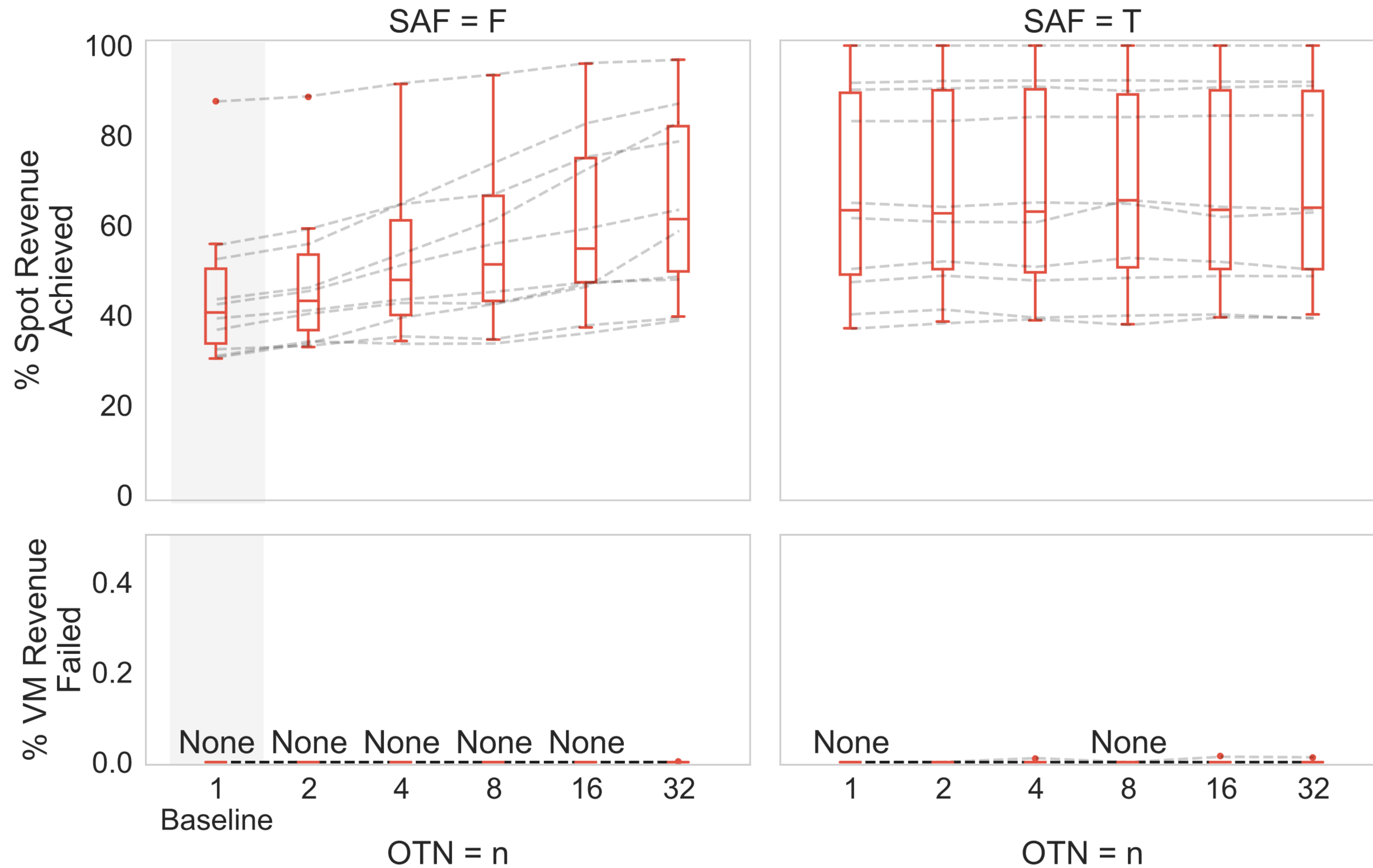
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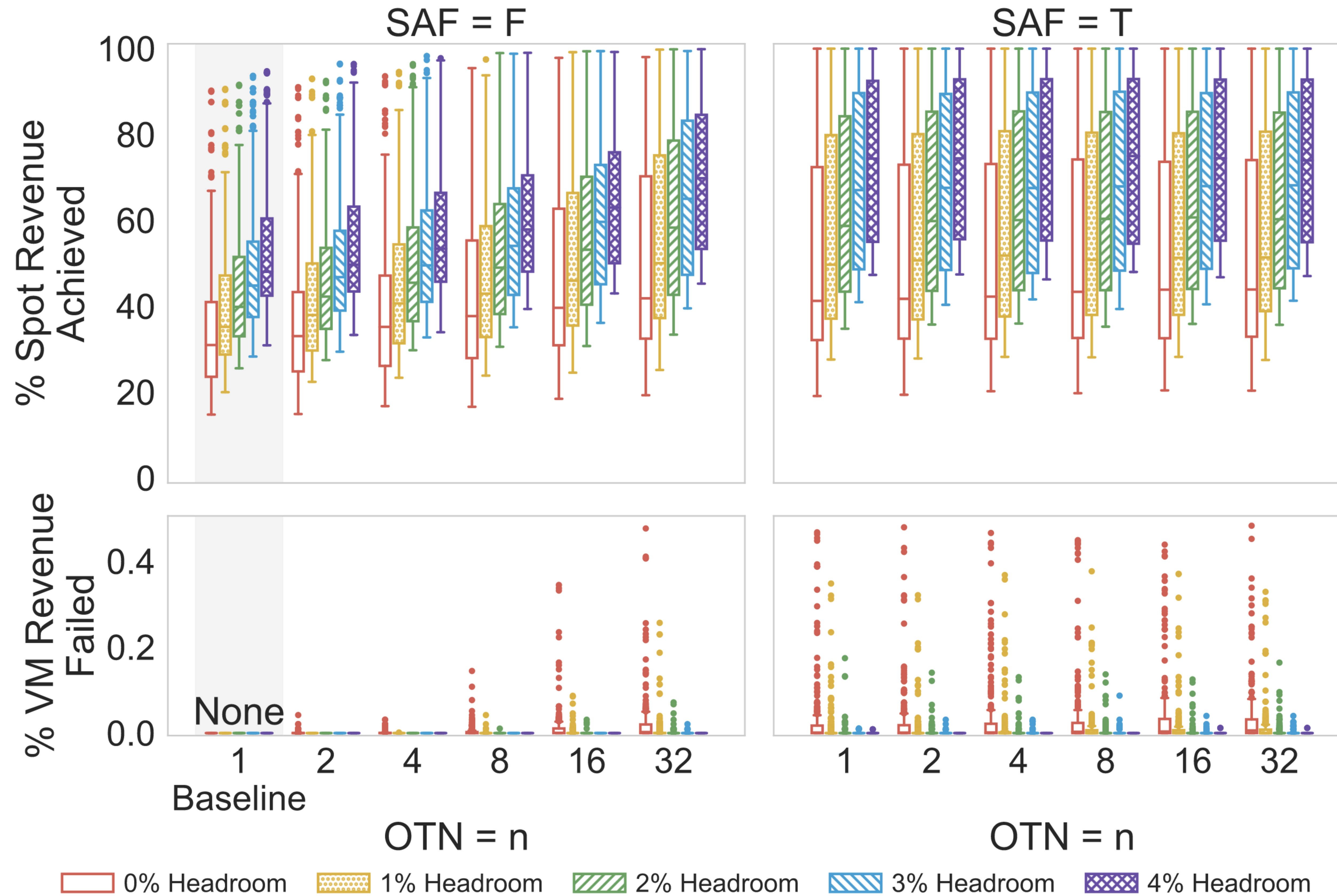
CoSpot achieves greater spot instance revenues with zero impact on VM revenue



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CoSpot Results Overview



Contributions

- CoSpot framework to achieve greater spot instance revenue without impacting VM revenue.
- Reusable VM/spot workloads with consistent concrete core/RAM resource requirements.

Code and workload artifacts for CoSpot can be found at:

<https://github.com/DCResourceManage/cospot-socc2022>